VALUE REALISATION OF DATA ANALYTICS TO IMPROVE BUSINESS INTELLIGENCE IN THE MANUFACTURING SECTOR IN THE BIG DATA ERA

By

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Submitted in accordance with the requirements

for the degree of

DOCTOR OF BUSINESS LEADERSHIP

in the

THE GRADUATE SCHOOL OF BUSINESS LEADERSHIP

at the

UNIVERSITY OF SOUTH AFRICA

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02 May 2023

DECLARATION

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Value realisation of data analytics to improve business intelligence in the manufacturing sector in the big data era

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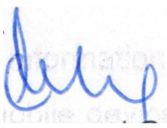

Garikayi Emmanuel Gondo Date: 02 May 2023

ABSTRACT

Currently, the fourth industrial revolution is driven by cyber-physical systems through interconnected emerging technologies that produce a lot of information, referred to as the big data environment. However, extracting value from the information presents valuable opportunities and insights to those who are able to analyse the data. The current environment requires managers to use technologies such as business intelligence systems (BI) to analyse the data. Technology has advanced; managers who do not embrace it to conduct business intelligence become spectators in the world of business where they should be dominating. The aim of this research study was to explore the value to be derived from data analytics application to improve business intelligence in the manufacturing sector. The main objective was to propose suitable general frameworks that can guide managers to analyse data in the big data environment using BI to create a competitive advantage. The specific objectives were to explore how external data are integrated with internal data and to examine what is limiting managers from using BI systems to analyse the resultant data to extract value during the decision-making process. The study design was an exploratory qualitative case study that involved Executives, Senior managers, and Consultants as implementers of BI. Data were collected through semi-structured interviews and analysed using Atlas_ti to generate codes and themes. A focus group validated the findings. The results revealed that BI systems are not plug-and-play; managers lack technical skills and time due to operational commitments. External consultants lack knowledge of the business process. Internal consultants lack facilitating conditions and training. Managers are not at liberty to share their data even though the data are already structured. They are afraid of violating ethics because there are no clear frameworks to integrate systems. Four frameworks emerged from this study (i) a framework to reach the pervasive level of business intelligence maturity level (ii) the Trust benefit framework for external data sharing (iii) the BI skills imparting framework and (iv) the Framework for adopting data analytics in an environment of other emerging technologies. The research study made an original contribution to the Unified Theory of Acceptance and Use of Technology theory. It suggests the incorporation of trust, risk, and ethical considerations as key moderators for sharing data and adopting data analytics.

Keywords: *Big data; Data analytics; Business Intelligence; Business Intelligence System; External data; Internal data; External data sharing; Frameworks; Enterprise Resource Planning System.*

PFUPISO

Parizvino, shanduko yechina yekubatwa kunoita mabasa mumakambani iri kufambiswa kuburikidza nematekinoroji akati wandei ari kuburwa. Matekinoroji aya anoburitsa ruzivo rwakawanda kwazvo kuumba nharaunda yakakura ye denhe reruzivo. Nekudaro, kutora kukosha kubva kuruzivo rwe nharaunda iyi kunopa mikana kune avo chete vane nzira dzekuongorora denhe idzva reruzivo iri. Iyo nharaunda itsva iyi inotoda kuti vakuru vemakambani vashandise masisitimu azvino seinonzi, bhizimusi rehungwaru (BI). Tekinoroji yafamba; zvekuti vakuru vemakambani vasingaigamuchire kuti vaite bhizimusi neungwaru vanosiiwa sevaokeri munharaunda yevemabhizinesi umo mavanofanirwa kunge vachitonga. Chinangwa cheongororo iyi chaive chekuumba hwaro hwakakodzera hunogona kushandiswa nevakuru vemakambani emuZimbabwe kuongorora denhe rerwuzivo munzvimbo huru vachishandisa sisitimu ye BI kuitira kuti vave pamusoro pevamwe vavo. Donzvo raive rekuongorora kuti denhe rerwuzivo rwekunze ringasanganiswa sei nedenhe rerwuzivo rwemukati uye zvozoongororwa kuti chii chinotadzisa vatungamiri vemakambani kushandisa sisitimu ye BI kuongorora denhe reruzivo rinenge rabuda kuti vabatsirwe panguva yekuita sarudzo yemafambiro avanoda kuzoita pabasa ravo. Nyaya iyi yakaongororwa kuchishandiswa mhando yaisanganisira vatungamiri vakuru vemakambani, vanounza masisitimu aya mumakambani, vapi vemazano vemukati avo vanoashandisa. Zvaibuda mukubvunzurudza zvakaunganidzwa nekuongororwa kuchishandiswa imwe sisitimu inonzi Atlas_ti kugadzira mipanda nemadingindira. Kaboka kadiki kakaumbwa kuti katange kanzvera zvakabuda. Mhedzisiro yacho yakaratidza kuti masisitimu e BI haasi ekungobayirira wobva watotanga kushandisa ipapo ipapo. Nekudaro vatungamiri vemakambani vanoshaya hunyanzvi hwekuashandisa uye nguva nekuda kwebasa ravo. Vanounza masisitimu aya mumakambani havanawo ruzivo rwemaitirwo emabhizimusi uye vapi vemazano vemukati vanoshayawo nzira yekubatsira nayo uye nguva yekuti vadzidziswe nevekunze. Zvakaratidzawo zvakare kuti vatungamira vemakambani havana kunyatso sunungukirwa nekupa denhe ravo reruzivo rwavo rwemukati nekuti hapana hurongwa hwakajeka hwekubatanidza masisitimu avo neekunze kuti vatambidzane denhe rezivo, saka vanotya kutyora mirairo yemubatanidzwa wemakambani. Kune avo vanoshandidzana havo, nzira ye denhe reruzivo rwekunze yakatogadzirwa kare asi, naivowo havanawo rusununguko rwekugovera denhe reruzivo rwavo. Zvirongwa zvina zvinotevera zvakabuda muchidzidzo chino (i) hurongwa hunodiwa kuti pasvikwe padanho rakakura rekuwedzera hungwaru (ii) Rubatsiro rwekuvimbika nehurongwa hwekugovana denhe reruzivo rwekunze (iii) hurongwa hwekupa hunyanzvi neungwaru mumabhizimisi uye (iv) Nzira inodiwa kugona kunzwera denhe reruzivo zvisinganetsi. Tsvagiridzo iyi yakaitawo kuti muono wepakutanga wekugamuchirwa kwekushandisa Tekinoroji (UTAUT) unyatso nzverwa nekugadziriswa kuti ubatanidze kuvimbika, njodzi, uye hunhu, sezvinhu zvakakosha pakugovana zivo neungwaru munharaunda hombe yedenhe reruzivo.

Mazwii akakosha: *Denhe reruzivo; Kunzvera denhe reruzivo; Ungwaru mumabhizimisi; Kugoverana nhenhe reruzivo rekunze; Nzira; Masisitimu ekushandisa muma company;*

DEDICATION

This thesis is dedicated to my wife Lilian Gondo and son Anotida Gary Gondo. Your unconditional love, support, and constant encouragement during this challenging journey where I also tested positive for COVID-19 were excellent. I also dedicate it in memory of my late son Panashe Emmanuel Gondo who died in a tragic car accident on 27 January 2014 on his way to Africa University in Zimbabwe for a third-year semester. This motivated me to pursue what he wanted to achieve in life.

ACKNOWLEDGEMENTS

I would like to express my most sincere gratitude to the following:

(1) The All-Mighty God for the provision of good health, guidance, and wisdom, and for taking care of me and my supervisor throughout this long challenging journey. This journey was disrupted by the COVID-19 pandemic at some stage, but God took us through it.

(2) My supervisor, Professor Lorna B Holtman for support and guidance. You shaped my academic journey through encouragement, constant feedback, patience, and kindness throughout this long journey that began from the proposal stage. Working under your supervision and guidance has been a rewarding experience that I will never forget.

(3) Professor Ravinder Rena for reviewing my work, quality check, constant feedback, kindness, and encouragement. I have learned a lot from you Prof.

(4) The UNISA bursary department for taking away the financial burden from me.

(5) Professor T Mgutshini, Professor E Greeff, and the Online Accelerated Postgraduate Support Programme Team, for a series of informative Ph.D. research sessions that helped me to benchmark and perfect my work.

(6) All the Professors who gave me valuable feedback during the colloquium presentations

(7) The ethical clearance committee for giving me valuable feedback and recommendations required to remain within the ethical boundaries.

(8) All the organisations, managers, and consultants who availed themselves to participate in this research study.

(9) Prof H. Hsieh and Mr. Kanechukwu Ikebuaku for being critical readers and keeping me on track.

(10) The language editor Mr. H.A Naidoo for editing my work.

(11) My family, Lilian Gondo and Anotida Gary Gondo, for the support and encouragement rendered.

(12) Last, but not least, Mr. Gilbrt Gumbo and Mrs. Nester Gumbo for moral support throughout the journey.

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LIST OF ACRONYMS

API	Application Programming Interface
BI	Business Intelligence System
CEO	Chief Executive Officer
DW	Data Warehouse
ERP	Enterprise Resource Planning System
ICT	Information and Communication Technology
IS	Information Systems
IT	Information Technology
MIS	Management Information Systems
SCADA	Supervisory Control And Data Acquisition
5 Vs	Five characteristics of big data Volume, Variety, Velocity, Veracity, Value

CHAPTER 1

INTRODUCTORY CHAPTER

1.1 INTRODUCTION

Big data are viewed as the most strategic resource of the 21st century, equal in value to oil and gold (Alharthi, Krotov & Bowman, 2017). This research study explores how Zimbabwean managers can analyse data using business intelligence systems to create a competitive advantage given the prevailing turbulent business environment. The chapter provides the background to the study, a discussion of the field of research study, the research study focus area, the expected practical contribution to policy, and theoretical gaps followed by a statement of the problem. An assertion and brief introduction of the theories underpinning the research study. This is then followed by, research study questions, objectives, and the purpose of the study. The chapter also provides the limitations, delimitations, and the adopted methodological approach. It then concludes by giving a brief background of adopted data collection and analysis approaches. Finally, there is an overview of the thesis.

1.2 BACKGROUND TO THE FIELD OF STUDY

The introduction of Information Technology (IT) has become an ever-increasing necessity for many organizations, especially businesses across different industries. They can now gather data electronically from various disparate sources and understand and harness them to make meaningful decisions. One such opportunity is to use analytics software, such as business intelligence systems (BI) (Olexova, 2014). Business intelligence is when valuable information and knowledge are provided to decision-makers by leveraging a variety of both structured and unstructured data sources (Sabherwal & Becerra-Fernandez, 2013, p.6). However, due to advances in technology, it can now further be defined as the development of systems, and technologies, including the underlying architecture, tools, databases, applications, and practices used to analyse critical business data to gain insights. (Chen, 2013). So it is important to point out early that a business intelligence system, usually referred to as BI is different from business intelligence which is the process of providing managers with valuable information as defined above. However, BI systems were designed for managers so that they can use them to conduct business intelligence hence the link between the two. Thus, organisations usually use a suite of technological solutions to analyse massive amounts of data when conducting business intelligence (Chaudhuri, Dayal, & Narasayya, 2011). In this research study business intelligence systems are sometimes referred to as simply BI.

The transactions generated and the transformation in information technology have brought a new era of big data that has also provided a new dimension of analysing information for business intelligence. Big data analytics and BI have a positive effect on digital transformation (Ahmad & Mustafa, 2022). This has proved to be a potential area for research studies that has received significant attention from academia, IT communities, governments, and other interested parties.

Therefore, technology has ushered us into the fourth industrial revolution being driven by cyber-physical systems through interconnected systems. This fourth industrial revolution is characterised by several new emerging technologies that are key drivers of Industry 4.0 that produce a lot of information. The following table 1.1 shows key drivers of industry 4.0.

Table 1.1: Key drivers of Industry 4.0

Document name	**Key drivers of Industry 4.0**	**Reference**
A comprehensive study on current and future trends towards the characteristics and enablers of industry 4.0	**Technology:** Cyber-physical systems,Internet of Things, Big data, Cybersecurity, Cloud Computing, Additive manufacturing, Advanved robotics, Modelling and simulation. All these technologies interact via real-time-inter-connectivity.	(Karnik *et al.*, 2022)
Industry 4.0 and supply chain performance: A systematic literature review of the benefits, challenges, and critical success factors of 11 core technologies	**Technology:**Additive manufacturing ,Augmented reality, Automation, Big data technologies, Blockchain, Cloud computing, Internet of People (IoP), Internet of Things (IoT), Robotics, Semantics technologies and Simulation	(Rad *et al.*, 2022)
Big Data Challenges and Opportunities in the Hype of Industry 4.0	**Technology:** Power of machines, Computing, Analytics, Connectivity, Cyber-physical systems, Internet of Things, Automation, cloud system, data exchange, Remote operations, Human-Computer interaction, 3D printing, Intelligent production, big data	(Khan *et al.*, 2017)

Big data for cyber-physical systems in industry 4.0: a survey	**Technology:** Cyber-physical systems, big data, Internet of Things, cloud computing, big data science, industrial information integration, human-computer interaction	(Da & Duan, 2019)
Industrial Artificial Intelligence in Industry 4.0 -Systematic Review, Challenges, and Outlook	**Technology:** Cyber-physical systems, the Internet of Things, ICT technologies, big data, and AI as one of the key technologies	(Peres *et al.*, 2020)

These interconnected systems and the resultant data make up the big data environment. Literature confirms big data as a by-product of business transactional systems such as Enterprise Resource Planning systems (ERP) (McDonald & L'eveill'e, 2014). This also include data produced by public service institutions (administrative data) and data from an abundance of new open-source tools that continue to emerge from Google, Facebook, Twitter, and LinkedIn. These sources breed unstructured, semi-structured, and structured data suitable for knowledgeable programmers and data scientists (Gokalp *et al.*, 2016; Baesens *et al.*, 2016). Other sources of data that have drawn interest are machine sensors, and vehicles both stationary and in motion (Matti & Kvernvik, 2012; Lăzăroiu *et al.*, 2022). Therefore, another way to define big data is to describe them in terms of transactions versus non-transactions and internal versus external (Zhao, Fan & Hu, 2014). It is therefore clear that big data do not only come from social media.

1.2.1 Big data analytics, and use of BI systems to extract value as a focus area

The big data subject is quite broad, it can be divided into several focus areas like big data storage, big data security, big data acquisition, big data cleaning, big data applications, and big data analytics. This research study focused on the latter (big data analytics). Big data analytics is getting sense and reflecting on data that cannot be managed via traditional means (Zakir, Seymour & Berg, 2015). It is the new path used by managers in top-performing organisations to move from insights to value (Ernest *et al.*, 2011). Technology has advanced to an extent of leaving data and analytics intertwined. However, "Acquiring data without analytics software to extract value is equivalent to simply improving the organisation's infrastructure" (Watson, 2014, p.1248).

Data sources are growing so fast, and data scientists have simultaneously developed an interest in harnessing these relatively untapped resources to increase the value of their organisations. This has seen many organisations adopting computer-based intelligence in their operations to make fast decisions and improve efficiency (Kester & Preko, 2015). One good example is that of the world's biggest transportation service provider *UBER*, which uses the real-time flow of data to maximum advantage by matching driver's cars and real-time demand, without owning the vehicles (Pigni, Piccoli, & Watson, 2016).

Globally, interest in using business intelligence tools to provide an all-inclusive information hub for policymakers and government officials has increased (Lee *et al.*, 2022).

This calls on businesses to use business intelligence systems come from shareholders, as they demand that executives and managers improve performance by reducing costs and increasing productivity to boost economic performance. In the big data environment, open data are universal, absent of membership or exclusivity to a specific group of users. These data sets are available in large quantities and can be accessed and used freely, shared, or built upon by anyone. They can also be distributed and reused for any purpose anywhere. (McDonald & L'eveill'e, 2014).

For years, the focus on IT has been on analysing data generated from internal sources. This is now shifting towards analysing both internal and external unstructured disparate data using analytics software, shifting the focus from transactional IT to analytical IT. The result is the emergence of analytical software such as BI to enhance competitive intelligence. Organisations are now positioned to mine the data and get insights (McDonald & L' eveill'e, 2014).

Information floodgates have now opened because new technologies will never stop emerging. Information is everywhere: computers, machine sensors, cameras, and mobile devices. The data come from internal and external sources, but there is also a lack of skills, knowledge, and wisdom to convert this information into valuable intelligence (Villars & Olofson, 2011).

Though the big data environment presents a huge opportunity as a source of information for decision-making, it suggests managers must also play their role to benefit from this 'new oil.' The data come with the following characteristics: volume, velocity, variety, veracity, and value (Bello-Orgaz, Jung, & Camacho, 2016), making it extremely complex to analyse them. This leaves a big question: *Do big data present a chance to exploit opportunities to harness these relatively untapped resources of large amounts of data to drive the value of organisations and improve performance*? This big data era has brought a new problem to managers in the form of information overload.

1.3 MOTIVATION FOR THIS STUDY

Besides the availability of data, data mining, and analytics technologies to transform the data, to gain valuable insights, it still remains a challenge for most managers, and in particular Zimbabwean managers to analyse data using business intelligence systems. In most cases, organisations use the ERP system for transacting and the BI system for data analytics. The BI system has a data warehouse used for storing the required data before they are analysed. These systems have capabilities to integrate with other systems, however, managers do not allow key trading partners to connect to their ERP and BI systems, they reserve them for internal staff only. This prevents key trading partners from getting the data they need in operations to make quality decisions. They then resort to hunting these data from the big data environment.

It is very hard to analyse data in the big data environment using manual means and traditional systems such as Excel. When a BI system is introduced, the technical team in the IT department is often assigned the duty of building the data warehouse. They usually fill it with the same internally generated data from transactional systems such as internal ERP, replicating it with the same data and leaving data from key trading partners. This duplication forces managers to revert to using the ERP transactional system and other traditional systems for data analysis instead of using BI because external data will be missing, hence there is no difference between the systems.

It suggests that analysing information in the big data environment presents valuable opportunities and insights, only to those managers who have the means and skills to do so. Organisations could access the information in the big data environment to improve performance using this “new oil.” Still, it appears managers prefer to continue to use traditional ways, working in silos, each having his/her datasets. Whether this is done deliberately to protect some privacy or lack of technical expertise or knowledge, only rigorous research study may yield an answer.

Research studies have shown that managers with analytical skills are in scarce supply and attributed this to the emergence of big data as indicated by Mckinsey Research Institute (Baesens *et al.*, 2016). A special committee in digital skills set up in the UK also acknowledged this shortage in its second report of the session 2016-17 and highlighted big data, as the primary cause (British Government, 2017). A global shortage in skills will impact Africa heavily because the few that acquire the skills will be attracted to developed economies. Efforts made by African countries to increase workers with digital skills are often dampened by these workers migrating to other countries (World Bank, 2020). Zimbabwe in particular has had a very high number of skilled labour migrating to other countries.

Externally generated data have grown enormously, and therefore, managers cannot continue to ignore them as input data. The challenge is, how to turn this information into usable intelligence. Though it appears the data can be easily accessed for analysis, sharing the data and ethical considerations are still a big issue (Herschel & Miori, 2017). If rights are not properly observed, access to external data can be harmful to particular groups or individuals by infringing on their rights (Hilbert, 2016). It then poses this critical question; *Can the external data be shared and just be analysed from their source?* To add to that, Tractenberg *et al.*, (2015) posits that, big data attracts practitioners from different backgrounds, and this makes it even more difficult to have a single code of conduct to deal with ethical issues around external data.

Perhaps the best way forward for organisations, for now, is to form smart partnerships and sign agreements for data sharing with key stakeholders such as suppliers, customers, and employees. Whether it is feasible to do that is subject to a research study. External data processing for sense-making forms an integral part of data analytics (Kwon, Lee & Shin, 2014). It, suggests that the unstructured external data source component has great value, but the myriad of ethical issues around them seem to hamper any hope of harnessing value from this source. One such grey area is who is assigned the critical role of bringing these external data sets into the organization's data warehouse for analytics. This cannot be left to junior staff or a single department, and also, is that person skilled enough to know what has to go into the data warehouse for intelligence gathering?

When using information from external sources, an organisation should bear in mind that there is always a thin line separating business intelligence and espionage. On 25 May 2018, the European Union (EU) adopted the General Data Protection Regulation (GDPR) Act. This piece of legislation is regulatory, meaning that it has to be applied in its entirety across the EU, unlike the previous legislation that was a directive. It also affects organisations processing and holding personal data residing in the EU regardless of the geographical boundaries (European Commission, 2018).

1.3.1 Knowledge Gap

Though there is plenty of literature on the characteristics and sources of big data, there is very little literature on sharing data among trading partners. The literature talks of external data in broad terms as mainly unstructured data that come from Geo maps, Google, Twitter, and Facebook, and often ignores structured external data residing in already existing customers and suppliers.

1.3.2 Policy Gap

There are various BI maturity models that have been developed to measure maturity but they do not provide a path to extend the use of BI to suppliers, customers, and business partners. This research study fills that gap by providing frameworks that can be used by managers as the path to reach that level and improve the use of business intelligence systems. The framework can be used by policymakers as the basis for crafting data exchange laws.

1.3.3 Practical Gap

The literature highlights the lack of skills and proposes using a data scientist to overcome this challenge. This thesis argues that it should be the manager who should use the business intelligence system to conduct the intelligence because intelligence gathering cannot be separated from the manager. The thesis close the gap by proposing the skills imparting framework to current managers within the working environment instead of asking them to go back to college to acquire the required skills.

1.3.4 Theoretical Gap

As indicated in the knowledge gap there is little literature on sharing data among trading partners. Benefits, trust, risk, and ethical considerations emerged as key concepts when sharing negotiable data with key trading partners in the big data environment. This research study proposes modifications required to the Unified Theory of Acceptance and Use of Technology (UTAUT) theory to incorporate them as key moderators for it to be useful in the adoption of big data.

1.4 STATEMENT OF THE PROBLEM

The big data environment is characterised by many new emerging technologies such as the Internet of Things (IoT), embedded systems, sensors, cloud computing/services, robotics, 3D printing, big data, artificial intelligence (AI), and many more. This has left managers confused as to which particular one to adopt in this fourth industrial revolution, whether their current

ERP and BI systems are still relevant and why data then emerge as, the ‘new oil’, when data have been available all these years (Dedić & Stanier, 2017; Guenduez, Mettler & Schedler, 2020). Managers have been lining up to digitalise at a slow pace without a clear framework, proper structure, and guidance for adopting a data analytics strategy. The outbreak of COVID-19 was a wake-up call as it sent shock waves, forcing everyone to stay home resulting in accelerated haphazard adoptions of technologies (Snyder & Barnakova, 2020). However, investing in technologies only, without analysing the resultant data from the interconnected systems, will be equivalent to having statistical tools and mathematical applications without anything to calculate (Sanders, 2016). In the current fourth industrial revolution where we are transisioning to the fifth, BI has become a critical issue for managers as decision makers, however some of the managers are still regarded as ordinary users with less experience to analyse data using BI (Choi, Panjaitan & Apriliasari, 2022).

Given that it is difficult to analyse data coming from these emerging technologies using manual means, there is a need to invest in analytics software and configure these systems to report directly to managers. Hence the clarion call for managers to simultaneously use analytics systems such as BI (Watson, 2014). However, when a BI system is installed to try and help these managers, they usually delegate its usage to either a data scientist, the IT department, or junior managers who have to work extra hard to integrate external data and internal data (McAfee & Erik, 2012). Whether this is due to a lack of skills or technical challenges in using these BI systems, only a rigorous research study can tell. Delegating the use of BI further complicates the manager’s role of intelligence gathering and predictive analytics, and certain critical issues will be overlooked. It will be as good as delegating the decision-making process because the decision about which information to gather or leave cannot be separated from the strategy. Many organisation fail because they make decisions in an information vacuum (Hasen, Saridakis & Benson, 2018). In most cases, supervisors are used to providing information but they sometimes distort it through a bevaviour called leveling and gatekeeping (O’Reilly & Roberts, 1974). This results in a lack of perfect information and thus creates a dilemma for decision-makers (Cheng, Yan & Yu, 2001). It also shows a lack of readiness for the fourth industrial revolution (Parshotam, 2018). Why then do managers continue to delegate the use of BI, only a rigorous research study can tell.

The other problem is that access to external data is also not straightforward, because these data sets enter the organisation, as pockets from disparate sources and form ‘silos’ of information in different departments. Big data are often viewed as only unstructured data flowing in social media, Google, Facebook, and Twitter, yet big data also include structured and semi-structured data hidden in already existing key trading partners and other new emerging sources. These data are needed in operation but trading partners currently do not consider integrating their systems to share standard datasets to exchange these data and make quality decisions. They resort to hunting for these critical data from strangers in the big data environment instead of negotiating to connect directly to the key trading partner's systems. As long as there are no clear frameworks to guide them, extracting value from the big data environment will continue to be elusive. How can an organisation successfully integrate external systems with internal systems ethically and then use business intelligence systems to analyse the data generated in this process to unlock value? Relevant, resilient, and a rigorous research study can answer these grey areas and improve companies' performance.

The problem is that, the current frameworks and BI maturity models concentrate on technical aspects neglecting what managers should do to get value from data to develop their competitive advantage.

1.5 ASSERTION OF THEORY IN THIS RESEARCH STUDY

This research study used three theories throughout the research study. The three identified theories were: (i) The Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh, Morris, Davis, & Davis, 2003) (ii) The Diffusion of Innovation Theory (DOI) (Roger,2003), and (iii) The Social Exchange Theory (SET) (Homans, Thibout, Blau, & Emerson cited in Emerson,2008, p.335). The Unified Theory of Acceptance and Use of Technology uses four constructs namely: (i) performance expectancy, (ii) effort expectancy, (iii) social influence, and (iv) facilitating conditions. These four constructs explain and influence users' intentions to use new technology and the subsequent usage behaviour (Ahmad, 2014). The DOI theory considers five steps through which technologies are adopted; (1) knowledge, (2) persuasion, (3) decision, (4) implementation (5) confirmation (Sahin, 2006). The SET theory is one of the most influential theories for understanding behaviour when exchanging valuables. It was mainly used to examine the exchange of data in the big data environment.

These three theories informed this research study up to data analysis and reporting of findings; hence they dominated the research study process. Chapter 4 is dedicated to explaining the three theories and the conceptual framework in detail.

1.6 AIM OF THE RESEARCH STUDY

The aim of the research study was to explore the value to be derived from data analytics application to improve business intelligence in the manufacturing sector.

1.7 RESEARCH QUESTIONS

This research study answered the following research study questions.

1. What factors promote the effective exchange and usage of data with external stakeholders in the big data environment?
2. What is limiting managers from using Business Intelligence systems to analyse data in the big data environment?
3. How can organisations effectively use business intelligence to improve performance and predictive analysis?
4. What framework would aid managers to analyse data, “new oil”, using business intelligence systems?

1.8 OBJECTIVES

The main objective was to propose suitable general frameworks that can guide managers to analyse data in the big data environment using BI to create a competitive advantage.

The following were the specific objectives:

1. Explore whether external data in key stakeholders’ systems can be accessed and analysed the same way internal data are analysed without compromising ethical issues in the big data environment.
2. Examine the effect of current systems of analytics on how managers analyse data and the effort required to use BI in the big data environment.
3. Establish the ways in which managers can effectively use business intelligence systems to improve performance and predictive analysis.
4. Develop sustainable frameworks for improving the use of business intelligence systems to make data-driven decisions in an environment characterised by a number of other emerging technologies.

1.9 SIGNIFICANCE / CONTRIBUTION OF THE STUDY

The study sought to raise awareness on how to analyse information in the big data environment using BI analytics systems and improve performance. This will help managers of various organisations to know the role of business intelligence systems when gathering and analysing voluminous data, which will also help them to improve their management styles.

Studies conducted up to this point mainly focused on the characteristics and benefits of big data. They are dominated by technical aspects without providing a path that can be used by managers to adopt big data (Qi & Yang, 2020). This results in difficulties in correctly assessing BI maturity (Cardoso & Su, 2022). The existing business intelligence maturity models are also narrative as they just provide measures of how mature an organisation is, in terms of using the technologies to conduct business intelligence. They also do not provide managers with a path to get there (Chuah & Wong, 2011). This current research study provided frameworks that can guide managers to adopt a data analytics strategy and improve performance in the big data environment. It provided the information exchange framework that can be used by managers to reach the pervasive level identified by Gartner‘s five-stage business intelligence maturity model (Shaaban *et al.*, 2011). It also provided modifications to the UTAUT to be useful in the adoption of data analytics in the current environment.

These frameworks will benefit policymakers and experts wishing to adopt big data initiatives in various fields. They will also be useful to other sectors of the economy where analysing voluminous data is a problem.

1.10 LIMITATIONS

The research study limitation is that big data is a new field with a paucity of published literature, especially in Africa. The researcher drew on cognate literature written elsewhere about big data, capitalising on advances in technology to access videos and electronically published literature in other developing economies. The research study was a case study involving a manufacturing company, managers, and consultants. The managers who participated in the study are from a food manufacturing company based in Zimbabwe hence the findings may not apply to managers in other sectors and other countries. The BI consultants who participated in the study are from a company that has implemented business intelligence systems for many companies in three countries Zimbabwe, Malawi, and South Africa. The way they implement BI systems may be different from how it is done by other implementing partners in other countries and continents.

1.11 DELIMITATIONS

The research study is delimited to shareable data in the big data environment generated within the accessible boundaries of Zimbabwe. There is interest in big data the world over; and Zimbabwe is also exploring ways of extracting value from the big data, this research study focused only on a company located in Zimbabwe. The research study area is new, and not many companies have implemented business intelligence systems. A case study of a company with processes that cover almost the entire value chain was ideal to explore the expiences of managers. Therefore, this research study is delimited to managers involved in the the decision making process who have implemented and used a business intelligence system.

1.12 BRIEF INTRODUCTION TO METHODOLOGY, DATA COLLECTION, AND ANALYSIS

To get a deep understanding, there was a need for the researcher to be immersed in the users' and participants' worlds to co-create understandings with them. The researcher, therefore, decided on a qualitative research study approach for this research study. The research study relied on in-depth interviews to get answers to the main research study questions. A total of 23 respondents participated in this research study. They comprised five executives, five senior managers, three internal consultants, and five external consultants. Five more internal consultants, who also work as managers in different departments, participated via a focus group.

Data were collected and analysed using Creswell (1998)'s non-linear iterative spiral model. The analysis started very early in the research study process; from initially collected data up to the representation of findings in an iterative process of (i) collecting the data, (ii) reflecting on the data, (iii) identifying gaps then planning for the next data collection cycle (Kitchin, 2014).

1.13 THESIS OUTLINE

This thesis has eight chapters organised as follows:

1.13.1 Chapter 1 Introduction

The chapter introduces what managers face when analysing information in the big data environment. A synopsis of the big data environment The research study problem was stated the theories used in this research study were asserted, and research study questions and objectives were presented. An outline of the significance and contribution to the study, limitations, delimitations, and a brief introduction to the methodology, sample size, data collection, and analysis.

1.13.2 Chapter 2 Literature Review

This chapter presents a comprehensive literature review focusing on the big data environment. It provides a background of big data, its definition, characteristics, clarification of complimentary terms, legal issues, challenges, and opportunities in the big data environment. It also gives an outline of how business intelligence systems are used to conduct data analytics, data mining techniques, and requirements to adopt big data strategies. Last but not least, it gives a brief explanation of business intelligence maturity models. The chapter concludes with a summary table showing findings from the literature and the identified gap that the research study intended to address.

1.13.3 Chapter 3 Theoretical and Conceptual Framework

The theoretical framework is presented, and a detailed explanation of the theories used as theoretical lenses in this research study is provided. The chapter also presents the conceptual framework aligned with the study theme as gleaned from the extant literature.

1.13.4 Chapter 4 Methodology

Chapter four introduces the methodology used. Major issues examined are the research study design, structure, the sampling criteria used to choose the participants., selection of data source, trustworthiness, reliability, ethics, and other methodological issues.

1.13.5 Chapter 5 Data analysis

This chapter presents the findings from in-depth interviews conducted with the 23 participants in this research study. The analysis followed thematic analysis and discussions and incorporated the findings from the literature and theoretical assumptions. These gave birth to the discussion of the findings.

1.13.6 Chapter 6 Discussions of findings

This chapter discusses the findings from the fieldwork comparing them with findings from the literature. The chapter discussed the findings following the same sequence of themes and sub-themes generated in chapter 5. New insights were highlighted and theories served as lenses to explore the results further. Conclusions are given as summaries below each theme. This formed the foundation of the frameworks that were developed in the next chapter.

1.13.7 Chapter 7 Development of frameworks and contribution to the theory

Chapter 7 presents the frameworks developed from the synthesised findings. The frameworks include contributions to theory. The frameworks are anchored on the research study questions and objectives to clarify the findings and recommendations.

1.13.8 Chapter 8 Conclusions and recommendations

Conclusions were drawn from the findings and frameworks are presented for managers and consultants who participated in this study. Recommendations for practice and further research study are suggested.

1.14 CHAPTER SUMMARY

This chapter provided the background to big data, the problem statement, research study questions, objectives, the significance of the study, and the limitations. The chapter highlighted that data come from emerging technologies that drive the fourth industrial revolution. Data emerged as, the “new oil”, needed by managers to move their organisations. The chapter also outlined in brief how the study was executed. The next chapter, the literature review, explores the extant literature in detail to understand: the sources of this “new oil”, its characteristics, opportunities, and challenges encountered, and what is required to extract value from data.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

Big data is a buzzword that has left many people wondering what really is big data (Davenport, Barth & Bean, 2012; Favaretto *et al.*, 2020; Gotmare & Nikam, 2022). In addition, the word big data is surrounded by many other terms such as Internet of Things (IoT), cloud computing, machine learning, Artificial Intelligence (AI), BI, and many more, making it even more confusing for managers to have a proper plan of extracting value from data in such an environment. Besides all this confusion, big data are said to bring value to organisations. This was a motivation for conducting this literature review of realising value from data in the big data environment.

This research study conducted a literature review using the following keywords as data search strategy (big data, big data definition, big data characteristics, big data challenges and opportunities, legal issues in big data, big data analytics, requirements to adopt a data analytics strategies, value realisation of big data, big data mining, business intelligence in big data environment, business intelligence maturity models). These keywords were selected in a manner that would provide as broad coverage of the big data subject as possible while remaining focused on extracting value from the data. Some of these keywords and concepts emerged during the literature review leading to further exploration.
The literature review was organized as follows, (1) understanding what big data are all about, including the source, (2) the need for external data and challenges encountered in the big data environment, (3) the link between data and analytics, and changes needed to adopt a data analytics strategy, then finally (4) data analytics and use of business intelligence systems to extract value including use of BI maturity models to measure business intelligence maturity levels.

The outcome produced four main key sections with related themes. These are presented in this literature review chapter. The following figure 2.1 shows how the literature review was conducted.

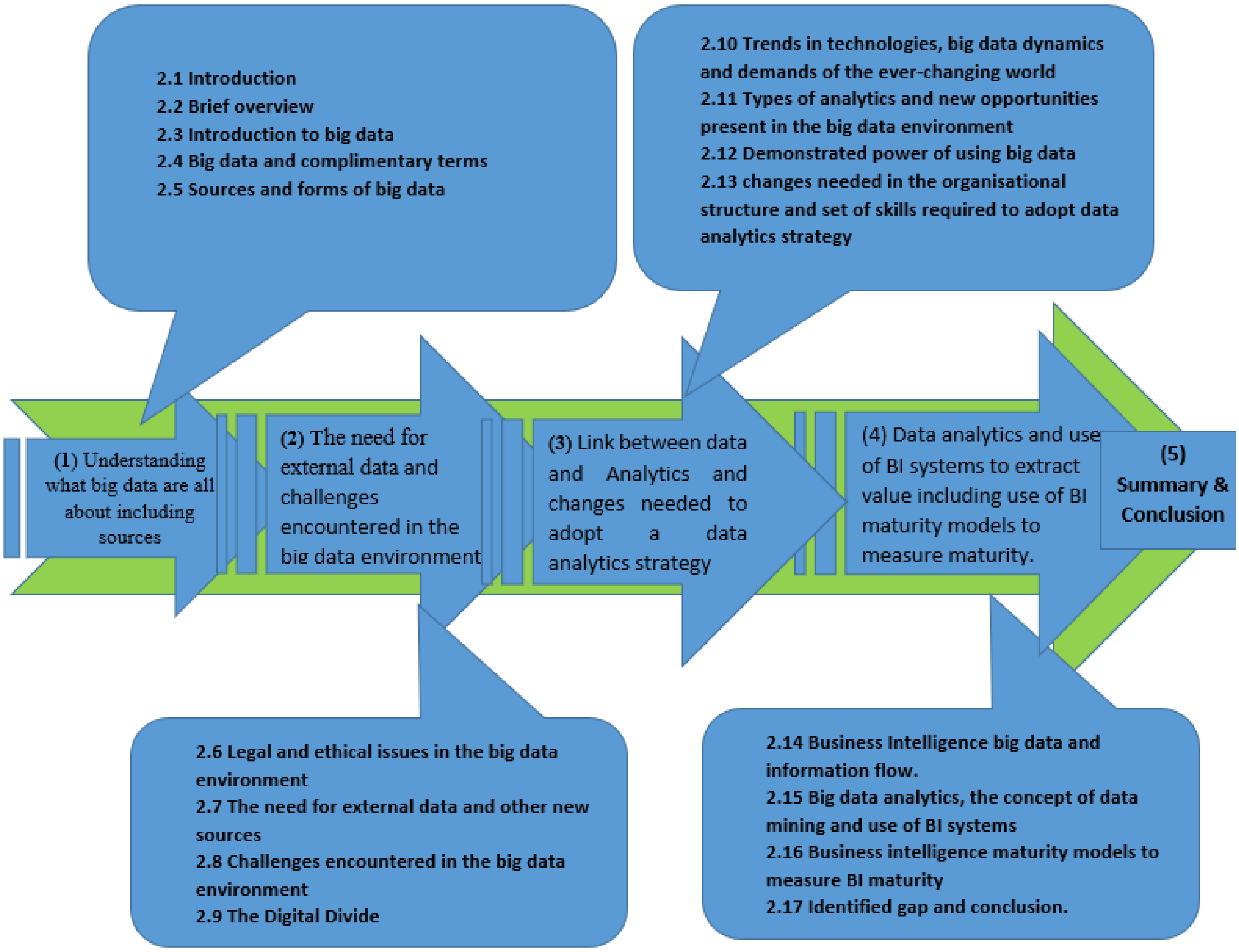


Figure 2.1: Literature review analysis map

The chapter is concluded by providing a summarised table of key issues found in the literature, the identified research study gap, and outlining the researcher's context and conceptual framework later used as the basis for building the final frameworks. A chapter summary is given at the end of the chapter.

2.2 BRIEF OVERVIEW

Information to make meaningful informed decisions needed by managers to drive business strategies is now available in abundance from different disparate sources, where it can be harnessed using technology. Besides the availability of data and improved technologies to transform the data into valuable insights. It is still a challenge to get value from the big data environment because external data enters organisations, as pockets that come from different disparate sources forming 'silos' of information in different departments. Therefore "big data are not always better data" (Ghasemaghaei & Calic, 2020, p.1).

The big data era has brought with it, a new problem to managers in the form of information overload. To add to that, it is very hard to analyse data in the big data environment using manual means and traditional systems such as Excel hence the interest in using BI tools to provide an all-inclusive information hub for policymakers and government officials (Lee *et al*, 2022). This has brought in a new dimension of analysing information for business intelligence and decision-making shifting the focus from transactional IT to analytical IT. However, most organisations have not changed their organisational structures to accommodate this change (Alharthi, Krotov & Bowman, 2017, p.289).

This transformation in IT has the same capacity to revolutionise the whole world the same way oil did hence the term, "new oil". Michael Porter of the Harvard Business School predicts that this new world of interconnected devices can change the dynamics of competition to an extent that it is now existential. This means that it is now related to human existence and experience (Siebel, 2017).

Many organisations are now adopting computer-based intelligence in their operations to make quicker decisions and improve efficiency (Kester & Preko, 2015). This has proved to be a potential area for research studies that has received great attention from almost all fields of study, academia, businesses, IT communities, governments, and other interested parties because information, is the cornerstone of almost all the decisions made in any organisation. This has also attracted data scientists who have simultaneously developed an interest to harness these relatively untapped resources to drive the value of their organisations. While academic and scientific research studies have made significant strides in addressing the volume part of big data, research that connects big data to operations has lagged behind (Roden *et al.*, 2017). Interfacing and linking different devices is no longer an issue. What seems to be lacking is a clearly defined roadmap to analyse the data generated by these various devices in the big data environment. This research study attempts to fill that gap by providing frameworks.

2.3 INTRODUCTION TO BIG DATA

Some argue that big data and analytics are among the most over-hyped and abused terms in today's information and technology circles because data have always been growing only that they are now growing at a fast speed and they will not stop growing. However, it is now the meaning and value that have become ambiguous (Devlin, 2016). If big data and analytics are not a new thing so what has changed then, to bring this hype? What has changed is the emergence of data from new sources through improvements in technology and the dire need to want to analyse these data, that have not been analysed before. The resultant massive amounts of data are difficult to handle using traditional relational database management systems; neither can they be analysed using traditional methods. This problem has seen technology advancing to an extent of leaving data and analytics intertwined (Watson, 2014).

Most businesses have been using data for recording and monitoring purposes. In other words, advancement in technological capabilities enables massive amounts of data to be generated, gathered, stored, analysed, shared, and distributed to various places using interconnected technological devices. This results in improved decision-making processes, improved economic activities, improved profitability, and eventually better living conditions (Newell & Cousins, 2015). Despite being underrated by the notion that data have always been growing. Big data are still seen as a game changer with the capacity to drastically change how businesses and institutions operate. Organisations should leverage these data to remain competitive. They will reduce costs, improve customer service, and adopt personalised marketing, resulting in better pricing (Lee, 2017a).

Unlike other technological advancements, the Chief Executive Officers (CEOs) themselves are leading big data initiatives from the top. In Germany for example, leading CEOs formed a group code-named Industry 4.0 with a mandate of advising the government on policy issues needed for the fourth industrial revolution based on artificial intelligence and the Internet of Things. In France, the CEO of Engie, Isabelle Kocher assembled a C-suit team to transform the company via big data (Siebel, 2017). Therefore, by adopting big data initiatives some companies will become more competitive and thrive in the current environment while those that choose to ignore big data are likely to face fierce competition and crumble. The only headache is, the data come with the following characteristics volume, velocity, variety, veracity, and value (Bello-Orgaz, Jung & Camacho, 2016) making it extremely complex to analyse them.

The main aim in this era of big data is to reduce escalating large-scale problems to levels that humans can comprehensively act upon through data harvesting (Dargam *et al.*, 2016). However, some bloggers and vendors have seen an opportunity to use the colourful phrase, big data, as the phenomenon of trying to capture attention thereby creating a marketing gimmick and leaving some managers confused and wondering whether big data is a marketing term or an IT term (Power, 2014). This confusion has seen the emergence of different definitions and various forms of big data in the minds of many (Favaretto *et al.*, 2020). Some define them as the aspects of voluminous data that come with computational difficulties when processing, storing and analysing them on a single machine (Kitchin & Mcardle, 2016).

The big data phenomena and its characteristics can best, be described by the HACE "theory", where the restricted view of each blind man leads to a biased conclusion (Tamhane & Sayyad, 2015), as depicted by the following figure 2.2.

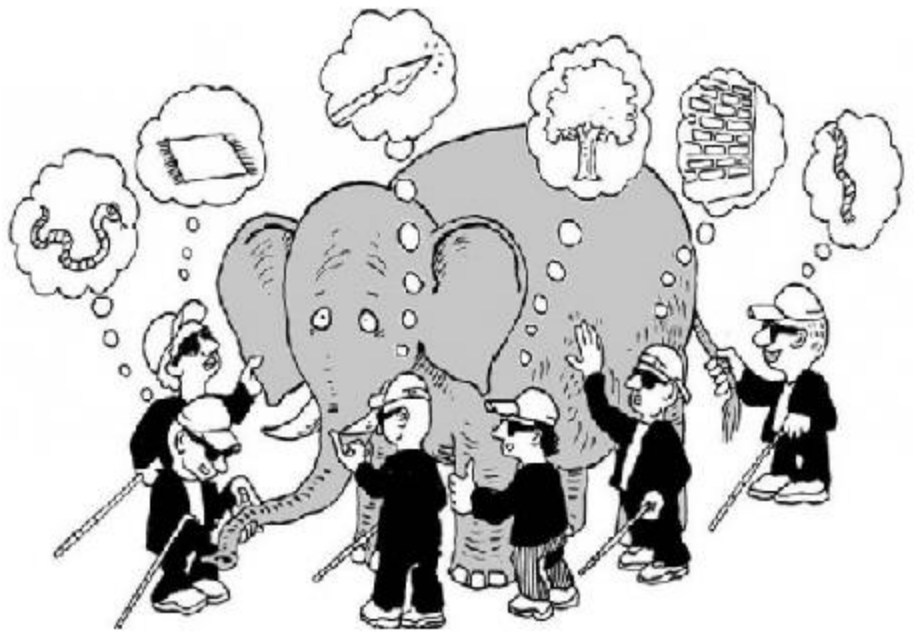


Figure 2.2: The Hace theory

Source: HACE (Tamhane & Sayyad, 2015, p.19).

The fact that big data have different meanings to different people has resulted in most IT projects being rebranded to big data projects, as vendors add this flair to win potential customers (Koronios, Gao & Selle, 2014). However, many big data experts argue that this confusion is common in the beginning phase of the big data revolution and they expect that soon many organisations will clearly understand what big data are all about. Thereafter, these organisations will join this bandwagon of relying on data-driven decisions in their operations (Cohen, 2018). When there is too much noise and confusion about a new topic like what is currently happening with the big data topic, the academic literature is the space to go and get to the bottom of the subject matter and find out the truth that separates the noise from scholarly signals (Frizzo-barker *et al.*, 2016).

To clear up confusion about what big data are, various scholars seem to have reached some agreement about certain characteristics of big data. For example, experienced government leaders from different sectors interviewed by a commission on big data set up by the American government defined big data as, large complex volumes of variable data that require advanced technologies and techniques to store, manage, analyse, and distribute (TechAmericaFoundation & FederalBigDataCommsion, 2012).

Big data are widely known by their characteristics of veracity, value, volume, velocity, and variety (Bello-Orgaz, Jung & Camacho, 2016; Bahrami & Shokouhyar, 2022). This makes them extremely complex to analyse. This research study adopted the following definition: "*Big data are a set of techniques and technologies that require new forms of integration to uncover large hidden values from large datasets that are diverse, complex, and of a massive scale*" (Hashem *et al.*, 2015, p.100).

Although in their analysis the authors only identified four characteristics of big data as volume, variety, velocity, and value leaving out veracity, this research study recognised and adopted all the five V's of big data that have been identified by other scholars. These five characteristics were further summarised by Ishwarappa & Anuradha, (2015) as shown in the following figure 2.3.

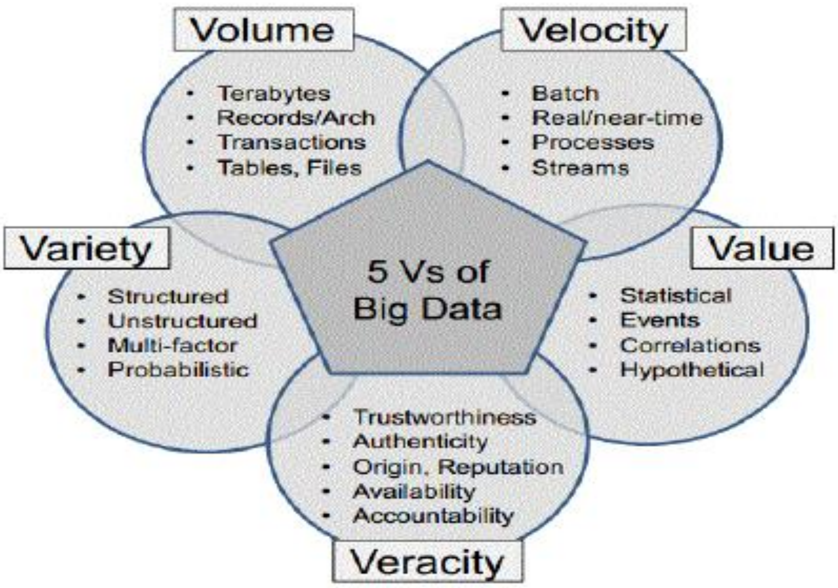


Figure 2.3: Characteristics of big data

Source: (Ishwarappa & Anuradha, 2015, p.320)

Though the term big data first appeared in 1998 (Fan & Bifet, 2015), in the literature, the five characteristics of big data were mainly discussed and agreed on by many authors between 2012 and 2015. Before that, big data were seen as a challenge and only three characteristics (volume, velocity, and variety) dominated the discussion (Kaisler *et al.*, 2013a).

Volume

The origins of big data emanated from the fact that organisations such as Google, Yahoo, Facebook, and Twitter, were creating a huge amount of data every day that continued to grow, resulting in more data than ever before (Fan & Bifet, 2015). This definition of big data still lingers in the minds of many today, whenever the subject of big data is introduced. "The big word in 'big data' itself defines the volume" (Kata, Wazid & Goudar, 2013) Therefore, volume, becomes the most distinctive feature of big data as it usually puts pressure on hardware and software, hence the confusion. However, it has to be noted early, that volume is just one of the five characteristics of big data.

Variety: Refers to various sources of data and is considered to be the main dispute challenge to data analysis (Banumathi & Aloysius, 2017). The bulk of data in the big data environment are unstructured making it difficult to put them into a relational database thereby complicating the role of data analysts and managers (Ishwarappa & Anuradha, 2015). At first, organisations were accustomed to internal structured data, stored in their servers only. However, as IoT gained momentum, many different types of data sources such as text, audio, video, graphs, and sensor data are now accessible. Thus the focus is usually on unstructured data. This presents an opportunity to tap into semi-structured and unstructured data imposing a new requirement for data storage.

Velocity

Velocity refers to the rapid relentless creation of data (Erevelles, Fukawa & Swayne, 2016). The speed at which these data are generated and moved around presents a huge challenge in data analysis (Monroe, 2012). These high-speed data need to be in real-time, near real-time, or in streams hence the term velocity (Demchenko *et al.*, 2013). Velocity affects both the hardware and the human capacity to handle the data, requiring high-speed processors to handle the data. Compared to the other characteristics of big data, velocity is considered to be more important as it enhances performance and innovation by providing much-needed timely insights (Ghasemaghaei & Calic, 2020).

Veracity

Veracity refers to datasets that are full of uncertainty (Shukla *et al.*, 2020). It was coined the fourth "V" and deals with the elements of doubt and reliability which include truthfulness, accuracy, and correctness (Rubin & Lukoianova, 2014). The main problem with data is that they can be misleading if incorrect., This is more prevalent in unreliable and outdated data, especially if they are coming from different conflicting sources., Therefore, to discover the truth from real-time data and avoid misinterpretation of facts from distorted information. The next generation of systems must manage veracity very well (Berti-equille & Ba, 2016).

Value

Value is an important feature that has driven the hype for big data as it brings added value from the collected data to improve processes, activities, and predictive analysis (Demchenko *et al.*, 2013). Adding value means filtering the most important data from all the data collected by the organisation from different disparate sources (Kata, Wazid & Goudar, 2013).

Therefore, this research study focused more on value, which comes from storing the data and analysing them using BI systems.

Many scholars have written a lot about the first three (3) characteristics of big data namely volume, velocity, and variety but as the discussion on the subject gained momentum, they introduced the other two characteristics, veracity and value (Mitchell *et al.*, 2012). Veracity as "V" number four represents an unreliable source of data such as customers' comments on social media. The fifth "V", value, represents data that comes with a low value from the original source compared to the volume. On the other hand, one has to bear in mind that analysing large volumes produce high value (Gandomi & Haider, 2015). Therefore, big data are, often defined along these five characteristics. From this, it is clear that big data do not only refer to vast mountains of data.

Goes, (2014) commented about big data in editor's comments in MIS Quarterly where he further discussed the relationships among these 4 "V's" highlighting that in IS research studies, hardcore disciplines have been working on volume and perhaps velocity (Baesens *et al.*, 2016). The most talked about "V", is volume since it refers to the amount, scale, and size of the data that produce the datasets that eventually determine how the data will be stored and processed (Heureux & Member, 2017). This has attracted the interest of hard-core sciences such as computer scientists, data scientists, database developers, and hardware developers who have been at the forefront of advancing big data initiatives. It appears that with time velocity at which the data fills up leads to an increase in volume and also veracity leads to variety while the value is squeezed in between (Tenkorang & Helo, 2016).

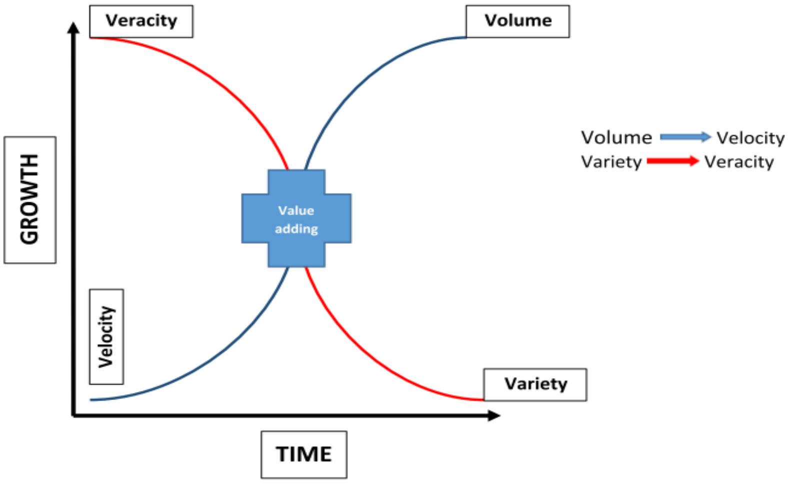


Figure 2.4: Relationships of the five V's

Source: (Tenkorang & Helo, 2016, p.530)

As indicated in figure 2.4, value addition is realised when all the four "V's" have been taken into account to extract value. Veracity starts on a high note and over time, it moves towards variety meaning that at first the data are not trusted and lack authenticity. It suggests that there is a direct relationship between veracity and variety meaning that with time as the organisation gets used to the data and starts trusting them, the variety increases. On the other hand, velocity is directly related to volume meaning that as the velocity begins to increase it will have a direct bearing on the increase in volume. Therefore, the value is at the epicenter of all the four "V's" veracity and variety then velocity and volume (Tenkorang & Helo, 2016). This appears to be a good model that could be built on, however, the element of external versus internal seems to be lacking in the model.

Other fields such as commercials take a keen interest in value, variety, and veracity since they want to extract value from a variety of trustworthy sources. For years, big data research studies were mainly centered on scientific disciplines. However, in management, it is now gaining momentum because of the value characteristic of big data, and it cuts across different disciplines within the same organisation. This resulted in various academic communities researching big data in management focusing on value discovery. Those in human resources are interested in organisational change through IT. Those in marketing and operations take a keen interest in value creation through strategic decision-making while those in finance focus on value realisation through business development (Sheng, Amankwah-amoah & Wang, 2017).

It is clear that the next breakthrough in innovation is going to come from big data (Gobble, 2013). This has seen many international conferences on big data such as the one held in the USA in 2020. It was divided into several focus areas such as big data storage, big data security, big data cleaning, big data modeling, big data applications, big data mining, and big data analytics. (Jerryzeng, 2020). This research study narrowed the scope and focus on big data analytics. Therefore there is a need to first demystify the confusion on big data and its complimentary terms.

2.4 BIG DATA AND COMPLEMENTARY TERMS

Big data are often confused with their complementary and overlapping terms like AI, machine learning, business intelligence, business analytics, data warehouse, data mining, and IoT. For example, the terms Business Intelligence and business analytics have different meanings but they are often used interchangeably by professionals. Managers must understand the difference to help them to choose the appropriate tools.

Business intelligence involves the use of tools such as BI analytics systems on data to manage day-to-day operations to produce informative reports that help managers to achieve current business goals. On the other hand, business analytics is statistically based where data experts use quantitative tools such as correlational analysis, regression analysis, factor analysis, forecasting analysis, and many other tools to make predictions about the future (Sharda, Delen & Turban, 2015; Harvard Unversity, 2021). They both work on data however, the latter may require the organisation to hire the service of a specialist in the form of a data scientist (Côrte-Real *et al.*, 2019) . The two overlap but business intelligence almost comes under business analytics and feeds into the latter (Zhao, 2021).

Though data scientists can be employed to work on any of the two, BI tools are meant for managers as they can be easily trained to use them to manage day-to-day operations but they usually confuse the two and hire a data scientist to conduct business intelligence for them. This research study concentrated on improving the use of BI.

Over the past three decades, BI has become so important for data analytics to improve business performance. However, the emergence of big data brought the big issue of the relationship between big data analytics and BI. What is now known is that “big data analytics is an integrated form of data analytics and web analytics" (Sun, Strang & Yearwood, 2014, p.3). In other words, big data analytics is a service of business intelligence represented by the formula Big data analytics = big data + data analytics + Data warehouse (DW) + Data mining (DM) + Statistical modeling (SM) + Machine learning (ML) + Visualisation + optimisation (Sun, Zou & Strang, 2015).

There are a number of other emerging technologies and tools that have been developed that now make the big data environment (Gokalp *et al.*, 2016). The focus should be on how to use these tools to extract value from the data.

For example, IoT assists in connectivity to access, several data sources thereby dealing with variety. Business intelligence and data mining are tools developed to try and deal with the extraction of value, while data warehouse deals with storage issues like volume and veracity. Usually, organisations focus on implementing one of these and then think they have adopted big data, yet they would have adopted just a complimentary portion of big data. Internet of Things is one such buzzword that has also dominated IT around the world without a generally agreed unique definition, yet it has unified the world under a common infrastructure of a global system of interconnected computer networks (Madakam, Ramaswamy & Tripathi, 2015).

The International Telecommunication Union (ITU) defines IoT as "a global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on, existing and evolving, interoperable information and communication technologies" (ITU, 2012) (Wortmann & Flu¨chter, 2015, p. 221). Joining this network society does not mean that one has implemented big data. However, one would have moved a step in the right direction by adopting big data because without the Internet it would be impossible to access data from a variety of external sources.

External data exchange in the big data environment is driven by two main drivers, namely the Internet and social media (Lee, 2017b). In Zimbabwe when demonstrations over fuel price increases code-named "shutdown Zimbabwe" turned violent on 14 January 2019, the government responded by shutting down the Internet. This meant all the services that relied on exchanging external data in the big data environment for collection and processing of data via social media, mobile devices, and the Internet such as vehicle tracking, internet banking, and cloud computing all came to a halt. The issue ended up in court and was only resolved after a week on 21 January 2019 when the high court ruled in favour of the Zimbabwe lawyers for human rights and the media institute for Southern Africa by ordering the government to restore the Internet (Nemukuyu, 2019).

Thus, extracting value from external data in the big data environment is not an issue for the sciences only but it cuts across different fields of study including social sciences, political science, lawyers, and management. Internet access, censorship, and human rights interests have always crossed the floor. On the African continent alone, the following 12 countries had to shut down the Internet for various reasons in 2016 and 2017: Algeria, Cameroon, Chad, Congo, DRC, Gabon, Gambia, Ethiopia, Gabon, Uganda, Zambia and Zimbabwe (Sutherland, 2018).

The Internet is at the core of big data technologies, especially when accessing external data. It is practically impossible to access customers' data without access to the Internet, therefore any move to shut down the Internet will affect the flow of data in the big data environment. From the above examples, it means access to external data such as from social media, Google, Facebook, and Twitter was not possible during the period of the Internet shutdown. Though the motive was for some other reasons it also affected a key source of big data for corporates. The African network information center, a body with the sole responsibility of assigning and managing Internet addresses in Africa, tried to come up with punitive measures of disconnecting governments that shut down Internet access in their countries, however, the move was resisted by member states in a meeting held in Nairobi, Kenya (Mukeredzi, 2017).

On the other hand, with AI, a computer can be programmed to do what it has been told to do and then complete tasks that are supposed to be done by humans. AI allows delegation of pattern recognition of processes usually done by humans, for example, over half of the world's stock trade is done using AI and this has resulted in increased velocity of trade, a task that would be difficult for humans due to the velocity and volume of data involved (O'Leary, 2013). Therefore, implementing AI does not mean an entire big data strategy has been implemented even though AI is part of big data initiatives.

A good big data strategy should incorporate all the five "V's" identified by the scholars. Although everyone seems to have agreed on the "V" representing value, it is not an easy task to extract this value. Maybe this is due to the lack of a framework that precisely gives guidance on how to extract this value. It appears that the value is different in organisations depending on the strategy being pursued by the organisation at a particular time.

This implies that organisations must go beyond just knowing the five “V’s” of big data but rather do something, to realise this hidden value. In this research study, the source of data, supported by real-time streaming played a critical role. Extra untapped sources have a great potential of bringing that extra value since some sources have been difficult to access. Certain sources have been left out due to a lack of technologies, frameworks and policies to access them yet they play a critical role and represent the much talked about ‘new oil’ present in the big data environment. If this is further broken into internal sources versus external sources, it will result in a much clearer picture. Therefore, there is a need to closely look at the sources of big data to get a clear understanding of what big data are all about.

2.5 SOURCES AND FORMS OF BIG DATA

What are the sources of big data? Where does the data reside? And who are the owners of big data such that organisations can approach the owners and start extracting value from them? These are questions being asked by many. The data originates from a variety of sources including external and internal and this brings in the concept of data sharing to realise value from the external data. The transactional systems used by the organisation for daily operations produce data through postings and logs from sensors and equipment (Dijcks, 2013).

Big data are, therefore, a by-product of business transactional systems such as an ERP and data from machine sensors; data produced by public service institutions (administrative data) IoT, social media, and networks such as Google, Facebook, Twitter, and Linkedin. With advances in technology, any person or device can now generate data and share them. If data can be shared and freely used and redistributed by anyone when required then those data are classified as open data (McDonald & L’eveill’e, 2014). Machine sensors in production lines, vehicles stationary and in motion, all generate valuable information that contribute to big data (Matti & Kvernvik, 2012). These devices contain data that can be turned into information and save organisations millions of dollars. One other important factor to note is ownership; with ownership comes a lot of responsibilities to ensure data accuracy (Kaisler *et al.*, 2013b).

Much of the data housed in organisations are historical data for regulatory requirements and these historical data also hide the data required for insights (Cognizant20-20Insights, 2011). Therefore, the data can be in the form of data stocks needed for historical analysis. Usually, these data are also needed by other users such as key trading partners for them to make informed decisions. However, it has been proven that more value is realised when attention is given to the flowing data than just analysing stagnant data stocks which are more historical. This type of analytics is called streaming analytics and has become more popular as organisations strive to analyse these real-time moving data from machine sensors, cameras, and real-time transactional postings during the decision-making process. Data are needed the most during the decision-making process to avoid making obsolete decisions (Davenport, Barth & Bean, 2012).

The data in the big data environment originate from non-transactional and transactional sources that breed different forms of data ranging from unstructured, and semi-structured to more organised and structured data (Baesens *et al.*, 2016). As the data passes through the various phases and channels of transformation it becomes difficult to identify and exploit opportunities due to information overload (Renee, 2013).

Of the five "V's" of big data, variety, appears to be directly related to the much talked about big data value, because more value is likely to be realised when a variety of sources are accessed than from one single voluminous source. This holds true, especially when it incorporates sources that have been difficult to access before. It is therefore very important to further classify the data according to three types of sources identified by Dijcks (2013) (i) traditional enterprise data (ii) sensor data which are machine-generated and (iii) social data from social media. This can also be looked at from another angle as representing the internal and external sources of big data (Opresnik & Taisch, 2015). However, it must be noted that, even if the organisation identifies the sources of external data it requires, it cannot gather those data without the owners' knowledge and consent, bringing in the concept of privacy, and legal and ethical considerations.

Organisations have been lining up to exploit the new opportunities that exist in the big data environment by organising workshops and training programs including degree programs to try and harness value from big data, without allocating enough space, time, and thought to ethical, legal, and privacy issues (Tractenberg *et al.*, 2015). Privacy is the biggest concern of big data and appears to be the main key needed to unlock the value hidden in the big data environment. If the approach to big data is correct, it will create new wealth for shareholders through improved performance and productivity. A wrong approach will result in poor decisions, violation of data security and private codes, harm the reputation of the organisation, and destroy the brands (The Futures Company: ACCA & IMA, 2013). Therefore, for an organisation to start harnessing value from the big data environment by incorporating external data without consequences there is a need for it to closely look at the legal environment and ethical issues in the big data environment.

2.6 LEGAL AND ETHICAL ISSUES IN THE BIG DATA ENVIRONMENT

Though the big data environment presents an opportunity that can change and transform organisations, it seems the legal framework is not yet ready for this huge opportunity and appears to be one of the major obstacles. However, it must be noted that advances in technology have always crossed the path of privacy starting from as early as the 11^{th} century in England when individual records for tax purposes and photographs were introduced (Yu, 2016). It has been proved throughout history that any advances in technology such as big data have the potential to drive economic change (Schmarzo, 2016).

To start using external data, privacy, legal and ethical issues should be treated with care but at the same time should not be barricaded. Building on this, it, therefore, entails that when advancing technology such as with big data, privacy is one of those humps that has to be ridden with caution until the intended destination is reached because it can derail any advances in that technology. The main problem with big data is that they involve various professions yet for a profession to develop, the practitioners in that particular field must proceed in line with a generally agreed code of professional ethics. With big data, the practitioners come from different backgrounds making it difficult to have a single agreed code of conduct (Tractenberg *et al.*, 2015). To address this, many organisations around the world are revisiting their laws to accommodate sharing of information. For example, Japan is revising its PPI Act of 2003 to achieve this (Yamamoto *et al.*, 2015).

The act aims to protect personal information and individual right but at the same time try to promote the creation of new industries and the realisation of a vibrant economic society that can enrich the quality of life of the Japanese people (Administrative_Agencies_Incorporated, 2020). While other countries are putting strict measures to restrict sharing of data. China has seen an opportunity and is encouraging data sharing to an extent of setting up the data stock exchange markets. These data-sharing and trading markets are booming and they expected the market to grow to over 8 billion (Li, Qian & Wang, 2018).

It appears that the key to start mining this new oil, presented in the form of data (information) is currently in the hands of those who create the legal environment of information sharing. The information can be personalised from different fronts, for example, companies and governments at the organisational level and then at the individual level. It is true that sharing data in the big data environment and its ecosystem of processes can improve the way organisations do business however, the ethical challenges associated with it should never be underestimated. For example, an analysis done on the EU general data protection regulation (GDPR) revealed that the legal requirements may need to be implemented technically during data processing (Gruschka *et al.*, 2018).

In India, the world's largest national digital identity platform called *Aadhaar* bears testimony of how the ensuing battles may end up in courts. *Aadhaar* is a unique biometric form of identification set up by the government of India. This *Aadhaar* system which every Indian was entitled to, was unique, designed to accurately and efficiently identify individuals, supported by a 12-digit random number (Abraham *et al.*, 2018).

In March 2016, the *Aadhaar* bill was passed empowering the government to use it as a money bill and this was heavily criticised by members of the opposition, civil society activists, and social commentators. This resulted in it being challenged in the supreme court because in 2013 the same court had ruled that *Aadhaar* could not be compulsory (Drèze & Tiwari, 2016). On 24 August 2017, the Supreme Court ruled that India's 1.3 billion citizens had a fundamental right to privacy hampering all the efforts to fight corruption and modernise the economy through big data. The opposition leader welcomed the ruling and celebrated the ruling by tweeting that it was a victory for an individual's liberty, dignity, and freedom (Parajuli, 2017). Later on 25 September 2018, the same supreme court of India ruled that *Aadhaar* was now voluntary.

This raised the critical question; could the private sector also have access to the data? This was immediately answered when the court struck down section 57 of the Act labeling it unconstitutional meaning that no company or private entity could use *Aadhaar* to seek identification from an individual (Parajuli, 2017). Though these systems appeared successful, research studies have shown that they raise issues around ethics and the big question of who owns the data, so they are vulnerable and they usually face resistance (Jain & Nandakumar, 2012).

From the above, it is clear that the war between privacy and economic benefits brought through advances in technology is not yet over. In the private sector, schemes such as *Aadhaar* could help organisations (e.g., banks) that require proof of residence when granting loans and following up on defaulters. In the public sector, it could help law enforcement agencies such as the police in verification, healthcare services, disaster management, and other economic activities (Agrawal, Banerjee & Sharma, 2017). Besides all these benefits of the big data environment, the ruling proved that ethics may not be compromised for the sake of saving certain sectors, hence the need to consider the rights of others. It, therefore, suggests that organisations must do a thorough job when developing systems meant to share and utilise information outside their controlled boundaries.

Perhaps organisations could get around legal and ethical problems by forming clusters where they could sign agreements to voluntarily share data. However, information providers usually keep information close to their chest and are not keen to give it away since information is power. This calls for good negotiation skills to get the data. For years, customer relationship management and supplier chain management have not been given great attention but it is now time they are given more attention than ever. To add to that there is a need to sign service-level agreements, to unlock the value of information hidden in the big data environment. A sound legal framework is what is missing for organisations to come up with successful big data projects. Business intelligence analytics must be done in a legally compliant way (Kemp, 2014).

The belief is that with big data, a data-sharing community is going to emerge with greater transparency on price, performance, reputation, and competition allowing businesses to create partnerships and build strong beneficial ties with their customers. This will allow organisations to tap into new services, a thing they cannot currently do, like the inclusion of automatic cash planning tools and instant credit rating (Henke & Kaka, 2018).

It is now time to classify customers into platinum, gold, silver, and bronze so that when it comes to negotiations they go beyond just negotiating for goods and services and also incorporate bargaining for the voluntary exchange of critical information needed in budgeting and strategic planning to improve the decision-making process. The first thing any manager looks for before taking any decision is information and anyone starved of information cannot then take meaningful decisions. How then can the information, be availed without infringing the rights of organisations remains a big issue. Though, consumer information is now an important aspect of businesses. The drawback is that the current laws that protect personal information are scattered among various laws without specific laws to address the issue (Deng & Yan, 2021).

It appears that the laws that have been crafted were mainly focused on protecting certain information. However, in business, there is information that must be exchanged to create value for organisations e.g. manufacturers of certain products need information about those who need their products for them to plan effectively. Information about who has consumed their product.

On the other hand, the USA almost produced an act to protect data through the FTC (Federal Trade Commission) (Glosson, 2016). Still, in the USA, Judge Preska concluded that the main challenge that faces governments in crafting the laws dealing with data is the doctrine of extra-territoriality, which limit sharing of data outside the country's borders (Glosson, 2016). The big data environment has a high chance of bringing the challenge of interstate commerce because data are boundless and can flow and get analysed anywhere making it difficult for a state to craft laws that apply to data within its boundaries only. However, it is also quite clear that external data cannot just be easily accessed for analysis and shared without ethical considerations because they are still a big issue (Herschel & Miori, 2017).

If rights are not observed properly, access to big data can be harmful to certain groups or individuals by infringing on their rights (Hilbert, 2016). It then poses this critical question; can external data be analysed from their source? To add to that, 'big data attracts practitioners from different backgrounds and this makes it even more difficult to have a single code of conduct to deal with ethical issues around them' (Tractenberg *et al.*, 2015). Perhaps the best way for organisations, for now, is to form smart partnerships and sign agreements for data sharing with key stakeholders such as suppliers, customers, and employees. whether it is feasible to do that is part of this research study.

External data processing for sense-making forms an integral part of data analytics (Kwon, Lee & Shin, 2014). It therefore suggests; the unstructured external data source component has great value but the myriad of ethical issues around it seems to hamper any hope of harnessing value from the data. One such grey area is who is, assigned the critical role of bringing these external data into the data warehouse of the organisation for analytics. Obviously, this cannot be left to junior staff or a single department, and also is that person skilled enough to know what has to go into the data warehouse?

When using information from external sources an organisation should bear in mind that there is always a thin line separating BI and espionage. Recently on 25 May 2018, the EU adopted the general data protection regulation act. This piece of legislation is regulatory meaning that it has to be applied in its entirety across the EU, unlike the previous legislations that were directives. It also affects organisations processing and holding personal data residing in the EU regardless of the geographical boundaries (European Commission, 2018).

2.7 THE NEED FOR EXTERNAL DATA AND OTHER NEW SOURCES

One critical question asked so far is, if so many challenges are associated with dealing with external data then why would organisations go that extra mile to analyse these external data? They do that because information is the cornerstone of any decision-making process, therefore when making important strategic decisions, organisations rely on converting external raw data into information and then analyse them to get insights. In an organisational setup, the need for data depends on the intended use of those data and the level of the manager on the management hierarchy, and in the process, external data are often, overlooked due to difficulties in getting them. External data are now needed more than ever because competition is now changing from rivalry between individual organisations to rivalry between entire supply chains where external business data analysis now plays a central role in the decision-making process (Trkman *et al.*, 2010).

In companies, there is a need to address three critical issues of uncertainties that arise due to delayed deliveries by suppliers of key raw materials, machine breakdowns of manufacturers, and fluctuations in customer orders. Lack of perfect information among the members of the supply chain is the main cause of this dilemma (Edwin, 2001). This is where sharing of external data in the big data environment plays a critical role to improve performance. Mckinsey analytics predict that, due to the emerging borderless world, new ecosystems will become more visible, replacing traditional industries and these will allow companies to pinpoint critical data points and sources along the value chain where data can create value. These ecosystems will vary by region and country depending on regulations and the size of the pool of youths who are tech-savvy consumers (Henke & Kaka, 2018).

If the strategic and operative exchange of data is, embraced by organisations along the supply chain, the benefits are immense as it results in the improved flow of products and services as well as cost reduction and value creation both upstream and downstream (Korpela & Dahlberg, 2017). The business to business integration can be classified into three forms, manual operations where data have to be manually transferred, electronic data interchange which is more of a point-to-point integration and finally a hub where one company can connect with many intermediates (Korpela & Dahlberg, 2017). However, many firms are still using old practises of managing costs (Bag *et al.*, 2021). To be able to extract value from external data, organisations should strive to move from manual external data interchange and integrate at the hub level.

A budget is one such important instrument used by an organisation to guide it in its operations and when making important business decisions. It is practically impossible to prepare a budget without historical data from key trading partners and future insights. The process of budgeting could drastically change for the better by incorporating external data from suppliers and customers in the big data environment (Griffin & Wright, 2015; Valle-cruz, Fernandez-cortez & Gil-garcia, 2022)

). For decades, manufacturing companies have been struggling to know the end-consumers of their products, relying on trade partners for such critical information. The emergence of big data has now made it possible for customer-centric organisations like Whirlpool to put sensors and track the final usage of their products (Woerner & Wixom, 2015). In a volatile situation, the budget is constantly, revised to remain on track. This, therefore, calls for sharing of critical data with key suppliers and customers when trading and preparing such an important tool as a budget to make sure that any changes along the supply chain are immediate, and incorporated into the new budget to make meaningful informed decisions.

Besides data from external sources, it has been difficult to also incorporate data from other internal sources such as machine sensors into the decision-making processes. However, with big data and advanced analytics, it is now possible to harness these massive amounts of data and transform them into information. This integration of communication technology systems, humans, and physical machines supported by advanced analytics is called cyber-physical systems (CPS). This has resulted in high plant availability and near-zero breakdown due to real-time data streaming resulting from advanced connectivity (Lee *et al.*, 2015). This represents the hidden opportunities that exist in the big data environment that could be taped into and unlocked to improve the performances of businesses. Adoption of these cyber-physical systems has led to the fourth industrial revolution in the manufacturing sector giving birth to what is called industry 4.0. Schlaepfer & Koch (2015) described the revolutions up to industry 4.0 as shown in the following figure 2.5.

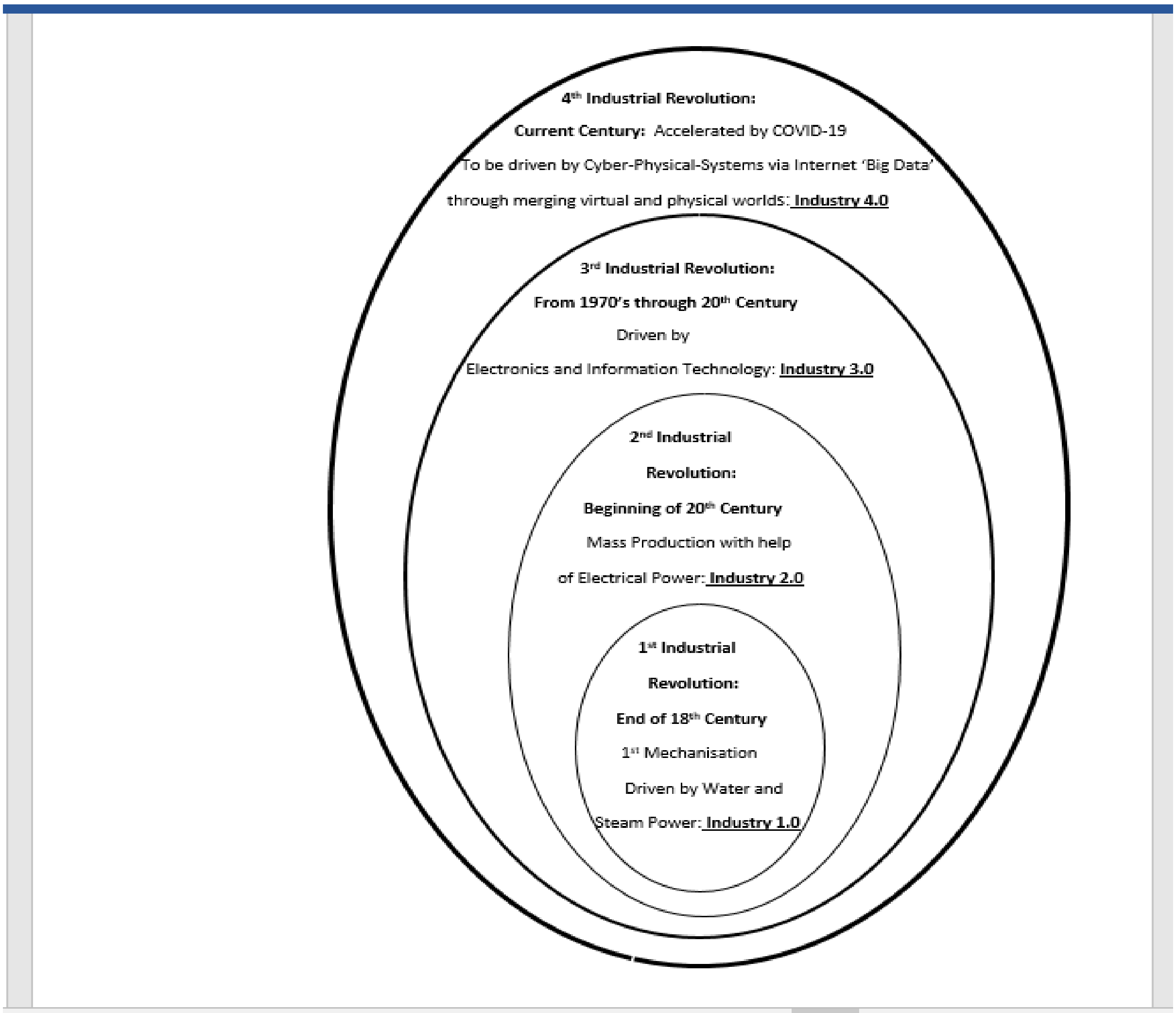


Figure 2.5: Industry 4.0 revolution

Source: Adopted from (Schlaepfer & Koch, 2015, p.3)

From figure 2.5 it is quite clear that the industry evolves and it relies on some dominant drivers at any particular time and no operation model lasts forever. There is no doubt that big data are going to revolutionise the industry. The above figure shows that the first revolution was driven by water and steam power, and the second revolution by mass production through the division of labour and electricity. The third revolution was driven by IT and automation. The German government noted that big data through cyber-physical systems is going to be the key driver of the fourth industrial revolution, resulting in what is called smart factories (Yin & Kaynak, 2015b).

German is leading this marked change of the fourth industrial revolution called industry 4.0, centered on cyber-physical systems. Though not yet fully implemented, the overall goal is to have self-awareness, self-predicting, and self-learning machines. When these are combined with further advances in science the resultant product will be control-centric, optimised, and intelligent smart factories (Lee, Kao & Yang, 2014).

However, before this industry 4.0, the concept of interlinking machines to communicate with humans was being used in Supervisory Control and Data Acquisition (SCADA) systems. The SCADA system is used to send messages or commands from machines to the external world using sensors and small-computerised units that provide a human interface. It is mainly used in monitoring and controlling mission-critical equipment in manufacturing plants including those of national interest such as power generation and water reticulation (Chauhan, Dewal & Chauhan, 2010). Before big data analytics, SCADA systems were only used to collect data and supervise plants. However, due to the emergence of big data and increased demand for real-time information for managers, SCADA is now being integrated with other new data sources and also used across operations and equipment in real-time streaming of data to improve prompt decision-making to reduce errors and pinpoint the source of the problem (Technavio, 2016).

The problem then arises; how can organisations tap into these external sources of the big data environment, combine them with internally generated data from other supporting technologies, analyse them, and use them for business intelligence to unlock value and create opportunities? It appears that the laws that deal with these issues have not been crafted or are in their infants. Besides the Internet, legal and ethical issues, there are also other challenges encountered within the big data environment and there is a need to examine them.

2.8 CHALLENGES ENCOUNTERED IN THE BIG DATA ENVIRONMENT

Various scholars seem to agree that there is untapped value hidden in big data, however, there are so many challenges that an organisation face when trying to tap into this value from the big data environment. Even though there have been advances in tools such as business intelligence and data mining software to analyse data, there has also been a shortage of people with the skills to use these tools.

A BI system is for managers. It helps them in the decision-making process to support their decisions (Hasen, Saridakis & Benson, 2018). They cannot delegate its use to junior staff, because critical information is likely to be ignored during information gathering and crafting of the strategy. Delegating its use shows lack of readiness for the fourth industrial revolution (Parshotam, 2018). Hence the call for managers to be tech-savvy and to use BI systems.

Delegating this role further complicates the role of analysing data. Instead of them focusing on strategic information needed in operation for decision-making they end up focusing on other information. This is where most organisations face challenges resulting in wasted effort. A report by McKinsey global research institute indicated that there is a huge shortage of managers with deep analytical skills required to analyse data in the big data environment (Chen, Chiang & Storey, 2012).

There is a need for professionals who can work with large quantities of data like data scientists. These can fill the gap lacking in traditional courses such as data cleansing and data organisation. They must be comfortable with the business language needed when dealing with data for decision-making. In most cases, this role is delegated to the information technology department which has to work extra hard to integrate external data and internal data (McAfee & Erik, 2012). Besides these challenges, organisations still try to gather data from the big data environment to get insights and make quality decisions using even manual means (Sivarajah *et al.*, 2017).

Sivarajah *et al.*, (2017) presented the challenges in the big data environment as demonstrated in the following figure 2.6.

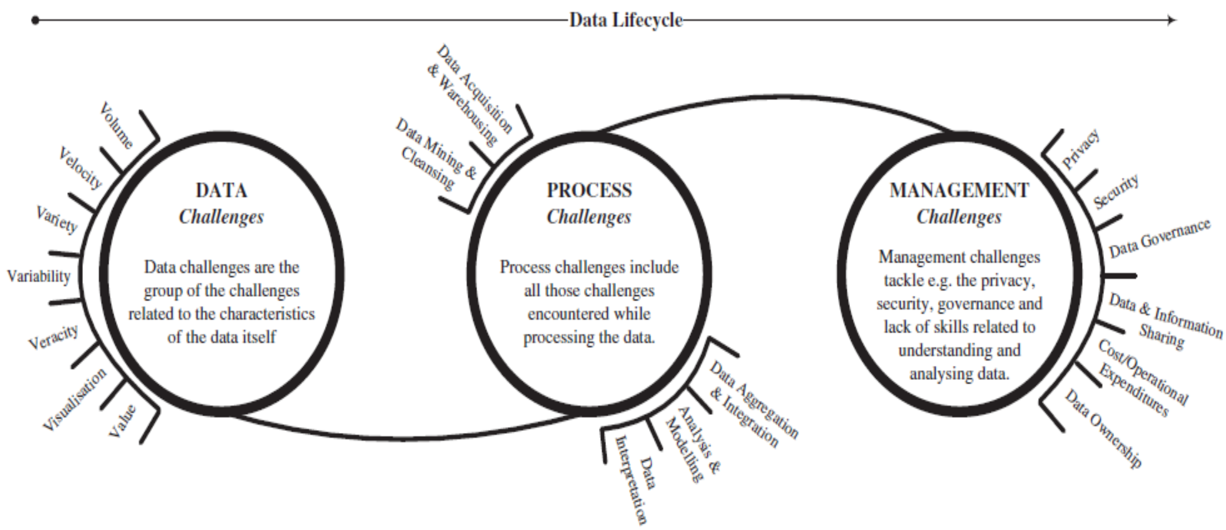


Figure 2.6: Challenges in a big data

Source: (Sivarajah *et al.*, 2017, p.265)

When acquiring data from different sources for analysis organisations face three main challenges, (i) data challenges, (ii) process challenges, and (iii) management challenges. From the above, data challenges are a group of challenges that involve the five “V’s” which are the characteristics of big data (Volume. Velocity, Variety, Veracity, Value) and the other two “V’s” validity and visualisation. Process challenges involve challenges that involve the processing of the data such as data warehousing, data mining and cleaning, data aggregation and integration, data analysis and modeling, and data interpretation. Management challenges involve privacy, security, governance, and lack of skills to analyse the data, information sharing, data governance, cost, and data ownership (Sivarajah *et al.*, 2017). This brings in the concept of people, processes, and data to overcome the big data challenges.

For an organisation to extract value from the big data environment, it has to closely look at the above challenges and find the best way of addressing them. It appears these challenges may not be left to the IT department alone, there is a need to also involve skills from other departments along the value chain. These data come from a variety of traditional and increasingly new sources, digital platforms, online content transaction records, sensors, or mobile devices leading to a complex ever-growing pool of structured and unstructured data. Therefore capturing value from these data is not straightforward and requires far more than a customary IT technology (Weigert, 2017).

The problem of data cleaning has always resurfaced to an extent that the industry has been forced to deal with it regularly (Rahm & Do, 2000; Sivarajah *al.*, 2017; Sandhu, 2022). This problem is, now more pronounced due to advances in technological devices that continue to generate data and the dire need to tape into the externally generated data, which comes from various disparate sources. Data cleaning is considered the main challenge due to the increase in the volume, variety, and velocity of data (Tang, 2014). It still appears the grey area is that of trying to analyse unstructured external data as it continues cropping up from many scholars. Therefore, more effort must now go towards identifying quality data and then efficiently acquiring and developing them to create value for analysis (Tenkorang & Helo, 2016). Before the organisation acquires the data and integrates them with its own data it has to put security measures in place by revisiting its security policies (EY, 2014). The much talked about new oil in the form of big data seem to be hidden in the external data and other new internal sources that have been difficult to access due to limitations in technologies. Other hidden factors may also hinder the adoption of big data initiatives like the digital divide.

2.9 THE DIGITAL DIVIDE

Extracting value from the big data environment is hinged on facilitating conditions such as access to information and communication technology (ICT), therefore any discussion on this topic should consider the digital divide to critically analyse the gap between those who do not have access to technology and those who have access to it, to identify those groups lagging. The digital divide is defined by OECD (2001) as "the gap, between individuals, households, businesses, and geographic areas at different socio-economic levels concerning both their opportunities to access information and communication technologies and to their use of the Internet for a wide variety of activities" (Doong & Ho, 2012, p.519). The international telecommunications union uses two indicators, (i) access and (ii) skills, when measuring digital preparedness while other versions concentrate on infrastructure and opportunity (James, 2012).

Most scholars on the digital divide still concentrate on this two-tier digital divide with the first tier based on Internet access and the second tier based on skills, however, there is a need to have a third one based on the outcome, which is tangible evidence of actual usage (Scheerder, Deursen & Dijk, 2017). This third tier is mainly influenced positively by habit, ICT skills, behaviour, and benevolence, according to a study conducted in Angola, an African country (Goncalves, Oliveira & Cruz-jesus, 2018).

The fact that continents and countries are at different levels of technological advancement means that their expected big data benefits also differ because what accompany developments in IT are inequalities emanating from different stages of deployment. The institutional theory states that the organisation's actions are not only driven by the organisation's goals but shaped by external factors such as political and social factors and the pressure from customers, trading partners, and government with industry leaders spearheading the change (Sun *et al.*, 2018). Some of the factors that affect them such as infrastructure development and policies that have a direct link to the extraction of value from the big data environment are beyond the organisation's control. Although more than half of the world's population has access to ICT the resources are not evenly distributed, for example, there is more fiber in Europe, Asia, and North America than in Africa (Doong & Ho, 2012).

On the other hand, big data are defined as a set of techniques and technologies that require new forms of integration to uncover value, by analysing those data. It, therefore, means, extracting value from big data depends on the adoption of technology. To add to that, it also means, one cannot take a big data strategy and apply it arbitrarily like a blanket across continents, countries, organisations, and even industries. This is because of the digital divide and IT gaps between industries and different companies, cultural barriers, intrinsic conservatism, bottlenecks in the labour market, different stages on the path to development, and financial bottlenecks. A study by KPMG showed that the insurance industry is the leader in big data strategy adoption and its inherent advanced analytics (Coleman *et al.*, 2016).

There is no doubt that the external data component of big data has great value, however, the world is digitally divided according to accessibility to technology, its utilisation, the underlying social and political situation, economic activity levels, education, e-commerce initiatives, infrastructure quality, and government support (Pick & Nishida, 2015). These are summarised in the following figure 2.7.

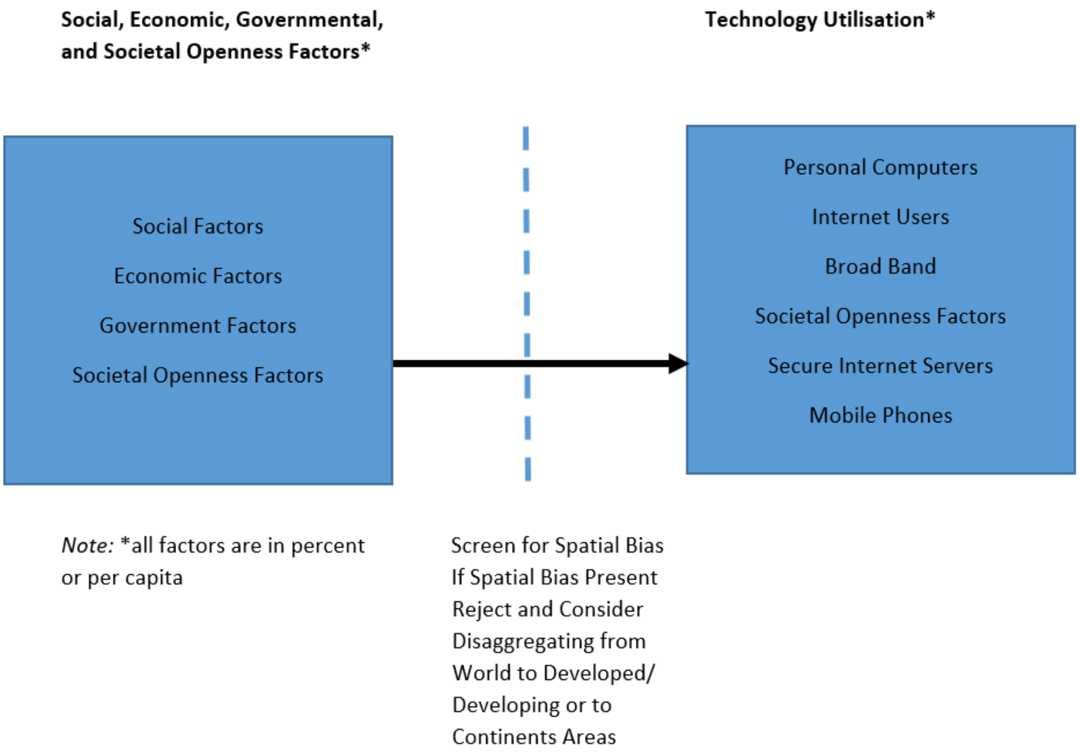


Figure 2.7: Technological forecasting and social change

Source: (Pick & Nishida, 2015, p.3)

There is therefore a need to also look at a country's position and the technological awareness and readiness of the society in which the organisation operates to embrace technology before data can be leveraged. According to Verma (2017), the adoption of big data analytics is affected by the following factors, the strategic value of big data analytics, complexity and compatibility of existing systems together with existing IT assets, support from top management, the internal data environment of the organisation, the type of industry, external pressure and the costs involved. This has led to differences in understanding the strategic value of big data resulting in some organisations deciding to adopt big strategies while others in similar industries facing the same conditions decide to shelve it a bit (Verma, 2017).

It appears that the wider the gap of the digital divide between an organisation and its strategic information exchange partners such as customers, suppliers, machines, devices, and employees the more difficult it is to adopt a big data strategy and the narrower the digital divide the easier it is to adopt a big data strategy. Considering that external data and new sources of data are, presumed to carry great value because they have been difficult to access before advancement in technology, it is the digital divide, which can form a basis for building a big data adoption framework. The global advancement in technology has seen the digital divide gap narrowing, mainly because no organisation operates without processing information. Therefore, as new technologies emerge many organisations grab them. There is a need to look at the trends in technologies so that we get an understanding of why managers may be reluctant to use modern ways of analysing data as they operate facing both the business oriented and the technical-oriented world.

2.10 TRENDS IN TECHNOLOGIES, BIG DATA DYNAMICS, AND DEMANDS OF THE EVER-CHANGING WORLD

From the 1950s to the late 1980s, researchers were simply using the term intelligence. Business intelligence became a popular term in the business and IT communities only in the 1990s. Ever since then, many other terms such as business analytics and data mining have been used to describe the techniques used to store and analyse a large amount of data from different sources using computer-based applications (Chen, Chiang & Storey, 2012). Various types, of software, are being developed with the view of analysing data in the big data environment. Some systems have the capability of analysing real-time data in motion. McKinsey global institute (2013) identified key enablers to dealing with big data as (i) data analytical skills (ii) advances in technologies and (iii) visualisation such as charts and graphs.

Information or knowledge comes from huge volumes of data, which come from various datasets. Various analytical techniques ranging from traditional manual means to highly sophisticated, analytical software to convert the data into information have been used to date. The whole idea behind analytics is to convert data from various sources into knowledge to make smart and well-informed decisions.

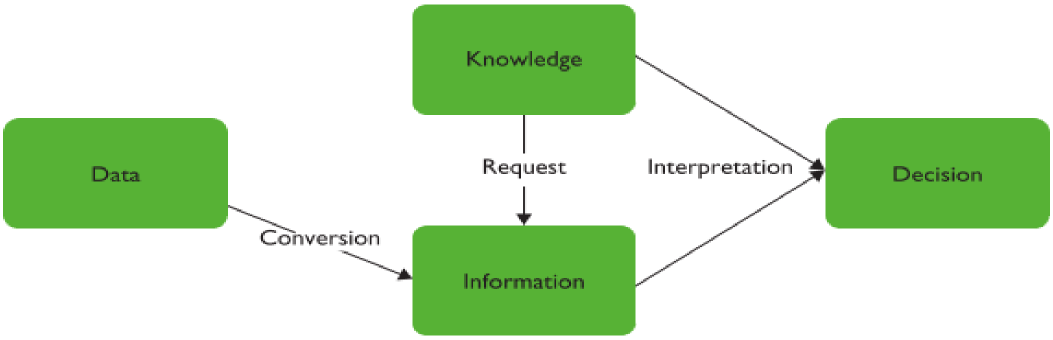


Figure 2.8: Relationship between data, information and knowledge

Source: (Pigni, Piccoli & Watson, 2016, p.20)

In figure 2.8, Pigni, Piccoli & Watson (2016, p.20) made it even clearer by showing that, to make quality decisions the much-needed knowledge comes from information that has been converted from raw data in the big data environment. This research study will assist managers to realise value from the big data environment to improve business intelligence and the quality of decisions made, through knowledge discovery.

Globally countries have put initiatives in place that promote the unlocking of opportunities hidden inside the big data environment. The power of technology to convert data from just information to knowledge in the decision-making process has also received scholarly attention (Chen & Zhang, 2014). At the EU open data strategy, Kroes (2012) said, "*It is now time to know that data are just like gold, the value is only realised after mining and analysing them*" (European Commission, 2012).

Previously, the conversion of information from raw data to information to discover knowledge was a mammoth task. The advances in technologies, and awareness of the use of tools such as BI systems coupled with an understanding of what are big data, have seen several scholars coming up with various frameworks to try and provide solutions to the big data problem. Advances in technology have made it possible to access external sources in the big data environment comprising data that have been very difficult to access such as data from mobile devices, social media, Google, and Twitter.

The explosion of data from multiple sources that exist in an unstructured format can be very complex to deal with because they cannot be handled by traditional relational databases. Hence the emergence of new databases such as Hadoop. The biggest challenge has always been that of the inability to process a large amount of data in a distributed computing environment of the big data landscape within a reasonable time (Reyes-Ortiz, Oneto & Anguita, 2015). An organisation must overcome this challenge before it becomes a data-driven organisation. This trend can be traced back from the 1980s up to early 2000 when organisations were battling with exponential growth in data volume as depicted in the following diagram by Roden *et al.*, (2017).

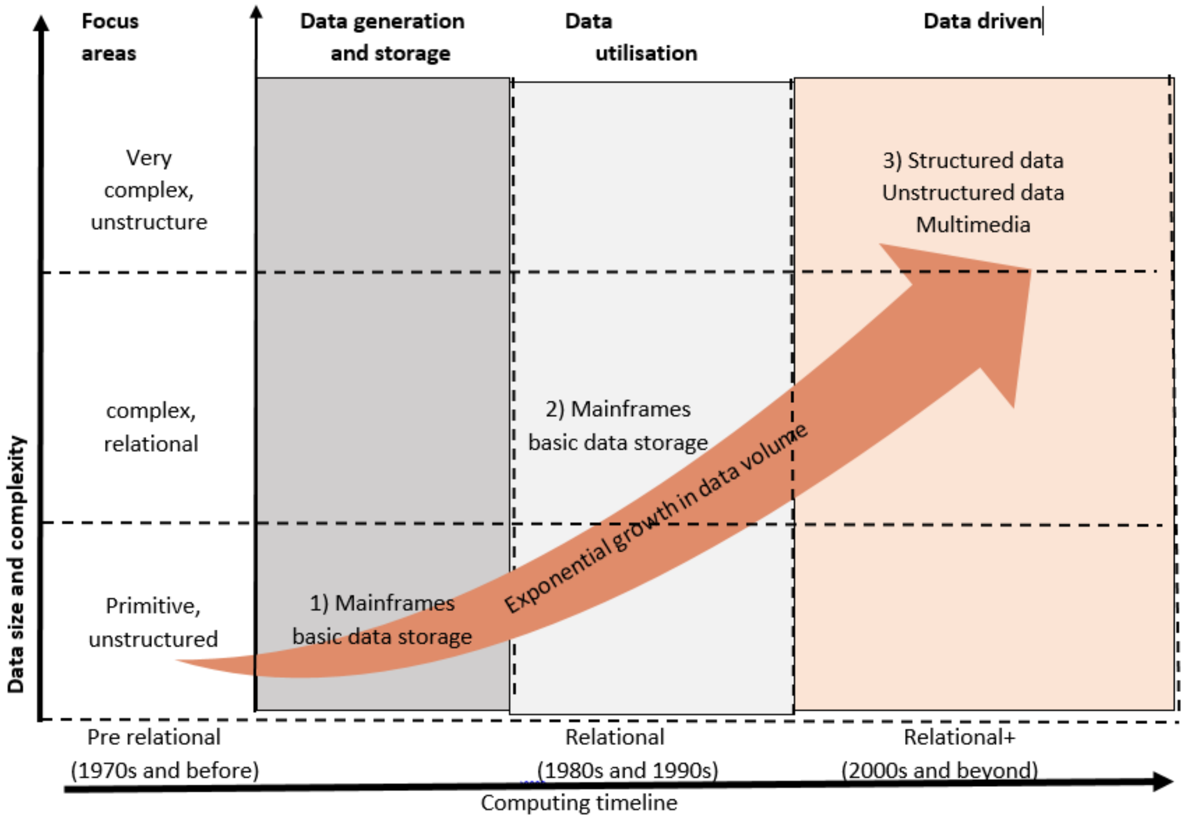


Figure 2.9: The evolution of big data

Source: (Roden *et al.*, 2017, p.931)

Figure 2.9 shows that up to the early 2000's the main worrying "V" out of the 5 "V's" was volume as mainframes were used to store mainly internally generated structured data. Data variety was limited due to the lack of other technological devices, the velocity was very low, and there was no veracity to worry about because the data were mainly structured data sitting on relational databases. As more devices fitted with sensors and mobile devices came on board coupled with social media the dire need to want to analyse the resultant unstructured data generated by these devices increased giving birth to big data.

Hadoop technology tries to cover this gap and answer the critical question that has been shadowing the adoption of big data strategy for years: Can the unstructured data be analysed from its source or it has to be on-site first before converting it into a structured format for analysis? With the Hadoop technology, the required data can now be analysed from the source via clustered interconnected systems. This emergence of hyper-connected collaborating systems via the web in both manufacturing and selling in the big data environment operating on relational databases had become inefficient and in response, the Hadoop technology has been adopted to try and address this dilemma (Lin, Harding & Chen, 2016).

Big data do not compete with other emerging technologies but rather are part of the new technologies and complimentary by both nature and definition. Ernst & Young (EY) (2014) added that familiarity and confidence in big data is a growing signal that big data adoption is now around the corner but remains on most organisations' boardroom radar. This suggests that what is lacking is a clear framework for use, by managers when adopting a big data strategy.

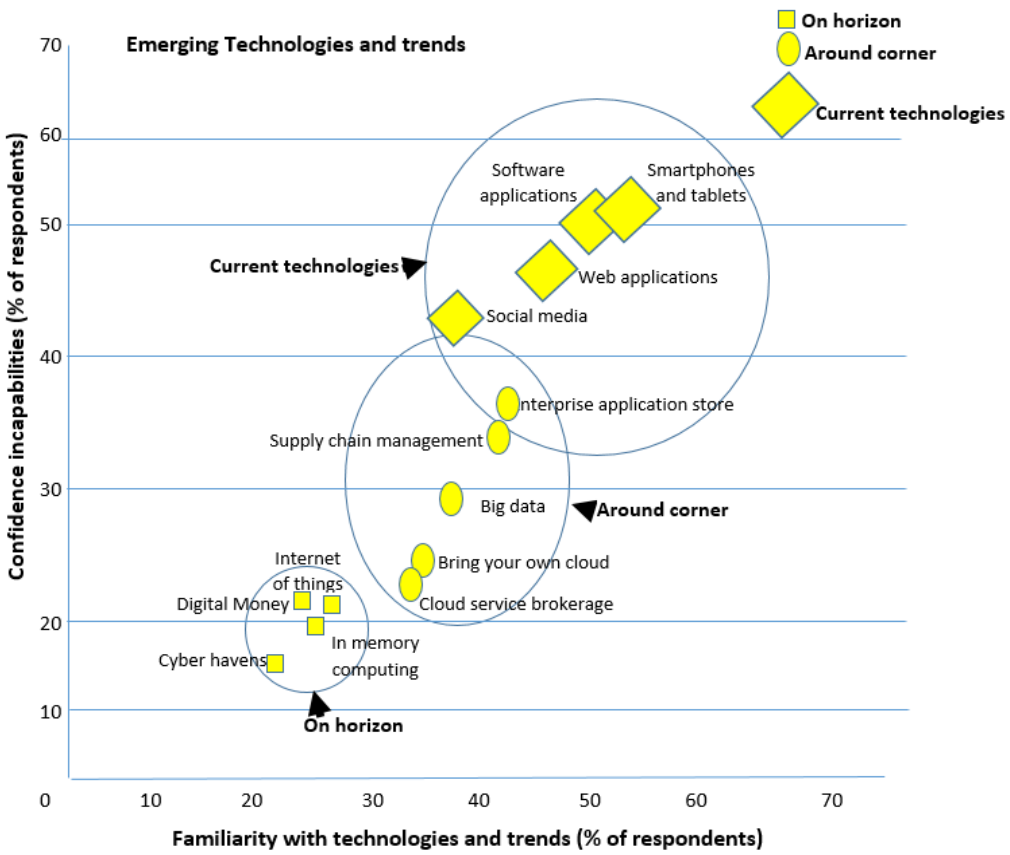


Figure 2.10: Big data changing the way businesses compete and operate

Source: (EY, 2014, p.3)

Figure 2.10 by EY (2014) show the technology trends and where we are with technology to incorporate big data. It shows that big data is around the corner, however, it has remained on that corner for quite some time. It is now clear that organisations must now begin the groundwork of becoming data-driven organisations by addressing key issues that promote the adoption of a big data strategy.

The focus on big data has been on optimising sales and business processes including other areas such as sports and city planning. However, Canada was one of the early adopters of big data in health, leading to the development of the Global Public Health Intelligence Network (GPHIN). It was used by World Health Organisation (WHO) during the outbreak of Severe Acute Respiratory Syndrome (SARS) in detecting signals of the outbreak and possible solutions (Dion, AbdelMalik & Mawudeku, 2015). In 2020, most organisations were forced to close shop and ask workers to work from home when the coronavirus hit the world hard, to the extent of almost crippling the world economy. Although, this came as a disaster it also presented an opportunity for those organisations that have been spearheading the adoption of big data initiatives as it enabled them to conduct transactions over the Internet through communicating devices instead of totally shutting down their companies and eventually the entire economy.

The same devices could also, be used to track possible carriers of the virus and assist in reducing the spread of COVID-19 by adopting conduct-tracking driven by technology. Zhao, Liu & Li (2020) used big data analytics to develop multi-linear models to explain variances of confirmed cases across Chinese cities using local population and passengers as variables to track passengers who left Wuhan between 1 January and 26 January 2020 (Zhao, Liu & Li, 2020). The power of big data analytics in the health sector was also witnessed on 31 December 2019 when a Canadian-based company Blue dot detected what would come to be known as COVID-19 using artificial intelligence and sent alerts to its customers (Long & Ehrenfeld, 2020). As technologies continue to advance, new opportunities emerge and present themselves.

2.11 TYPES OF ANALYTICS AND NEW OPPORTUNITIES PRESENT IN THE BIG DATA ENVIRONMENT

Making quality decisions always require access to large volumes of all forms of data from various sources needed in the decision-making process. This has now become an essential component of management, especially in a turbulent environment because it allows organisations to achieve real competitive advantage (Košcielniak & Puto, 2015). When making decisions, many executives rely on information prepared by internal staff, however, research studies show that most of the information prepared by staff on the ground never reaches top management including the board except when directly requested because it is generally screened by intermediate levels (Citroen, 2011).

On the other hand, "*data-driven decisions are better decisions, it is as simple as that. Using data enables us to decide on the basis of evidence rather than intuition, for that reason big data have the potential to revolutionise management*" (McAfee, 2012, p.2). Advances in technology and the availability of a variety of data in the big data environment have enabled some communities to now exploit this new opportunity of getting the relevant data and insights needed to make timely, accurate, and fast decisions by analysing data in motion coming from a myriad of sources including machine sensors. These new data do not mean that companies have to change their business strategies. However, it rather calls on them to re-visit their business models, to explore new opportunities that exist in the big data with a view of resolving previously unanswerable provocative questions that have been difficult to answer. This will help them to improve business processes of decision-making that support the implementation and monitoring of well-articulated strategies (Woerner & Wixom, 2015).

These new types of data were never analysed before and are very difficult to access and have become one of the key elements of competitive advantage because of the increased variety of sources of data that can incorporate the automated decision-making processes to improve the bottom line (Garg, Singla & Jangra, 2016). Some companies have gone further and tapped into new opportunities that now exist in the big data environment of using data as a means of generating revenue using two methods called (i) data monetization, which is the act of exchanging information-based products and services for legal tender or other value; and (ii) digital transformation, which is digitalisation with capabilities to obscure business boundaries, making it difficult to tell who their trading partners are (Woerner & Wixom, 2015).

The big data era has also seen rigorous research studies that resulted in advanced technologies that deal with data such as the BI system; allowing organisations to come up with accurate predictions by applying predictive analysis using what-if scenarios. In his book, Schmarzo, (2016) divided the opportunities following the value chain as follows: In **procurement,** big data solutions are used to identify the most cost-effective suppliers that deliver products on time without damage. In **stores**, big data solutions are used to optimise inventory levels and incorporate predictive analysis on buying patterns, demographic, weather, and events. In **manufacturing,** the solutions may flag machinery breakdowns, and monitor quality and process variances. In **sales, marketing, and distribution** big data present a lot of untapped opportunities in the form of supply chain activities that rely on external factors needed to achieve strategic goals and objectives such as economic conditions, best marketing, and product mixes, order and delivery tracking using geo maps and perishable goods management (Ziora, 2015).

This indicates that big data bring in a lot, of new untapped opportunities that have been difficult to access before the big data era. If properly embraced big data can be used to galvanise the corporate strategy by supporting the following digital disciplines, information excellence by improving processes and asset utilisation, solution leadership to produce better products and improved services, collective intimacy where massive data points are processed and finally accelerated innovation (Weinman, 2018). In manufacturing, big data brings in greater asset sustainability and overall equipment effectiveness that leads to reduced downtime through just-in-time maintenance, eliminating costly invisible patterns of degradations that often lead to failure by turning massive data into information (Lee *et al.*, 2015).

There is no doubt that the unstructured and semi-structured portion of big data has great value. Some companies end up investing heavily in collecting and storing the data and research studies have shown that the bulk of the data have never been analysed or used. This has discouraged many managers because they have not realised any benefit from this accumulation of data (Cohen, 2018). However, this does not change the value that big data carries, some may call big data an element of culture in the information technology circles and a marketing term for sure, but they have to know that it is also a springboard for advancing trends in technology and it also opens new avenues and approaches of understanding the world.

The decision-making process can be greatly improved to make much-needed instant decisions through new data streams communicated by various sensors connected to various industrial equipment, automobiles, delivery vehicles, and shipping crates. These can be configured to send signals of the current location, loads, movement, direction, temperature, and humidity (LOHR, 2012). However, it has to be clear that capturing and storing the data does not add any value, the value is only realised when the data are used by managers for a useful purpose, such as in decision-making (Power, 2014).

The real deal of getting value from big data is in predictive analytics because it allows businesses to forecast future events outcomes and behaviours, and this is the game changer, it forms the cornerstones on which future business survival is built. To realise that value it is better to look at the purpose and period of analytics by classifying analytics into five classes. These are: (i) descriptive analytics, which focuses on the past, (ii) operational analytics, which focuses on the present moment, (iii) diagnostic analytics, which combines the past and the present to deduce causation, (iv) predictive analytics, which focuses on the future to forecast what may happen. Then finally, (v) prescriptive analytics which takes into account all the other four to try and simulate future behaviours (Devlin, 2016). To further clarify how the decision-making process can be enhanced by these different classes of analytics, Sivarajah *et al.* (2017, p.266) developed the following very useful analysis.

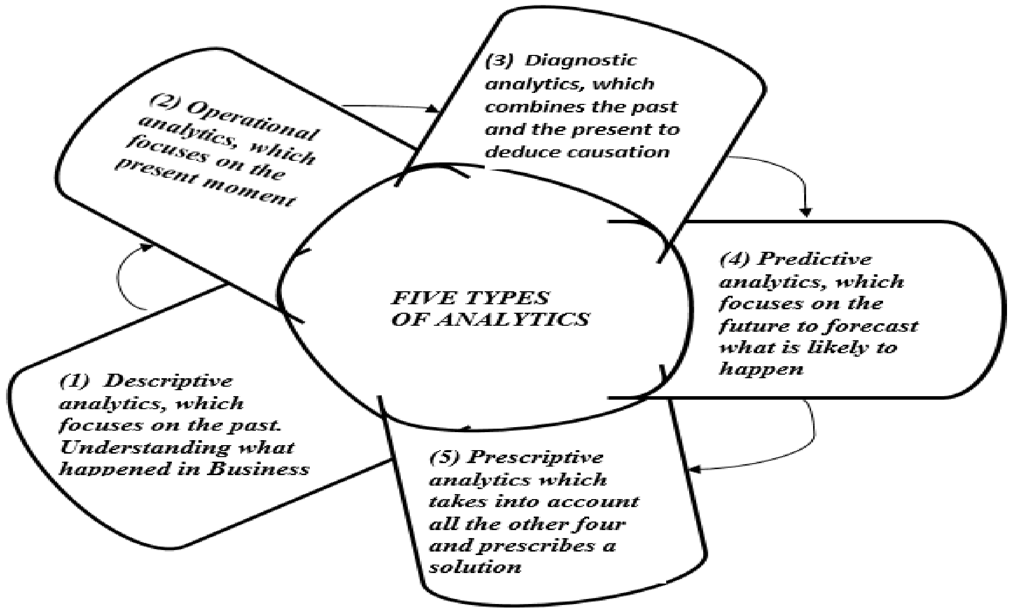


Figure 2.11: Types of analytics

Source: Adapted from (Sivarajah *et al.*, 2017, p.266)

Figure 2.11 demonstrates that we need big data analytics to move from just doing descriptive analysis that only helps us to understand the 'what happened in business' question to predictive and prescriptive analysis which gives us insights needed to make quality decisions and take appropriate actions. As explained earlier, big data analytics analyses all forms of data, structured data, semi-structured data, and unstructured data needed to achieve predictive and prescriptive analytics which is the desire of every organisation. Therefore, adopting big data analytics will enable organisations to move a step further in data analytics by analysing both sets of data thereby creating a competitive advantage.

According to Fan and Bifet (2015), when dealing with big data as a new emerging topic, there is a need to first address the controversy surrounding it by distinguishing big data analytics from just analytics since data will continue to grow and will never become small again. There is also a need, to remove the notion that bigger data are always the better data and rather find solutions that incorporate real-time analytics. There is a need to dispel the hype that Hadoop-based systems are the best, and rather look for the best programming platforms, that also cater for medium-sized companies, and, also consider ethics when dealing with big data (Fan & Bifet, 2015). The power of big data is perfectly demonstrated when real-time operational analytics is adopted in an operation. Providing some practical examples may be useful to understand and demonstrate the power of big data.

2.12 DEMONSTRATED POWER OF USING BIG DATA

The potential of big data has drawn the interest of organisations such as the European Statistical System (ESS) and the UN to such an extent that in 2013 they signed a memorandum in Scheveningen to consider using big data as input to official statistics (Kitchin, 2015). Various organisations in different industries have already experimented by adopting big data initiatives in their operations and the results show that big data have the potential to revolutionise any industry.

In the tax industry, a good example is that of the world's biggest transportation service provider *UBER*, which uses the real-time flow of big data to maximum advantage by matching driver's cars and real-time demand, without owning the vehicles (Pigni, Piccoli & Watson, 2016). Big data have also, been used in various sporting disciplines to get strategic insights from opponents. For example, in soccer, on 08 July 2014 when the German soccer team beat Brazil 7-1. It was followed by an announcement by SAP AG on 11 July 2014 that they had entered into a partnership with the German football association to deploy and use their business intelligence system to turn big data into smart informative decisions to come up with the improved performance of players (Yin & Kaynak, 2015a).

Tesla motors are taking the motor industry by storm through the use of big data where various interconnect technologies and devices fitted with sensors and software dubbed 7.0 are upgradeable via the Internet without a dealer. It offers features, such as blind-spot detection, automatic braking, and guiding itself to destinations thereby allowing the car to drive itself on highways without a driver's intervention (Ramsey, 2015).

Vehicle tracking systems that use GPS and cloud computing with features to measure driver activities such as hard breaking, and near collision have been, deployed by various organisations around the globe. These could be automatically fed into the drivers' balanced scorecard to eliminate biased human elements when rating drivers during performance appraisal. The power of big data to revolutionaries the world through real-time analytics is seen in self-driving cars where the convergence of technologies that include computers, sensor fusion, machine learning, and cloud computing all interact to give real-time decisions (Cheruvu, 2017). The following figure 2.12 depicts this.

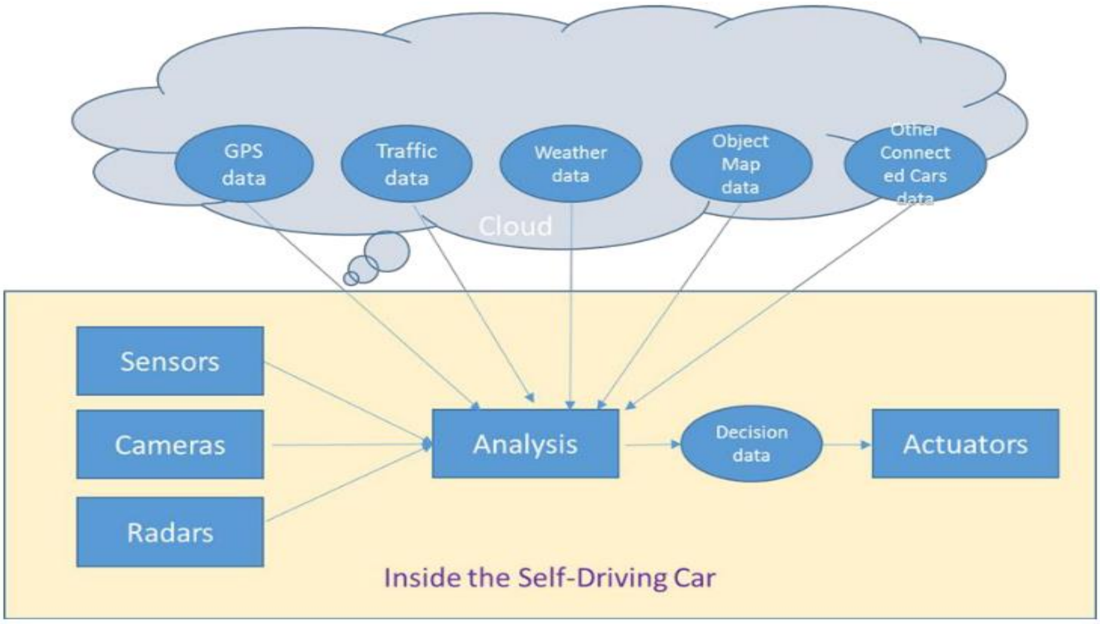


Figure 2.12: Data flow in a self-driving car

Source: (Cheruvu, 2017, p.2)

The typical model in figure 2.12 could also be used to revolutionise other industries such as manufacturing to leave managers with a duty of just interpreting results from interconnected devices through data analytics. As can be seen in figure 2.12, analytics is at the center of everything as data comes from a variety of sources that include sensors, cameras, radars, and GPS, enabling access to other information in the environment of the car that may affect it such as traffic, weather, object map and movement of other connected cars. This is the much-needed predictive and prescriptive analysis found in big data analytics that helps to gain insights and make quality decisions.

We expect this same thing to happen very soon in the manufacturing sector. The late Stephen Jay Gould asserted that where science and technology intersect with social economics systems, there will be radical disruptions resulting in a point he called "punctuated equilibrium" (Siebel, 2017, p.1). *UBER* and Tesla have already done this in the motoring industry. However, it appears the benefits to be derived from big data differ from industry to industry and appear easier to adopt and apply on particular operations targeting to improve certain operational efficiency through delivering incremental change and improved efficiency than on transforming the entire cooperate strategy (Roden *et al.*, 2017). Adopting a big data strategy on the entire corporate strategy requires the involvement of data entry points on key departments along the entire value chain that may require modifying the corporate structure. Therefore, for an organisation to get real value by exploiting the opportunities that exist in the big data environment it must first address certain critical factors. It has to engage in preparatory work and also revisit its organisational structure.

2.13 CHANGES NEEDED IN THE ORGANISATIONAL STRUCTURE AND SET OF SKILLS REQUIRED TO ADOPT A DATA ANALYTICS STRATEGY

Despite all the identified challenges and barriers associated with it, big data are still viewed as the most strategic resources of the 21st century with an equivalent value of oil and gold but many organisations are not yet ready to tap into these resources (Alharthi, Krotov & Bowman, 2017). Big data initiatives are driven by three key drivers, (i) increasing revenue, (ii) reducing costs, and (iii) increasing productivity. Therefore, an organisation cannot brush aside big data as just a buzzword because these three drivers are the reasons for implementing BI systems used by its competitors on the battlefield to analyse the resultant data (Marin-Ortega *et al.*, 2014). For an organisation to successfully implement a big data project and start extracting value from data, a holistic approach is required to first address the following barriers identified by Alharthi, Krotov & Bowman (2017).

Table 2.1: Barriers to big data and solutions

1. Technological barriers		
Infrastructure readiness	(Trelles et al., 2011)	Commodity hardware should be used to enhance process power and storage capacity.
Data complexity	(Douglas, 2013; Johnson, 2012)	Specialized software tools and algorithms should be used such as MapReduce and Hadoop, to store, manage, and analyse complex data in a more efficient, reliable, fast economical manner (Van Rijmenm, 2014).
2. Human barriers		
Lack of skills	(Douglas, 2013; Hoffman & Podgurski, 2013; Schouten, 2013)	Organisations should collaborate with educational institutions to align their educational curriculum with the industry requirements for big data skills. Industry and academic institutions should collaborate on providing practical training to address missing skills in the field of data analytics and big data (Miller, 2014).
Privacy	(Douglas, 2013; Van Rijmenam, 2014)	Legislative bodies are required to endorse laws that protect individuals from the misuse of data (Schadt, 2012). Organisations need to accommodate this legislation as well as incorporate general best practices for handling sensitive customer data into their policies and operations.
3. Organisational barriers		
Culture	(LaValle et al., 2011; McAfee & Brynjolfsson, 2012)	Successful cultural change can be achieved by having a clear organisational vision in relation to big data (Rogers et al., 2006)

Source: (Alharthi, Krotov & Bowman, 2017, p.289)

Table 2.1 by Alharthi, Krotov & Bowman (2017, p.289), it is clear that big data issues are mainly centered on management and the culture of the organisation than technology (Ernest et al., 2011). Management plays a big role however they face the above three main barriers, (i) Technological barriers, which refer to the lack of infrastructure readiness and data complexity; management should invest in appropriate technologies to overcome this challenge. (ii) Human barriers, which include lack of skills and privacy. To overcome these barriers management should train its staff so that they get the required skills, and are knowledgeable about the laws that protect individuals and sensitive customer data. This goes beyond the organisation's boundaries and calls of academic institutions to come in with appropriate curricula to address industry needs, (iii) Organisational barriers, which refer to the structure and culture of the organisation. There is a need for a clear vision and a clear big data strategy to overcome the challenge (Alharthi, Krotov & Bowman, 2017, p.289).

Many examples of big data initiatives have been given but very few repeat themselves leaving managers reluctant to adopt these big data initiatives on the assumption that these initiatives deliver once only benefits (Braganza *et al.*, 2017). However, there is no one best-fit strategy for implementing big data initiatives as it depends on the grand strategy and generic strategy of the business and the type of industry. Of all the four grand strategies (stability, expansion, retrenchment, and combination) that an organisation can pursue at any given time, it seems that big data fits well with the expansion grand strategy. Big data are almost one size fits all on the generic strategy where it can be used as a new weapon to deal with competition through the faster speed of execution, leading retention of current customers, the attraction of new customers from competitors, reduced cost of servicing them and finally improved profits. Most of the scholarly articles have not given too much attention to well-structured coherent processes for implementing big data projects (Braganza *et al.*, 2017).

From the literature, it seems for an organisation to implement a big data project that adds value, it should first introspect itself and identify its position on the two models identified in the literature, that is the business model maturity index by Schmarzo and the BI maturity level model by Gartner. This will enable the organisation to play its role of moving to the most appropriate positions of these two models to find the best footing for launching the big strategy, allowing it to go for the sources of data required by key strategic drivers and then access and harness these data during strategy implementation. The challenge is on how to turn this information into usable intelligence and this appears to be a mission impossible without revisiting the organisation structure.

The usefulness and relevance of information in the big data environment depend on how the information is adapted to a business strategy. Organisations should move away from the traditional way of focusing on generated data from all sources and then try to extract value. Instead, they should focus on the relevant data they need in their strategy (Constantiou and Kallinikos, 2015). Long-lasting structured valuable information that addresses the organisation's long-term goals and objectives is required. This is because a business strategy is hinged on information systemically collected to serve a purpose for decision-makers.

It appears that the reason why organisations are facing challenges when trying to adopt big data initiatives is that they are trying to maintain their existing structures while at the same time trying to adopt a big data strategy. When big data burst onto the scene the first organisations to tap into its abundance were firms such as eBay, Google, Facebook, and LinkedIn and everyone is now trying to follow the same strategy. However, for big data to work it has to integrate perfectly with already existing traditional forms of analytics in the company. If this does not happen, the company has to revisit its organisational structure to benefit from big data. However many organisations simply adopt big data strategies using old organisational structures (Davenport, 2013).

In most cases, any new strategy results in a new dimension of the organisational structure therefore adopting a big data strategy cannot be an exception (Korhonen, 2014). According to Grossman & Siegel (2014), the ideal organisation structure framework required to derive value from big data through analytics should address the following key areas,
(i) An organisational structure that views analytics as a separate key functional area similar to other functions like manufacturing, sales, and marketing, human resources, finance, internal audit, and procurement.
(ii) Have in place an analytics governance committee that governs and dictates the required data for analytics and deployment of analytics models.

(iii) Incorporate data scientist(s) with deep knowledge of business, computers, and analytics in the organisational structure as depicted by the following figure (Grossman & Siegel, 2014; Côrte-Real *et al.*, 2019).

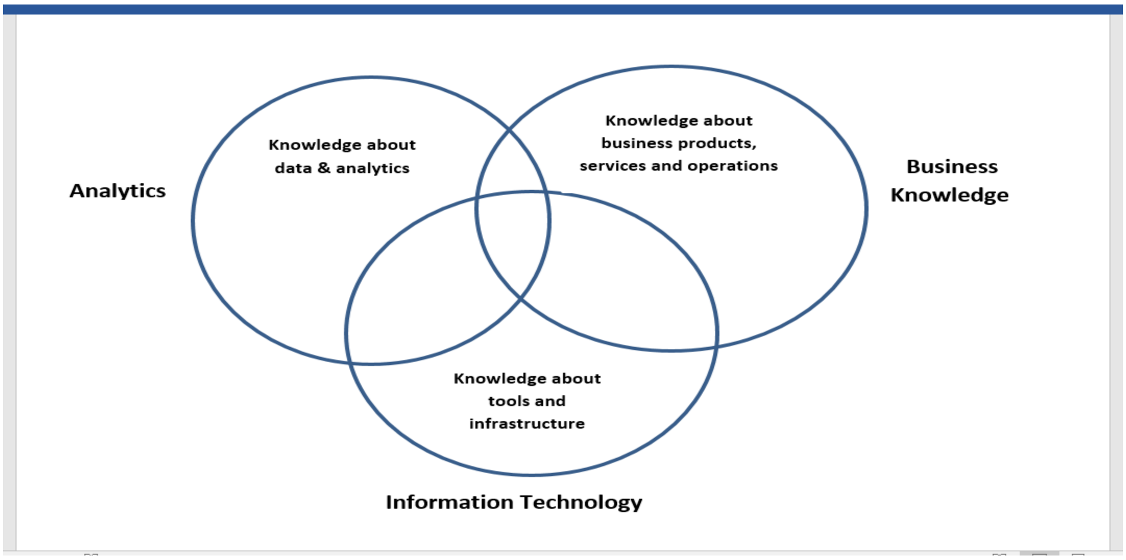


Figure 2.13: The knowledge required by data scientists

Source: (Grossman & Siegel, 2014, p. 21)

In figure 2.13 Grossman & Siegel (2014) sought to integrate analytics, business knowledge, and information technology and suggested that without using data scientists with the above combination of skills, analysing data in the big data environment will remain a challenge. They suggested revisiting the organisation structure to place data scientists centrally or decentralised to do the analytics on behalf of management (Grossman & Siegel, 2014)

Three models are used to deploy these data scientists. In the first model, they are placed in a central pool where they are expected to pursue a common goal with each data scientist expected to spearhead the needs of the department. In the second model, they are decentralised and they work from their respective departments. However, in this model sharing knowledge and coordinating common goals becomes a complicated issue. In the third model, only critical data scientists are placed in the central pool, The idea is to create a link between departments to avoid islands of data and silos of analytics that usually exist in departments. (Grossman & Siegel, 2014). To derive value from big data, companies may need to invest in data scientists who can support traditional managerial functions (Sestino *et al.*, 2020)

Research studies show that managers with analytical skills are in scarce supply and attributed this to the emergence of big data as indicated by the Mckinsey research institute (Baesens *et al.*, 2016). However, COVID-19 has accelerated the scale and speed of digital transformation because of the need to work from home, putting pressure on human resources leaders to speed up the process of recruiting and training people to align their organisations accordingly (Engler, 2020). A special committee in digital skills set up in the UK also acknowledged this shortage in its second report of the session 2016-17 and highlighted big data as the main cause (British Government, 2017). The big question that remains is if big data now requires the use of a data scientist, *how have organisations been operating using BI systems?*

2.14 BUSINESS INTELLIGENCE, BIG DATA, AND INFORMATION FLOW

Business intelligence is when knowledge is delivered to decision-makers at the right location at the right time and in the right form. It, therefore "combines data gathering data storage, and knowledge management with analytical tools to present complex internal and competitive information to planners and decision-makers" (Negash, 2015, p.178).

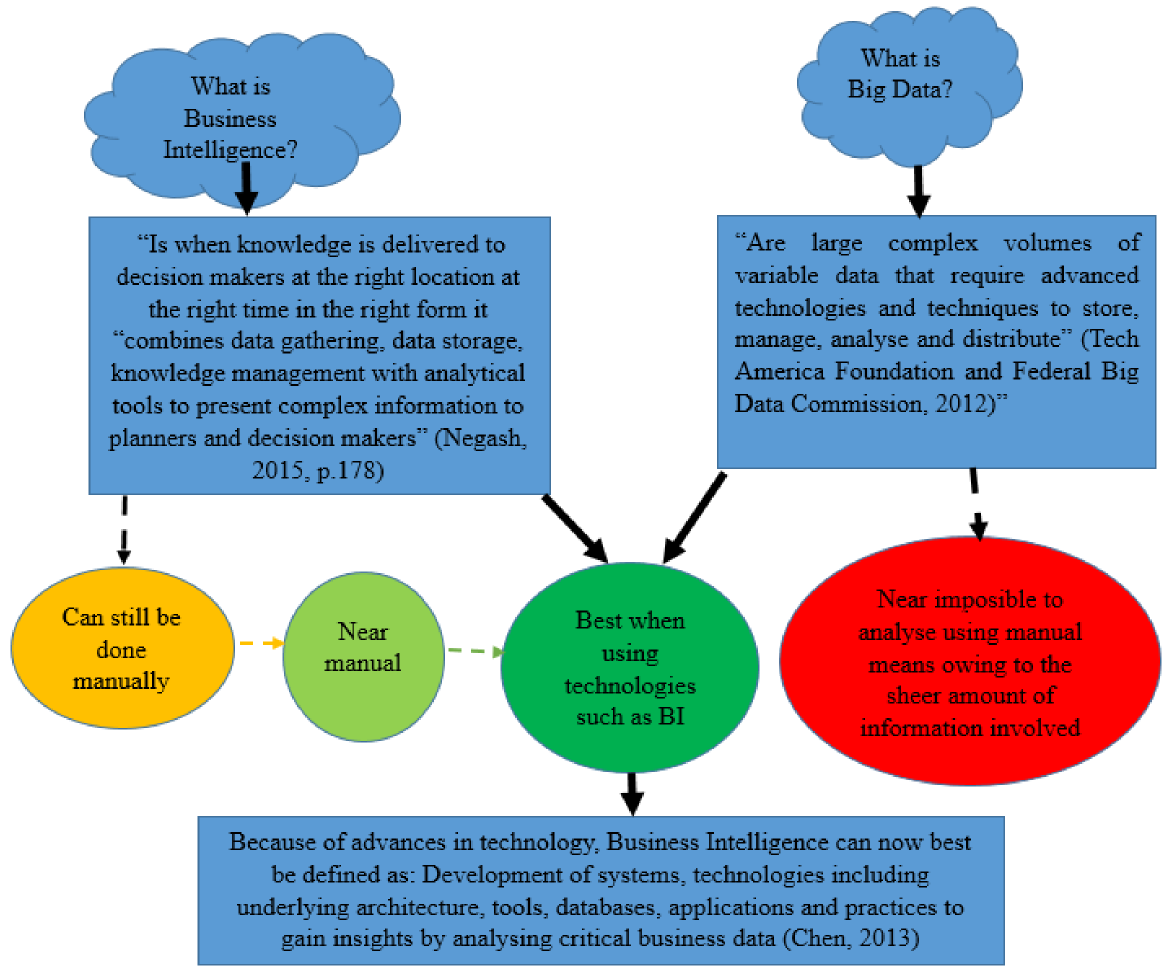


Figure 2.14: Link between Business Intelligence, advances in technologies, and big data

Source: Author's construct

Figure 2.14 shows that business intelligence has traversed from manual, and near manual up to the current use of technological systems. Before the arrival of computers, gathering and storing data was done manually. Computers were developed in the 1960s mainly for scientific and transactional purposes. However, because of the need for management decision-support systems, the years that followed were dedicated to developing decision-support systems. The arrival of ERP systems resulted in the generation of huge internal data that gave birth to data warehouses and decision support systems. Eventually, BI systems were designed to process real-time data and provide accurate information. These systems use the data warehouse concept which originated from the initial decision support framework published by Ralph Sprague in 1975 (Watson, 2009). It is therefore still possible to conduct business intelligence manually but it will be difficult and does not create a competitive advantage in the current environment.

For an organisation to function and effectively execute its strategy, accurate information must flow throughout the entire organisation. "Many theorists, in fact, argue that an organisation should be viewed as an information processing system (Galbraith, (1977); O'Reilly & Pondy, (1980); Simon, (1973); Tushman & Nadler, (1978)" cited in Glauser, 1984, p.613).

In their book, business analytics for managers, Laursen & Thorlund (2017) argued that business analytics is an advanced discipline within business intelligence. They designed a business analytics model that highlights how information is requested and supplied in an organisation and the role of a business analyst in an organisational setup (Laursen & Thorlund, 2017).

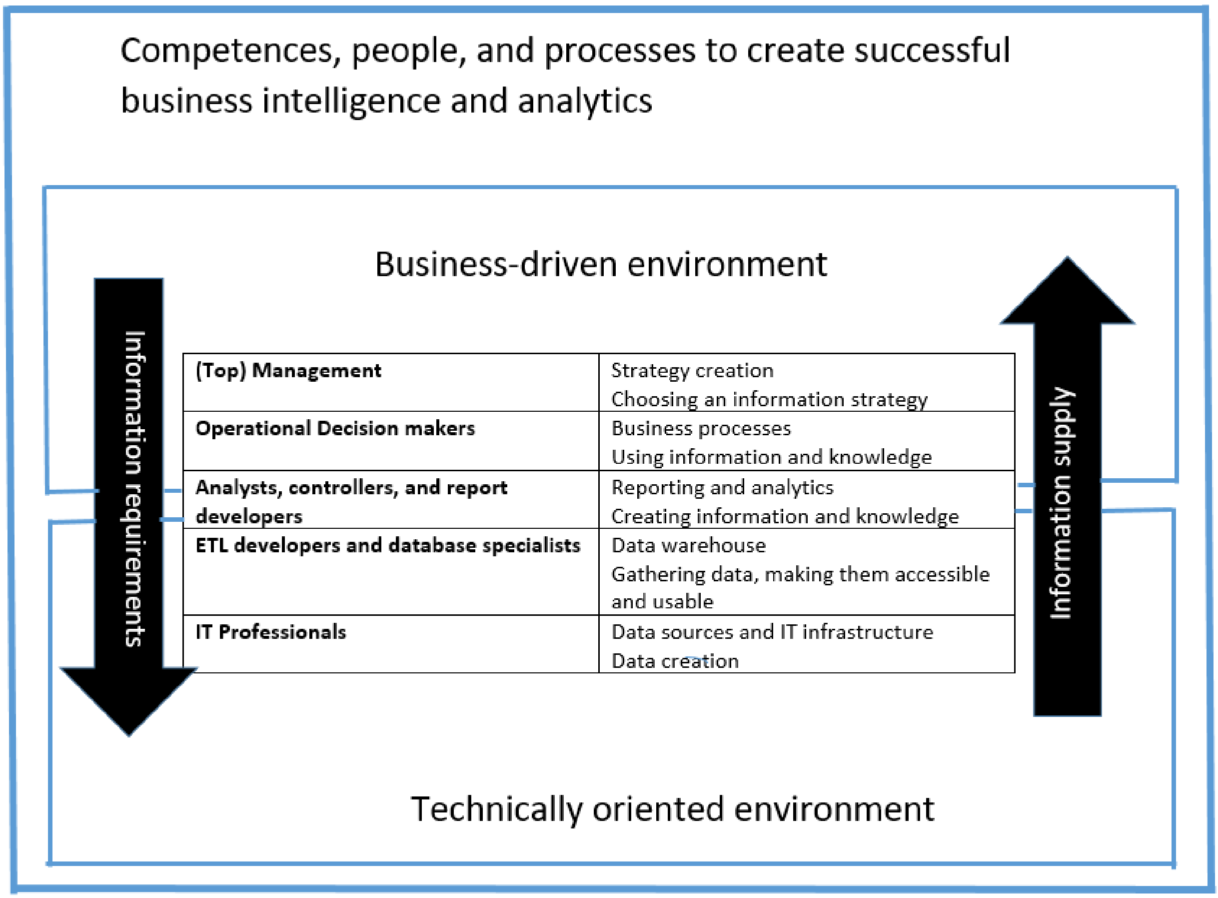


Figure 2.15: The BA model

Source: (Laursen & Thorlund, 2017, p.3)

Figure 2.15 by Laursen & Thorlund (2017, p.3) shows that top management request information for decision-making from lower managers. However, because of advances in technologies, there is now a need for IT professionals at the very lower level, who then identify the data sources through systems integration. In between, there is also a need for analysts and developers who play the role of modeling the reports through analytics to create much-needed information and knowledge for managers. Some organisations might not have these people, therefore top management has to request the information directly from IT or directly from the devices. However, they usually face a roadblock because of the technical jargon involved.

Other organisations may have analysts, but these analysts may not know what top management wants, creating a huge knowledge gap, and raising the big question of whether top management has enough time to configure the devices and do the analytics themselves. To add to that do they trust the information that comes from the devices? There is also the issue of accountability where senior managers would always want to hold someone accountable for the information they pass upward, therefore they would rather prefer to get the information from humans than devices thereby increasing the chances of information being manipulated (Laursen & Thorlund, 2017).

Upward information flow is usually distorted in an organisation due to hierarchical statuses as supervisors try to block the free flow of information through behaviour referred to as sharpening, leveling, and gatekeeping to avoid answering a lot of questions and being exposed. Wilen-Sky (1967) dealt with this at great length in the notion of "information failures" which occur when accurate information is distorted intentionally or unintentionally as it is transmitted to decision-makers (O'Reilly & Roberts, 1974). This long-time problem is likely to be eliminated through interconnected devices if big data initiatives are adopted. This is achieved when devices are involved in the automatic transmission of accurate information within the organisation without human interference.

Knowledge workers outside the information systems department have been playing an important role in the processing of accurate information in an organisation and this is how spreadsheets gained popularity (Chan & Storey, 1996). The emergence of big data and advances in technology combined with the complexity of analysing the resultant data has brought confusion to some managers as they are finding it difficult to leave spreadsheets and adopt BI systems. Organisations that successfully implement big data strategies rely on three pillars, they pay attention to data flows as opposed to the data stock, they also rely on data scientists and data modelers than analysts and they move analytics from the IT department (Davenport, Barth & Bean, 2012). The big question is, *should we now concentrate on data flows and ignore internal data stocks such as those residing in key stakeholders' systems?*

Big data has completely changed the dimension of analysing data, making it complex to use traditional methods such as regression and excel spreadsheets but now requiring the use of necessary tools. Business intelligence software offers an organisation the opportunity to better understand its market and business operations by analysing critical business data. Various types of software are being developed (Chen, Chiang & Storey, 2012). The BI system also comes with the much-needed concepts of data mining and system integration capabilities that can be used to extract value.

2.15 BIG DATA ANALYTICS, THE CONCEPT OF DATA MINING, AND THE USE OF BI SYSTEMS

According to Wang, Kung & Anthony (2018), big data analytics encompasses various analytical techniques such as descriptive analytics and mining /predictive analytics that are ideal for analysing large amounts of data. It is a way of getting sense and reflecting on data that comes too fast in large volumes in an unstructured format that cannot be managed via traditional methods (Zakir, Seymour & Berg, 2015). These data are the path used by top-performing organisations to move from insights to value (Ernest *et al*., 2011).

Dedić & Stanier (2017) present a figure visualising the relationship between approaches and indicate that knowledge discovery is the broader picture of analysing information in an organisation that covers four focus areas: (i) data analytics, (ii) big data analytics (iii) big data and (iv) business intelligence. They further demystify the confusion, ambiguity, and misunderstanding of some of the terms such as business intelligence, big data, data analytics, and knowledge discovery by developing a visual representation of the relationships between these terms as shown in the following figure:

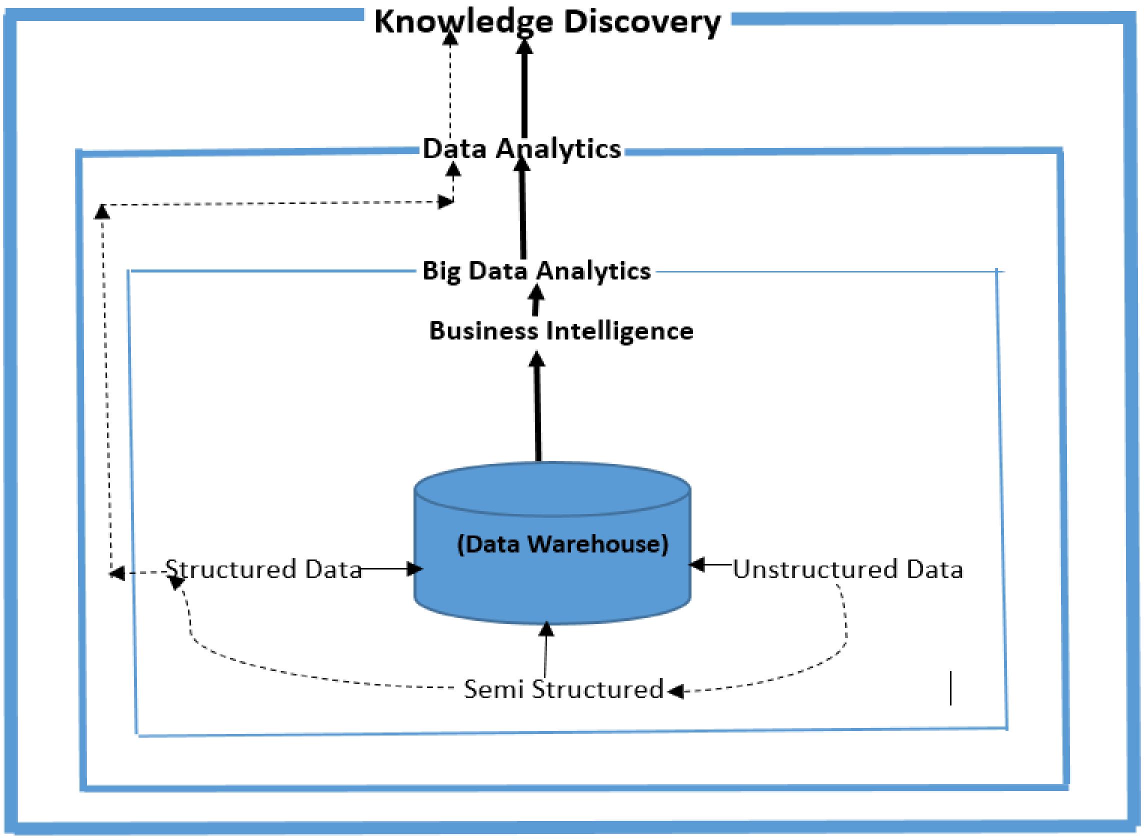


Figure 2.16: Visual representation of the relationship between approaches

Adapted from Source: (Dedić & Stanier, 2017)

As shown in figure 2.16, there are three key focus areas when analysing information in an organisation. These are, (i) knowledge discovery, (ii) data analytics, and (iii) big data analytics. Knowledge discovery (the outer square) is too broad and incorporates all the other focus areas and is practised by almost all organisations. Similarly, for every organisation to function effectively it has to engage in data analytics by analysing some data either manually or using computers (the middle square). Organisations use data and engage in analytics as a source of knowledge and influence to create a competitive advantage in the ever-changing environment (Król & Zdonek, 2020). Big data analytics (the inner square) goes further and incorporates big data and makes use of a data warehouse and business intelligence software and other tools to analyse both structured and unstructured data.

The traditional way is shown by the dotted arrows and it also involves data analytics that also results in knowledge discovery though not in a very effective way. Big data analytics is effective and is also part of data analysis. However, it is more focused on big data and interacts with the big data environment via the use of business intelligence analytics, other software, and a data warehouse to harness data from both structured, semi-structured, and unstructured data sources (Dedić & Stanier, 2017). Whichever way they are analysed, big data are analysed more effectively using computer software.

Therefore, big data analytics goes beyond just focusing on the characteristics of big data. There is a need to classify big data into five classes, (i) **data source,** to establish if data are easily accessible and whether they can be trusted. It seems the new sources; represent the untapped resource that has the potential of bringing in much-needed value; (ii) **content and format,** to find out whether the data are structured, semi-structured, or unstructured. The unstructured and semi-structured content is the one that has been difficult to tap into. However, because of the advances in technology and developments in the big data environment, it is now possible to access this low-hanging fruit hence the hype; (iii) **data stores** to establish whether the data are easy to store or retrieve in a document or database format, pictures or graphs; (iv) **data staging,** whether they are clean, transformed, and suitable for analysis. Lastly, (v) **data processing** whether they are batched or real-time. It is believed that processing real-time moving data has more value than processing historical batched data (Hashem *et al.*, 2015).

With advances in technology and the emergence of big data, business intelligence has changed over the years now requiring new means of gathering and analysing information for decision-making. However, getting the data in a BI system require about 80 percent of the time and effort emanating from poor data quality, politics around data ownership, ethical consideration, and incorporation of legacy technologies (Watson & Wixom, 2007). The classification creates a platform to tap into vast opportunities that are brought about by the ever-changing world of technology.

Without analytics, big data will simply be massive amounts of data; on the other hand, analytics only without big data will be equivalent to having statistical tools and mathematical applications without anything to evaluate. It is the combination of the availability of the massive amount of data and analytics, supported by the advances in technology and computing power that makes big data meaningful and insightful (Sanders, 2016).

Therefore, for a start one very important thing to bear in mind is that it is difficult to analyse information in the big data environment using manual means, applications and technologies are required to achieve this. Accessing the required data and storing it within the organisation's system landscape without using analytics software to extract value is equivalent to simply improving the organisation's infrastructure (Watson, 2014). To make a breakthrough in industry big data must be decomposed into the following four sequential models, namely, (i) data generation, (ii) data acquisition, (iii) data storage, and (iv) data analytics, along the value chain of an organisation (Yin & Kaynak, 2015a).

This research study narrowed the scope and focuses on the last one, data analytics because it is the one concerned with the extraction of value to answer the question, of what is limiting managers from using business intelligence systems to analyse information in the big data environment. This is the main interest of managers, though they must also be involved in data acquisition as well. These important tasks may be achieved by making use of the BI systems defined as decision support systems that enable managers, executives, and other knowledge workers to make fast and better-informed decisions (Chaudhuri, Dayal & Narasayya, 2011). The following figure 2.17, shows the architecture of a typical BI system.

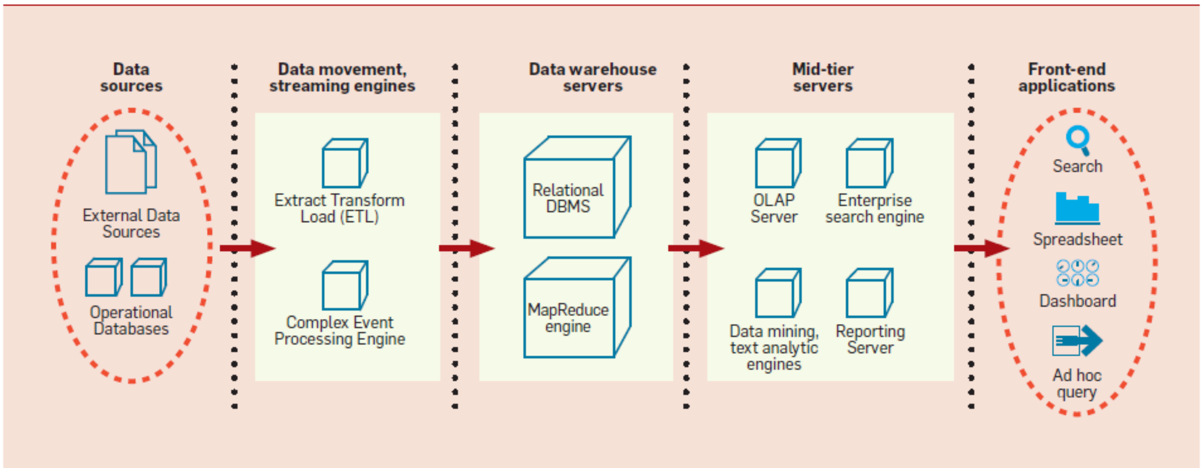


Figure 2.17: Architecture of business intelligence system

Source: (Chaudhuri, Dayal & Narasayya, 2011, p.90)

The architecture of the BI system in figure 2.17, shows that BI can still be used to analyse data in the big data environment which come from two main sources, (i) external source comprises mainly unstructured and semi-structured data; however there are also accessible structured data residing in key trading partners and, (ii) internal source comprises mainly operational structured data from operational databases. These two sets of data have to be acquired using extraction and integration tools from a BI system to build a data warehouse of a relational database. The relational database model was conceived by Codd in 1970. It is widely used in computer architecture to store data in related tables that have roles, and columns in the schema that specifies the structure (Berg, Seymour & Goel, 2013).

In addition to the relational database, the BI architecture has search engines, data mining engines, reporting servers, and OLAP servers. These are used to extract data for analytics. Then other front-end applications such as spreadsheets, dashboards, and ad hoc queries are used for analytics to provide managers with the much-needed insights to enjoy the benefits of big data analytics.

In this research study, it was the external source section and the structured data section that seemed to be the key enablers for a breakthrough if the untapped value is to be realised. Relational databases have been mainly used to store internal transactional data while the building of the data warehouse is, usually left to the IT department. They end up replicating the entire data in the ERP transactional system and are not clear on what to take from external sources. Data of great value is likely to be left out in the external source yet this represents the untapped new oil. It appears that currently there is no clearly defined framework on who decides what data to bring in from external sources and those involved in bringing that data. This requires in-depth knowledge of BI analytics, data modeling skills, and foresight of what needs to be achieved from the data to create value.

Software development companies have invested a lot in BI tools to extract value from the data. An organisation has two options, (i) to work with analytics software service providers or (ii) to deploy packaged analytics tools on-premise (Herschel, Linden & Kart, 2014, p.1). Every year Gartner publishes various business intelligence systems in a magic quadrant. It provides information about their opinion on BI software vendors including their service providers. This helps managers to choose an appropriate BI system that addresses their corporate strategy and vision. The other benefit is that the software providers are classified into four categories (i) niche players, (ii) challengers, (iii) leaders, and (iv) visionaries, as is in the following example. However, it has to be noted that no path or road map is provided to guide organisations on how to implement a data analytics strategy. The following figure 2.18 is Gartner's 2020 magic quadrant.

Figure 2.18: Gartner's 2020 magic quadrant for analytics and business intelligence platforms

Source: (Gartner, February 2020)

Traditionally, organisations have been analysing data using other applications such as excel but it has to be known that this is more challenging (Chen & Zhang, 2014). The spreadsheet features are now built into the developed business intelligence systems.

It goes beyond just ETL (Extracting, Transforming, and Loading), there is a need to try and understand the available data and this is followed by data cleaning, formulating the problem, and finally data analysis (Lin & Ryaboy, 2016). Business intelligence is then improved when an organisation constructs knowledge from structured and unstructured data available in (legacy) systems, to move from knowledge to wisdom (Houten & Spruit, 2015).

2.16 BUSINESS INTELLIGENCE MATURITY MODELS TO MEASURE BI MATURITY

"*Organisations do not need a big data strategy as much as they need a business strategy that incorporates big data*" (Schmarzo, 2016, p.4). According to Schmarzo (2016), organisations need to focus on new sources of data, but before they begin any discussion on that, they need to understand their current level of big data business model maturity index and then separate the way they treat big data from data science.

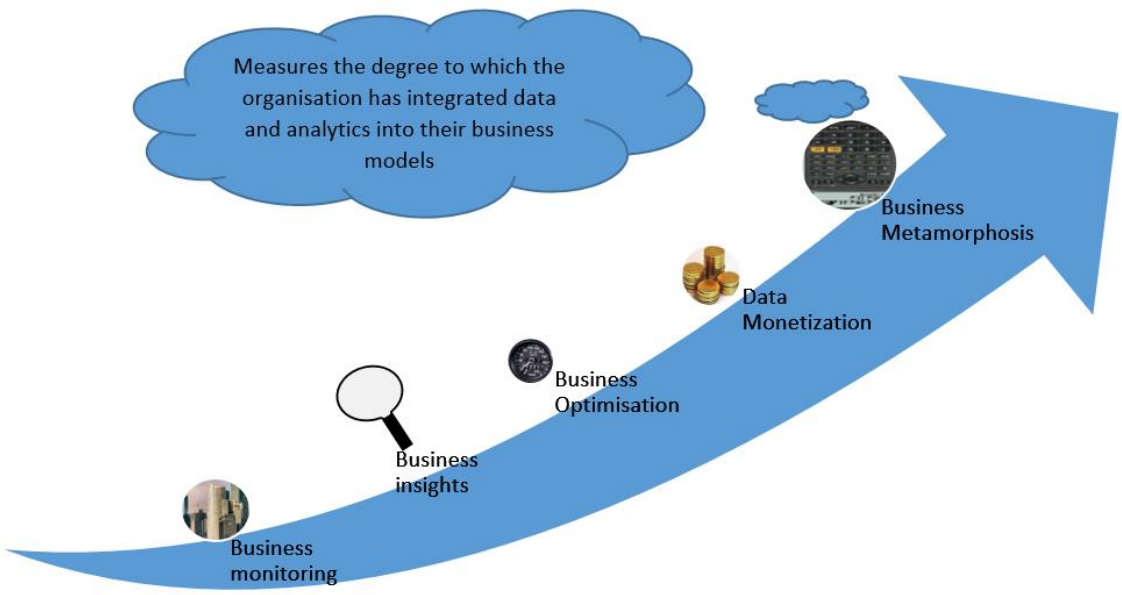


Figure 2.19: Big data business model maturity index

Source: (Schmarzo, 2016, p.5)

The **big data business model maturity index** illustrated in figure 2.19 is an informative model developed by Schmarzo (2016) that can be used by organisations that wish to incorporate big data and analytics into their models of business strategies. This model has 4 phases where phase 1 is called the **monitoring phase** when the organisation is leveraging the BI system to analyse data in the data warehouse to monitor performance. Phase 2 is the **business insights** leveraging on predictive analytics to uncover insights hidden in internal and external data sources. Phase 3 is the **business optimisation** phase when the organisation applies prescriptive analytics from uncovered insights to deliver actionable insights or recommendations. Phase 4 is the **data monetization phase** when the organisation creates new sources of revenue by leveraging on trading customer behavioural data to advertisers by selling data or operational insights into new markets, like what cellular phone providers do (Schmarzo, 2016). Phase 5 is the **data metamorphosis phase** when the organisation leverages data, analytics, and resultant insights to transform its business model. However, there are no clear frameworks to guide managers on how to reach these stages. Many organisations rush to phase 5 without first investing in the required software, infrastructure, tools, and appropriate skills.

These models only assist organisations to identify their position towards readiness to adopt big data initiatives, they do not assist organisations on how to get there and this is the purpose of this study to try to fill that gap by providing frameworks. It must also be noted that, overcoming the problem of integrating the data from different sources signals just the beginning of challenges in the big data environment because organisations often do not know which data to harness and what to do with the data and this is where most organisations face a 'roadblock' then abandon any ambition of using external data. There is a chain of activities that often requires collaboration and coordination between departments to create a coordinated flow of activities (Janssen, Voort & Wahyudi, 2017). Management plays a critical role in addressing these factors that hinder the extraction of value from the big data environment. It, therefore, suggests that big data issues are mainly centered on management and the culture of the organisation than technology (Ernest *et al*., 2011).

On the other hand, information is the lifeblood of every manager engaged in any decision-making process regardless of the department or level. In this big data era, it seems that the challenge of analysing the information is being hampered by the fact that Universities and other institutions of higher learning have not been training degree programs and courses in data science needed when dealing with big data. Therefore, currently, there is no coordination when dealing with data in the big data environment resulting in different views, conceptions, and perspectives. However, the good news is that some universities around the globe offer degrees up to the Master's level in this emerging discipline (Provost & Fawcett, 2013). For now, this lack of knowledge has left managers pondering whether there is a need to hire data scientists because they do not yet know the purpose, importance, and value of this emerging profession (Power, 2014).

Many scholars have written about the factors that must be addressed before the value is realised from the big data environment. IDC developed a score called the knowledge quotient and identified the factors as process, socialisation, technology, and culture. Process refers to the ability to access, analyse and share all relevant information originating from inside and outside the organisation while socialisation refers to the ability to share and reuse that information. Technology refers to the availability and satisfaction with access to unstructured information, analysis, and sharing of software. While culture refers to management's support, funding, and recognition of information as the key asset of the organisational (Schubmehl & Vesset, 2014). These factors play a critical role as the data passes through various stages of acquisition, cleaning, and integration before the process of extracting insights called analytics begins as identified by Gandomi & Haider (2015).

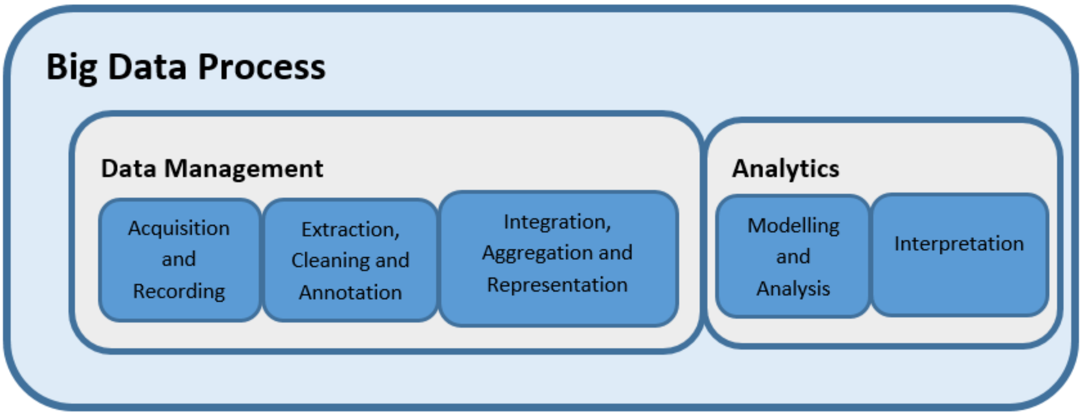


Figure 2.20: Processes of extracting insights from big data

Source: (Gandomi & Haider, 2015, p.141)

Figure 2.20 shows that there is a chain of activities involved in data analytics that includes acquisition and recording, extraction and cleaning of the external data before integrating it with internal data. Analytics and interpretation of quality results depend on cleanly modeled data.

For years, organisations have been generating and working on internal data using traditional ways of analysing them. However, what seems to be the game changer that needs further exploration is the need to integrate systems to tap into the external data element such as customers, suppliers, and other partners' data. They have been operating at different levels of knowledge of utilising analytics software in the big data environment. They now need to scale up by riding on advances in technology that include analytics software such as BI tools.

Many scholars have devoted a lot of time to this subject and developed several BI maturity models. Several maturity models have been developed since the 1970s. Some maturity models measure maturity in terms of business process for example the business process maturity model (BPMM) is used to assess and improve business processes (Looy *et al.*, 2013). When big data came on board, big data maturity models were also developed to measure and evaluate organisations' readiness in terms of infrastructure technology, capabilities, skills, and competencies needed to adopt big data initiatives (Nda & Hamid, 2020). However, it has to be noted that these models tend to overlap, for example, the big data maturity model incorporates readiness to use BI systems to analyse data in the big data environment. These models help organisations to evaluate how far they have gone in as far as adopting BI is concerned, which is also key in adopting big data initiatives.

Hribar (2010) analysed the following six (6) BI models.
(i) The Business Information Model by (Williams & Thomann, 2003) classifies maturity according to levels 1 to 3 of information usage. The first level deals with what users want to access. The second level deals with who should have access and when they should access it. The third level deals with how the information can be improved.

Users must perform self-evaluation by completing a well-documented questionnaire to see if they have achieved the levels. There must be an alignment to governance and delivery guided by BI's strategic position. There is a need for collaboration among business units, taking into account the following, business culture, process culture, decision culture, and technical readiness for information analysis (Chuah & Wong, 2011).

(ii) The TDWI Business Intelligence Maturity Model by Eckerson (2007) focuses on technical aspects and classifies maturity according to grades infant, child, teenager, adult, sage, gulf, and chasm. It concentrates on technical aspects, especially the data warehouse. The infant stage consists of prenatal and infant and it lasts until a data warehouse is created with fragmented data sources. The child stage is when many workers now join in while the teenager stage is when the scope of using BI is broadened. It reaches the adult stage when it becomes enterprise-wide to deliver strategic goals. The last stage is called the sage stage when it extends to other enterprises. In between the infant stage and the child stage, the is a gulf that is not so wide or deep to be crossed. Then between the teenage and adult stage, there is a chasm that contains challenges and obstacles that have to be overcome by the teenager (Shaaban *et al.*, 2011).

(iii) The Business Intelligence/Performance Management Maturity Model by AMR Research Company. This model concentrates on performance management using the balanced scorecard. It classifies maturity according to levels 1 to 4 namely: reacting, anticipating, collaborating, and orchestrating. The reacting level is more tactical as the organisation relies on desktop software and ad-hoc queries run by individuals. These individuals will be asking themselves, where have we been? At anticipating level, dashboards are developed, visible, and used by everyone. At collaborating level key performance indicators are developed and shared among managers and then incorporated into the business strategy. At orchestrating level top executives develop an interest and a top-down approach is adopted. At this stage, expectations are high across all levels (Hribar, 2010).

(iv) Business Intelligence Maturity Hierarchy which is classified into four stages namely: data, information, knowledge, and wisdom. Some authors argue it is incomplete to represent business intelligence because the author developed it from a technical point of view (Chuah & Wong, 2011).

(v) The Infrastructure Optimisation Maturity Model, which focuses on optimising the infrastructure by classifying it into two, (1) business productivity infrastructure optimisation (BPIO) which focuses on simplifying business processes by integrating information technology and management through communication and corporation. The second is, (2) application platform infrastructure optimisation (APIO) which focuses on quality decisions derived from the quality of data (Hribar, 2010).

(vi) Gartner’s a five-stage Business Intelligence Maturity Level used to measure how mature an organisation is to adopt BI. The model is a five-staged BI maturity model. The five stages are: (1) unaware (2) tactical (3) focused (4) strategic and (5) pervasive. The model provides a non-technical view but rather considers the business's technical aspects.

Some software developers use these models to market their BI tools by classifying different customers (Hribar, 2010).

However, some of these models are too narrative, some focus on technical aspects while others focus on business only. This leaves managers without a clearly defined path to adopt big data strategies and this has been the main point of failure. There is also no appreciation of dirty data, lack of skills, and unengaged sponsors (Chuah & Wong, 2011). Top management ends up delegating the adoption of big data strategies to the information technology department to do whatever they can do to create value from the data, which then forces it to take the technical route.

A closer look at these BI maturity models reveals that management plays a critical role in changing the organisation's culture by adopting the resource-based view of recognising information as a key resource of the organisation.

This research study adopted Gartner as the leader with its five-staged BI maturity model then incorporate the other models to support it on technical aspects. It mainly focuses on Gartner's last two, strategic and pervasive. Where the organisation would have a clear business strategy for the development of BI from the highest management level. This is when BI becomes pervasive across the entire organisation to be part of the organisation's culture extended to customers and suppliers. This then gives room to adopt big data initiatives since big data and BI are interlinked. The following figure 2.21 shows Gartner's five-staged BI maturity model.

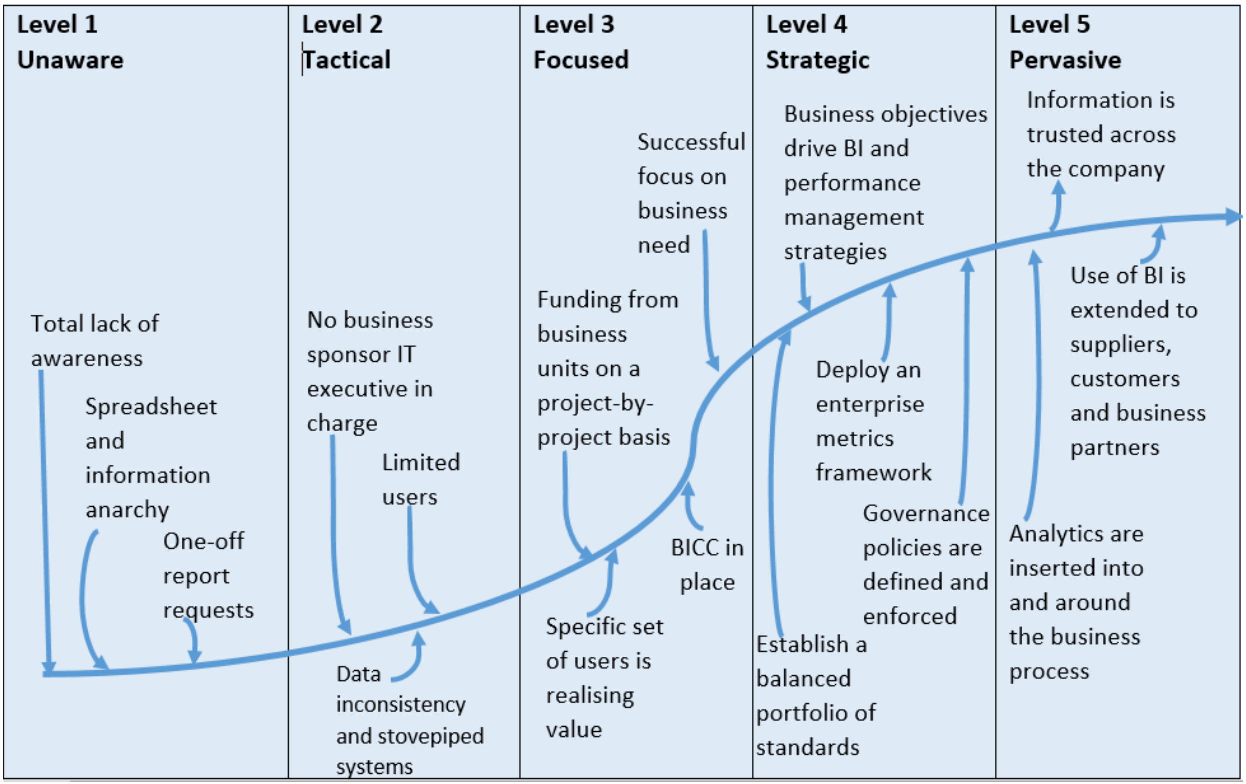


Figure 2.21: Business intelligence maturity level

Source: (Gartner, 2008, cited in Shaaban *et al.*, 2011, p.3)

At level 1, the unaware stage sometimes called "information anarchy" data are inconsistent across departments and there is excessive use of excel spreadsheets. At level 2, tactical stage data are in silos with limited use, business is not very much involved but the IT department is involved as it takes charge by supporting various applications in various departments. At the level 3 focused stage, a specific set of users begin to realise the value of analytics, and business gets involved but there is data replication and no single version of the truth as each business unit pursues its own project resulting in several databases across the organisation. At the level 4 strategic stage, business objectives drive BI, as senior managers get involved in the deployment of enterprise-wide data, and this results in the construction of a data warehouse. A group of people collaborating at the department level, form alliances to deal with data cleaning and alignment issues signaling the beginning of enterprise-wide usage of analytics software. At level 5, the pervasive level, information is then trusted across the whole organisation and it is now time for the organisation to mine the data for insights bringing in the concept of data mining (Shaaban *et al.*, 2011). This research study extended Gartner's level 5 to provide managers with a model to adopt big data strategies.

Even though an organisation may want to move from a certain level to another level it cannot do that without adopting modern ways of analysing data. This has seen many organisations increasing their investment in analytics software such as BI systems to mine data from various sources for analytics. This concept of data mining forms the cornerstone of adopting a big data strategy, therefore a deep understanding of this concept is of paramount importance.

2.17 IDENTIFIED GAP AND CONCLUSION

While academic and scientific research studies have made significant strides in addressing the volume (how the data are stored) and velocity (speed of execution), research studies on connecting big data analytics to operations have lagged (Roden *et al*., 2017).

There is a lack of well-structured coherent processes or frameworks for implementing big data projects (Braganza *et al.*, 2017). The current literature on big data analysis is dominated by the technical aspects of analysing the data and often ignores big data complementary resources such as humans, intangible assets, and other technologies to create business value (Qi & Yang, 2020). There is a need to take data and access to the data as a starting point, because without the data there is no BI to talk about (Cardoso and Su, 2022). Therefore, not much attention is given to well-structured coherent processes that can assist organisations to adopt big data, hence big data has remained on the radar of most organisations' boardrooms (Braganza *et al*., 2017). The current BI maturity models are too narrative and they focus on maturity, based on technical aspects or business. They do not provide managers with a path to get there (Chuah & Wong, 2011).

The problem with big data is that it is being researched from different fronts involving practitioners from different backgrounds from the scientific, commercial, social, and academic fronts. They seem to have agreed on the characteristics of big data as the 5 "V's" fine but when it comes to the development of theory, they seem to take different directions; the scientific side seems to concentrate on volume while the commercial side takes a keen interest in value. This has resulted in what professor Peter Grindrod termed academic research science versus commercial players or big science versus big economic impact encouraging science not to compete with commercial opportunities but rather support them (Grindrod, 2017).

When researching to either fill the knowledge gap or solve a problem a researcher must be guided by a common belief called a paradigm to understand and address the problem. This will assist the researcher to have a clear picture of whether reality exists or not, by at least knowing something before deciding on which methodology to adopt. This becomes the researcher's ontology, epistemology, and methodology respectively (Patel, 2015).

There are usually two main opposing paradigms that underpin quantitative and qualitative research studies, and these are positivism and interpretivism also referred to as constructivism or naturalistic (Petty, Thomson & Stew, 2012). Three more paradigms namely pragmatism, subjectivism, and critical are sometimes used and there is no generally agreed paradigm to adopt (Patel, 2015). These paradigms help shape the research study approaches whether the approach will be a deductive approach, one testing a theory or it will be an inductive approach; one building a theory, framework, or model. It has been proven that combining the two approaches in a single research study has greater advantages than relying on only one approach (Saunders, Lewis & Thornhill, 2009).

Big data is relative, a new field spanning different disciplines with a broad research study question of exploring factors that hinder the extraction of value from it. To the best of the knowledge of the researcher, there is currently no single reality as it is being debated and interpreted in different ways across the globe, therefore, anything that solves the big data problem is acceptable (Patel, 2015), and this perfectly, suites the pragmatism paradigm, therefore, this research study adopted the pragmatism worldview.

Pragmatism does not choose sides as it looks at both the positivist and the interpretive worldviews (Tashakkori & Teddlie, 1998). It believes that objectivists and subjectivists are not mutually exclusive. Therefore, it puts more effort into trying to solve the problem by adopting both (Wahyuni, 2012). What is facing the world today is that researchers in big data come from both positivism and interpretivism and currently there is no agreed position. Therefore, the researcher has to be immersed in the participants' world allowing them to actively contribute and be involved in constructing the reality (Petty, Thomson & Stew, 2012). Some scholars researching big data employ the scientific approach and they believe that there is a need to deduce some theories while others believe there is a need to induce some theories into this big data social phenomenon (Kitchin, 2014).

Given such a scenario, taking a pragmatic position will be beneficial in that it will produce a balanced position as we try to advance knowledge in big data research studies (Maxcy, 2003; Watson, 1990). The fact that researchers come from different fields building a generally agreed theory has also been a major challenge. The University College of London (UCL) has been organising annual workshops on the theory of big data since 2016 to try and overcome the challenge of big data theoretical underpinning by gathering experts from around the world (University College London, 2017). There is, therefore, a need to understand scientific principles and explain relationships between variables, which makes it adopt the deductive approach but at the same time, there is also a need to be immersed in the users' world which makes it adopt the inductive approach.

Some theories have been developed on big data however there is no generally agreed-on theory and challenges of extracting value from it still exist. The deductive approach tests existing theories while the inductive approach involves the building of a theory. When there are no clear, defined theories the researcher should be immersed in the users' world to understand the phenomenon through social interaction(Kitchin, 2014). Initial engagement plays a critical role as the initial framework is developed. This then leads to the building of better frameworks, models, and theories (Saunders, Lewis & Thornhill, 2009, p. 149).

This research study sought to explore ways of realising value from big data. Therefore, there is a need to, look closely at the accepted 5 "V's" of big data, the main sources of big data, which are external versus internal then align these to the value chain. As discussed earlier Gartner identified the master data management (MDM) framework that involves differentiation in data domain definition. This framework is fundamental to pursue if ever organisations are to extract value from the big data environment.

It appears extracting immense value from the big data environment is, hinged on how an organisation integrates its internal data generated from its transactional systems with the data coming from the external source. It is this external source element, which seems to contain a major component of the "crude oil" of the "new oil" in the form of information hidden in the big data environment. Therefore, to get value both external and internal data have to be analysed. There is a need to link big data to business strategy through strategic data entry points. Academic and scientific research studies have made significant strides in addressing the volume and velocity part of big data but research studies on connecting big data to operations have lagged (Cohen, 2018). The effort that these individuals from different backgrounds have put into trying to construct reality within the big data phenomena has opened doors for further research studies (Wahyuni, 2012). Adoption of big data in the manufacturing sector in developing economies such as South Africa and Zimbabwe face the following barriers, lack of infrastructure, data security concerns, skills shortages, lack of regulatory framework, lack of standards and lack of implementation strategy (Maisiri, van Dyk & Coeztee, 2021).

However, these experiences may change from time to time resulting in new perspectives (Hennink, Hutter & Bailey, 2011). Many researchers have researched the big data topic but not much attention is given to well-structured coherent processes of implementing big data projects (Braganza *et al.*, 2017), hence big data remains on the radar of most organisations' boardrooms. This research study tried to fill this gap by developing a framework to follow when implementing big data initiatives that incorporate both internal and external data to extract value. In such a situation, the researcher has to be close to generate a deep understanding. Glaser & Strauss (1967) in their book, "the discovery of grounded theory" gave advice, that for a qualitative research study to yield good results, the researcher must approach it without preconceived ideas. According to them, the researcher must approach the research study without even theory or literature (Glaser & Strauss, 1999).

However, Strauss and Corbin later argued that in a practical world, it is difficult for humans to unlearn what they have already learned, therefore the researcher goes into a research study area with the background of relevant literature because it forms the basis of professional knowledge, therefore it must be approached with an open mind, not an empty head (Thornberg, 2012). According to Burton (2007, p.27), ignoring established theories and research study findings by others implies a loss of knowledge, they argue that "*a dwarf standing on the shoulders of a giant may see further than the giant himself*" and this helps the researcher not to miss well-known aspects and avoid reinventing the wheel (Thornberg, 2012).

This research study followed this line of thinking by riding on the shoulders of the three theories and relying on gaps identified in this literature chapter therefore, the theoretical and conceptual frameworks were underpinned by that.

The following table 2.2 is a summary of the key findings that emerged from the literature review.

2.18 SUMMARY OF KEY ISSUES DISCUSSED

Table 2.2: Summary of key issues discussed

Key Issues Discussed	Key Issues Observed

SECTION 1 **Introduction to the characteristics of big data (5 v's).** At first, there were just 3 V's dominating big data i.e. (Volume, Variety, and Velocity). The fourth 'V', veracity, represents data from an unreliable source, and the fifth 'V', Value, represents data that comes with a low value from the original source (Gandomi & Haider, 2015). **The big data definition** The (TechAmericaFoundation & FederalBigDataCommsion, 2012) defined big data as "Large complex volumes of variable data that require advanced technologies and techniques to store, manage, analyse and distribute" This research study will adopt the definition by (Hashem *et al.*, 2015, p. 100): "big data are a set of techniques and technologies that require new forms of integration to uncover large hidden values from large datasets that are diverse, complex, and of a massive scale"	Because of advances in technology, the floodgates have opened. Information is now everywhere, computers, machine sensors, cameras, and mobile devices. big data are not just volume, other characteristics such as velocity, variety, veracity, and value also play a critical role. These characteristics are more pronounced when the unstructured external data are incorporated. Internal data are usually structured. big data can also be defined in terms of transactions versus non-transactions and internal versus external (Baesens *et al.*, 2016). Some argue big data are the most overhyped and abused term, data will not stop growing: It is now the meaning and value that have become ambiguous (Devlin, 2016).
Confusing terms that are Complimentary to big data. Bloggers and vendors have seen an opportunity, to use the colourful phrase, "big data", to capture attention (Power, 2014). Certain terms such as the Internet of Things, Machine learning, and Artificial Intelligence, that complement the adoption of big data are often confused. The International Telecommunication Union (ITU) defines the Internet of Things as "A global infrastructure for the Information Society, enabling advanced services by interconnecting (physical and virtual) things based on, existing and evolving, interoperable information and communication technologies" (ITU, 2012) (Wortmann & Flu¨chter, 2015, p. 221).	It is important to understand key terms and complementary technologies and their role in a big data environment, otherwise, the big data phenomena will best be described by the HACE "theory", where the restricted view of each blind man leads to a biased conclusion (Tamhane & Sayyad, 2015). Experts argue that this confusion is common because we are in the beginning phase (Cohen, 2018). When there is too much noise and confusion about a new topic the academic literature is the space to go to separate the noise from scholarly signals (Frizzo-barker *et al.*, 2016).
Sources of big data Big data are bi-products of business transactional systems (e.g. ERP). Data from machine sensors, vehicles stationary and in motion (Matti & Kvernvik, 2012). Data produced by public service institutions (Administrative data). Data from networks such as Google, Facebook, Twitter, and LinkedIn. Data from non-transactional and transactional sources breed unstructured, semi-structured to structured data (Baesens *et al.*, 2016).	Data in the big data environment comes from a variety of sources but is channeled into the organization via two main sources (external source and internal source). There is a need to establish strategic data entry points along these two main sources. Much of the data housed in organisations is internal

	historical data for regulatory requirements (Cognizant20-20Insights, 2011).
<u>SECTION 2</u> **<u>External Data</u>** The external unstructured data are scattered in different unrelated locations (Schubmehl & Vesset, 2014).	External data are difficult to get because they come in 'silos' in a structured, semi-structured, and unstructured format, making it difficult to store and analyse, however, to get value, both external and internal data have to be analysed. The big question is; how do external data enter the organisation? Acquisition of external data cannot be left to one single individual or department and must be done by people with the necessary skills. It calls for other technologies such as Hadoop to handle external data.
<u>Legal and Ethical Issues</u> In India, the national digital ID platform, *Aadhaar* faced legal challenges that were later decided in courts and it was celebrated as a victory for an individual's liberty, dignity, and freedom (Parajuli, 2017). In the USA, Judge Preska concluded that the main challenge is the doctrine of Extraterritoriality (Glosson, 2016). An agreed code of ethics is the major challenge because big data cuts across different fields of study (Tractenberg *et al*., 2015). The Internet is also a source of big data, however, the Internet shutdown is also a big problem. In Africa, the following countries had to shut down the Internet for various reasons (Algeria in 2016: to stop children from cheating, Cameroon in 2017 during English-speaking region protests, Chad in 2016 for elections, Congo in 2016 for security reasons to stop publication of illegal results, DRC 2015 to stop protests, Gabon 2016 before the elections, Gambia 2016 immediate election period, Ethiopia 2016 to stop protests, Gabon 2016 internet curfew due to political tensions, Uganda 2016 before re-inauguration, Zambia 2016 presidential results protests, Zimbabwe 2016 shutdown Zimbabwe protests.	Big data involves practitioners from different backgrounds i.e. scientific, commercial, social, and academic. (Tractenberg *et al*., 2015). The scientific side concentrates on volume, the commercial takes interest in value, (Baesens *et al*., 2016) while others take a keen interest in legal issues. The legal framework is not yet ready because the big data environment cannot be accessed easily because of legal, ethical, and Internet shutdown issues. These issues sometimes span across borders bringing in the doctrine of extraterritoriality (Glosson, 2016). Without the internet, it would be difficult to access data from a variety of external sources.
<u>Challenges in Big Data</u> The following challenges are encountered in a big data environment:	To overcome the challenges encountered in the big data environment, management plays a big role because big data

(i) Data challenges (ii) Process Challenges and (iii) Management Challenges (Sivarajar *et al*.2017, p.265). Management faces the following challenges: Technological barriers (Infrastructure readiness and Data complexity), Human barriers (lack of skills and Privacy), and Organisational barriers (Culture) (Alharthi, Krotov & Bowman, 2017, p.289). Then there is also the Digital divide challenge defined by (OECD,2001) as "The gap, between individuals, households, businesses, and geographic areas at different socio-economic levels about both their opportunities to access ICT and to their use of the internet for a wide variety of activities" (Doong & Ho, 2012, p.519). The International Telecommunications Union uses two indicators, to measure the digital divide (i) access and (ii) skills, (James, 2012). It is mainly influenced by habit, ICT skills, behavior, and benevolence (Goncalves, Oliveira & Cruz-jesus, 2018). McKinsey Research Institute indicated a huge shortage of analytical skills required to analyse data in the big data environment (Chen, Chiang & Storey, 2012). A special committee on Digital skills in the UK also acknowledged this shortage (British Government, 2017)	issues are mainly centered on the management and culture of the organisation than technology (Ernest *et al*., 2011). The wider the digital gap between strategic partners (customers, suppliers, machines, devices, and employees), the more difficult it is to adopt a big data strategy. There are three main challenges (i) Data challenges (ii) Process changes and (iii) Management challenges
SECTION 3 **Power of Big Data and opportunities** Big data benefits differ from industry to industry, easier to apply to operations targeting to improve operational efficiency that delivers incremental change (Roden *et al*., 2017). The big data ecosystems will vary by region and country depending on regulations and on how big the pool of youths who are tech-savvy consumers (Henke & Kaka, 2018) The process of budgeting could drastically change for the better by incorporating external data from suppliers and customers in the big data environment (Griffin & Wright, 2015). The emergence of big data has now made it possible for customer-centric organisations like Whirlpool to put sensors and track the final usage of their products (Woerner & Wixom, 2015). This integration of communication technologies and systems between human and physical machines supported by advanced analytics is called cyber-physical systems (CPS) results in high plant availability and near-zero breakdown due to real-time data streaming resulting from advanced connectivity (Lee *et al*., 2015) leading to the fourth industrial revolution in the manufacturing sector giving birth to what is called Industry 4.0 (Schlaepfer & Koch, 2015) The late Stephen Jay Gould noted,	The power of big data is perfectly demonstrated when real-time operational analytics is adopted in operations and manufacturing resulting in Smart Factories

"whenever science and technology meet social economics systems, something that has been stable for a long time is likely to be disrupted in a radical manner creating a point called 'punctuated equilibrium'" (Siebel, 2017:1)	
<u>Trends in Business Intelligence</u> From the 1950s up to the late 1980s, researchers were simply using the term intelligence because there was no computer. Business intelligence became a popular term in the business and IT communities only in the 1990s. Ever since then, many other terms such as business analytics and data mining have been used to describe the techniques used to store and analyse a large amount of data from different sources using computer-based applications (Chen, Chiang & Storey, 2012). From the 1980s up to the early 2000 organisations were battling with exponential growth in data volume (Roden *et al*., 2017)	Business intelligence has traversed from manual means to near manual up to the use of sophisticated technological systems such as business intelligence.
<u>Changes needed in organizational structure to adopt big data</u> Organisations do not need a big data strategy as much as they need a business strategy that incorporates big data" (Schmarzo, 2016, p.4). Management plays a big role because, Big data issues are mainly centered on the management and culture of the organisation than technology (Ernest *et al*., 2011). There is a need to revisit the organisation structure to place data scientists centrally or decentralised to do the analytics on behalf of management (Grossman & Siegel, 2014)	Managers may find it difficult to analyse big data. There is a need for an organizational structure that incorporate Data scientists or analyst with the necessary technological, business, and analytics skills.
<u>SECTION 4</u> **<u>Big data analytics and types of analytics:</u>** Technology has advanced to an extent of leaving big data and analytics intertwined (Watson, 2014). Without analytics, big data will be equivalent to having statistical tools and mathematical applications without anything to calculate (Sanders, 2016). "Acquiring data without analytics software to extract value is equivalent to simply improving the organisation's infrastructure" (Watson, 2014, p.1248). There is a chain of activities often required before adopting big data analytics (Janssen, Voort & Wahyudi, 2017). The activities involve Data acquisition and recording, Extraction cleaning and annotation, Integration aggregation and representation, modeling, and analysis then interpretation (Gandomi & Haider, 2015). There are five key focus areas when analysing information in an organization, (i) Knowledge Discovery, (ii) Data Analytics, (iii) big data	Integrating data from different sources signals just the beginning of challenges organisations often do not know what to do with the data and face a 'roadblock' (Schubmehl & Vesset, 2014). There is a need to distinguish big data analytics from analytics since data will continue to grow and will never become small again. A need to remove the hype that Hadoop-based systems are the best, and rather look at them together with the best programming platforms (Fan & Bifet, 2015). There are various types of analytics (i) Descriptive analytics, which focuses on the past, (ii) Operational analytics, which focuses on the present moment (iii) Diagnostic analytics, which combines the past and the

Analytics, (iv) big data, and (v) business intelligence. knowledge discovery is too broad and it incorporates all five focus areas. Data analytics covers the other four areas namely data analytics, big data analytics, big data, and business intelligence. While big data analytics covers big data and business intelligence.	present to deduce causation (iv) Predictive analytics, which focuses on the future to forecast what may happen. Then finally (v) Prescriptive analytics takes into account all the other four to try and simulate future behaviors (Devlin, 2016). This research study is going to focus on big data analytics to improve business intelligence which covers all three areas big data analytics, big data, and business intelligence.
Shortage of Skills McKinsey Research Institute indicated a huge shortage of analytical skills required to analyse data in the big data environment (Chen, Chiang & Storey, 2012). A special committee in Digital skills in the UK also acknowledged this shortage (British Government, 2017)	To overcome the skills shortage, there is a need for data scientists or analysts with the following skills, analytics skills (i.e knowledge about data and analytics) Information Technology skills (knowledge about tools and infrastructure), and business knowledge skills (knowledge about business products, services, and operations) in organisations intending to adopt big data initiatives (Grossman & Siegel, 2014, p.21). To derive value from the big data, companies must invest in data scientists who can support traditional managerial functions (Sestino et al., 2020). These will play the role of gathering business information requirements and then translating them into technical requirements for the creation of analytics reports.
Business Intelligence Models There are various business intelligence models. Gartner developed a five-stage Business Intelligence Maturity Level for Business Intelligence. There are also other models as well like the Ladder of Business Intelligence (LOBI) model, The Business Information Model by (Williams & Thomann, 2003), The TDWI Business Intelligence Maturity Model by Eckerson (2007), The Business Intelligence/Performance Management Maturity Model by AMR Research, Business Intelligence Maturity Hierarchy which classifies according to four stages Data, Information, knowledge, and wisdom. The Infrastructure Optimisation Maturity Model concentrates on infrastructure.	Business Intelligence models only assist organisations to identify their position towards readiness to adopt big data initiatives, they do not assist organisations on how to get there. Schmarzo developed a 5 stage Big data Business Model Maturity Index but acknowledges that what they have not done is translate the index into a set of recommendations to assist organisations to move from one stage to another.

2.19 CHAPTER SUMMARY

This chapter reviewed literature that was organised into four main sections as follows, (1) understanding what big data are all about including source, (2) the need for external data and challenges encountered in the big data environment, (3) the link between big data and analytics and changes needed to adopt big data analytics strategy, then finally (4) Data analytics and use of business intelligence systems to extract value including the use of BI maturity models to measure maturity level. A summarised table of findings from the literature was provided.

The main objective of this research study was to develop frameworks therefore; there was a need to closely look at what is already known and believed, then come up with a methodology that will help to answer the main research study questions using the knowledge identified in the literature chapter. This allowed this researcher to be immersed in the participant's world with background knowledge in an endeavour to construct reality. The next chapter presents the theoretical and conceptual frameworks that were used in this research study to answer the research study questions.

CHAPTER 3

THEORETICAL AND CONCEPTUAL FRAMEWORK

3.1 INTRODUCTION

This chapter provides a background to the theoretical framework used to inform this study. The chapter begins by giving a brief background of how specific theories are used during a research study to reflect on the contributions of other authors. This was done to get insights as to what particular theories apply to which stage of the research study process and how they should be applied at specific times. The input includes the various ways of using theories, their visibility, and their influence, especially in qualitative research studies. This motivated the selection of the three theories used in this study (i) The Diffusion of Innovation theory (ii) The Unified Theory of Acceptance and Use of technology and (iii) The Social Exchange Theory. The chapter concludes by reflecting on engagement with the three theories to reach a common ground.

3.2 USE OF THEORIES IN RESEARCH STUDIES

Qualitative research studies may be conducted with theory or without a theory. In a case where no theory is used, then grounded theory will be used to provide a theory at the end of the research study (Paterson, 2013). There is no rule of thumb to use only one theory, as two or more theories may be used in a research study. When a decision to use a theory is taken, the main questions to ask are, at what stage is the theory used? and what role does it play in the research study? Theories influence how data are collected understood and analysed. It goes beyond just description but allows for the interpretation of findings from the research study process (Bradbury-Jones, Taylor & Herber, 2014).

There are various ways of using theories in qualitative research studies as suggested by Bradbury-Jones, Taylor & Herber (2014). The following table 3.1 shows the five levels of theoretical visibility typology in a research study.

Table 3.1: Levels of Theoretical Visibility typology

Level of Theoretical Visibility	Descriptor
Level 1: Seemingly absent	Theory is not mentioned at all

Level 2: Implied	Theory may be mentioned or discussed in some detail (mainly in the background or introduction sections) and reference might be made to theorists in the field, but no explicit statement is made about the influence of these in the study.
Level 3: Partially Applied	Researchers explicitly locate their study within a particular theory but then seem to abandon efforts to link, apply or interpret their findings in that context. The theory is used only partially throughout the research study process in relation to the research study aims and objectives, interview questions, or data analysis.
Level 4: Retrospectively applied	Theory is considered at the end of the study as a means of making sense of the research study findings. In this case, the theory is introduced as an afterthought.
Level 5: Consistently Applied	Theory is consistently applied throughout the entire research study process. Theory guides and directs the various phases of the research study process and can be tracked throughout a published article.

Source: (Bradbury-Jones, Taylor & Herber, 2014, p.137)

This research study used level 5 of the theoretical visibility topology. The three theories were, consistently applied throughout the entire research study process. They guided and directed the various phases of the research study process from idea formulation, testing, modification, and polishing of the ideas, to the methodology, the formulation of the research study questions, the data analysis, and the interpretation of the results. When everything from research study questions, and purpose, to methods, forms a cohesive whole, it is referred to as methodological congruence (Mills & Birks, 2014).

When a researcher identifies a problem and thinks of an idea to conduct a research study, two schools of thought emerge. One by Frankfort-Nachmias and Nachmias (1992) cited in Berg (2000, p.17) proposes (i) ***theory-before-research*** as follows: Idea->Theory->Design->Data Collection->Analysis->Findings. The other one by Merton (1968), cited in Berg (2000, p.18) proposes (ii) ***research-before-theory*** as follows: Idea ->Design->Data Collection->Theory ->Analysis->Findings. These two suggest that the researcher has to do one stage after the other without revisiting the previous stage.

Berg (2000) argues that for better results a researcher must encompass both models to have a spiral model that continuously re-examines theoretical assumptions and refine ideas, therefore for every two steps forward the researcher must take one or two steps backwards to refine ideas, and the theoretical assumptions as shown in the following figure 3.1.

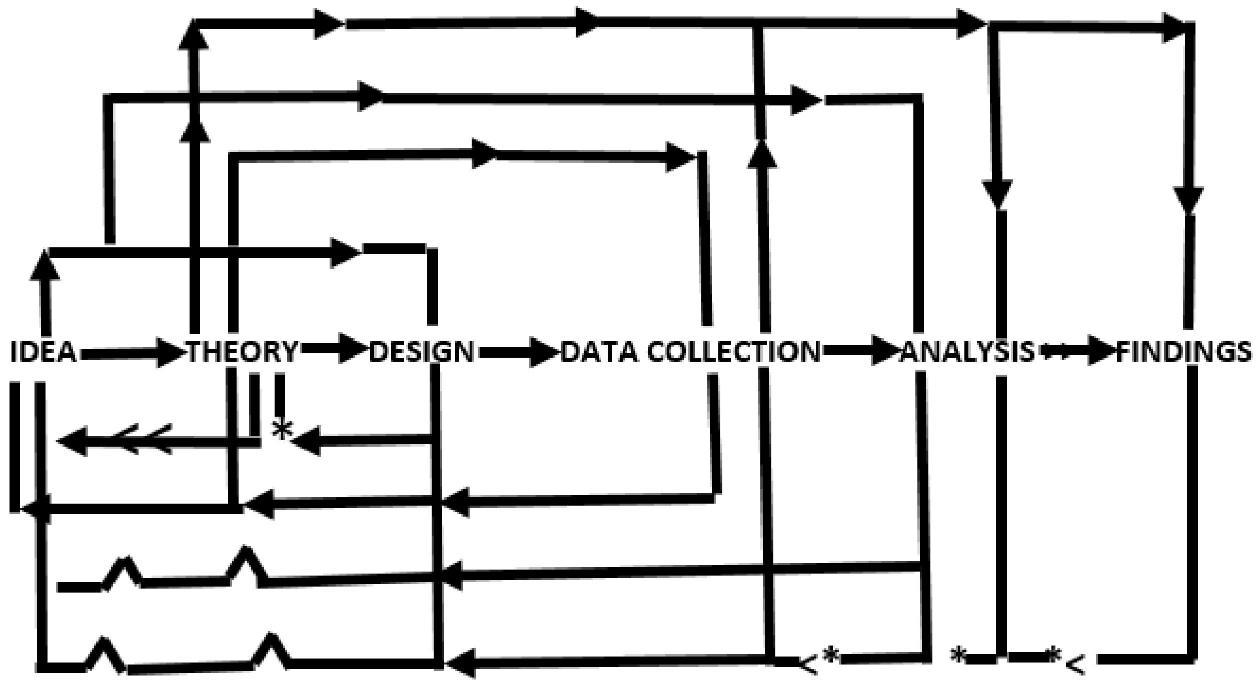


Figure 322.1: Designing a qualitative research study

Source: (Berg, 2000, p. 19)

This research study's main objecive was to develop frameworks, therefore it adopted the inductive approach to build those frameworks. The research study adopted the model in figure 3.1 by Berg (2000) to feed into the conceptual and final frameworks.

Theories and models are meant to connect the researcher to existing knowledge that come from ideas. They give the researcher lenses to explain patterns and relationships, and predict, and understand complicated problems from a particular angle. Hence, the researcher is guided on how to approach the phenomenon by asking relevant questions. However, the researcher must guard against forcing the data to fit into these theories during the data analysis phase.

3.3 THEORETICAL FRAMEWORK UNDERPINNING THIS RESEARCH STUDY

"*Theoretical and conceptual framework are mandatory ingredients of good qualitative research* study *because they explain the path of the research* study *and ground it firmly to constructs*" (Adom, Hussain & Joe, 2018, p.1). In addition, the authors say these frameworks help in the extension of knowledge by making the research study more meaningful by providing the blueprint that guides the research study. A theoretical framework also helps others to understand the lenses being used by the researcher to look at the problem.

When a researcher is faced with a problem such as this and decides to conduct qualitative research study to find out why things seem to be happening in a certain way, the first port of call is to find a theoretical framework to explain the why question. Every research study must have a starting point; usually, this point is an idea from a particular problem or a situation. In some instances, ideas originate from what one hears or experiences and this shapes the research study orientation towards a theory, creating a relationship between the ideas and theory.

Theories are general and comprehensive statements that describe different aspects of some phenomenon. They are interrelated ideas that describe various patterns concepts, processes, and relationships. Some big data researchers believe, the reason why data in the big data environment is not being analysed is because of the complexity of the data, while others believe managers are yet to see the value of big data (Hong, Zhang & Meeker, 2018). As highlighted in literature McKinsey research institute indicated a huge shortage of analytical skills required to analyse big data (Chen, Chiang & Storey, 2012), and a special committee in digital skills in the UK also acknowledged this shortage (British Government, 2017)
These three theories provided the theoretical lenses to look into the various reasons why managers are yet to adopt big data analytics in their organisations. UTAUT and DOI have dominated big data studies (Naysary *et al.*, 2022). The UTAUT theory has been cited more than 16581 times (Haddad, Ameen & Mukred, 2018; Indarto, Ayu & Setianto, 2021). SET has also been applied in big data studies because it contains motivation factors that lead to the acceptance of big data solutions(Camargo *et al.*, 2018)

3.3.1 THE DIFFUSION OF INNOVATION THEORY

Everett Rogers, a professor of communication studies authored the book entitled *Diffusion of Innovation Theory*. He highlighted the process by which an innovation is communicated over time via the social system and its channels. Five determinants affect the rate of adoption of innovation. These are (i) relative advantage, (ii) compatibility (iii) complexity (iv) trial ability, and (v) observability of which the first three are crucial in adopting IT innovations (Sun *et al.*, 2018)**.**

(i) Relative advantage refers to "the degree to which an innovation is perceived as better than the idea it supersedes". For an organisation, analysing data in the big data environment is perceived to bring increased competitiveness, improved supplier engagements, improved customer services improved business intelligence, and improved business opportunities. The research study was approached with the view that maybe managers do not see the relative advantage of sharing data in the big data environment and using the BI systems to analyse that data.

(ii) Compatibility is "the degree to which an innovation is perceived to be consistent with the existing values, past experiences, and needs of potential adopters". Big data analytics must be compatible with existing infrastructure such as the existence of the BI system and the network infrastructure. Internet is also required to allow managers to tape into various sources of data for analysis and this played a critical role in the sampling. The research study was approached with the view that maybe BI systems are not compatible with the organisation's infrastructure and ways of analysing data from managers' past experiences.

(iii) Complexity which refers "to the degree to which an innovation is perceived as difficult to understand and use" this can be used to measure the complexity of using the relevant applications needed to analyse data in the big data environment and ask the relevant questions during the interviews (Sun *et al.*, 2018). The research study was approached with the view that maybe BI systems are complex and difficult to understand and use.

(iv) Trial ability which refers 'to the degree to which the innovation may be trialed and modified". It was ideal for the research study to be conducted in an organisation that is trying to use BI systems and consultants who have experience in implementing the BI systems to find out if the systems are difficult to modify, and:

(v) Observability refers "to the degree to which the results of the innovation are visible to others" (Sanson-Fisher, 2004). The approach was to find out if managers are aware of the benefits of taping into the voluminous data available in the big data environment. These factors influence the diffusion rates in IT (Lyytinen & Damsgaard, 2001). Instead of persuading others to change, the experiences of other adopters play the role of triggering the evolution (Robinson, 2009).

The innovation-decision process involves 5 steps (1) Knowledge (2) Persuasion (3) Decision (4) Implementation (5) Confirmation. The following figure 3.2 demonstrates the 5 steps.

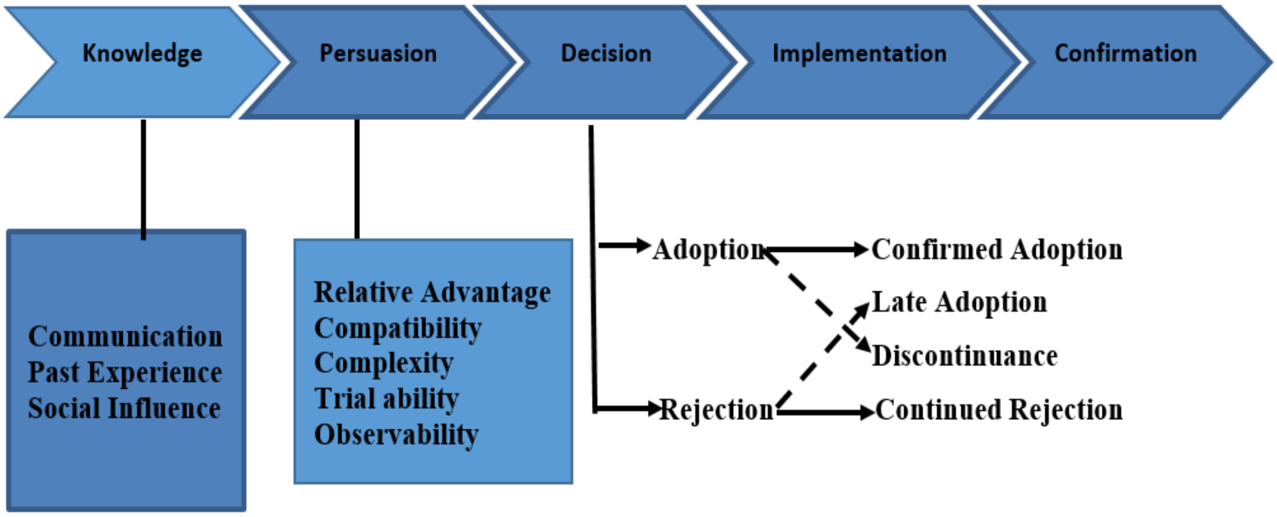


Figure 23.2: The innovation-decision process

Source: Adapted from (Sahin, 2006, p.15)

During the knowledge stage, an individual learns about the existence of the innovation via several communication channels and then seeks to know more about the innovation, and how it works and this results in awareness knowledge. During the persuasion stage, the individual is either interested or not interested and then develops either a negative or positive attitude towards the innovation. The individual makes a decision either to adopt or reject the innovation. After the innovation is adopted it is then implemented to start using it and during the confirmation stage, the individual looks for support to continue using the innovation (Sahin, 2006).

The DOI theory was also used to check the organisation's readiness to integrate its systems with external stakeholders such as customers and suppliers and the effect it has on placing the organisation as an innovator, early adopter, early majority, late majority, or laggard. It was used to choose an organisation that has moved a step towards adopting big data initiatives in their business strategies to realise value from the big data environment. Big data is an emerging field that is generating a lot of interest from academia including business scholars and corporates that are now at different stages of implementing and incorporating big data initiatives into their operations.

The adoption of a new idea, product, or service is not an overnight phenomenon and does not happen simultaneously across all systems, therefore there are five adopter categories (1) Innovators which constitute about 2.5% and comprise those who want to be first to try the innovation (2) Early adopters which constitute about 13.5% comprising of those who are comfortable with change and adopting the new ideas (3) Early majority which constitute about 34% comprising of those who adopt the innovations before the average person (4) Late majority who also constitute about 34 % comprising of those who are sceptical and are only prepared to adopt the innovation after it has been generally accepted by the majority of the population then finally (5) Laggards who constitute 16 % who are usually very traditionally conservative and are the last to make the changeover to the new technology (Robinson, 2009)

The following Figure 3.3 shows the five categories of people in Rogers' DOI theory (1) Innovators (2) Early adopters (3) Early majority (4) Late majority and (5) Laggards.

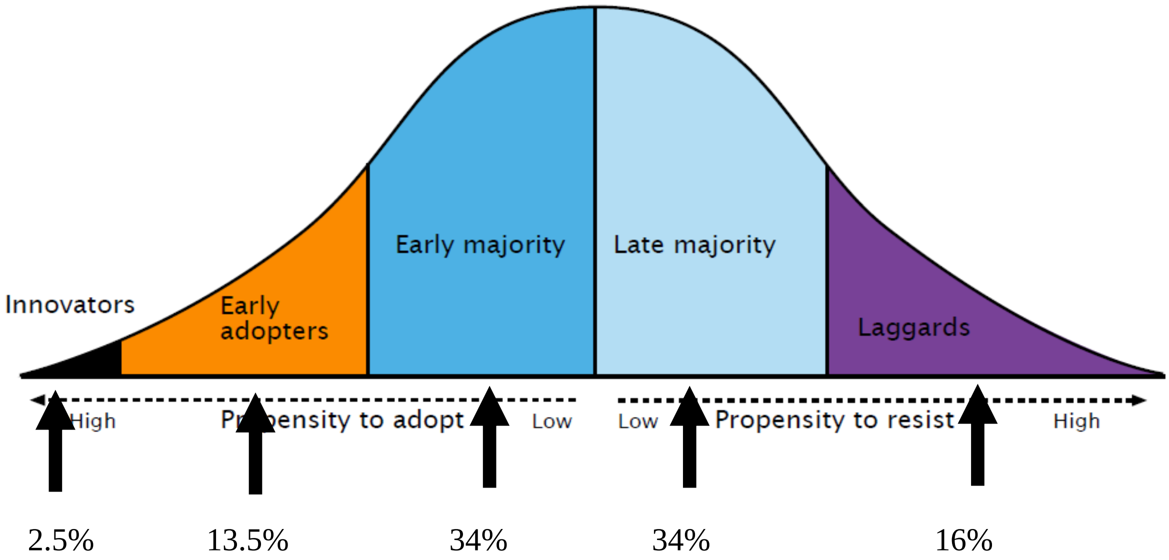


Figure 3.3: The diffusion of innovation theory

Source: (Robinson, 2009, p.4)

As shown in figure 3.3, this theory seeks to explain why and at what rate new ideas and technology are spread and it is applied in various management disciplines but mainly in marketing and information technology where it helps implementers to advance the diffusion of selected technologies to explain individuals' decisions to adopt or their intentions to adopt. This theory can be used to explain the current evolution where organisations are at different stages of adopting big data initiatives into their corporate strategies. This helped this researcher to appropriately categorise the organisation and then ask appropriate questions to answer the main research study questions.

For big data, the DOI theory may be interpreted as follows: Innovators are those organisations that are clear that they can benefit from the big data, and then act on it immediately. These are the *UBER* and the Tesla electric car companies. Early adopters are those organisations that are trying something with big data to be in it as well. The early majority are several organisations that seem to be benefiting from adopting big data initiatives by also trying it. The late majority are those organisations that see everyone adopting big data initiatives and joining the rest. Finally, the laggards are those organisations that see that if they do not adopt these big data initiatives it's going to work against them if they decide that they cannot avoid it.

This kind of analysis is supported by many scholars on big data, who argue that confusion with big data is common because we are just in the beginning phase of this big data revolution. They expect that soon many organisations will clearly understand what big data are all about and join this bandwagon of relying on data-driven decisions in their operations (Cohen, 2018). Peers help to speed the spread of innovation where they can use the innovation to attract new adopters by creating competitive pressure to adopt the technology resulting in a bandwagon of adoptions. However, technology adoption and DOI in the IT discipline are intertwined (Williams, Rana & Dwivedi, 2015).

3.3.2 THE UNIFIED THEORY OF ACCEPTANCE AND USE OF TECHNOLOGY

The adoption of Information technology is also affected by yet another theory that seems to also have an impact on why managers are delaying the adoption of big data initiatives and can also be used to explain what is happening with big data in conjunction with the previously explained diffusion of innovation theory. This theory is the Unified Theory of Acceptance and Use of Technology. The theory was developed by integrating and reviewing eight dominant theories (Williams, Rana & Dwivedi, 2015):

The Theory of reasoned action (TRA)

Technology Acceptance Model (TAM)

The Motivational model (MM)

Theory of planned behaviour (TPB)

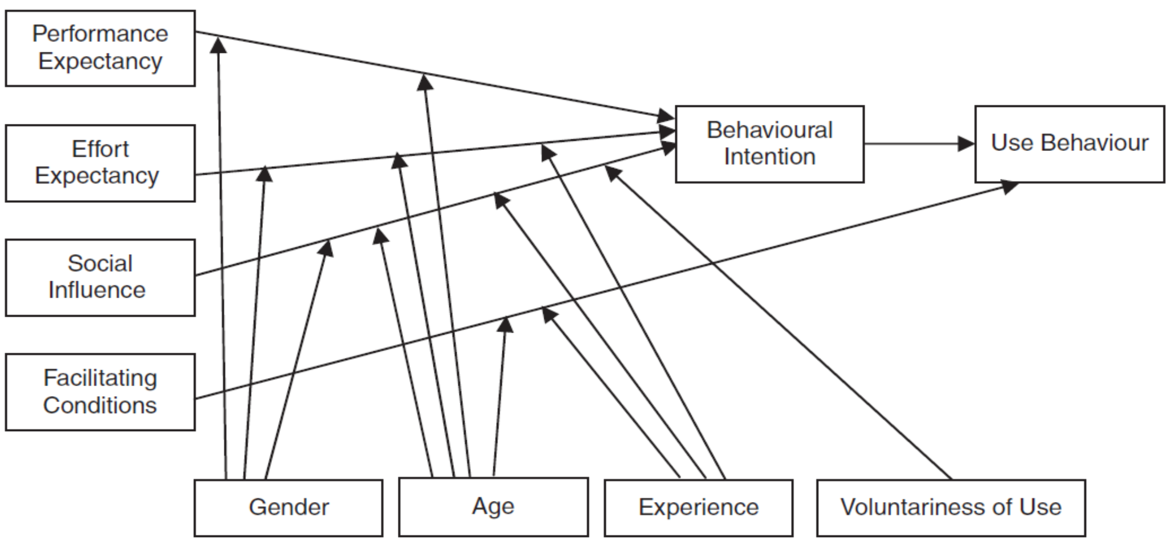
A combination of TAM and TPB (C-TAM-TPB)

The Model of PC Utilisation (MPCU)

Innovation Diffusion Theory (IDT)

Social Cognitive Theory (SCT)

Therefore, UTAUT aimed to explain users' intentions to use an information system and the subsequent usage behaviour. The theory uses four constructs (i) Performance expectancy (ii) Effort Expectancy (iii) Social Influence and (iv) Facilitating conditions. Then there are four moderators used to moderate the four constructs in UTAUT and these are (i) Gender (ii) Age (iii) Experience and (iv) Voluntariness of use (Ahmad, 2014). The argument is that these factors also play a big role in adopting new technology. Data analytics now require the use of technologies such as business intelligence systems that are designed to analyse large volumes of data. Hence the decision to use a case study of a company that has already implemented a business intelligence system. The following figure 3.4 depicts the UTAUT theory.



Source: Venkatesh *et al*. (2003)

Figure 3.4: The Unified Theory of Acceptance and Use of Technology

Source: (Williams, Rana & Dwivedi, 2015, p.444)

These constructs represent an intention to use and usage behaviour, and they can be linked to the adoption of big data initiatives.

i. Performance expectancy refers to the degree that an individual believes that using the system will help him/her to improve performance. The literature highlighted that some managers still think that big data are the most overhyped and abused term. They think data have always been growing only that they are now growing at a faster speed and they will not stop growing. Managers end up asking the question: where are the new benefits? (Devlin, 2016). Managers have many expectations from big data initiatives, so the theory helped me to ask these managers appropriate questions to interrogate their expectations. The research study was approached with the view that maybe managers are not using BI systems because they don't see the benefits of sharing data in the big data environment and using the BI systems to analyse the data.

ii. Effort expectancy refers to the perceived ease of use of the new system in other words the degree to which the prospective user expects the new system to be free of effort. With big data, most managers believe there is a lot of effort needed to use BI systems to incorporate big data into the business strategy hence big data remains on the radar of most organisations' boardrooms. Since the BI system is the main tool used to analyse data in the big data environment, certain skill sets are required to use BI which calls for an effort therefore the researcher thought this may be the obstacle hindering managers from adopting big data analytics initiatives so the researcher used the UTAUT theoretical lenses to look at why managers are not using BI systems. The research study was approached with the view that maybe BI systems are complex and difficult to understand and require a lot of effort to use

iii. Social influence refers to the degree an individual perceives others including important people believe he or she should use the new system. Since this has been the main driving force to adopt big data initiatives. Organisations are now under pressure from stakeholders such as their boards, customers, and suppliers to adopt big data initiatives. Similarly, middle managers are also under pressure from senior managers and boards to adopt big data initiatives. The interview questions sought to find out if managers really see the value of adopting big data analytics in their operations.

iv. Facilitating conditions refer to the degree to which an individual or organisation believes that an organisational structure and technical infrastructure exist to support the use of the BI system. The interview questions also sought to find out if managers are aware of the existence of facilitating conditions that currently exist such as the availability of the BI system and other infrastructure like machine sensors. This view was also used in choosing an organisation that has implemented a BI system intending to use it, and managers and consultants who have worked with the BI systems.

The UTAUT also has four moderators for the above constructs and these are (i) Gender (ii) Age (iii) Experience, and (iv) Voluntariness of use (Ahmad, 2014). Out of the many, age, experience, and voluntariness of use, were all used in this research study to moderate the constructs.

3.3.3 THE SOCIAL EXCHANGE THEORY

Over and above the UTAUT and DOI theories, the researcher mainly used the SET theory to look at my first research study question, what factors promote the effective exchange and usage of data in the big data environment? and the objective of exploring whether external data in key stakeholders' systems can be accessed and analysed the same way internal data are analysed without compromising ethical issues in the big data environment

The SET theory was developed in 1958 by an American Sociologist George. C. Homans when he published an article entitled "Social behaviour as exchange". Later on in his own words in (Homans 1984, cited in Redmond, 2015, p. 3) said "*As I might have anticipated, my theory, therefore, got stuck with the name of 'exchange theory'. This was too bad, not only because the theory is not limited to social behaviour that looks like exchange but also because it suggested that the theory was a special kind of theory*" (Redmond, 2015). The theory has the following elements (i) <u>cost</u> and <u>rewards</u> where cost can be effort, time, and money. Rewards can be acceptance and payment, that is worth something or results in an outcome.

Therefore, worth = rewards - cost or outcome = rewards - costs (ii) As a result individuals compare results and come up with equity and inequity or distributive justice to the benefits (Redmond, 2015). Trust is viewed as of paramount importance even in other fields for example where the idea of interpersonal trust is extended to organisations (Ybarra & Wiersema, 1999). SET is one of the most influential theories for understanding organisational behaviour when organisations are engaged in exchanging of valuables and this usually results in interactions that generate results. However, SET's constructs have not been fully identified. Rewards can also be referred to as reciprocity or repayment in kind, however, one thing is certain, relationships evolve generating trust, loyalty, and mutual commitments (Cropanzano & Mitchell, 2005).

In the case of sharing data in the big data environment, costs can be taken in the form of effort, risk, and time required. Rewards can take the form of accepting to share the data. Then worth will take the form of subtracting costs from rewards. After this calculation the managers will ask the big question, is this idea of electronically sharing data trustworthy or worth pursuing? This will result in perceived benefits which are then interpreted differently by the different organisations via their managers' opinions.

Adopting big data initiatives in operations is hinged on acceptance of the usage of technology to exchange data for the benefit of the organisation and this may happen over the five steps of DOI (i) knowledge awareness (2) persuasion (3) decision (4) implementation (5) confirmation. Therefore, the three theories, the DOI, UTAUT, and SET theories were perfect theoretical lenses to inform research study questions in this research study.

3.4 ENGAGING THE THREE THEORIES ON COMMON GROUND

All three theories complement each other and provide different angles of theoretical lenses to look at the ways of extracting value from the big data environment. The following ven diagram shows how the three theories complement each other with expected benefits being at the center of it. The following figure 3.5 shows how the three theories were engaged on common ground.

Engaging The Three Theories On Common Ground

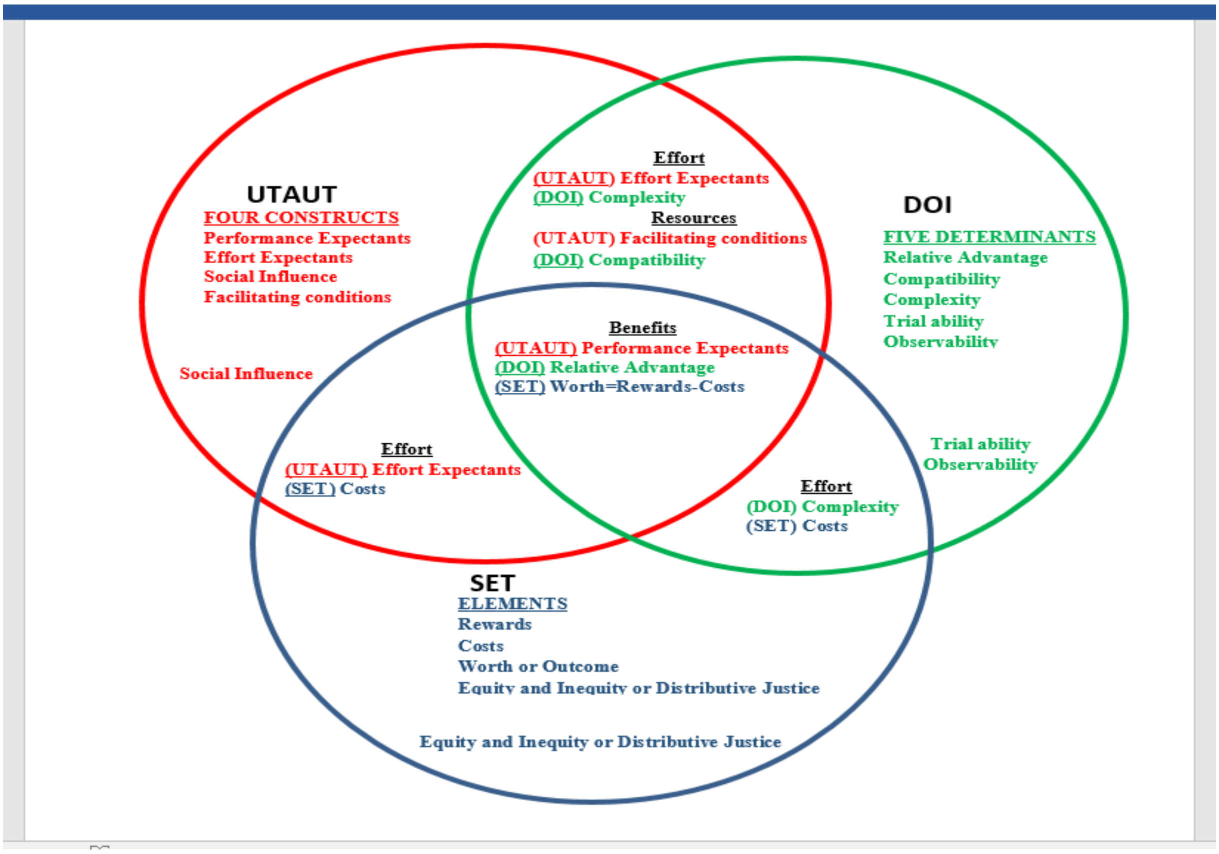


Figure 3.5: Engaging the three theories on common ground

Source: Author's construct

Both the UTAUT and DOI have been widely used in studies looking at the adoption of new information technologies. They all talk of perceived benefits: the UTAUT via its construct performance expectancy which refers to the degree that an individual believes that using the system will help him/her to improve performance and the DOI via its determinant relative advantage which refers to the degree to which an innovation is perceived as better than the idea it supersedes. These were used to check if managers see any benefit associated with using Business Intelligence systems to analyse data in the big data environment. In addition, the SET theory talks of benefits via worth which is calculated as follows worth = rewards - costs. In this research study, the benefits for the first two UTAUT and DOI refer to technological benefits, and the one under SET refers to the benefits of exchanging data in the big data environment.

The DOI and UTAUT have common elements as they try to explain the rate at which new technology is adopted and accepted. Some authors have gone further to differentiate between adoption and acceptance defining adoption as the use of technology for the first time and acceptance as the continued use of the technology. The UTAUT does not consider the phases that lead to the adoption of the new technology while the DOI theory goes a step further by stating the five communication channels that technology has to go through before being accepted, (i) knowledge-awareness, (ii) persuasion (iii) decision (iv) implementation and (v) confirmation (Kiwanuka, 2015).

All three theories talk of effort, the DOI via its complexity determinant, and the UTAUT via its effort expectancy construct and these were used to find out whether BI systems are complex and difficult to use and whether there is a lot of effort required to use these BI systems. SET talks of effort via costs which can be measured by the effort, time, and commitment required to electronically share data with key stakeholders such as customers and suppliers, and this was used to check if data can be exchanged. The three theories aim to explain users' intentions to adopt and use new technologies, ideas, and innovations including sharing of data and the effort required. Compatibility in DOI works hand in hand with facilitating conditions in UTAUT.

The three theories helped in assessing the environment in which managers work and also to ask appropriate interview and probing questions. They provided appropriate lenses to view managers' experiences when working with BI systems, BI consultants, and the organisations involved in the implementation of BI systems. Since they complement each other in viewing the same thing, that is, adoption, acceptance of technology, and sharing of data electronically, they helped to view the problem from different angles.

3.5 CONCEPTUAL FRAMEWORK

Research study must have a structure in mind that best explains the progression of the phenomenon being studied to assist the researcher in constructing a worldview. It reflects the researcher's thinking of the entire research study process to produce his/her own constructed model to explain the relationship that exists between main variables (Adom, Hussain & Joe, 2018).

The gap is on who to assign the duty of bringing in the externally generated data into the organisation for analysis. This cannot be left to one single individual or department it has to be done by collaborating departments and by people with the necessary skills and a call for culture change as this forms the basis of building valuable data. These external unstructured data are scattered in different unrelated locations, therefore, unlocking value from this content is not an easy task, and many organisations face roadblocks in the processes (Schubmehl & Vesset, 2014).

These data are scattered in different locations the same way different species of fish are scattered across the globe in different streams, rivers, dams, and oceans. It, therefore, appears extracting value from the big data environment is like fishing, where the anglers must know certain things on hand before the fishing expedition. First, they have to be clear whether fishing is going to happen in a stream, a river, a dam, or an ocean. Similarly, with big data, an organisation must be clear with the sources of data needed in its business strategy. Secondly, the anglers must know the type of fish they target to catch because this affects the strategy to employ, the tools to use, and the kind of fish to catch, because fishing in a stream is different from fishing in an ocean.

Similarly, there are various methods of harnessing value from different sources in the big data environment. This preliminary framework is worth pursuing and may form the basis of building the final frameworks for adopting a big data strategy and linking them to the business strategy through data entry points. Without strategic data entry points, it will be like building a lake and then filling it with fish species that are not consumed by the community. Therefore, there is a need to explore ways of creating value for the organisation by having a framework that is, built along these strategic data entry points for an organisation that interfaces with the big data environment. Such points could be along Porter's value chain since ERP systems were, designed from the same concept as depicted by the following framework.

Externally generated data have grown enormously therefore, organisations cannot continue to ignore them as input data. After identifying the sources of the required data to drive the strategy, it is of paramount importance to identify the big data entry points within the organisation. The following figure 3.6 represent the conceptual framework which is based on propositions found in the literature. Data required by managers to make quality decisions come from mainly two sources, (i) the external sources and the (ii) internal sources and enter the organisation via departments along the value chain. This results in the formation of two main data domains the external domain and the internal domain. These domains provide managers with information they need to make strategic decisions. Managers can make use of technology to analyse the data, however, they choose manual means instead of using the BI system to analyse the data. The theoretical concepts identified in UTAUT, DOI and SET explain why managers act this way.

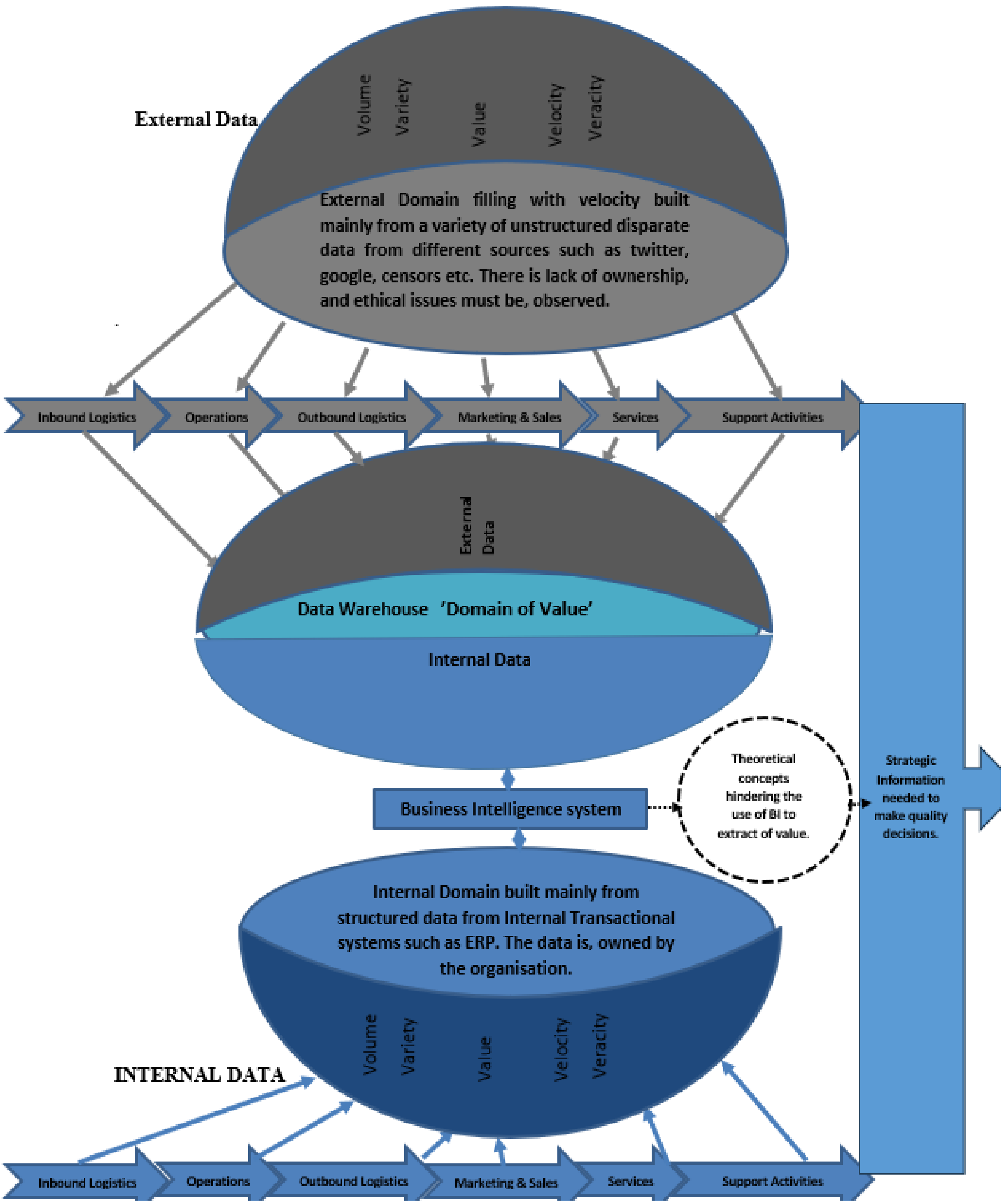


Figure 3.6: Conceptual framework

Source: Author's construct

Figure 3.6 represents the proposed relationships among the postulated concepts from literature and theoretical constructs. It brings in the concept of external and internal data sources. The literature review chapter presented an extensive literature review and what came out is that managers get their data mainly from two domains: The external domain and the internal domain. The external domain contains data from external sources and is the grey area because managers do not have control of the external processes that generate the data. The internal domain contains data mainly from internal transactional systems such as ERP and managers have control of the internal processes.

The two domains have to be combined together to form the domain of value. The BI system is then used by managers to analyse the resultant data to make quality decisions. In the previous section the theoretical constructs were discussed and one of the UTAUT constructs, "effort expectancy" refers to the perceived ease of use of the new system. In other words, the degree to which the prospective user expects the new system to be free of effort. The DOI theory also has complexity as a construct which refers "to the degree to which an innovation is perceived as difficult to understand and use" These two theories UTAUT and DOI state that technology can only be adopted if it is easy to use, and there are benefits of using it. They also explain users' intentions to use a new system and the subsequent usage behaviour and usually social influence drives the adoption.

The domain of value represents the benefits and is constructed on the basis of the expectancy construct of the UTAUT, the relative advantage determinant of the DOI, and the worth construct of the SET. Managers are persuaded to make a decision to implement BI using the five stages of the DOI. If they do not use BI then the assumption is: maybe, BI systems are difficult to understand and use, or maybe they invested due to social influence. SET weighs the cost of social interaction against rewards therefore, its constructs were used to look at external data exchange. The assumption was, maybe there are more costs compared to benefits when tapping into external data.

External data enter the value chain as pockets of unstructured data characterised by the five "V's", then enter the data warehouse in the same state while the internal data leave the value chain structured and ready to analyse and enter the data warehouse organised but characterised by the same five "V's" of big data.

However, issues to do with data quality, trustworthiness, accuracy, authenticity, reputation, availability, and accountability, which constitute the fifth "V" (veracity), are more pronounced in external data (Ishwarappa & Anuradha, 2015). Internally generated data are, pushed by the organisation via the BI system into the data warehouse 'domain of value', while externally generated data are pulled from various disparate sources into the data warehouse. When pushing data, the organisation has some control, since it is dealing with data it has created.

From the above, it appears that the grey area is the initial data entry points to incorporate external data into the data warehouse, as this is associated with a lot of work such as cleaning, organising, and aggregation of the data for them to make sense, and ready for analytics. This also requires special skills that are currently scarce. Ethics are usually violated resulting in dire consequences, therefore, it deters many organisations, leaving the hidden value in big data. An organisation cannot try to analyse the data directly from the external source as the data come from different databases hence the need for the HADOOP NoSQL database.

These problems escalate as the domains grow and data sources increase. Perhaps to overcome this problem, organisations may have to form partnerships, clusters or common beneficial domains, with those willing to share the data for a common cause. Maybe this sharing of data may help to address the grey area of dealing with external data (Baesens *et al.*, 2016). An almost similar principle that worked was the Australian urban research infrastructure where an e-infrastructure was established in 2010 that encouraged the sharing of datasets of particular importance to development. The result was that there was an improvement in service delivery and economic activity.

The quality of life for urban dwellers also improved as the coordination of different sectors became easy (Sinnott & AURIN-Technical-Team, 2016). Gartner also proposed a fundamental framework of MDM (Master Data Management). Master data management has recently attracted a lot of attention due to an increase in big data applications.

This framework recognises the importance of the concept of datasets and e-infrastructure sharing but tries to guard against a single point of failure that could emanate from an error originating from one single source within the system and then be catastrophic across the whole ecosystem. It, therefore, proposes that instead of arbitrarily sharing the data there is a need to only share useful data that supports the vision and strategy of the organisation thereby leaving room to clean the data before using it (Ng *et al.*, 2017). A similar study was conducted in New

York city utilising open data for taxis containing taxi trips. Leveraging big data analytics the system was used to predict demand and locations in smart cities (Iqbal *et al.*, 2018).

Data are expensive to store therefore there is a need for organisations to select which data to store if the value is to be extracted from the data. The external domain contains a variety of unstructured data that requires NoSQL databases such as Hadoop to analyse. Any effort by an organisation to try and, replicate storing of these data on-premise or on the cloud will result in huge costs and this will diminish the value of those data. Trying to mine the data directly may also not yield value since big data contain various data with veracity from disparate sources.

Organisations have to find and identify an angle to mine from big data. On the other hand, there is this other internal domain building from within the organisation mainly from internal transactional systems such as ERP systems, which contain mainly structured data and use relational databases. At least these data are usually structured and are under the organisation's control.

3.6 CHAPTER SUMMARY

The chapter first reflected on the use of theories in research studies and theoretical visibility topology. This formed the basis for how the researcher intended to use the selected theories in this research study. The researcher then justified why he chose the three theories (UTAUT, DOI, and SET) as theoretical lenses. The chapter provided a section where the three theories were engaged and their common elements were identified. Benefits emerged as the major component of all of them. The chapter also provided the conceptual framework that was constructed from the theories and knowledge gained from the extant literature.

The next chapter is the methodology chapter which indicates how the research study was designed. The chapter covers the research study structure, type, and strategy, the sampling criteria used to choose the participants, the selection of data source, trustworthiness, reliability, ethics, and other methodological issues.

CHAPTER 4

METHODOLOGY

4.1 INTRODUCTION

Research study methodology is defined as a systematic way of solving the research study problem. It is the science of studying how the research study is conducted scientifically by illustrating the various steps adopted by the researcher and the logic behind them in the same manner that an architect demonstrates the design of a building. Therefore it may take different dimensions (Kothari, 2004). A good research study methodology must be designed using established ideas that address four critical areas (Creswell, 2003):

1. Epistemology, refers to the theory of knowledge that informs the research study, for example, objectivism and subjectivism.
2. The theoretical perspective and philosophical stance that lies behind the methodology (Positivism, post-positivism, interpretivism, and critical theory)
3. The methodology, strategy, or plan of action that links methods to outcomes that govern the use and choices of methods such as case studies, experiments, or surveys.
4. Methods, techniques, and procedures to be used in the research study (questionnaires, interviews, and focus groups)

Creswell (2003) proposed a framework for a good research study design built from these ideas as depicted in the following figure 4.1.

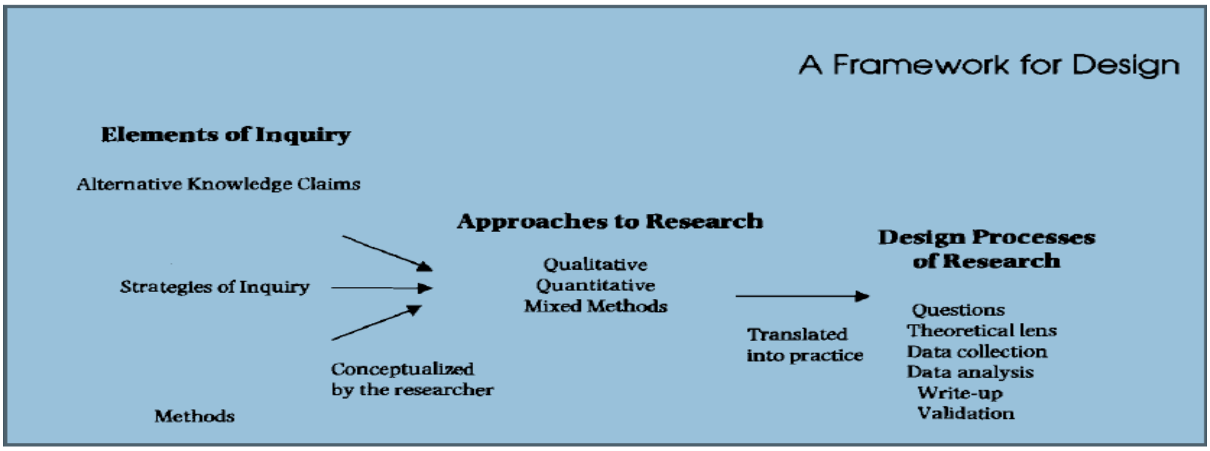


Figure 4.1: Framework for research study design

Source: (Creswell, 2003, p. 5)

A good qualitative research study is ideally supposed to delay a literature review until the data analysis is nearly completed to avoid forcing data into pre-existing concepts and also to keep the researcher free and open to any new data that make itself visible (Thornberg, 2012). However, in a practical world, it is difficult for humans to unlearn what they have already learned, therefore the researcher goes into a research study area with the background of relevant literature because it forms the basis of professional knowledge (Schreiber, 2001).

The argument is that “a dwarf standing on the shoulders of a giant may see further than that giant ” (Thornberg, 2012). In the same context, this research study methodology chapter has been informed by the extant literature and professional knowledge guided by the research study questions, to choose appropriate strategies of inquiries for it to be more practical in its application. This chapter discusses the adopted research study methodology in detail, paying particular attention to Creswell’s framework as shown above.

This will be followed by the systematic methodological way that was used to solve the research study problem beginning with the research study design matrix followed by the research study structure. In the research study structure, The researcher, pick and explain various sections from the philosophical view, ontology, epistemology, axiology, research study type, research study strategy, sampling method, data collection up to the data analysis component. The research study was, guided by the research study questions therefore this methodology chapter produced a design that helped provided answers to the research study questions.

There was a need for this researcher to be immersed in the users' and participants’ worlds to jointly create understandings together with them through interviews. This automatically made this research study qualitative research study. The research study relied on in-depth interviews to answer the main research study questions. The following section clearly explains the adopted research study philosophy, design matrix and the structure used in this research study.

4.2 RESEARCH STUDY PHILOSOPHY

Mackenzie & Knipe, (2006) argue that without first choosing a paradigm, all the subsequent processes of research study design, methodology, and methods may be affected. As such drawing from Patel (2015) the adopted paradigm for this research study shaped the research's ontology, epistemology, and methodology perspective. It is difficult for a researcher to come up with a good methodology and a product without clearly stating these in a research study. In most cases, two opposing paradigms, positivism and interpretivism, are used in quantitative and qualitative research study respectively and they are also referred to as constructivism or the naturalistic approach (Petty, Thomson & Stew, 2012).

A third one called pragmatism, which does not take sides and looks at both the positivist and the interpretive worldviews, is sometimes used (Tashakkori & Teddlie, 1998). Big data is a relatively new topic attracting interest from different fields around the world with no single agreed-upon common approach. Some scholars researching big data employ the scientific approach and they believe that there is a need to be deductive when approaching the big data topic, while others believe there is a need for an inductive approach (Kitchin, 2014).

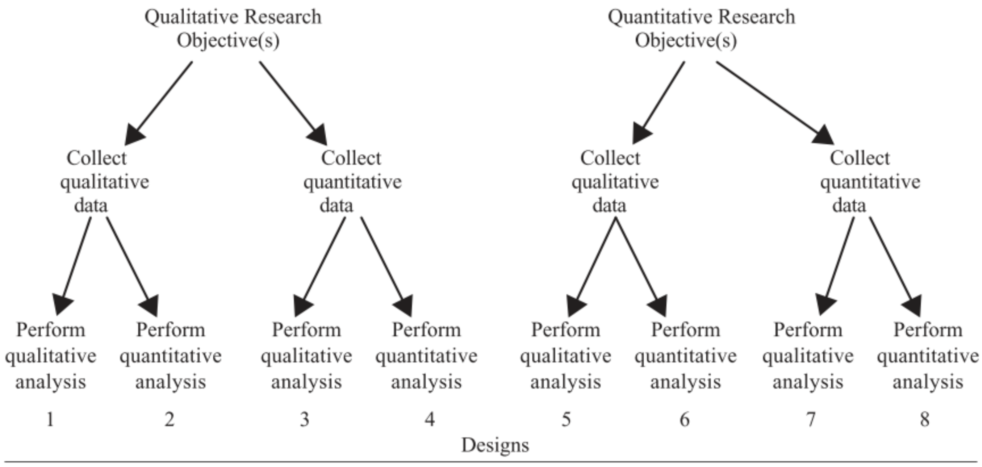
Given such a scenario, taking a pragmatic position was beneficial in that it produced a balanced position (Maxcy, 2003; Watson, 1990; cited in Johnson & Onwuegbuzie, 2004, p. 16). Drawing from Creswell, (2003) this research study believed that objectivists and subjectivists are not mutually exclusive; therefore, it adopted the pragmatic paradigm. Instead of concentrating on methods, the research study problem was the most important issue. Therefore, more effort went into trying to solve the problem as suggested by Wahyuni, (2012).

Researchers are also compelled to choose between two opposing views realism and relativism as ontology. With realism, the researcher believes that truth exists, it can be measured using objective measurements and there is one single reality. With relativism the researcher believes, there is no single reality therefore multiple versions of reality exist, and it is interpreted in many different ways.

This research study believed that there was no single reality or truth therefore; the researcher was subjective by interpreting the meanings and experiences of users to see what would emerge (Castellan, 2010). The researcher adopted relativism as ontology and then took an emic approach of jumping into the pool of managers and consultants to be immersed in their world to jointly understand their meanings that contributed to the construction of reality. (Petty, Thomson & Stew, 2012).

4.3 THE RESEARCH STUDY DESIGN

The research study adopted the qualitative research study design matrix **(mono-method (1))** developed by Johnson & Onwuegbuzie (2004). The required data were collected and analysed using qualitative techniques (extreme left side) as depicted in the following figure 4.2 (Johnson & Onwuegbuzie, 2004).



Note. Designs 1 and 8 on the outer edges are the monomethod designs. The mixed-model designs are Designs 2, 3, 4, 5, 6, and 7.[10]

Figure 4.2: Mono-method matrix:

Source: (Johnson & Onwuegbuzie, 2004, p.21)

4.4 THE RESEARCH STUDY STRUCTURE

McMillan & Schumacher, (2010) argue that researchers are required to come up with a blueprint outlining how they will conduct their research study so that they control the factors that may interfere with the research study. This will help the researcher to organise the work of collecting and interpreting data in a systematic way that produces credible results to answer the research study questions.

Three theories UTAUT, DOI, and SET were adopted as theoretical lenses in the research study and also played a role in the design of the research study structure. This research study adopted the following research study structure and these are, as shown in the following figure 4.3 and subsequently explained in this chapter.

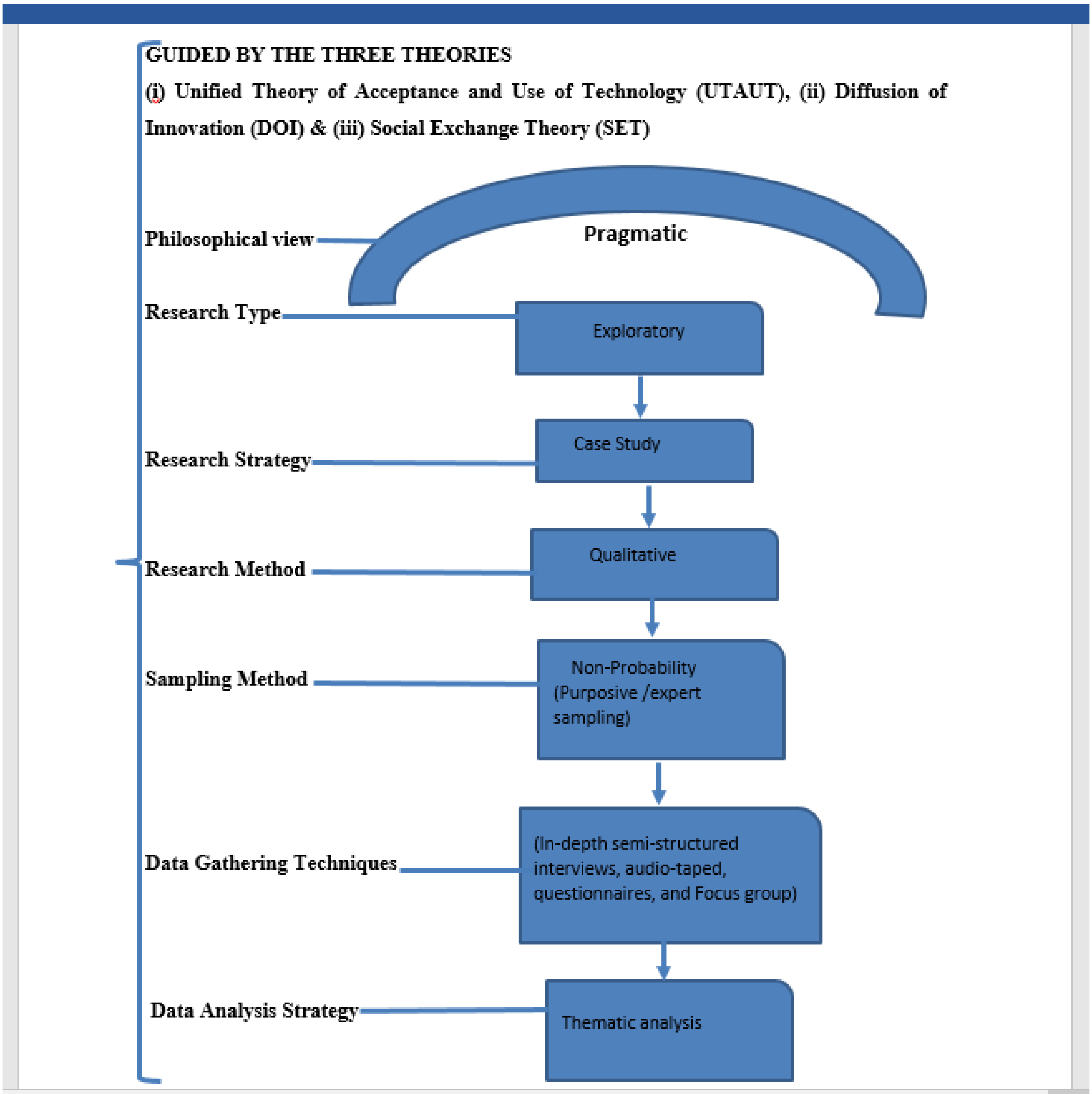


Figure 4.3: Research study structure

Source: Adapted from Source: (Saunders, Lewis & Thornhill, 2009, p.138)

An explanation of the philosophical thinking behind the methodological research study structure in figure 4.3 and justification of its adoption is presented in the next sections.

4.4.1 RESEARCH STUDY TYPE

A qualitative research study can be classified as either descriptive, exploratory, or explanatory (Saunders, Lewis & Thornhill, 2009). This research study adopted an exploratory study as it tried to explore the experiences of managers and consultants already working in the big data environment who come face to face with factors that hinder data analysis.

First-hand information was the most meaningful data, therefore this researcher was on the front line guided by the three theories (UTAUT, DOI, and SET). Exploratory research study is ideal when there is a lack of direction, especially when studying a phenomenon, which is typically the current state of big data (Milliot, 2014). An exploratory researcher starts by reading literature to get a deep understanding of the subject. Once the researcher understands the subject, it is now time to interview experts before embarking on the expedition. Saunders, Lewis & Thornhill, (2009) posits that an exploratory researcher should not be blinkered to look towards one single direction, because this type of research study is flexible and adaptable to change.

Big data is in the developmental stages of an emerging phenomenon that is currently being explored the world over. Extracting value from the big data environment requires the use of BI systems and this falls under decision support systems used by managers in the decision-making process. In this research study, senior managers and executives who are the preparers and users of information were incorporated into the research study. The researcher also included BI consultants as experts in the field of ERP and BI systems and a focus group to guide the exploration. One advantage of exploratory research study over other types of research study is that as it progresses, the direction can be refined until the intended destination is reached (Saunders, Lewis & Thornhill, 2009).

4.4.2 RESEARCH STUDY STRATEGY

Drawing from Wedawatta, Ingirige & Amaratunga, (2011) the research study strategy was based on research study objectives, questions, philosophical foundation and existing knowledge of using business intelligence systems in the big data era. The research study adopted the exploratory case study strategy that also incorporated experts in the form of consultants in the field of big data analytics, in one single research study to provide a larger picture of a complex phenomenon by comparing results to avoid extraneous variations (Ogawa & Malen, 2011). A case study was ideal, to explore the practical experiences of managers and consultants of a company that has implemented and used a BI system. The research area is in the early stages of development and this suits an ideal real life case.

Yin (1984) classifies case studies into three categories, exploratory, descriptive, and explanatory. When the research study area is in the early stages of development, Robson, (2002) posits that there is a need to find an ideal real-life case that can be studied in detail to get a deep understanding by conducting an empirical investigation.

4.4.3 RESEARCH STUDY METHOD

When a researcher decides to be pragmatic, he/she is not compelled to look equally at both sides. Therefore, a researcher may adopt a purely qualitative status depending on how the researcher intends to answer the main research study questions and the data that become visible (Kothari, 2004).

Qualitative research study uses participants' observations, in-depth interviews, document analysis, and focus groups while quantitative research study uses questionnaires, surveys, and systematic measurements. The researcher decided to be on the ground collecting primary data to answer the main research study questions. The three theories that underpinned the lenses were the UTAUT, DOI, and SET. Therefore, interview questions, sampling methods, and data collection and analysis all hinged on these three theories as the researcher interacted with participants to understand the phenomenon.

The three theories were helpful in understanding issues of the importance of the big data phenomenon by making data collection and analysis an iterative process of (i) collecting the data, (ii) reflecting on the data, and (iii) identifying gaps and then planning for the next data collection. This was then used to direct the next interviews (Kitchin, 2014). According to Yilmaz, (2013), using questionnaires in a qualitative research study is sometimes common because a small number of closed-ended questions that are quantitative with follow-up questions that require further elaboration qualitatively may be, encountered.

Due to the COVID-19 pandemic restrictions, this researcher used the same technique to request open-ended written responses from participants to allow them to choose the preferred method of answering the interview questions. However, only one participant preferred to respond in writing all the others participated via face-to-face interviews.

4.4.4 POPULATION SAMPLING AND SELECTION OF DATA SOURCES

When sampling in an environment where characteristics or traits are similar such as with big data and the main objective is to develop frameworks, critical cases must be chosen to constantly compare and refine the collected data with concepts and categories (Saunders, Lewis & Thornhill, 2009). Valerio *et al.*, (2016) posits that this type of sampling is ideal when dealing with a specific issue which is typical of big data. The following table 4.1 shows the profile of participants, the data collection method and sampling method used for the research study .

Table 4.1: Profile of participants and sampling method

Classification	Category	Number	Interviews or Questionnaire	Industry	Sampling Procedure
Group 1	Company (A)	1		Manufacturing	Purposive/Non-probability/
Group 1	Executives company (A)	5	In-depth interviews	Manufacturing	Purposive/Non-probability/Homogeneous
Group 1	Senior managers company (A)	5	Open-ended questionnaire	Manufacturing	Purposive/Non-probability/Homogeneous
Group 1	consultants company (A)	3	In-depth interviews	Manufacturing	Purposive/Non-probability/Expert
Group 2	Company (B)	1		ERP and BI Implementation	Purposive/Non-probability/
Group 2	BI Senior Consultant company (B)	1	In-depth interviews	ERP and BI Implementation	Purposive/Non-probability/ Expert
Group 2	BI Team leader company (B)	1	In-depth interviews	ERP and BI Implementation	Purposive/Non-probability/Expert
Group 2	BI consultants company (B)	2	In-depth interviews	ERP and BI Implementation	Purposive/Non-probability/Expert
Group 3	Organisation	1		Hardware / DB Implementation	Purposive/Non-probability/
Group 3	BI Consultant Hardware company (B)	1	In-depth interview	Hardware / DB Implementation	Purposive/Non-probability/ Expert
Group 4	Organisation	1		Focus Group	Purposive/Non-probability/
Group 4	The focus group comprised 5 internal consultants who represent departments	5	Focus group discussion	Focus Group	Purposive/Non-probability/

	researcher as the facilitators				
TOTAL	**Individuals**	**23**	**In-depth interviews =17** **Questionnaire =1** **Focus Group =5**		

This research study adopted homogeneous non-probability purposive sampling. This enabled this researcher to intensively study a single case of a broader phenomenon so that results obtained from it can be used to generalise across a larger set of units (Gerring, 2004). Big data has left more questions than answers leaving almost everyone wondering what is happening. A homogeneous, purposive expert sample enabled this researcher to focus on subgroups of participants with similar interests in analysing big data. For example, executive managers, senior managers, external BI consultants, and internal BI consultants were selected and the researcher then studied the group in great depth focusing on the knowledge and experience such a group possessed.

In this research study, there was a need to subject consultants in the field of BI and other supporting technologies to purposive and expert sampling (Etikan, Musa & Alkassim, 2016). Therefore, the sample was selected from a company in Zimbabwe that has implemented and used the BI tools needed in a big data environment such as a transactional system like an ERP system, a BI system, and data warehouses. In addition, the selected company has implemented and used the tools for some time. This came in handy, in that it subjected managers and consultants with different lengths of working experience in data analysis, using both excel, ERP system, and BI systems to purposive sampling.

The plan for this research study was to have a sample size that would maximize the breadth of the research study, and then focus on quality. To achieve this the selected manufacturing company was ideal because it had all the activities found along the value chain from inbound logistics to outbound logistics including service. In addition, it also has machine sensors as one of the sources of data input because the researcher intended to incorporate them as another data source in the research study.

Therefore, the sample for this research study comprised one company in the manufacturing sector and another one that specialises in the implementation of BI systems. The BI company also specialise in hardware and database implementations and finally, one focus group was formed from participants from various departments of the manufacturing company.

Ahluwalia *et al.*, (2007) posits that in qualitative research studies, the researcher should attract participants with the most relevant characteristics to the research study, *"The pond you fish in determines the fish you can catch".* Therefore, the level of analysis was drawn mainly from the executives and managers who are decision-makers, then external and internal consultants involved in the implementation and configuration of BI systems, and a focus group made up of business process innovators mandated to improve systems including BI analytics.

Manufacturing company: The company in which the case study was conducted was among the first companies in Zimbabwe to use the SAP ERP system. It implemented the first versions of the SAP ERP 3.1 I, system in 1999 and it has been using the system ever since then. It upgraded two times in 2003 from version 3.1I to version 4.7 and in 2011 from version 4.7 to the current ECC6 version and plans to upgrade to the latest SAP S4HANA version. The organisation also implemented the BI system in 2014 and it has been using it ever since then. Three groups of users are involved in the setting up and running of the current BI system and these were as follows; external BI consultants involved in installing and setting up the BI system, senior managers and executives who use the system to make decisions, and internal ERP consultants trained by external consultants to design reports.

ERP and BI deployment company: From this group, participants comprised (i) senior consultants (ii) team lead consultants (iii) BI/ERP consultants. Usually, a team of external consultants is engaged to deploy ERP and BI systems. Often there is a missing link between what these systems do and management expectations. It was, therefore, ideal to incorporate a team of consultants from a renowned ERP and BI consulting company to subject these experts in the field of BI and other supporting technologies to purposive sampling.

Such consultants provided a platform for finding out the challenges they encounter when deploying solutions to extract value from the big data environment and this also helped in establishing, how they deal with external data entry points along the value chain and the limitations in accessing and using such data. In most cases, the ERP and BI deployment company appoints one or more senior consultants as the project manager responsible for deploying consultants to the project. There was a need to incorporate them into the research study because they play the critical role of linking the consulting company and top management of the company implementing BI systems.

Focus group: Morgan, (1996) argue that a focus group can also be used as a complementary tool to follow up on interviews, explore specific opinions and experiences in more depth to add breadth, and also as a tool to evaluate a qualitative research study to confirm findings on in-depth interviews. Dilshad & Latif, (2013) explains that focus groups can be used in three different ways (i) as self-contained when they are used to access the viewpoints accessed separately (ii) as supplementary to validate the findings of a qualitative research study (iii) as triangulation to compare with in-depth interviews.

In this research study, the focus group was used as triangulation to add flesh to in-depth interviews by exploring specific opinions and experiences in more depth to add breadth, and also as a tool to evaluate and confirm findings on in-depth interviews.

There was a need to discuss this topic in a focus group represented by a participant from each department. The selected participants only participated once, via the focus group, and were not included in interviews and questionnaires. Usually, the challenges of big data are discussed at great length in such a group. Therefore, their opinions played a critical role in this research study.

4.4.5 RATIONALE FOR CHOOSING THE ORGANISATIONS AND PARTICIPANTS AND EXCLUSION CRITERIA

To come up with a research study that would contribute and add to the body of knowledge it was ideal to deal with an organisation that has implemented both the ERP and the Business Intelligence system and managers and consultants that have worked with these systems. The level of analysis was drawn from top managers who are decision-makers, and consultants with years of experience working in the big data environment.

General hand employees were excluded from the selection criteria because they usually do not interact with business intelligence systems for decision-making purposes. Those selected are managers who either receive or prepare information for decision-making purposes. From the ERP and BI deployment company the selected consultants implement BI those who are not directly involved in the implementation of BI systems were excluded. Similarly, managers who are not at the forefront of this research study and implementation of BI and administrative staff were also excluded.

(i) The executive managers

Executive managers represent a function such as manufacturing executive, commercial services executive, finance executive, and human resources executive and are the highest level of management in the selected organisation. As the internal “owners” of business processes, they are involved in strategic and policy decisions including the decision to invest in ERP and BI systems. They also know how external data enter the organisation through strategic data entry points along the value chain and the limitations in accessing such data, including using and sharing such data in the big data environment. This formed an oasis of good ideas as the researcher tried to build the frameworks (Corbin & Strauss, 1990).

Two of the executives have worked with the ERP system since its inception in 1999, one has ten years of experience working with it and the other one has six years of experience working with it. They were both in the organisation when the Business Intelligence system was Implemented in 2014. Therefore, they are all aware of the existence of the ERP and BI system because some of them were involved in choosing the current ERP and BI system and they all receive business Intelligence pre-configured reports. However, they do not develop the reports on their own. They prefer the reports to be developed by the internal consultant from the IT department. This motivated the researcher to conduct this research study to find out what is limiting them from developing BI reports on their own in the BI system to enable them to analyse data in the big data environment.

(ii) Senior managers

These senior managers in the research study report to the executives and prepare reports for them in most cases, they revert to preparing these reports in excel after extracting the data from the ERP system. Out of the five managers interviewed in this research study, four have worked with the ERP system ever since its inception in 1999, and they were all in the organisation when the BI system was implemented in 2014 and only one has a one-year experience working with these systems. They are the providers and users of a variety of sources of data needed for decision-making along the value chain. They also manage, machine sensors on the production floor, cold room sensors, cameras, sensors fitted on vehicles both stationary and in motion, and mobile devices. Therefore, they are all aware of the BI system and they all receive BI pre-configured reports; however, they all do not develop the reports on their own and prefer that the reports be developed by the internal consultant from the IT department. This prompted me to research what is limiting them from developing their report in the BI system to enable them to analyse data in the big data environment.

Hence one of the dominating Interview questions to all the executives, managers, and consultants both external and internal was: *"In your own opinion as an executive/manager/BI consultant, who do you think should design and develop BI reports between executives, senior managers, middle managers, and BI consultants and why do you think so?"*. One of the constructs of UTAUT states: if an effort is required users may not use the new technology the DOI theory also has a complexity which refers "to the degree to which an innovation is perceived as difficult to understand and use". Most of the time these managers revert to using the ERP system and excel when analysing data for decision-making yet analysing data now requires them to use technologies such as the BI system where the data can be put into a data warehouse before being analysed.

The internal consultants

The three internal consultants interviewed have worked with the ERP system ever since its inception in 1999 and are ERP consultants who were involved in setting up the BI system and the development of the initial reports and subsequent ones. They are referred to as process innovators and they double as managers who are involved in operations in their departments and work with the developer from the IT department who has been trained to develop reports.

(iii) The external BI consultants

The external consultants are the agents or the owners of the BI systems. The five external consultants interviewed have worked with the BI system for over five years and they work for an organisation that implements ERP and BI systems. They specialise in implementing BI systems and are currently assigned to various BI projects outside the country while one is on a project in Zimbabwe. Two of them were involved in implementing the current BI system being used by the manufacturing company that was used as a case study in this research study.

4.5 DATA GATHERING TECHNIQUES

According to Kothari, (2004) data collection forms an integral part of research studies and the process begins soon after the problem has been defined and the design has been put into a plan.

It is also always desirable to prepare and test the data collection techniques and instruments before they are used in the research study (Kothari, 2004). This area must be given great attention because if it is not done correctly the outcome of the research study may be questioned. This research study employed the following data collection techniques:

4.5.1 INTERVIEWS

According to Dicicco-bloom & Crabtree, (2006) interviews are mostly used in collecting data in qualitative research studies where there is a need for a face-to-face, in-depth understanding of individuals' experiences. Interviews are structured (premeditated, standardized questions) and unstructured (open-ended, non-premeditated). With both of these, the interviewer and the interviewee engage in a sort of discussion. This research study used semi-structured interviews, to interview functional senior executives, senior managers, external consultants, and internal consultants since they all dictate the sources of data needed in the decision-making process.

This gave this researcher a clear picture of the challenges they face in getting such data, including from external sources. Whether they trust data from external sources as well as their perception of sharing their data with outsiders. The interviews were used to identify any possible gaps in skills and to find out their opinion regarding the sources of data and the way they collect and pass the information along the value chain.

4.5.2 FOCUS GROUP DISCUSSIONS

This took the interview to a further level. A focus group came in handy in that the subject was discussed at great length among those with an interest in the subject. Participants representing various departments were allowed to discuss the topic. They comprised 5 participants each representing a particular department along the value chain, 1 represented finance 1 represented ERP/BI implementing consultants and 1 represented engineering and production, 1 represented procurement 1 represented human resources and the researcher was the facilitator. This was done to discuss the challenges and validate the outcome of the interviews. The selected participants only participated once, via the focus group, and were not included in interviews or questionnaires.

4.5.3 QUESTIONNAIRE

Using questionnaires in qualitative research studies is common because open-ended questions can be, used (Yilmaz, 2013). Due to the COVID-19 pandemic, the participants were given the option to respond in writing. Out of the seventeen participants, only one participant opted for that, while ten were interviewed face-to-face and seven via zoom. The advantage of giving responses in writing is that the respondent may complete the questionnaire at their leisure. It also gives those respondents who are not comfortable being interviewed a chance to also participate in the research study. The researcher can reach them as well and this facilitates data triangulation.

4.5.4 PILOT STUDY

To validate the reliability of the questions in this research study, a pilot study was conducted with five participants (who were hence not part of the main research study) in the selected manufacturing organisation. The five participants were drawn from a list that resembled that of the main research study as follows: 1 executive, 2 senior managers, and 2 consultants all from the manufacturing company.

Kim, (2011) posits that a pilot study is vital before a fully flagged research study is conducted because the results can be used to confirm the feasibility of the research study hence it is sometimes referred to as a feasibility research study. Hazzi & Maaldaon, (2015) adds that it gives the researcher room to iron out some logistics problems, implement modifications, and also to refine interview questions. In this research study a pilot study was needed to test the quality of the interview protocol and it gave the researcher advanced warnings of where the project would fail thereby giving him room to adjust instruments before the main research study (Chenail, 2011). It was used to refine interview questions, research study instruments, and logistics issues before conducting the main research study.

Since all the participants had access to the Internet and email the questions were sent a day before the interview for them to familiarise themselves with the questions and clarify issues before the actual interview. This allowed participants to create their own appropriate time to think of answers and ease the pressure. It also allowed participants to leave the questions halfway and think later. The final interview guides used in the research study are attached as appendices at the end of the thesis.

4.5.5 VALIDITY OF THE RESEARCH STUDY INSTRUMENTS

To enhance the validity of the instruments, colleagues carrying out similar studies and experts in the area of big data environment were requested to appraise the instruments. This is recommended when qualitative research study is based on relativism ontology where it believes there are multiple realities and the epistemology is that the researcher and participant will jointly create understandings (Eriksson & Kovalainen, 2016). This was exactly the case in this research study. In such a case it is advisable to give validity enough attention (Kihn & Ihantola, 2015). This situation calls for validity and reliability to be substituted with trustworthiness which comprises the four dimensions (i) credibility (ii) dependability (iii) confirmability and (iv) transferability (Backlund, 2005).

a) **Credibility:**

The researcher must demonstrate familiarity with the topic to create a link between their knowledge and the materials. This will allow other interested parties a chance to participate and determine whether they are in agreement with the claims (Kihn & Ihantola, 2015). It is sometimes difficult to apply a generalisation to people who are so diverse and culturally different. The issues of quality of research study and credibility intersect with the audience and intended purpose of the research study.

Participants in this research study were, carefully selected from groups that are almost representative of a larger group that has a common interest in the subject, of 'extracting value from the big data environment'. The credibility of qualitative research studies is hinged on the background, qualifications, and experience of the researcher since it is the person who is the major instrument of data collection and analysis (Backlund, 2005). 'Etic' the perspective of the researcher must be in line with 'Emic' the perspective of the social group being studied (Hansen, 2010).

To gain credibility in the fieldwork this research study used the following procedures.

(i) Prolonged engagement to examine any distortions, perceptual, selective, and misconstruction of the research study questions,

(ii) Triangulation: By getting information to illuminate the research study question from more than one source through in-depth interviews and from a focus group

(iii) Peer debriefing, the researcher asked colleagues (other consultants and managers), to look into the research study and comment.

b) **Dependability:**

This refers to a carefully documented traceable research study process achieved by recognising that the knowledge generated is bound by time, context, culture, and value (Decrop, 1999). This research study, it was achieved through the overlapping method. Interested participants from (i) the manufacturing company, (ii) ERP and BI deployment company, and (iii) a focus group were all incorporated into the research study to allow for further future researchers in the field to repeat the work.

c) **Confirmability:**

Atlas ti was used in this research study audit trails of electronically recorded materials such as interviews field notes and records will remain available such that if anything needs verification or further research study, they can be easily accessed. This will ensure that the data speaks for itself by demonstrating that the findings indeed came from the data, not the researcher's predispositions.

This Atlas ti software is quite handy in that it deals with both data collection and data analysis removing chances of data manipulation. Therefore, the use of the Atlas ti played a crucial role in this research study because the instruments do not depend on human skills and perception.

d) **Transferability:**

Researchers must demonstrate that it is possible to apply the findings of their research study to other circumstances and interested parties within the broader groups without being immediately rejected. To achieve this, participants must be selected purposefully so that the results are also transferable to other respondents and other contexts (Anney, 2015).

In this research study, the participants were, purposefully selected, and placed into groups that are representative of the broader group of interested parties. The selected manufacturing company in this research study is a blue-chip company listed on the Zimbabwe stock exchange, which is a good example representing other manufacturing companies, and it also contains all the activities found along the value chain including those found on a non-manufacturing company.

The selected ERP and BI deployment company is based in Zimbabwe and is a gold partner in the implementation of BI systems in Africa and has consultants doted in many countries in Africa.

e) **Authenticity:**

In qualitative research studies, it is sometimes difficult for the researcher to authenticate that he/she was indeed there on the ground for it to make sense to others. If a researcher fails to prove authenticity valid research study findings may be reduced to mere technicalities of following a pre-defined set of specified criteria, making it difficult to differentiate it from quantitative research study (Modell & Humphrey, 2008). Authenticity helps to avoid the production of desktop research study.

Quantitative research study relies on accuracy, and this is usually, proved through numbers while in qualitative research study, numbers do not feature.

This is supported by the quote *"Not everything that can be counted counts and not everything that counts can be counted" 'which comes from Bruce Cameron's 1963 text Informal sociology A casual introduction to Sociological thinking, though this quote is frequently ascribed to Albert Einstein.'* (Kenna, Mryglod & Berche, 2017, p. 1). There was a strong case for conducting this research study qualitatively for all the selected groups and the academia at large. Companies are spending millions of dollars in trying to deploy BI solutions that help them to extract value by analysing data from the big data environment however, there appears to be a huge gap in what the final users (managers) expect and what consultants who deploy these systems think are the solutions to the problem. There are also very few courses in academia, that try to address the problem since big data is a new field.

4.6 FIELD WORK AND DATA COLLECTION PROCESS

The main challenge with qualitative data analysis is that it comprises large complex sets of texts of collected data from interviews making it complex to analyse. To overcome this challenge Atlas ti (SCIENTIFIC SOFTWARE DEVELOPMENT (GERMANY), (1997), was used to generate codes, themes, memos, and reports that count the codes in the data, for analysis (Driscoll, Salib & Rupert, 2007). This came in handy in that, this research study used the transformative design strategy to analyse the data, and it was possible to achieve this with Atlas ti. The data transformation strategy allowed this researcher to develop codes from the qualitative data that eventually lead to the development of themes and finally the frameworks (Caracelli & Greene, 1993). The advantage of using this method was that it allowed the processing of large volumes of qualitative data (Leedy & Ormrod, 2015).

The research study adopted the thematic data analysis method. Data were grouped into codes according to themes and then categorised according to areas of interest using Creswell's (1998) spiral model. The model consisted of organisation, perusal, classification, and synthesis. The researcher continuously re-examined theoretical assumptions by always taking one or two steps backwards to refine ideas as he built the frameworks. The following figure 4.4 explains the whole process followed by the researcher from raw data collection up to the final product.

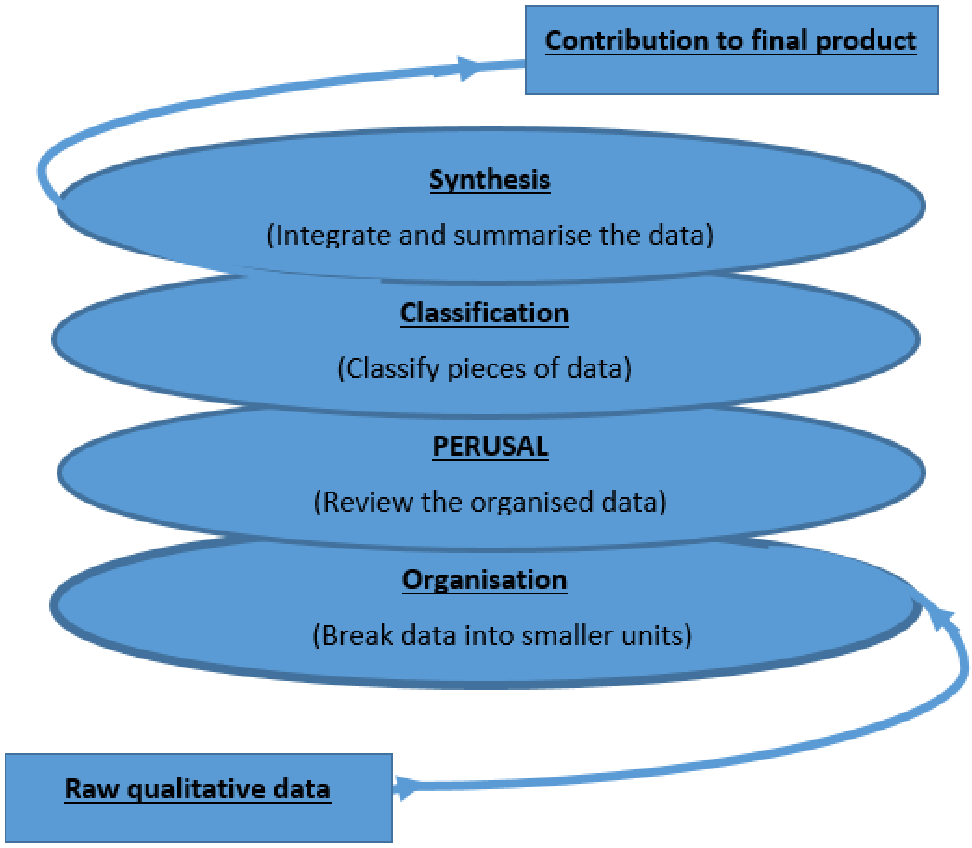


Figure 4.4: Data analysis spiral model based on Creswell (1998)

Adopted from (Creswell, 1998)

Step 1: Organisation: Involved breaking down large bodies of the text of the collected data into sentences and individual words.

Step 2: Perusal then involved an initial overview of the organised data to get an early interpretation of the big data phenomenon.

Step 3: Classification of the data involved classifying pieces of data to identify specific patterns of the data to enable the development of code-switching.

Step 4 Synthesis: involved integrating and summarising the data in tabular or diagrammatic form to compare it to existing theory to form a basis for building a framework (Creswell, 1998).

The research study passed through all these phases that involved "open coding" where categories and dimensions were identified as "axial coding" where conditions and strategies were examined.

The main intention of this research study was to also come up with frameworks, therefore the researcher adopted the inductive approach to data analysis. In such a situation, Berg (2000) recommends using a spiral model that continuously re-examines theoretical assumptions by always taking one or two steps backwards to refine ideas hence the adoption of Creswell (1998)'s model and the assertion of theoretical underpinning in the introduction in chapter one.

Data analysis began very early, soon after collecting the first set of data (Creswell, 1998). This made it an interrelated iterative process of (i) collecting the data, (ii) reflecting on the data, (iii) identifying gaps then planning for the next data collection (Kitchin, 2014).

In qualitative research studies, the researcher is the main instrument. It is practically impossible to conduct a qualitative research study without negotiating for access to sites and participants. To add to that, all qualitative research studies require the researcher to establish, develop and maintain relationships with participants (Devers & Frankel, 2000). In this research study, access was negotiated for and granted. A relationship was established with the participants who voluntarily agreed to participate despite their busy schedules. The whole process of collecting data took about six months, employing Berg (2000)'s iterative process. The first interview was conducted on 28 February 2021 and the last interview on 18 August 2021. The following table provides snapshots of the process followed in this research study.

The following table 4.2 shows the steps followed during data collection, the.actual process of data analysis is provided in detail in chapter 5.

Table 4.2: Data collecting Process

Research study activities	Targeted data
Initial engagement played a critical role as the initial frameworks were being developed. The experiences learned from the pilot study played a key role in guiding the first interview.	Initial insightful data
Data collected from the first three interviews were input into Atlas_ti.	The initial insightful data
The initial data analysis was conducted on these data, generating themes and codes using literature, theoretical constructs, and personal interest from the conceptual framework to postulate the lens.	The initial Insightful data
More interviews were conducted on a quota basis from all groups in the sample. The themes and codes developed from the initial data were refined and the initial frameworks were developed	Further collected data
Final data were collected on a quota basis from all groups in the sample analysed confirming and modifying the final frameworks.	Final collected data
The focus group was engaged in the discussion to triangulate, generate explanations and confirm the frameworks	Focus group discussion
Final data were collected on a quota basis from all groups in the sample to confirm data saturation.	A total of 23 respondents participated in the research study and saturation was reached at interviewee number 15 and continued to 18. A focus group later engaged to confirm findings

The following table 4.3 indicates the research study participants.

Table 4.3: Composition of participants

Executive Managers	**Senior Managers**	**Internal Consultants**	**External Consultants**	**Focus Group Participants**
Executive A8	Senior Manager A4	Internal Consultant A1	External Consultants A2	Participant 1
Executive B11	Senior Manager B5	Internal Consultant B7	External Consultants B3	Participant 2
Executive C13	Senior Manager C9	Internal Consultant C12	External Consultants C6	Participant 3
Executive D17	Senior Manager D10		External Consultants D15	Participant 4
Executive E18	Senior Manager E14		External Consultants E16	Participant 5
TOTAL 5	**TOTAL 5**	**TOTAL 3**	**TOTAL 5**	**TOTAL 5**

As shown in table 4.3, a total of 23 respondents participated. The saturation level was reached at interviewee number 15 and continued to 18. A focus group was later engaged to confirm the findings. Executives are the decision makers, whilst senior managers prepare and provide information to executives whilst consultants implement BI systems. These were purposefully incorporated into the research study and in-depth interviews were conducted with 17 participants. One executive opted to respond via a written questionnaire. Five participants were put in a focus group for discussion.

4.6.1 ETHICAL CONSIDERATIONS

When a research study involves collecting and analysing other people's data, ethics become a very big issue because irreversible mistakes with the possibility of rendering the whole research study a wasted effort may be committed. The success or failure of a research study lies in professional conduct which is rooted in ethical consideration (Daniel, 2016).

Therefore, this research study tried by all means possible to observe ethics from the very onset. The researcher sought ethical clearance before commencing the research study. This was meant to protect both this research study and the rights of all those involved in this very important research study. Leedy & Ormrod (2015) summarise ethical issues into four main categories (i) protection from harm where the researcher should not expose participants when the research study involves human beings (ii) voluntary and informed participation where participants should be informed of the nature of the research study and be given an option to opt-out, if they agree they will be asked to sign the informed consent form, and this is the case in this research study (iii) right to privacy where the research study should respect participants' right to privacy by keeping their information in a strictly confidential manner by giving them codes and this was the case in this research study to protect participants from other powerful individuals that would put pressure on the researcher to investigate certain issues on their agenda (iv) honest with professional colleagues where researchers should not fabricate findings to come up with biased conclusions because "honest researchers do not hesitate to acknowledge their indebtedness to others" (Leedy & Ormrod, 2015, p.123).

In the same line of thinking Berg (2016) further added that ethics play a role in transforming a doctoral student from being a student to a scholar and developed an eight-ethical principles checklist to achieve that. The first principle involves the big problem of plagiarism and honesty and this can be overcome by using tools such as turn it in. The second principle on the checklist involves risk assessment where the researcher has to look into anticipated risks and inform participants. The third principle involves informed and the researcher must request participants to sign informed consent sheets, the fourth principle involves privacy and confidentiality where the researcher must restrict third-party access. The fifth principle involves data handling and reporting. The sixth principle involves handling mistakes and avoiding negligence. The seventh principle involves working with a mentor such as a supervisor and the eighth principle involves following institutional review board guidelines such as the ethical clearance committee (Berg, 2016). These were all observed in this research study.

4.6.2 INFORMED CONSENT

The process of informed consent is the cornerstone of any ethical research study because it acts as an invitation to the participant to voluntary participation in the research study (Whittle, 2014) It describes the research study project and the participant's involvement in it including a guarantee of privacy and anonymity (Leedy & Ormrod, 2015). In almost all research studies involving humans, informed consent is ethically and legally required (Joffe *et al.*, 2001). In order to uphold the highest ethical principles, witten permission was sought from executive management of the organisations included in the research study. Respondents were first given the participant information sheet and then requested to give informed consent to participate in this research study by signing the informed consent form. This was critical to allow only those who wished to be part of this research study the right to do so and leave room for those who wanted to withdraw to do so. A copy of the informed consent form used in this research study is found in appendix D and a copy of the participant information sheet is found in appendix E.

4.6.3 ANONYMITY

In this research study, it was of paramount importance to protect the identities of participants to avoid any harm. Therefore, no identity details of the participants were given during the presentation of the results. Anonymity is the process of not identifying the identity of the participants, therefore data collected by a researcher should be anonymous (Williams & Baryamureeba, 2006). Anonymity is like a water-tight barrel held underwater, there are always pressures that lead to holes in the researcher's efforts to maintain anonymity (Saunders, Kitzinger & Kitzinger, 2015).

Therefore, anonymity is crucial in this era of the internet because cross-linking information online may cause the anonymity barrel to burst and it is mainly harmful if the research study involves something that has received widespread media attention where anonymity can be traced to well-known code names. To overcome this in qualitative research studies, researchers must go further and collaborate with participants over anonymity issues during the interview and agree with the participant on certain pseudonyms to carefully manage to identify details (Saunders, Kitzinger & Kitzinger, 2015). This research study adopted the same strategy of assigning pseudonyms to hide the participant's real name.

4.6.4 CONFIDENTIALITY

The rule of thumb is to make sure that information from participants is used by the researcher only and for the research study (Williams & Baryamureeba, 2006). Participants in this research study were given assurance of adherence to confidentiality. No names of participants were printed. Data were handled in a strictly confidential manner.

To protect participants' confidentiality in qualitative research studies where the questionnaire is used it is advisable to separate interview responses from questionnaire responses and also encrypted them with a secure password if they are delivered online (Leedy & Ormrod, 2015). This was the case in this research study where the researcher tried all means possible to use participants' private e-mail addresses.

4.6.5 HARM TO PARTCIPANTS

Harm can be put into two main categories of physical and psychological and usually affect vulnerable populations like employees (Leedy & Ormrod, 2015). To avoid any harm to participants the researcher handled the collected data in a strictly confidential manner and identies of participants were protected by not printing their names. This was done in order to protect their dignity, privacy, and confidentiality throughout the research study. The researcher also adhered to COVID-19 regulations of wearing a face mask, maintaining social distance and sanitising hands during interviews to minimise the COVID-19 risk.

4.7 CHAPTER SUMMARY

The chapter highlighted that the researcher adopted relativism as ontology, then took an emic approach of jumping into the pool of managers and consultants to be immersed in their world, to jointly understand the meanings by conducting a qualitative research study guided by the three theories UTAUT, DOI, and SET. A research study design was presented and justification was made for each of the selected options. Major Issues such as the sampling criteria used and justification to choose the participants were discussed. The chapter also highlighted that a case study was used to study a real-life case to get a deep understanding of this emerging field of research study. The chapter concluded by explaining how data were collected. The next chapter is the data analysis chapter. It explains in detail how the data were analysed using thematic analysis via the Atlas_ti software to generate codes and themes.

CHAPTER 5

DATA ANALYSIS AND FINDINGS

5.1 INTRODUCTION

This chapter presents the data analysis and findings that were obtained from this research study. The chapter begins by outlining the chapter layout and introducing the main themes that were used to analyse the data. Atlas ti was used to create codes that were then used to create sub-themes that were finally grouped to form the main themes.

Recapping from chapter 3; Theoretical framework under the sub-heading, “Uses of theory in research studies”, two schools of thought emerged. One school of thought by Frankfort-Nachmias & Nachmias (1992) cited in Berg (2000, p.17) believes in *theory-before-research* as follows: Idea->Theory->Design->Data Collection->Analysis->Findings. The other school of thought by Merton (1968), cited in (Berg, 2000, p.18) believes in *research-before-theory* as follows: Idea ->Design->Data Collection-> Theory ->Analysis->Findings.

The researcher adopted Berg's (2000) assumptions and argues that for better results a researcher must encompass both models to have a spiral model that continuously re-examines theoretical assumptions and refines ideas. Therefore, for every two steps forward the researcher took one or two steps backwards to refine ideas and theoretical assumptions (Berg, 2000).

For qualitative research studies to yield good results, the researcher must approach it without preconceived ideas (Saunders, Lewis & Thornhill, 2009).

In qualitative research studies, it is sometimes difficult for the researcher to authenticate that he/she was indeed there on the ground for it to make sense to others. According to Baxter and Chua (2008), if a researcher fails to prove authenticity in qualitative research studies valid research study findings may be reduced to mere technicalities of following a pre-defined set of specified criteria, making it difficult to differentiate it from a quantitative research study (Modell & Humphrey, 2008). Authenticity helps to avoid the production of desktop research. Qualitative research studies must produce valid and credible results, “the aim is to provide a guarantee that the report or description is correct” (Eriksson & Kovalainen, 2008. p. 292).

The researcher's approach when presenting the data was to first introduce the main theme and then show the sub-themes that formed that main theme. For each sub-theme, the researcher first re-examined the theoretical assumptions and then provided a narrative summary. The summaries are supported by key extracts from the semi-structured interviews presented in data tables (found in Appendices B1 to B19). Each of the 19 sub-themes has a table in the appendices and the tables are arranged in the sequential order of the sub-themes. The data were analysed using the theoretical lens informed by the three theories, UTAUT, DOI, and SET. As stated, the actual interviews are attached as an appendix.

The following figure 5.1 shows the analysis map that was used in this chapter. The analysis was divided into four main themes shown along the arrow and the 19 sub-themes are shown as branches attached to the main themes and the chapter conclusion is at the end of the arrow.

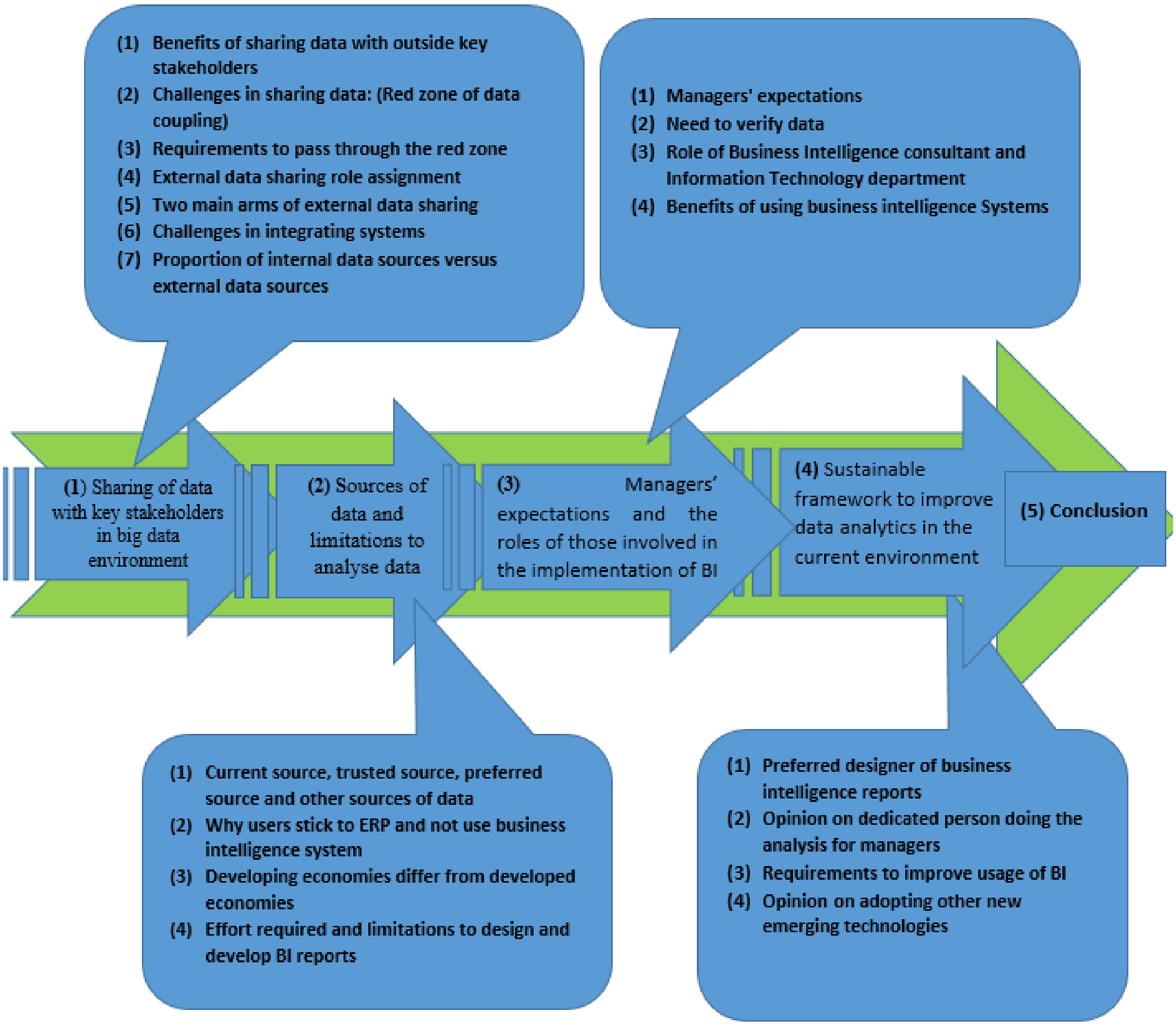


Figure 5.1: Data analysis map: All sections

The first section's main theme is *Sharing of data with key stakeholders in the big data environment*, and the following are the sub-themes: (i) benefits of sharing data with outside key stakeholders, (ii) challenges in sharing data: (red zone of external data coupling) (iii) requirements to pass through the red zone of data coupling, (iv) external data sharing role assignment, (v) two main arms of external data sharing, (vi) challenges in integrating systems, (vii) proportion of internal data sources versus external data sources

The second section's main theme is *Sources of data and limitations to analyse data in the big data environment* and the following are the -sub-themes: (i) current source, trusted source, preferred source and other sources of data, (ii) why users stick to ERP and not use the BI system, (iii) developing economies differ from developed economies, (iv) effort required and limitations to design and develop BI reports.

The third section's main theme is *Managers' expectations and the roles of those involved in the implementation of BI* and the following are the sub-themes: (i) managers' expectations, (ii) the need to verify data, (iii) the role of BI consultant and the information technology department, (iv) benefits of using BI systems,

The fourth section covered the main theme, *Sustainable framework for managers to improve data analytics in the current environment* and the following are the sub-themes: (i) preferred designer of BI reports, (ii) opinion on using a dedicated person to analyse data for managers, (iii) requirements to improve the usage of BI, (iv) opinion on adopting other new emerging technologies in the current environment.

5.2 FIRST MAIN THEME: SHARING OF DATA WITH KEY STAKEHOLDERS IN THE BIG DATA ENVIRONMENT

Though organisations are lining up to tap into the big data environment to extract value, it seems there is no collaboration amongst the organisations themselves to exchange their data with customers and suppliers before they approach strangers in larger pools like Google, Twitter, and Facebook.

The following figure shows the analytical map for section one. The map is provided at the beginning of each section. The section being analysed will be highlighted and all the other sections will grey out as shown in the following figure 5.2.

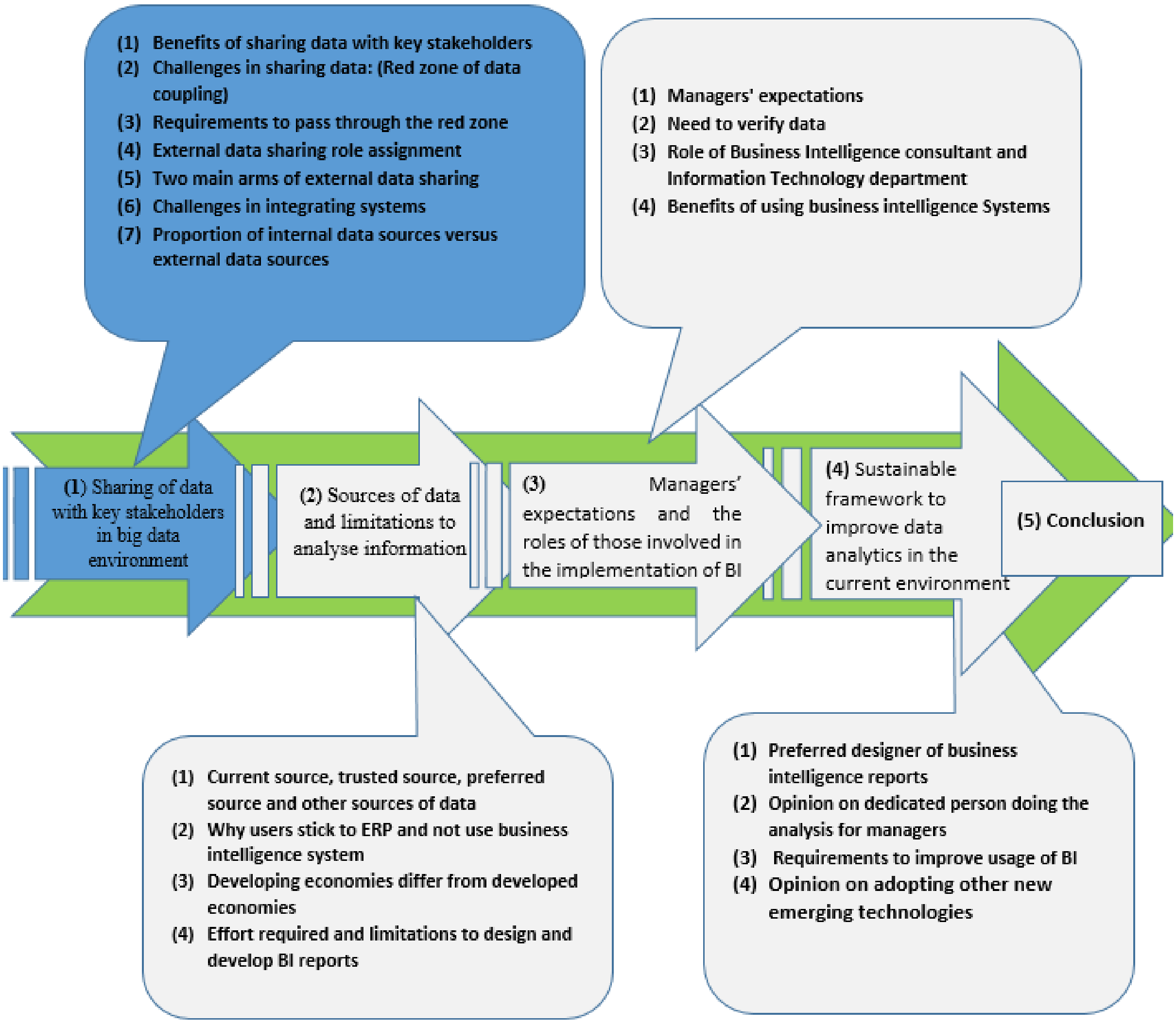


Figure 5.2: Data analysis map: Section 1

5.2.1 Benefits of sharing data with outside key stakeholders:

The main aim was to find answers to the first main research study question: *What factors promote the effective exchange and usage of data with external stakeholders in the big data environment?*

Objective 1: Explore whether external data in key stakeholders' systems can be accessed and analysed the same way internal data are analysed without compromising ethical issues in the big data environment.

The main interview question and probing questions were.

- What is your opinion on exchanging strategic data such as in your budget with external strategic partners such as your customers and suppliers via interconnected systems and who do you think should be assigned that role if it were to arise in an organisation?
- Are you prepared to share your data?

- Do you see any benefits?
- Do you think it is something feasible?

The following is a summarised version of the extracts from the interviews with the respondents. To avoid a situation where the researcher advances his thinking and opinions, the approach was to pick a theme under discussion, then first provide theoretical assumptions, and then responses in a summary form sometimes citing important quotes.

5.2.1.1 Theoretical Assumptions

Though external data are said to be scattered in different locations, it is important to note that part of that data resides with key stakeholders such as customers and suppliers. Are these key stakeholders prepared to share their data? Is the manufacturer also prepared to share, do they see benefits in electronically exchanging the data and if so, then, why are they hesitant to share their data in the big data environment? The three theories underpinning this current research study indicate that technology can only be adopted if there are benefits to be derived from it. Therefore, both the performance expectancy construct of the UTAUT, the relative advantage determinant of the DOI, and the worth construct of the SET provided theoretical lenses to check if managers see any benefit associated with using BI systems to electronically exchange data with key stakeholders (customers and suppliers) in the big data environment.

According to the SET theory, worth is calculated via the formula: worth = reward - costs. Performance expectancy refers to the degree that an individual believes that using the system will help him improve performance while relative advantage refers to "the degree to which an innovation is perceived as better than the idea it supersedes". For an organisation, access to data in the big data environment, analysing these data, and extracting meaning for the organisation, is perceived to bring increased competitiveness, improved supplier engagements, improved customer services improved BI, and improved business opportunities. The five stages of the DOI theory were also used, to check if the managers are knowledgeable and aware of the benefits of sharing data. The persuasion stage informed whether the managers are interested or not interested to adopt and implement the idea of sharing data electronically.

The DOI theory was also used to categorise the organization as either (1) innovators (2) early adopters (3) early majority (4) late majority or (5) laggards in sharing of data.
The theories influenced how the researcher asked the interview and probing questions.

Below is the summarised version of the interview extracts from the first theme that can be traced back to the table provided in Appendix B1. The interview transcripts and the original audio versions are also available in Atlas ti and also as copies. This is done to validate the findings and to prove that the investigation was not influenced by any bias.

5.2.1.2 Summary of findings: Benefits of sharing data with key stakeholders

In a normal ideal environment, a company would not object to integrating its internal systems with that of its key stakeholders such as suppliers and customers. It should assist the organisation make quicker decisions, eliminating errors and improving accuracy making customers and suppliers happy. The managers are aware of this, however, they are currently operating manually; they communicate with their customers and accept orders telephonically. They record the orders on sheets and then compile loading sheets. An ideal system would allow for the integration of their systems with those of their key customers resulting in automated orders being automated. Wherever there is human interference, mistakes are bound to happen in capturing information. Sometimes documents get lost. If the systems are interconnected the problems of returns will also be reduced because customers will place an order based on what is in stock on the system.

> "*…Looking at it from a value chain point of view the positive side is: if your key stakeholders know where you are coming from and where you are going, the supplier relationship management will be managed easily and you will not have supply gaps because you would have shared what you are going to do and on the customer side as well because those volumes or the key data which is the volumes that you are going to sell they are coming from the customer saying they want so much so it will be just confirmation from our side" (Interviewee No 4, 7 March 2021)*

In the latter quotation, an example of how to meet customer needs can be as follows: if the manufacturing company needs a million packs per month of product C or product D it will be easy to achieve the budgeted production output. Managers believe that if systems are interconnected and data are confidentially shared with key customers and suppliers, then planning becomes easier on either side.

In the case of a manufacturing company, the suppliers of materials have less risk than the manufacturer. For example, with certain ingredients, there is not much that the manufacturer can do if it logs into the supplier's system and note that the supplier's capacity is X, even if those data are shared (unless that data are shared with a supplier's competitor). The risk to the supplier is much less because they want their capacity to be known so that when the manufacturer is dealing with them it knows their capacity to produce the required quantities. Therefore, if the sharing of data is benefitting both companies and even the consumer and possibly anyone further down the value chain, it will be a benefit.

There will be much more benefits in sharing data electronically with a few companies; one would have to choose which company has the required data. For example, if the manufacturing company uses a lot of sugar or a lot of maize meals and some companies supply those products, it might be much better to electronically share data for planning purposes. Therefore, if they share data with key stakeholders where there is no conflict of interest there will be mutual benefit.

There is a need to point out the possibilities of these benefits to the leaders of organisations for them to consent to electronically share some of their strategic data for ease of planning. The ease of doing business, which the current Zimbabwean government is also discussing, would be very easy to implement. The suppliers and customers will know that they will access whatever data they want to use. They will have access to platforms to check for available stocks and also where to source items from.

Taking a cue from the plant maintenance module, it should be possible to connect suppliers of key spares for packing machines and have access to their warehouses to see what spares they have, at what prices, at what locations, and at which sites. The spares will be sourced in the shortest possible time to allow the manufacturer to plan its work by placing the orders on time. The manufacturing company can plan for services knowing what the suppliers have in stock and the lead times of when the spares will be delivered. Less time is spent planning for the activities, unlike when using phone calls.

Some of the companies have already embarked on such initiatives and they are bearing fruits. An example is the recently launched e-fuel system, an electronic system for ordering fuel. That system enables the customers to see the supplier's fuel stock and it enables the customer to place orders electronically without having to interact with them over the phone. The customers can also see the prices and the movements. The only major challenge or limitation could be having prices in Zimbabwe RTGs dollars which fluctuate daily. They are trying to address this by moving their prices to a stable currency.

> *"...We can also form our own data value chain with our key stakeholders such as customers and suppliers and share data" (Interviewee No 9, 23 March 2021).*

Company X is the parent company with many subsidiary companies that include, a feed company, a dairy company, a pork company, a chicken company, fast foods outlets a distribution network, and a bread company on its value chain. For a company like that to electronically share strategic data within its subsidiaries along that value chain, everyone would benefit.

There will be no mistakes, the information will flow seamlessly and human error in capturing data is reduced. Therefore, if it's automatically generated from the system where it is known that there is a model, there will be no mistakes and it will be accurate as long as the issues of confidentiality are addressed.

To enable either party to plan properly, the manufacturer must be able to log into its customers' or suppliers' systems. If a customer wants to order products from the manufacturer, it would be easier if they were to have access to stock information in the supplier's warehouses, place their order and wait on the supplier to deliver the order.

An example is the sharing of reorder levels for products and materials with customers. They can see at what rate the manufacturing company is producing whatever they are buying from the supplier. They can therefore start preparing for the next supply stage.

> *"…We are faced with the COVID pandemic this kind of initiative can actually help to improve business-to-business interaction without having to physically meet" (Interviewee No 18, 18 August 2021).*

This creates efficiencies and effective reorder patterns because there will be a reduction in bureaucracy, and paperwork and also a reduction in personal visits to customers. But there has to be a limit on what the customers can access.

The reverse is also true when the manufacturer is dealing with its suppliers and wants to place orders. It also needs to know what the suppliers have in stock to also plan effectively. If the manufacturer is having growth plans its suppliers should be able to know that the manufacturer is planning to grow and be able to foresee its coming needs. The suppliers can also plan for the manufacturer's planned growth. In this global world, it's critical to electronically share data. An organisation cannot live in isolation. Customers and suppliers must know what they expect as forecasts so that certain information can be prepared in advance. If the manufacturer does not share data, then it will be disadvantaged when it expects delivery because suppliers did not know the manufacturer's intentions in advance.

5.2.2 Red zone of external data coupling

5.2.2.1 Theoretical Assumptions

Before we start looking for external data it appears there is a red zone already because the manufacturer is not at liberty to share the data and the reverse is also true with the suppliers and customers. All four constructs of the UTAUT of performance expectancy refer to the degree that an individual believes that using the system will help him improve performance. Effort expectancy refers to the perceived ease of use of the new system, in other words, the degree to which the prospective user expects the new system to be free of effort. Social influence refers to the degree to which an individual perceives others, including important people, believe he or she should use the new system. Facilitating conditions refer to the degree to which an individual or organisation believes that an organisational structure and technical infrastructure exist to support the use of the system. All these constructs were used to examine this critical code as it appeared to play a critical role in why organisations are not at liberty to share data with stakeholders and forms the basis of the framework that the researcher set out to construct.

The compatibility determinant of DOI which refers to "the degree to which an innovation is perceived to be consistent with the existing values, past experiences, and needs for potential adopters" was also used to examine this theme and code. In the conceptual framework, the researcher indicated that external data are a grey area. The social exchange theory played a key role in influencing the way the researcher asked questions to ascertain if it is worth it to electronically share data using SET's formula: worth = reward – costs.

This was done this way because the managers proved that they are aware of the benefits and they have also installed the BI system so the researcher wanted to check any other issues that may be limiting the sharing of data. The following is the summarised version of the interview extracts table provided in Appendix B2. The interview transcripts and the original audio versions are also available in Atlas ti.

5.2.2.2 Summary of findings: The red zone of data coupling

Sharing of data is always sensitive. It's guided by the data governance rules of the country or of the organisation. There has to be consent and the data have to be used for a clearly defined purpose. However, there must be a plan or a way of sharing the data securely.

> *"…It must be handled with care, especially in organisations that are in competition with each other where you have stiff competition" (Interviewee No 1, 28 February 2021).*

This is prevalent in underdeveloped countries, where there is stiff competition among a few companies competing with each other for the same small market. The fear is that the competition may end up knowing the manufacturer's strategies.

Strategic documents like a budget may contain competitor information. Therefore, an organisation may find itself opening up to competition by sharing too much data which may not necessarily be beneficial to the stakeholders. That data may end up in the wrong hands. If the organisation is listed, it may end up pre-empting the information that may not yet be ready for publication.

The other possible problem is when the organisation has a supplier who is also supplying its competitors. There is no guarantee that the supplier will not share the data, by accident or even deliberately. The data can end up in the wrong hands, changing the competitive landscape for the manufacturer. This can be a major limitation. Therefore, there is a need for secure environments to ensure that there is no hacking of data.

What makes an organisation succeed is its strategy and once the strategy is known by everyone it is no longer a strategy. Certain issues should never be shared, for example, trade secrets. This is why an organisation should put data-sharing restrictions in place.

> *"…Sharing of data must be done with specific partners where there is no conflict of interest between the suppliers or customers" (Interviewee No 6, 28 March 2021).*

Not everything can be shared. It depends on a particular stakeholder, and hence, negotiations can be done per customer. It should be executed by the executive who is directly involved with that customer. Executives guide which data should be shared because the data in business is sensitive.

Margins and stock holding are strategic confidential issues, that should never be shared. Relationships that exist between some of the key stakeholders and the organisation's competitors can be a problem. For example, some of the suppliers of packaging materials are owned by competitors so the question is where does it end? If those suppliers have access to vital data, will they share it with the organisation's competitors since they are in the same industry? These are some of the reservations that organisations have when sharing data electronically.

How long the organisations that want to share data have been operating together, and whether they are customers or suppliers are important considerations. If it is a new engagement, then the issue of trust comes into play. The manufacturer may not be very sure whether the new customer is attempting to access data for other purposes. Trust is not an issue when one shares data with the other party knowing very well that the other party will keep whatever data that he/she gets as confidential as possible.

Taking the Zimbabwean situation as an example, issues of trust are very critical.

> *"It's a question of trust, let's look at the Zimbabwean situation where I think issues of trust are very critical because we are living in a situation where there are a lot of bad things happening all over, so whether you are a supplier or you are a customer you wouldn't want a situation where any person would come into your system" (Focus Group Participant 4, 08 July 2021).*

They would rather have a situation where they sit down and discuss what they have with the prospective customer. But in an economy where trust is not an issue, they would welcome any person logging into their system and assessing what to purchase.

These limitations are also present when dealing with global trading and global sourcing, where Zimbabwe is a high-risk country which means upfront payment is expected. The question in this situation is if the manufacturer is paying upfront, are we sure the goods will be delivered? The manufacturer is also afraid to engage in such transactions to electronically share data with any new supplier, therefore, trust is key in business. Organizations would always want to know who they are dealing with because, at the end of the day, they may lose money or jeopardize operations due to issues of trust.

> *"…Even if NDA (Non-Disclosure Agreement) is signed with key stakeholders, but as long as the key stakeholder has other relationships of ownership with the organisation's competition it will be tricky. These key stakeholders also hold strategic meetings where they discuss issues with their customers and the big question then is, won't they discuss the organisation's plans with competitors?" (Interviewee No 11, 26 March 2021)*

Therefore, data have to be shared confidentially. If it is a budget, for example, it should be speaking to what the supplier gives to the company and other aspects of the budget should not be shared. Customers only need to know about the volumes that the manufacturer plans to do for the lines that they buy and no other lines to avoid exposing everything.

There has to be a limit to how much data are accessed, otherwise they can end up accessing proprietary information to the manufacturer's detriment and use it to support the manufacturer's competitors.

> *"…There have to be limitations to how much data they can access otherwise, they can even populate and deliberately corrupt the manufacturer's systems and take advantage to destroy the manufacturer in terms of competition" (Interviewee No 13, 07 April 2021).*

The manufacturer wants assurance that their data are secure and can only be used for the intended purpose. Therefore, the organisation should share appropriate data at the right time.

This calls for enough time to plan for the data to be shared. Currently, organisations are hesitant to share data because everyone is trying to protect their territory, but if designed with proper securities and authorisations levels it should work. Database administrators should ensure that when the data are electronically shared with outsiders they will not be hacked; if that happens it affects the data that the internal users rely on. That stage of sharing data has not yet been reached therefore managers prefer to get the critical data or requests through e-mails.

Sometimes the suppliers say they are out of stock when the stocks are reserved for someone else. The managers want a situation where they can log into the supplier's information systems, see stock levels, be able to place an order and take delivery as soon as possible.

Businesses might not want to give the public the impression that their business is not doing well. Sharing the data electronically in the big data environment might make this obvious. That might end up scaring potential customers.

5.2.3 Requirements to pass through the red zone of data sharing

The question was:

What then do you think needs to be done to start exchanging and sharing data electronically with strategic key stakeholders such as customers and suppliers?

5.2.3.1 Theoretical Assumptions

Organisations are under pressure from key stakeholders to tap into data in the big data environment. The researcher used a social influence lens to view data on this theme. This refers to the degree that an individual perceives others including important people believe he or she should use the new system. Facilitating conditions refer to the degree to which an individual or organisation believes that an organisational structure and technical infrastructure exist to support the use of the system was also used. The assumption was if the organisations have already invested in technologies to exchange data, why are they not using them to electronically share data? There is a need for a BI system to be in place as a facilitating condition to pass through the red zone of data coupling. Compatibility in DOI works hand in hand with facilitating conditions in UTAUT. Regarding sharing of data, the data must be compatible with existing infrastructure such as existing ways of operating. Past experiences when dealing with customers and suppliers can be categorised as compatibility.

The following is the summarised version of the interview extracts table provided as Appendix B3. The interview transcripts and the original audio versions are also available in Atlas ti

5.2.3.2 Summary of findings: Requirements to pass through the red zone of external data coupling

As the organisation scales its technology to link up with its customers or vendors to electronically share data, firewalls that guard the organisation against the ingression of cyber-attack or any other threats become necessary. MOUs and NDAs are other forms of data protection.

> *"…There is a need to sign a Memorandum of Understanding (MOU), Non-Disclosure Agreements (NDAs) with the partners to highlight that the data are for them only and they cannot share with others except to transact between the two?" (Interviewee No 5, 09 March 2021).*

The traditional way entails physically signing these agreements and declaring any conflict upfront. The managers in the current research study are unaware of any other way that this can be done electronically to ensure that the agreements are not breached.

Therefore, there should be a service level of agreement to ensure that shared data are kept private. There must be privacy and legal policies in place to guide the parties. Trust between the stakeholders might allow this to work if they can maintain confidentiality.

Data security is of paramount importance. For every department, there should be the head of the department as well as data stewards who will be responsible for data sharing. It would ideally have the approval of both the top-level senior executives (e.g., the CEO and CIO) and those of the reporting executives. The latter are responsible for this more directly within an organizational structure. A neutral consultant could lead a discussion with the team and take them through the whole process of sharing data so that those both involved and impacted by this issue can understand that it is not a destructive program, but rather is meant to enhance business operations.

The organisation should first of all screen their sensitive data and then only publish a piece of public domain data they are sure does not compromise security. . For example, payroll is very sensitive data and cannot be shared. In the ERP, the tables for payroll are encrypted. Formulae and recipes need to be protected too. Only data relevant to the trading partners should be shared. The BI solution has authorisation levels that can be enforced so that people cannot see what they are not supposed to see. Therefore, investment in similar technologies that allow data communication between entities is required.

The best way to share data is usually via proper applications that are meant for that purpose. There is a need to build proper interfaces that are secure, that also allow for the third party to access the data easily and that is also robust in terms of the audit trail. There is also a need to limit the amount of data mining that one company can do on another. This has to be stipulated in the MOU and service level agreement (SLA) signed by both companies. The executives or board would have discussed and decided that if we share ABC it would benefit us this way and if we then share D.

The MOU, confidentiality agreement, and SLA between the two companies should specify what data will be available from one company to the other company and state that the given data should never be shared.

> *"…If possible, whatever is put in the MOU must also indicate that there will be severe penalty should confidentiality be breached by either party to make it legal and binding, you can put something there to indicate that there will be a severe penalty be it a legal penalty or financial or something that prevents confidentiality to be breached" (Interviewee No 9, 23 March 2021).*

. Companies have to find other companies that would benefit the organisation either up the value chain or down the value chain, and the managers have to look at modalities of sharing data. The executives have to identify the data value chain of their companies and then go up and down the line and communicate what they are offering to share. This way companies can form data value chains with their key stakeholders and share data for mutual benefit. However, for benefits to be realised, the shared data needs to be correct as it may negatively impact their subsequent decisions.

Another way to publish the data agreed securely on a web portal and purchase a certificate that will make that connection a subscription-based HTTPS connection. However, the limitation of this is that it costs to maintain this service.

5.2.4 External data sharing role assignment

The researcher sought to explore who should be assigned the critical role of deciding which data to share and who should craft the SLAs, MOUs, and NDAs. The main interview question asked the executives, the managers, and the consultants:

Who do you think should be assigned the role of deciding which data to electronically share with external strategic partners? And why do you think so?

5.2.4.1 Theoretical Assumptions:

The assumption was, maybe exchanging data electronically with key stakeholders is complex and a sensitive area that requires special role assignment to bypass. Maybe organisations do not want to be pioneers as in DOI where organisations are classified as an innovator which constitutes about 2.5% and comprises those who want to be the first to try the innovation. (2) Early adopters which constitute about 13.5% comprise those who are comfortable with change and adopting new ideas. (3) Early majority which constitutes about 34% comprising of those who adopt the innovations before the average person. (4) the late majority who also constitute about 34 % comprising of those who are skeptical and are only prepared to adopt the innovation after it has been generally accepted by the majority of the population then finally (5) Laggards who constitute 16 % who are usually very traditionally conservative and are the last to make the changeover to the new technology (Robinson, 2009). The researcher wanted to find out if the organization sees it as an important role that should be considered and given the attention it deserves.

The following is the summarised version of the interview extracts table provided as Appendix B4. The interview transcripts and the original audio versions are also available in Atlas ti

5.2.4.2 Summary of findings: External data role assignment

The responsibility of deciding which data to electronically share should be at the executive level and not at any other level. Therefore, if there is any engagement with suppliers to electronically share data, sensitive issues should be discussed and shared at the executive level, and then implemented at the operational level. Whatever is done in the organisation is aimed at achieving the objectives of the company, and the objectives are set by the senior executives and executives (leadership) and implemented by the managers (management). They know the direction the company wants to take and the rest follow and implement.

> *"The executives know what kind of data to be shared. This is why even in terms of company policy, executives and senior managers sometimes say we don't want everybody to talk to the press about the company" (Focus Group Participant 4, 8 July 2021).*

The role would suit someone good at figures, versatile, with that extra eye to see what is happening in the business and understand the business as a whole. He/she is someone with integrity, honesty, and the ability to maintain confidentiality Certainly, someone with IT and business experience with knowledge of BI systems experience and who can understand trends and how one thing can affect the other would be a good fit. This kind of data sharing enables one to forecast what the implications would be. Creating BI reports would be the result.

Therefore, because of the above requirements, the role may be delegated to an appropriate person. However, in terms of defining what has to be accessed decisions have to be made at the executive level so that whatever competitive data of the organisation is protected. The senior managers are better placed to decide which data can be accessed and shared, which data are sensitive, or what can be shared as they are more hands-on and they understand business processes. They can also decide what aspects of reports are communicated with the executives, how information is presented, and what the reports will cover. The IT executive should be involved to ensure data security.

5.2.5 Procurement and sales and marketing as the two main arms of external data sharing

It was important for the researcher to explore the role of procurement and sales and marketing since they were identified as the possible data entry points for electronically sharing external data.

5.2.5.1 Theoretical Assumptions

The assumption was why these two departments are viewed by the managers as the ideal departments for sharing external data. Is it because the benefits come from customers and suppliers? The researcher used the performance expectancy of the UTAUT which refers to the degree that an individual believes that using the system will help him improve performance. Is it because of the relative advantage which refers to "the degree to which an innovation is perceived as better than the idea it supersedes"? Do the managers believe that they have a relative advantage if they exchange the data via these two departments? Is it because of the complexity determinant of the DOI which refers "to the degree to which an innovation is perceived as difficult to understand and use" where dealing with external stakeholders such as suppliers' and customers' data are complex? The theme was approached with the thinking that it is complex to share data therefore it requires a special role assignment within the organization, and it cannot be done by everyone within the organization.

The following is the summarised version of the interview extracts table provided as Appendix B5. The interview transcripts and the original audio versions are also available in Atlas ti

5.2.5.2 Summary of findings: Procurement and sales as interfaces

> *"…The interface between the organisation and the outside world is mainly done via the two main departments, the procurement arm of the business and the sales and marketing arm of the business" (Interviewee No 5, 09 March 2021).*

These are the two critical entities that naturally interface with the external world. They exchange transactional data daily with suppliers and customers (retailers). They also know the repercussions of any other data linking the organisation and its suppliers and customers.

When looking at marketing currently, it is necessary to consider external data from social media. In some instances, some organisations are merging external data from Facebook, Instagram, and Twitter for marketing purposes. Therefore, an organisation wanting to pursue a marketing strategy via these platforms and also use them as a strategic point of advertising would now mix internal data with external data.

> *"…Looking at your procurement systems surely you need now better collaboration with your key suppliers because it must now become your best strategy to say if my supplier knows that I am going to require the following items and this is my probable production and so on and so on so it's not every department that should share data" (Interviewee No 8, 23 March 2021).*

What makes an organisation succeed, is its strategy. If the suppliers know that the manufacturer requires certain prescribed items and the probable production, it will be easy to plan for it. Not all departments need to be involved. It may not make sense to other departments, but from the procurement and marketing departments, it makes a lot of sense. These two entities can then use it as a strategy.

After discussing data sharing and the role assignment, the researcher then decided to find out from the BI consultants, if it is easy to integrate the systems and share the data. The following theme code was assigned to explore this aspect.

5.2.6 Challenges in integrating systems

5.2.6.1 Theoretical assumptions

The UTAUT has four constructs and one of the constructs, "effort expectancy" refers to the perceived ease of use of the new system. In other words, the degree to which the prospective user expects the new system to be free of effort. It was used here to reveal any challenges faced when integrating systems and if there is some effort required. Construct number four, facilitating conditions which refer to the degree to which an individual or organisation believes that an organisational structure and technical infrastructure exist to support the use of the system was pertinent here:

The DOI theory's complexity which refers "to the degree to which an innovation is perceived as difficult to understand and use" was used to measure the complexity of integrating the relevant applications needed to analyse data in the big data environment. This helped the researcher to ask relevant questions during the interviews (Sun *et al*., 2018). Therefore, this section of the research study was approached with the view that maybe BI systems are complex and difficult to integrate with other systems and to use. The following is what came emerged from the data.

The following is the summarised version of the interview extracts table provided as Appendix B6. The interview transcripts and the original audio versions are also available in Atlas ti

5.2.6.2 Summary of findings: The issue of integrating systems

The main challenges when integrating with other external systems are that the privacy policies might take quite a long time. It is also not easy to get approvals to open systems including allowing other parties to access the systems. However, the advancement in technology demands that the systems should be integrated.

> *"…There are also a lot of challenges when integrating old systems with the latest systems. There is a lot of development work that needs to be done to integrate the applications such as a need to build the Application Programming Interface (API). If*

> *that API is not readily available, then it becomes costly to develop it" (Interviewee No 2, 02 March 2021).*

Tools might not be integrating seamlessly with probably the ERP or the database to which the organisation wants to connect. The BI implementer cannot inform the managers that this is not possible as the new system cannot connect to this other system because it's an old system/ the drivers are no longer there/ it's a very new system and drivers are not yet available/ a specialist of the old software program (e.g., COBOL) is needed to integrate with the new software. There might now be a need for third-party software which could become an extra cost to the organisation. The organisation might not be willing to invest in another solution These are the challenges that consultants usually encounter.

Most of the data that come from external sources will be unstructured data (e.g., JSON file format). The data needs to be cleaned or formatted to the required format within the data warehouse. This will enable the designers to create proper data mats for extracting data. Data come from different systems in different formats and sometimes a system like a BI system getting data from a system like the ERP system might encounter difficulties. That data will have different formats. To try and integrate those two different date formats, for example, the consultants have to standardise them. Furthermore, if a date field is configured as free text in an open-source system someone can put a date in a format they want so standardising that is painful for the consultant.

The other challenge is generally, resistance to change. Whenever there is a change concerning new technology, people feel threatened. Generally, people think that Information technology replaces jobs. Some of the resistance comes from the people who might see the value in integrating the systems; they will be pondering whether they will be part of the new system or whether they will be eliminated.

There is a need to choose standardised systems that integrate seamlessly with key stakeholders' systems. If the organisation's customers and suppliers are running on different platforms, then the organisation may end up having four different systems to integrate with. The process of integrating those systems might be a challenge.

An organisation usually deals with a mixed bag of suppliers where largely very corporatised entities may understand the impact of ERP solutions and they may be prepared to share the data. Then there are those upcoming smaller businesses running on non-formalised systems that are still very cautious about their businesses and how much they can share. These will be reserved in terms of their preparedness to share. However, the managers believe the concept of integrating systems to share data is a worthwhile framework or concept to try in the market.

5.2.7 Proportion of internal data sources versus external data sources

The main interview question asked was:

When building the data warehouse what has been the proportion of internal data sources versus external data sources and why do you think it is like that?

5.2.7.1 Theoretical Assumptions

The assumption was that external data are difficult to access and acquiring it requires effort compared to internal data. The UTAUT's construct "effort expectancy" which refers to the perceived ease of use of the new system was a theoretical lens to explore the data from the interviews. The experience moderator of UTAUT was used to look at data with the assumption that maybe experience plays a big role in tapping into external data. The facilitating conditions construct refers to the degree to which an individual or organisation believes that existing technical infrastructure can be used to tap into external data.

The DOI theory's complexity which refers "to the degree to which an innovation is perceived as difficult to understand and use" was also used to measure the complexity of using the relevant applications needed to tap into the external data. This section of the research study was approached with the view that internal data are easier to tap into compared to external data due to data integration issues.

The following is the summarised version of the interview extracts table provided as Appendix B7. The interview transcripts and the original audio versions are also available in Atlas ti

5.2.7.2 Summary of findings: The composition of external data versus internal data

The experience of external BI consultants is that most organisations keep and analyse more internal data. This is because most organisations have both ERP and business intelligence systems. Therefore, these organisations discard the other systems because the ERP incorporates many modules that integrate.

> *"…So when we then come in as Business Intelligence consultants it will be more like transferring data from the ERP to the BI system, making it more of internal data" (Interviewee No 15, 28 April 2021.*

Organisations appear to prefer creating a web portal so that suppliers, customers, and other external users transact via that web portal. The web portal is the platform for their internet transactions so only specific data are then stored in a database for that purpose. However, when it comes to analysing data, managers analyse mostly internal data. The exception is the marketing department where external data are very critical to analyse information about the competition. Usually, they have to resort to searching for that data. Hence, when the business intelligence consultants arrive, they mainly deal with extracting data from the transactional ERP system.

> *"…Organisations only get targeted specific data from external sources they do not take everything to avert the risk associated with getting external data" (Interviewee No 6, 12 March 2021).*

They obtain risk compliance data about a customer which constitutes a small portion of the data warehouse and in terms of volumes, it is usually more internal data than external data. Therefore, it depends on the type of organisation, how their infrastructure is set up and whether they prefer internal data to reduce costs. External data would be limited data and would be accessed from social media platforms.

This marked the end of analysis of the first main theme. The following figure 5.3 shows the analysis map of the second main theme and the codes that were assigned.

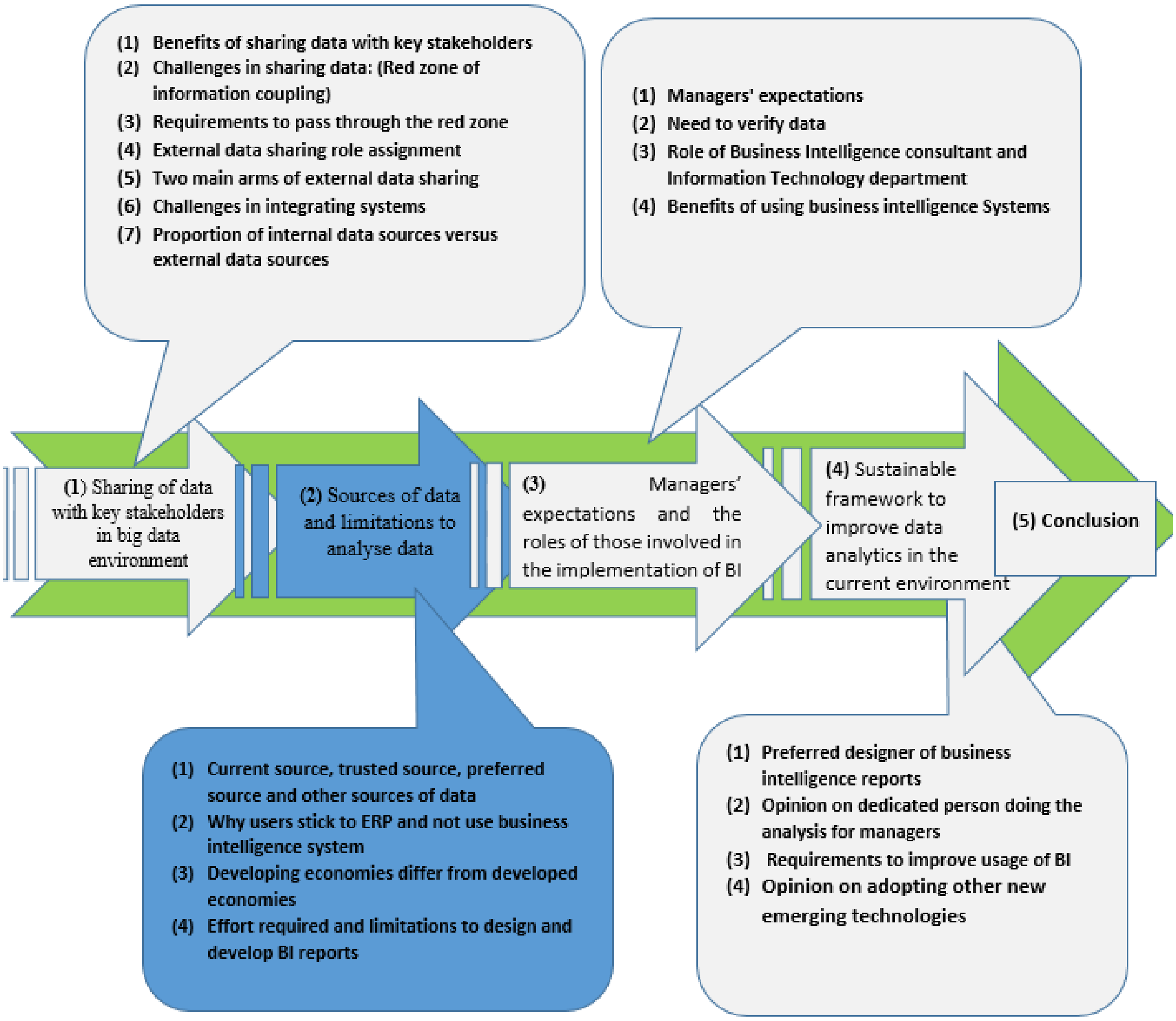


Figure 5.3: Data analysis map: Section 2

5.3 SOURCES OF DATA AND LIMITATIONS TO ANALYSE DATA IN THE BIG DATA ENVIRONMENT

5.3.1 Sources of data

The literature indicates that data sources play a significant role when an organisation embarks on an analytics journey in the big data environment. According to Schmarzo (2016), organisations must focus on new sources of data, for them to realise value from big data. The researcher explored the managers' current, trusted, and preferred sources of data.

5.3.1.1 Theoretical Assumptions

Are managers knowledgeable and aware of the other sources of data and the benefits in the form of relative advantage and effort expectancy? Do they believe that facilitating conditions exist, in the form of organisational structure and technical infrastructure such as BI to use various sources of data including machine sensors? The interview and probing questions sought to find answers to all these questions underpinned by the highlighted theoretical constructs. The researcher followed the communication stages of the DOI theory. The assumption was since the managers decided to adopt and implement the BI system, they have moved past the persuasion stage and have developed a positive attitude towards the innovation of using BI systems. But do they trust this new source of innovation and do they continuously use the technology? The confirmation stage of the DOI communication stages starts when the individual looks for support to continue using the innovation. Are the managers using BI systems or do they revert to old ways of doing things? This question guided the thinking behind the interview and probing questions.

The following is the summarised version of the interview extracts. The table is provided in Appendix B8. The interview transcripts and the original audio versions are also available in Atlas ti

5.3.1.2 Current, trusted, and preferred sources of data for analysis

About 90% of the data used by managers to prepare reports comes from the ERP system. For example cost efficiencies, and production volumes, usually come from the ERP system. This is why managers want the data in the ERP system to be as accurate as possible. They use those data to write reports, which helps them in the decision-making process. Decision-making requires accurate data. The remainder, about 10%, is not in the ERP system; for example, the state of equipment in the plant is sourced elsewhere.

> *"…Ok with me I use the different sources but the one I very much trust is the ERP because that's where the transactions take place and that's where everything is put I also trust the BI system as well as long as they speak to each other on the reports because the BI is being fed from the ERP. I trust the information that I get from mobile devices especially the qualitative yes because I get to know what people are producing. I also trust machine sensors and CCTV, because they inform me when things are going wrong. From human beings? not so much, I don't trust people because they usually try to manipulate the information, they might not always be trustworthy but I know if I get information straight from the system that's the final" (Interviewee No 12, 28 March 2021).*

The managers believe that the data generated from the ERP is more credible and reliable. Their current sources are more like a semi-automated system, where someone obtains data from the machines. Sometimes they count output and input that into the ERP system before generating reports. The reports are all in the ERP system and submitted to superiors in Excel format with comments, suggestions, and recommendations. However, the ideal situation is when reports are configured to generate automatically from the ERP system either daily, weekly, monthly, or annually.

Instead of executives having to go through 10 or 20 individual reports which are in the ERP system, they should get consolidated summary reports or single summary reports. For example, a report from engineering, and manufacturing can be summarised and sent to the GCE. The senior managers want a scenario where they can access the system and generate specific reports that are commensurate with their sections.

The BI system is suitable for that, although, the ERP system as the primary source is the trusted source of data. Therefore, that data can also be converted into a BI system because the reports from the BI system are easier to look at, and are in the required format. BI systems are more customised than the ERP, however, the ERP as the transactional system is the primary source. As an alternative, the managers end up using the Excel system for easy manipulation so that they can then do trend analysis. Charts can be created from that data and executives can easily read these and make decisions from that data. The qualitative data are communicated via mobile phones and WhatsApp.

The researcher used probing questions to find out if the managers were happy with the current scenario and to check which source they trusted from the many available sources.

What emerged from probing during interviews is that most of the managers were schooled using the ERP system. Some are the pioneers of that system and have been using it since its inception in 1999. They rely on it to check costs, sales, profit, and loss. They search in the ERP system and they believe everything is there. To them, the data that is input into ERP is very critical, and through the 22 years of using the system, the organisation has matured in using the ERP system. They also have social platforms where they share information and quickly update on the economic and political landscape. It is, not data on cost and substance.

Managers do not trust information coming from individuals, but they trust something that is on record like the ERP system.

> *"…Some people tell lies to try and hide something, some give you correct information but you also now need to verify and maybe use past experience to know that so and so tell the truth so and so you need to be very careful so that you also scrutinise it further" (Interviewee No 14, 28 March 2021)*

They prefer auto-generated reports because for example, if a machine is running, the manager would prefer the number of units that are counted by the machine to the number counted by a person who may make counting errors.

Therefore, depending on the kind of information requested there are different platforms that they trust, for example, for the performance of the company, they trust ERP because the information is directly from the transaction data. If they want to understand what customers are saying about the company, then other sources such as Facebook and other social media platforms are trusted. On such platforms, they normally extract qualitative data in the form of comments from people but they consider as balanced information. People use these platforms to say good or bad things about the company. Influencers use social media to debate the company's products and to broadcast what the customers are saying to the market.

5.3.1.3 Other sources of data

Besides, the ERP and BI platforms, managers get information from other platforms such as social media. Updates for matters that may require urgent decision-making and where everyone would be informed are made possible. They can comment immediately as opposed to waiting for a report from an ERP system. When they are out of the office, without access to the ERP system or BI system, social media platform close this gap.

5.3.2 Why managers do stick to using the ERP and do not use the business intelligence system for analytics.

Managers indicated that they prefer to use the ERP for analytics instead of using the BI system. It was, therefore, important for the researcher to probe to understand why they prefer the ERP system over the BI system.

5.3.2.1 Theoretical Assumptions

The assumption was that perhaps BI systems are difficult to use. The researcher used the effort expectancy of UTAUT as a lens to examine this. It refers to the perceived ease of use of the new system; in other words, the degree to which the prospective user expects the new system to be free of effort. The researcher also used as an analytical lens the performance expectancy of UTAUT, which refers to the degree that an individual believes that using the system will help to improve performance, and the relative advantage construct of DOI, which refers to "the degree to which an innovation is perceived as better than the idea it supersedes". These constructs influenced the way the research study questions were asked.

The following is the summarised version of the interview extracts. The table is provided in Appendix B9. The interview transcripts and the original audio versions are also available in Atlas ti

5.3.2.2 Summary of findings: Why managers stick to using the ERP instead of BI for analytics

The advantage of the ERP reports is that the reports are enterprise-wise, the ERP looks at information on a broad scale and its real-time data. The reports reconcile with other departments and they are balanced. That linkage in systems ensures that any activity in one department will affect other departments, including finance. This is important to managers. ERP information is therefore traceable information.

For instance, the quality management (QM) module, does not work in isolation, it works with the materials management (MM) module and the finance module. The moment one sees a report that is related to quality management, the senior managers automatically know, that information has been inputted from other modules such as production planning (PP) and MM modules and finance modules. On the other hand, some of the issues that the manager needs to communicate to other departments may not yet be in the BI systems. In the ERP all the modules reconcile and the managers have refined this over the 22 years that they have been using the ERP system. They are now accustomed to that system.

> *"…I was fortunate enough to have grown up using and also been a pioneer of the ERP system that we are currently using from 1999 up to date and this is 2021 so that's 22 years using the ERP system and most of the reports are inside the ERP system so we have matured as a company in the use of the ERP system. I would really trust the data I get from the ERP system" (Interviewee No 5, 09 March 2021).*

The managers also do their daily activities of capturing costs in the ERP system and these automatically reflect in finance to generate a real-time P&L and are in a position to see how they are performing day by day. They can track their margins and variations thereof which will allow them to correct a problem before they generate a month-end report. For example, they can quickly see in the second week that they will not achieve the margins projected and can then improve on managing costs as an option to mitigate this variance. All the departments will thus be told to reign in on costs to achieve the margins being prioritized. They immediately react by putting on hold other planned activities and reserving them for the following month or pursuing a cheaper method of doing those activities. Each activity can easily be tracked daily in the ERP rather than waiting for month-end when they submit their final report to the executives. When they wait until month-end and then try to explain to them that they could not meet the costs target because of whatever factors; that will be too late. Therefore, they do trust the reports from the ERP because they know they have been generated from the system through activities that are interlinked.

These synergies between data shared, especially between one department and another are regarded by the managers as critically important. An organization might have a BI system in production that talks only to the production activities. If that information is not showing in the engineering BI system, then it means, that even though the production department may be using the same BI system; the reality will be that they will not have sight of all the additional relevant information, for example, being current in terms of the required equipment availability and any other relevant engineering activities. This is because they will have their version of the specific scenario versus the one engineering can see; which in this case will not be the same. This will not be ineffective because BI solutions should ideally speak to the overall priority of the business and not only that of the specific business area. If the BI solution is not speaking to the business and providing accurate information; then the consequence will be that the basic input data to multiple decisions will be incorrect and resulting in serial bad decision-making. The integrity of the basic input data upon which further projections are based is critical; as is the ability of the relevant role players to have access to view this information as and when required. This implies that when managers are preparing reports, the data objects should be easily accessible, understandable, and accurate. ERP is based on internal information while a typical BI comes with additional features which make information clearer as well as provide more readable formats.

What invariably happens is that when the confidence levels in the existing information are low, managers simply go to a more trusted source the ERP system itself.

> *"…The BI system is easier to look at and go through because they are in a format that one requires. BI systems are more customized than your ERP but obviously, the ERP is the source" (Interviewee No 13, 07 April 2021.)*

The other major reason put across by the managers is, resistance to change. Most users simply, resist using the BI system and stick to using the ERP in terms of reporting. With that being the case, the BI system will essentially be redundant within the organization. Generally, people are also found to be resistant to change because they feel threatened and intimidated when a new solution is introduced or they perceive it as such. In practical terms, it also includes the perception, warranted or not, that the new system might be difficult to learn which then also has staffers simply reverting to using Excel and the ERP for basic analytics.

> *"…I use excel because it is the one that I have mastered and become familiar with. I have been using excel for more than 20 years and it makes my life a bit easier and for the BI I don't have a lot to do in there" (Interviewee No 9, 23 Mach 2021).*

This highlighted that every new system has challenges in terms of acceptance, amongst which are the existing familiarity with current data sources, the systems that go with them, and the modes of analysis that accompany them.

Usually, when preparing reports, managers take all the reports from the ERP system and convert them to excel. In a typical BI system, the potential exists that some reports may have different viewing options as opposed to how they are viewed in the ERP; which by itself further reduces confidence levels in the data picture being presented and results in further inefficiencies and costs.

> *"…Business Intelligence is good but maybe why I do not rely on it continuously is because you cannot fully rely on one source I still need to verify so you find that in BI there are some reports when you go into ERP they will be different so you still need to see whether these were configured correctly and what other information is missing that need to be updated in BI so that they will talk to each other so if that is missing then I will revert back to the ERP" (Interviewee No 10, 24 March 2021).*

There is therefore a need to see whether these reports were configured correctly and then look for the missing information that needs to be updated in BI so that the two systems are consistent in what they present; regardless of format. The manager will be continuously going back and forth to the ERP to search for the missing information and this has a damaging effect on overall productivity. The managers believe that as the organization moves to new technologies whether it be in manufacturing or other areas; the system integrates into the ERP as well to ensure both data consistency and integrity.

The ERP system is the primary source of an organization's transactional information and there are enough standard controls related to the input of data that provide a reasonable level of confidence to the users. These controls include restricting access to only those responsible for the required data entry to ensure the data source and entry process has a high level of reliability and thus promoting a higher level of data confidence. Most managers discard the BI system because the ERP incorporates many usable modules. For example, the financial module, the quality control module, the production planning module, the plant maintenance module, the human capital management (HCM) including the payroll module as examples; all exist in the ERP.

The necessity for both a comprehensive and inclusive process of all role-players at all the required levels; is of paramount importance to avoid unnecessary situations and their associated complications. Sadly and more often than one would like to acknowledge; external consultants go into BI projects and find themselves working with typically the IT department for reasons that have to do with software hosting and accessibility issues; then find themselves interacting on functional business areas such as procurement or engineering, without engaging with the actual functional experts themselves. This is more common than is often acknowledged. This type of situation gives the IT staffers a disproportionate influence over the process beyond their actual expertise and often leads to “solutions” crafted without the relevant business area and its operators. This is a recipe for inefficiency and dysfunctionality within an organization. Many potential solutions never come to the foreground because the expertise of that area is never consulted because of this type of situation that is allowed to evolve.

The following is the summarised version of the interview extracts, a table is provided as Appendix B10. The interview transcripts and the original audio versions are also available in Atlas ti.

5.3.3 Developing economies differ from developed economies

Managers indicated that the current environment in which they operate is different from developed economies. It was, therefore, important for the researcher to probe them to understand what they meant by that.

5.3.3.1 Theoretical Assumptions

The assumption was that perhaps managers do not want to invest in facilitating conditions because they believe they do not have the financial resources. The researcher used the facilitating conditions construct of UTAUT to look at this. The construct refers to the degree to which an individual or organisation believes that the technical infrastructure exists to support the adoption of the BI system.

5.3.3.2 Summary of findings: Developing economies differ from developed economies

"…The preference is to have a fully integrated system as seen in typically advanced economies" (Interviewee No 5, 09 March 2021)

The managers wish to have automation in their factories as well but they are limited financially. This current situation introduces multiple challenges such as disjointed machinery with varying levels of automation which leads to the ability to access coherent training options being extremely difficult. This also prevents them from sending their staff for training. This state of affairs also means that the ability to interconnect machine sensors and incorporate the data into the BI data warehouse becomes virtually impossible. Other factors limit managers from using the business intelligence system to design their respective reports.

The researcher decided to allocate themes to find out if there is any effort required, by the managers to design BI reports.

5.3.4 Limitations to design and develop BI reports

From previous sections, the managers highlighted that they expect the BI system to come pre-configured with reports that reconcile with what is in the existing ERP. This suggests, there is some effort required from staffers to design BI reports for their organization.

5.3.4.1 Theoretical Assumptions

The approach taken in this regard was to use the effort expectancy of UTAUT (which is the perceived ease of use of the new system in other words the degree to which the prospective user expects the new system to be free of effort) and the complexity determinant of DOI being "the degree to which an innovation is perceived as difficult to understand and use". This influenced and underpinned the researcher's thinking in this section. The lingering questions were, do managers think that BI reports are difficult to design and develop? Do the consultants also think the same way? These questions were driven by the fact that if the reports are easy to design and develop, why then are managers not designing them? The dominating question posed to participants in this section was, who should design the BI reports?

The following is the summarised version of the interview extract outcomes. A table is provided in Appendix B11. The original interview transcripts and the audio versions are also available in Atlas ti

5.3.4.2 Summary of findings: Limitations to design and develop BI reports

5.3.4.2.1 Effort required: Time

> *"…In my own opinion in as much as the senior managers and executives within the organization may have the capacity to design reports, they do not have time" (Interviewee No 1, 28 February 2021).*

Most of the time they are busy with strategic issues, so at that level, designing BI reports may be a challenge. It will be more like asking them to do operational duties. Therefore, they should either create more time or allow the internal consultants to work with the external consultants so that they have a properly designed system.

5.3.4.2.2 Effort required: Skills

Senior and executive managers cannot design reports unless they have some technical know-how to be able to do so. They need to bring an expert in the form of an external or internal consultant to facilitate crossing the technical gap and ensure that the reports come up the way they want.

> *"…It takes time for someone to know the entire BI solution" (Interviewee No 16, 03 May 2021).*

However, nowadays technology is moving fast and they can now make use of artificial intelligence and machine learning. By using these latest technologies, they are in a position to map their way; however, this is time-consuming. Without modern BI tools, they would have to go for focused training sessions to be taught how to do it.

However, it is important to note that whilst many of these same managers have not been trained to use either Excel or the ERP; they generally found some way to use its basics. Perhaps it is because it's easier for them to start using it at home on their laptops and can generate a higher degree of familiarity with it. With BI they have to be at their workplace for them to connect with it and explore its options. They argue BI is difficult to work with unless one has an IT background. They prefer to use internal consultants but they may also lack the expertise hence they end up working with external consultants. Trained internal consultants do not call regularly for assistance but sometimes a very complex error comes out and in such a case the external consultant is always ready to assist.

5.3.4.2.3 Effort required: Knowledge of Business Processes

The advantage of using internal consultants in designing BI reports is that the internal consultants are more exposed to the requirements of the business. Internal consultants are already in the company and ought by definition to know the overall business processes very well.

External consultants cannot develop the reports on their own because they are not familiar with the day-to-day business processes of the organization.

> *"…We cannot develop BI reports on our own because we need input from internal people. If you are developing financial reports, you need input from the financial people in that organization because they know the day-to-day processes" (Interviewee No 15, 28 April 2021).*

They do not have the insight into the requirements which are relevant to the organization so they may end up producing a system that is not user-friendly at all. The ideal scenario is that the internal input comes from the functional people within the organization in the form of internal consultants or managers.

This is the same scenario with the IT department, it cannot work in isolation, because there are some business processes that the IT department is not aware of and that is where the other departments come in to give direction and specify in detail how the BI reports should be designed.

5.3.4.2.4 Effort required: Knowledge gap in using BI

Most managers believe that if they are given a chance to look at the BI system, they will know how to navigate through it and design reports. Currently, an internal consultant from the IT department develops BI reports and they are automatically sent to managers via auto-generated e-mails daily.

This concluded the findings and discussions of the limitations of using BI systems to analyse data in the big data environment theme. The researcher moved on to the next theme to find out the managers' expectations, the roles played by those who drive the BI agenda, and what they think are the benefits of having a BI system in place. The following figure 5.4 shows the analysis map and the codes that were assigned.

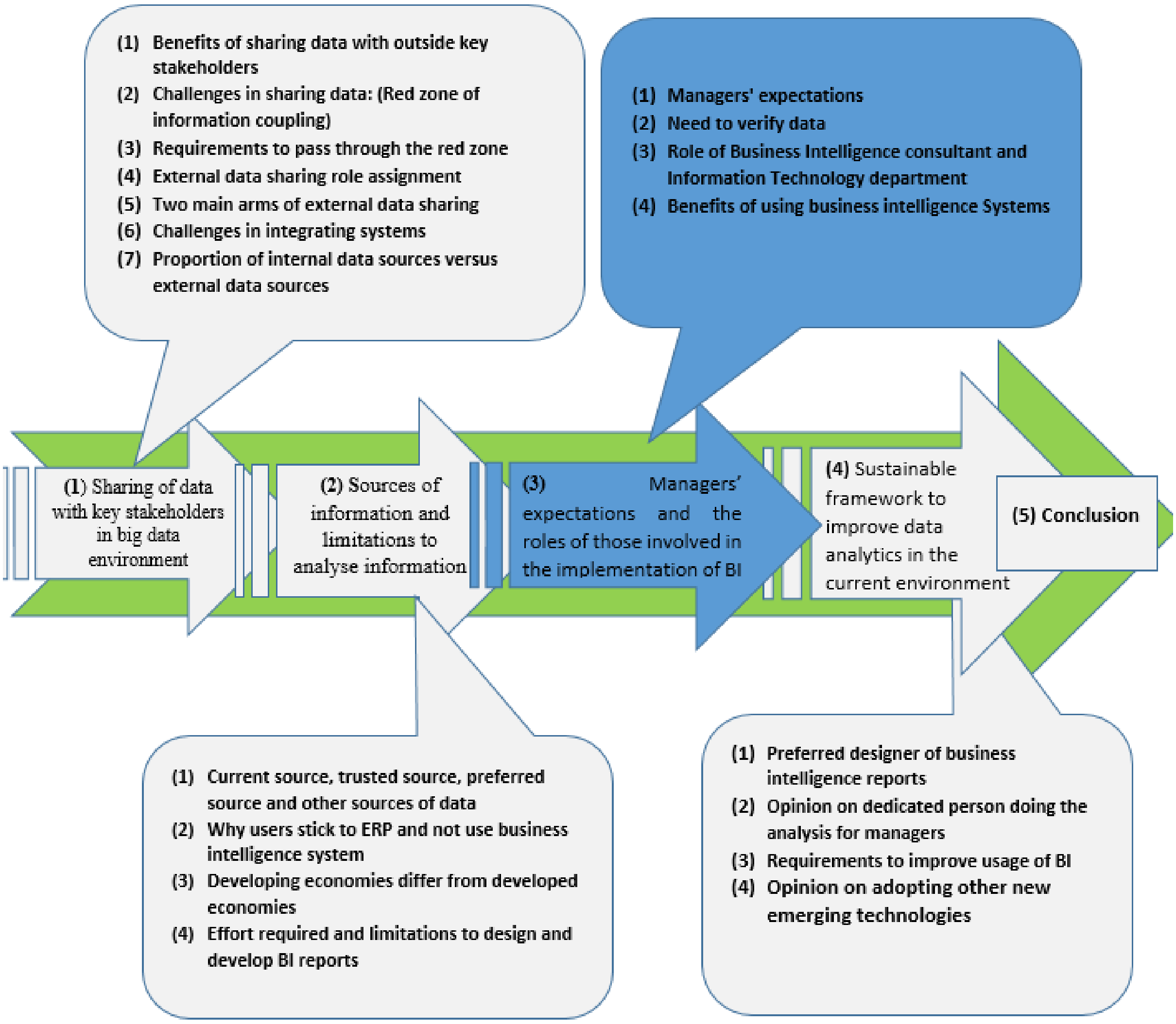


Figure 5.4: Data analysis map: Section 3

5.4 MANAGERS' EXPECTATIONS AND THE ROLES OF THOSE INVOLVED IN THE IMPLEMENTATION OF BI

Faced with a situation where managers may lack time and technical skills; internal consultants may lack technical skills and external consultants may also lack knowledge of the business processes; it was important to know the managers' expectations in such an environment. The following theme code was assigned for the purpose.

5.4.1 Managers' expectations

5.4.1.1 Theoretical Assumptions

Managers are aware of the benefits associated with using BI systems because they have already decided to adopt and implement the BI system. Following Rogers' five communication stages of the DOI theory: knowledge awareness, persuasion, decision implementation, and confirmation, we can say the managers are now at the confirmation stage where the individual looks for support to continue using the innovation (Sahin, 2006). If that support is not rendered or the benefits are not proven, then there will be discontinuance in using the system. The researcher used this thinking to hear the participants' views, and the following is what the managers said.

The following is the summarised version of the interview extracts, a table is provided as Appendix B12. The interview transcripts and the original audio versions are also available in Atlas ti.

5.4.1.2 Summary of findings: Managers' expectations

Managers want auto-generated reports from the BI system so that they eliminate human intervention which they regard as prone to errors and fraudulent activities.

> *"…If properly configured auto-generated reports are more credible. I think what we want to see at the end of the day is the use of automated reports so we eliminate human intervention which is prone to errors. This also reduces the number of people that are doing non-value-adding things because most of the time some of the work will not be value-adding because the systems are already doing it anywhere. If you have Business Intelligence and ERP system doing everything for you then eliminate that then improve on accuracy and timelessness then reporting and decision making will be faster" (Interviewee No 15, 28 April 2021).*

Measurements in the lab could be directly linked to the BI system rather than getting that from the lab technician. In production, machine breakdowns could be recorded and automatically reported to facilitate fast decisions to service machines before they fail, or to replace them before the cost of maintaining them becomes prohibitive. Currently, they are relying on manual records from individuals manning these machines.

Every month they spend 2 to 3 days preparing those reports by pulling data from the ERP and putting it in excel. The COVID era was an eye-opener and has changed the way they want to work. If that could be done through BI then it will be a good way of doing business because it will allow them to spend more time on critical issues in operations.

Their plea to the IT team is the internalization of automation like with the overall equipment effectiveness (OEE) for example, using internal people. They believe the internal consultants could lead the configuration. They would like to get the data directly from the machines where the data are generated.

> *"…My plea to the Information Technology team is to lead the configuration so that the machines in the factory talk to our computers if they could. I prefer a system whereby for example away from my office I can check the production output figures" (Interviewee No 4, 07 March 2021).*

They believe once they have defined their report requirements with the consultant the report should be automatically generated by the BI system to hit their mail or their phone. If the information is formatted the way they want, they will be able to make informed decisions.

There should be key liaison persons in the form of knowledgeable managers within the department who can assist others. These managers become the host to the consultants otherwise there will be a problem where the consultants design fancy things not addressing the problem that the department is facing.

For now, they are only focusing on internal data because external data are not readily available internally, they have to look for it elsewhere. There is no platform where they can get the external data easily yet some of their departments require external data to make concrete decisions. The managers said they want to verify the reports first before they are certified as correct.

Verification of information emerged as the grey area that needed to be explored further. The researcher wanted to know which system they use to verify the information and under what circumstances they verify the information. A code was assigned and the following is what emerged.

5.4.2 Need to verify data

5.4.2.1 Theoretical Assumptions

The researcher used trial ability which refers 'to the degree to which the innovation may be experimented and modified" The idea was to find out if managers abandon their traditional ways when new sources and new ways of analysing the data immerge. The aim was to check whether the managers trust the new sources a hundred percent without verifying and which system they use to verify among the previously highlighted trusted and preferred sources.

The following is the summarised version of the interview extracts, a table is provided as Appendix B13. The interview transcripts and the original audio versions are also available in Atlas ti.

5.4.2.2 Summary of findings: The need to verify data

For managers, there is a need to verify data from various sources whether from human beings or another system. Sometimes there may be a need to look for the person responsible for entering the figures into the ERP system to confirm the captured data. At times the people capturing the data make mistakes, they may even omit an entry. Therefore, where the systems get data from, is only as good as the data entered. (GIGO principle)

> *"…Verification in an ERP system is made possible because when posting in an ERP system, document numbers are automatically generated in the system so anyone can still verify unlike in BI" (Interviewee No 10, 24 March 2021).*

If a report is wrong in an ERP they can drill down to verify that data using document numbers. If a manager has been working with these reports for a long time, they will have a trend to see that this is an outlier reporting item. This can trigger a need to verify that data using physical documents which can be scanned or e-mailed to the manager.

The researcher moved to the third theme under this section to explore the roles of the External BI consultants and the IT department in a BI environment.

5.4.3 Role of the external BI consultant and the IT department

5.4.3.1 Theoretical Assumptions

The assumption was that BI is not a plug-and-play solution and because of that they are both difficult to design as well as develop; thus managers need some assistance from technical support staff. The researcher, therefore, used the effort expectancy construct of UTAUT which is the perceived ease of use of the new system (in other words the degree to which the prospective user expects the new system to be free of effort) and the complexity construct, of DOI (which is the "the degree to which an innovation is perceived as difficult to understand and use").

This underpinned the researcher's thinking and influenced the way the questions were asked. The following is the summarised version of the interview extracts on the role of the external BI consultant and the IT department. A table is provided in Appendix B14. The interview transcripts and the original audio versions are also available in Atlas ti.

5.4.3.2 Summary of findings: The role of the information technology department and external consultants

> *"…The purpose of a business intelligence consultant is to come up with a semantic layer if it is messed up then it's difficult for the managers and even senior executives to understand how to transform data into information" (Interviewee No 6, 12 March 2021).*

The semantic layer is built in such a way that the objects can be used by everyone when preparing reports. Once the semantic layer is properly defined by the consultant and the objects are very clear, then the current practice is simply to "drag and drop" the specific focus items. The managers can also use graphs if desired. If the internal consultants have been trained in this area, then it's not necessary to work with the external consultant on the same issues because they will also be able to support the managers adequately.

In the above context, the roles of the BI consultant, managers as well as the IT department are still relevant. The modeling component is the technical part of the reporting that could require someone from IT or an appropriately skilled person in database terminologies. These technical staff then model the required information and rename the technical columns to use the day-to-day terms that are known by everyone connected to the use of the system within the organization. With databases some of the terms are not written using the day-to-day language; as an example, a specific field for a date might be written in some numeric characters. It will be the role of the consultant or IT person to rename those fields so that when the managers are viewing the objects, they will just see them in the terms they are familiar with.

> *"…IT's main role is, for selecting the infrastructure, they are the ones upon consulting business would determine to say now depending on your requirements and your volumes of data and your strategic plan this is the best tool for you. They are also involved in setting up the environment or the infrastructure and in the initial development of reports. They are also responsible for the management of the data warehouse from building it, optimising and maintaining it and all the other administrative work, including security" (Interviewee No 6, 12 March 2021).*

The IT department also comes in as the key stakeholder in terms of the specifications of the BI systems. They should lead user departments on how to carry out the implementation of the BI project as well in the initial development of reports. Usually, when the project commences, the external consultants give the IT department recommendations on the appropriate sizing of the servers required for the project. It is the role of the IT department to make those servers available for the consultant to work in. At the end of the project, IT owns the solution and becomes the first line of support. They are expected to resolve any minor issues that might arise concerning connectivity and access to the server hosting the BI solution. These roles are usually well-defined in terms of the aforementioned two aspects.

The researcher moved on to explore whether the respondents are aware of the benefits of using business intelligence systems as the last sub-theme of this section.

5.4.4 Benefits of using business intelligence systems

5.4.4.1 Theoretical Assumptions

The researcher used the performance expectancy of UTAUT which refers to the degree that an individual believes that using the system will help him/her to improve performance and the relative advantage of DOI which refers to "the degree to which an innovation is perceived as better than the idea it supersedes" as lenses. For an organisation using business intelligence; it is perceived to bring increased competitiveness, improved supplier engagements, improved customer services, and improved business opportunities. The nature of the assumed "improvements" is also a potential measurable.

The following is the summarised version of the interview extracts on the benefits of using business intelligence and interconnected systems and devices. A table is provided as Appendix B15. The interview transcripts and the original audio versions are also available in Atlas ti

5.4.4.2 Summary of findings: The benefits of using business intelligence and interconnected systems and devices

There are many benefits of using a BI system and the effect they have on behaviour and the intention to use the BI system. The interviewees were asked if they are aware of the benefits of having the BI system and several interconnected devices; the following is an example of their views.

> *"…These days we are living in a world where all decisions are fact-driven an organization needs to have a Business Intelligence Solution in place to enable them to do those fact-based decisions and predictions" (Interviewee No 6, 12 March 2021).*

This allows businesses to have insights into the current state of business, into the future, and their relationship with the past. Decisions are made using these capabilities to help the business to grow and operate optimally. If the managers want a competitive edge in the current environment, they need an analytics solution in place. They can use the BI solution and other interconnected systems to understand how their competitors and customers are behaving in the environment and use their data as a strategic tool to respond. This will assist them to make decisions timeously and accurately.

A good example is the vehicle tracking systems that can add significant value to the organization by looking at the drivers' behaviour. One of the challenges with drivers is that they handle one of the organization's most valuable assets which they typically use off-premises. They go to places where the manager may not know nor see them; thus using sensors becomes the managers' only source of objective data upon which to understand a driver's behaviour. The manager can also use those sensors as valuable tools to protect the vehicles as a cost-saving measure to monitor fuel consumption (another significant expense to the organization).

Therefore, it is key in this modern-day world to have interconnected systems. From the manufacturer's side, it will enable the buyers to follow up on their orders and the engineers to verify the availability of spares at the source before placing orders. They need solutions that access all the information in the environment and send it back into their data warehouse capability to make informed decisions. A business intelligence system then gives them the ability to analyse the information using what is commonly now called dashboards.

Sometimes it is not good for organizations to stick to the ERP for reporting because ERP systems are good for transacting but are not very useful for reporting. An ERP may not cater for all the business's reporting requirements. In such a case an application development company can be hired to develop an internal solution for only that specific aspect. Therefore, an organization may have two or three solutions for different aspects of its operation. The data that is then put into a data warehouse acts as summaries in star skimmers, fact tables, and dimensional tables, The major benefit of this approach is that for analytical purposes the average calculations are done at the database level and set in the data warehouse.

It could be argued that data in the BI data warehouse is usually replicated from the ERP system; however, it is important to note that it is stored in the context of 'normalisation'. Normalisation is the process of organizing data in a database table by creating relationships, Data in an ERP system is not usually in the form that is appropriate for analysis. In BI it is data warehoused if it is "de-normalised" so that it is presented in a manner that optimizes reporting. It is in this context when the principles by either Inmon or by Kimball are implemented where the principles of data warehousing apply.

This concludes the third section which deals with the four sub-themes; namely (i) Managers' expectations (ii) the need to verify data (iii) the role of the business intelligence consultant and Information technology department and (iv) Benefits of using business intelligence system.

In the last section, the following are focused on: (i) the preferred designer of BI reports (ii) the opinion on using a dedicated person to do analytics for managers, and (iii) the requirements to improve the usage of BI.

The researcher moved to the next theme. The following figure 5.5 shows the analysis map and the codes that were assigned.

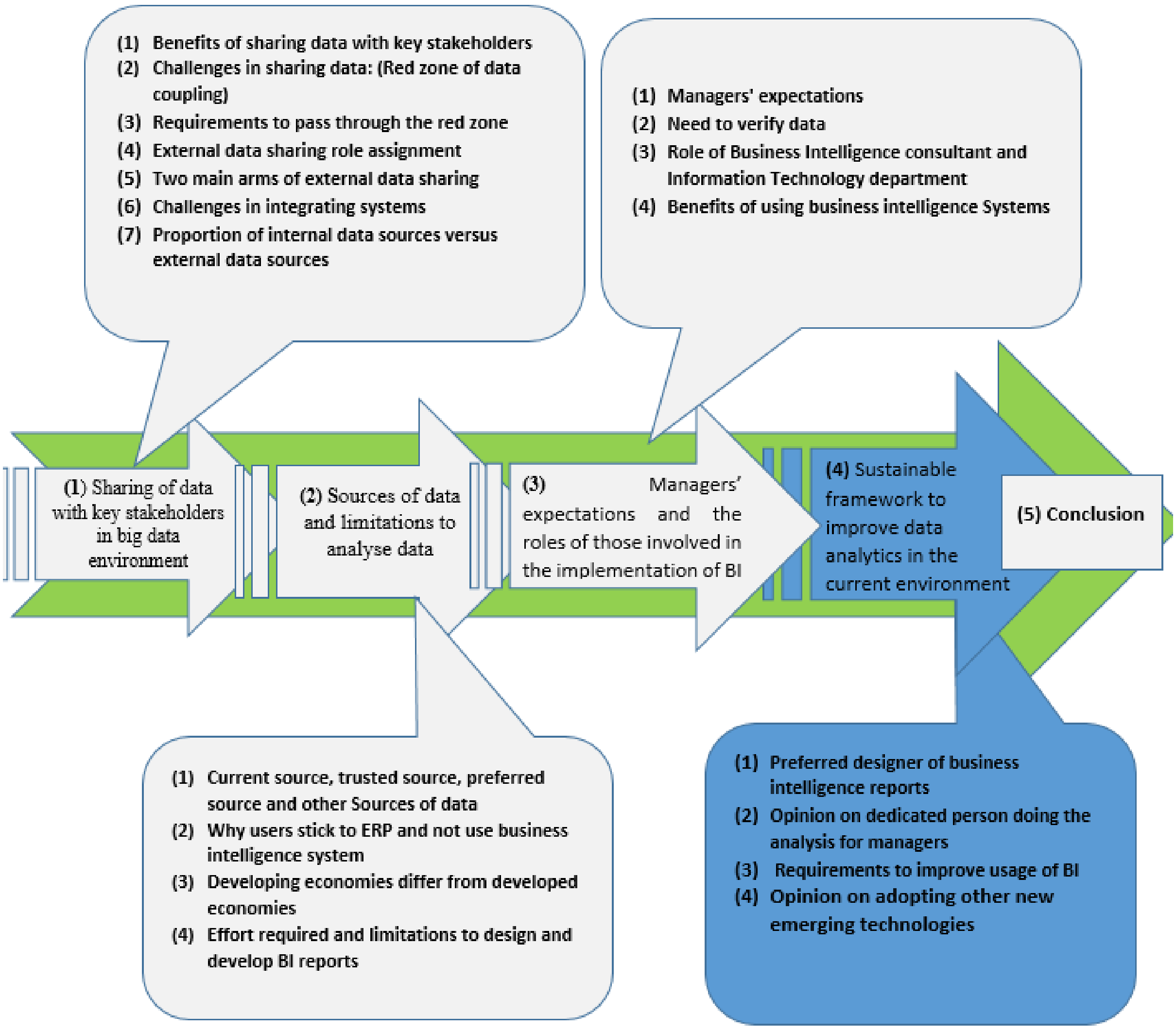


Figure 5.5: Data analysis map: Section 4

5.5 SUSTAINABLE FRAMEWORK TO IMPROVE DATA ANALYTICS IN THE CURRENT ENVIRONMENT

From the preceding sections, it is clear that BI is not a typical plug-and-play solution; both the managers and the consultants have to work hard to derive specific benefits from this process. From the limitations section, it was highlighted that managers are limited technically and do not have time whilst external consultants are limited in terms of business processes and internal consultants are limited in terms of both technical and business processes. The researcher focused on finding out what the preferred designer of BI reports is in such an environment. The following themes were assigned.

5.5.1 Preferred designer of business intelligence reports

The main Interview question to both executives, senior managers, and consultants was, *"in your own opinion, who do you think should design and develop BI reports between executives, senior managers, middle managers, and BI consultants and why do you think so?"*

5.5.1.1 Theoretical Assumptions

The assumption was there is a low uptake of BI solutions and even when the solution has been implemented the managers seem to avoid using these solutions. The researcher used two constructs of the two theories to review this perspective. The assumption was based on the effort expectancy of UTAUT which refers to the perceived ease of use of the new system; in other words, the degree to which the prospective user expects the new system to be free of effort and the complexity of DOI; which refers "to the degree to which an innovation is perceived as difficult to understand and use". This underpinned the researcher's thinking that perhaps managers need training or at the very least someone capable within this context, to work with a consultant.

The following is the summarised version of the interview extracts on the preferred designer of business intelligence reports. A table is provided in Appendix B16. The interview transcripts and the original audio versions are also available in Atlas ti.

5.5.1.2 Summary of findings: Preferred designer of business intelligence reports

The following is the outcome of the interviews.

Three approaches emerged (i) an all-stakeholders approach where all of them must be involved, (ii) the middle-of-the-park approach, and (iii) the lower-level approach to the designing of BI reports.

All stakeholders approach where all of them must be involved

The main reason why all stakeholders should be involved in the design of the reports is that all reports are not the same and this needs to be different based on their targeted audience. There are reports for the executives, reports for senior and middle managers as well as different functional areas of the business. The suggestion is that those lower-level reports, for example, middle managers, should have formats based on the fact that typically supervise or advise. For executive reports, the executives should design these themselves. The typical outcome of this process is something like a circle, with initial reports that come with the system being designed by BI consultants as the first circle and then reports used by managers as the second circle. Reports used by executives are typically the third circle as they encompass all the other reports. BI is mainly focused on executives and senior managers to enable them to make more informed decisions when analysing available data. They are the ones who know exactly what kind of data they require and what kind of business intelligence they require. It is thus consistent that they are the ones to design those reports within their reporting areas.

Another feature noticed during this process was that managers work with subordinates and it is very easy for them to give their subordinates deadlines to generate a report: *'Can you produce this report by midday tomorrow'*. The subordinate is now under pressure to produce that report even though they know the manager can have the report with the click of a button. Sometimes managers dwell too much on operations and what usually suffers is the data analysis component.

> *"…I think managers should design reports because they know what they want, and how they want the information presented. So as much as they might not be hands-on but still they need those reports for decision-making so if they delegate it to a lower level they might not capture other things that are needed at a strategic level of decision-making" (Interviewee No 10, 24 March 2021).*

The executives must be aware of this very important aspect and come up with an ideal organisation structure to address this.

The whole process of the all-stakeholder approach starts with the data administrator who is responsible for databases to make sure the data structure is perfect. Next is the role of the data engineer whose role now is to cleanse that data, extract it from the source, and manipulate it to come up with the required data warehouse. There is also a business analyst whose role now is to tap into the data mats and visualise the data in the data warehouse which is a very close approximation of designing a report. At this stage, any manager including executives should be able to do his/her departmental report using simplified BI tools.

The middle of the park approach is when the senior managers design the reports.

The argument is, that senior managers have one arm that speaks to operations and the other arm that speaks to executives, and therefore they are better placed to design the reports. They are also closer to the source of the data and should know what they want to achieve.

> *"…The senior managers are more on the day–to-day operations, they also report to executives so they are better placed to design BI reports" (Interviewee No 9, 23 March 2021).*

These managers also work with the supervisors who also give them information that they put together in a summary form and which then goes to the executives for them to make their own decisions.

> *"…Managers have an understanding of the upper side and the lower side of business i.e. operational KPIs (Key Performance Indicators) and strategic KPIs since the executives, request information from them so the managers are better placed to design the reports" (Interviewee No 6, 12 March 2021).*

In the case of a manufacturing operation, those senior managers know how the speed of a certain issue affects production efficiencies. All the information they are seeing may be coming from sensors in the factory that are linked to the BI system.

The manager defines what is needed to go into the report and the report should come out as defined. As a start, they can design these reports using the tools that they are familiar with, which may include putting in on paper or even in an Excel sheet. The whole idea is to at least have a design to put forward to the consultant in a format that enables the consultant to have a general sense of their requirements.

That way the initial BI reports will at least be done by a technically well-versed person who knows the database technology whilst working with the senior managers. The reports will be reliable and trusted because they would have been developed based on what the senior managers want. If the organisation has got internal personnel who are good at BI technology, then the development of reports can be done in-house. In cases where the organisation does not have such personnel, it is better to outsource this technology so that the external consultants will lead in a very clear way on how to design the reports and at the same time train the managers and internal consultants in that process.

The lower-level approach to the designing of business intelligence reports

The other approach is the lower-level approach of designing BI reports, where lower-level managers with the help of internal or external consultants design the BI reports. The argument for this approach is focused on the time constraints faced by senior managers and executives who may have the capacity to design reports but not necessarily the time to do so. The external consultants highlighted that they prefer to work with lower-level managers.

This preference was followed up with a question posed to the consultants by the researcher and the response was:

> *"…The low-level managers are more hands-on, with BI some staff might get technical and the executives do not have the time and patience to spend a bit of time researching technical issues that crop up. So executives and senior managers must just present their requirements e.g. to see sales per region and then the low-level managers with the help of consultants develop the report based on that. In the process, the consultants must also train the lower-level managers to develop the reports that are consumed by the people higher up like the executives and senior managers" (Interviewee No 15, 28 April 2021).*

Lack of time and lack of skills appeared to be big issues that continued to emerge. The researcher then decided to explore the idea of having a dedicated person to do the analytics for managers

5.5.2 Opinion on using a dedicated person to do the analysis for managers

5.5.2.1 Theoretical Assumptions

The assumption was, there is low uptake of these BI solutions and even if a solution has been developed the managers seem not to use it for analytics. The researcher used the effort expectancy construct of the UTAUT theory which refers to the perceived ease of use of the new system, in other words, the degree to which the prospective user expects the new system to be free of effort and the complexity construct, of DOI, which refers "to the degree to which an innovation is perceived as difficult to understand and use". This underpinned the researcher's thinking that perhaps managers needed a dedicated person competent to do data analysis for them. This influenced the way the researcher asked the interview and probing questions under this theme.

The following is the summarised version of the interview extracts on the opinion to have a dedicated person to do the analytics for managers. A table is provided in Appendix B17. The interview transcripts and the original audio versions are also available in Atlas ti

5.5.2.2 Summary of findings: Opinions on using a dedicated person to do the analysis for managers

Two scenarios emerged from this theme being, (i) those who believe that a dedicated person is needed and (ii) those who believe that there is no need for a dedicated person.

i) Those who believe that a dedicated person is needed

If managers in a department are limited technically and also lack time due to commitments in operations, then definitely it makes sense to have a dedicated person to do analytics for the entire department. For example, in departments such as manufacturing and engineering, managers sometimes have an almost exclusive focus on operations, and data analysis is often neglected because of this.

> *"Take for example a department like engineering, they deal with breakdowns and plant maintenance, and usually when the engineers are dealing with breakdowns everyone will be running around to solve the problem so in such a department there is a need for someone who just stands and have a bird view, not involved in the rush and running around to look at the problem so that next time it will not recur" (Focus Group Participant 1, 08 July 2021).*

For engineers the work is hands-on, so one or two people should do data analysis and the rest of the team have their focus on their core business to ensure the required work is being done.

In manufacturing and engineering, that person is needed now more than ever in the age of transitioning to "smart factories".

This role requires someone good at systems with some programming background and who understands the pertinent operational or business issues and is then in a position to provide computer-based solutions. That person becomes the department's call point person in terms of technological development issues within that department.
However, senior management or executives are usually not very comfortable with the idea of having a dedicated person.

> *"…A dedicated person is ideal if that person is also driving the agenda of the business information system in that particular department" (Interviewee No 4, 7 March 2021).*

That specific person will over and above his or her duties be assigned the responsibility of continuously spearheading these processes whether they be manufacturing processes, sales processes, finance, or human resources. That person must be good at systems and understand the relevant issues; he/she must be able to both assess them and provide solutions. This would also depend on the structure of the organization's digital strategy.

However, some managers argued that a BI system is for the managers therefore, everyone should use it.

> *"…Once one person is doing data analysis for the whole department, then all the other managers in that department will shun the system for that person to do the analysis and produce the reports" (Interviewee No 11, 26 March 2021).*

It is not necessarily about one person doing all the work for others, everyone should be involved in basic analytics. Once you assign one person to do data analysis it will only be one person who knows the system and the reports. Yet the system is for everyone. That does not promote the use of the BI to support a deeper understanding of the business environment. They argue if information can easily be "automated" and managers are trained on how to mine the data from the system; then they should do it on their own.

> *"…A dedicated person won't be fully utilised because some of the information that people in the department require can easily be automated so what then will that person be doing. That person would not add value but someone who is doing other responsibilities as well will add value" (Interviewee No 13, 07 April 2021).*

The above would be the case if the system is configured correctly and reports are coming out correctly and the managers are trained on how to mine the data from the system. Perhaps that person can be given other duties like monitoring the system to minimize unauthorized access.

The researcher decided to further explore what then needs to be done by managers to improve the usage of BI and start mining the new value opportunity in the form of big data.

5.5.3 Requirements to improve the usage of BI

5.5.3.1 Theoretical Assumptions

The approach was to focus on the low uptake of BI solutions and even when the solution has been developed, the managers seem not to use the solution. The researcher used the performance expectancy of UTAUT which refers to the degree that an individual believes that using the system will help him improve performance and the relative advantage of DOI which refers to "the degree to which an innovation is perceived as better than the idea it supersedes".

The assumption was that perhaps the managers do not see the benefits. The managers think of the effort expectancy of UTAUT which refers to the perceived ease of use of the new system in other words the degree to which the prospective user expects the new system to be free of effort the complexity of DOI which refers “to the degree to which an innovation is perceived as difficult to understand and use”.

The following is the summarised version of the interview extracts on requirements to improve the usage of BI. A table is provided in Appendix B17. The interview transcripts and the original audio versions are also available in Atlas ti.

5.5.3.2 Summary of findings: Requirements to improve the usage of BI

. “…I strongly believe that the success of any technological development does not start with sophisticated systems it should target what people cherish the most. What do I mean, if you want people to embrace business intelligence systems, new systems, and gadgets, start with what they require daily, this is how it works” (Interviewee No 8, 23 March 2021).

For example, if a travel and subsistence form is automated, people would want to claim their money, and even lower-level employees will be forced to use the gadgets to enter their claims. They can only be paid effectively on time if they use a mobile device to claim their money. This means an organization would have planned an automation agenda for the lowest possible employee in the company. This is how technology is implemented and users are directed to its application. Whether that is the correct approach or not; is another question. Therefore, the basic thing is to examine current manual systems being used daily and to find the big issues there. Once that is done then it will be much easier to introduce any system; BI included.

> *“…The configuration of the reports needs to be simplified; the managers do not want it complicated because at the end of the day what they want to do is to get as much information as they can but it should be giving them value. BI should be customized so that managers can be able to say if I do this it will come out like this if I do this it will be like this” (Interviewee No 13, 07 April 2021).*

There is an improvement in how BI software companies are designing reporting solutions. They are trying to promote self-service to reduce the effort that is required for anyone to generate a basic report. They are now employing more drag-and-drop functionality in their reporting solutions so it is now possible for executives to generate reports easily.

> *“…To improve the usage of BI systems, it all depends on the value that the organization puts in information. Sometimes in meetings where information is used, most people just use their experience which is not backed up with information from systems. There is a tendency to ignore information that is coming from system reports. Therefore, management should put value in the information and somehow make it*

very clear in their policies or in the way they interact with people to say, do not just say something without backing it with information from systems" (Interviewee No 7, 18 March 2021).

Whenever somebody makes a statement, it should be backed up with information from a credible source like the ERP system or the BI system or even cite the source of information as a matter of policy. People should not use past information which is not backed with facts on the ground to avoid decisions being taken based on that supposition.

For BI to function well both business people and technical people should work together. There are situations where there is no buy-in, especially from top management; which inevitably means that such designs are usually not very successful. Executives are the ones that provide the funds and projects usually fail because they lack backing from the top.

"…It is all about putting value in the information that is already there and when people are put to task for them to analyse that information and make decisions based on facts, then most people will be able to jump on and use the BI systems" (Interviewee No 7, 18 March 2021).

The questions to consider are: do they want to do it, would they like to do it, and do they have to do it? Once it is clear what the motivation is, the orientation for better technological advancement and the organization's need for it; would support such an approach.

However, this also depends on the specific manager's key result area as well. In some functions like finance where quantitative inputs are more critical; managers in such departments are more supportive of designing their own reports. However, other managers who are measured on the qualitative data; appear to have more challenges when they want to design their own reports. Training in that context is critical.

There is a need to expose the whole organization, to the benefits of BI before anything else is done. In this case, it is a matter of finding ways of highlighting to people the purpose of a BI system and the advantages of using such a system in the organization. This is important especially if it is the first implementation of BI. It should be a top-down approach whereby it starts from the top being supported by the highest level because it involves some level of investment in either the mobile tools or automated machine sensors to count the output at the end of a production line. The fact that it needs investment in capital expenditure means it has to be supported from the top, and that way it can be implemented and be effective.

Managers have to ensure that issues concerning support, such as training and upgrading are also incorporated into their budgets because from time to time there will be a need to upgrade the hardware and software as the process unfolds.

Some of the managers have been involved in the implementation of many systems. They argue that systems must be given time to mature so implementers must have the patience to allow these systems to be improved until they are perfect. If the implementer is not sensitive to this need for patience, people will easily default and revert to their old ways even if those were processes that took time and could be less reliable.

Systems have to be integrated so that they do not appear as silos. This will prevent user fatigue because people are managing several systems at the same time. They might object because there are too many systems and each system might need its own monitoring.

> *"…If an organisation has got IT as a standalone department, it can be used to assist in spearheading the agenda of going digital because technology is now the new life. Currently, there is a crisis due to COVID-19 lockdowns and there is no choice but to embrace technology so there is no way an organisation may want to stick with what it's currently using because that system it is currently using can become obsolete, and can stop anytime. These days people can work online from home. They need all these platforms to be effective and one of the systems can be a fallback at the end of the day. It is very important for an organisation to always explore as many IT information systems as it can because we are in the times of technology" (Interviewee No 10, 24 March 2021).*

When training people on the value of the new system it will bring to the fore certain important issues which must be included, for example, giving them a guarantee that IT will not make their jobs redundant, this will ensure that resistance to change does not occur.

A system's uptake is as good as the level of how much people believe in it. The companies that offer these solutions must expose the rest of the business community to the benefits of going onto these platforms. They must link it to issues of costs and efficiencies. The recent COVID pandemic indicated that these systems made it possible to continue doing business and not having to physically meet did not stop this process.

People want to adopt these solutions. It is now the role of the Organisational Change Management (OCM) consultant to make people aware of these solutions. However, OCM consultants are rarely seen on projects yet the role is very critical. They hype up the users so that they get excited about any new solution coming on board. They are the link between the strategy and its execution on the ground. Without them, the project is likely to fail.

Having exhausted all the other sub-themes, the researcher decided to close by exploring the managers' opinions on a number of new emerging technologies. From the preceding sections, it was quite clear that the managers trust their ERP and BI systems. However, we are now living in a world characterised by a number of other new emerging technologies. This new environment requires managers to embrace these emerging technologies and also change the way of doing business to exploit big data opportunities. The questions in the researcher's mind were: What are managers' opinions about these emerging technologies: Are they confused by these emerging technologies, do they intend to embrace them, or do they think the ERP and BI systems are enough for them? The researcher allocated a sub-theme to look at this important aspect and this formed the basis of providing a sustainable framework to work in this new environment of emerging technologies.

5.5.4 Opinion on adopting other new emerging technologies in the current environment.

5.4.4.1 Theoretical Assumptions

The DOI theory's complexity construct which refers "to the degree to which an innovation is perceived as difficult to understand and use" was used to look at this theme. The five communication stages of the theory (i) knowledge-awareness, (ii) persuasion, (iii) decision (iv) implementation, and (v) confirmation, were used since the managers make the decision to adopt and implement the new emerging technologies. They helped to measure the complexity of integrating the relevant emerging technologies needed in the current environment. They were helpful to ask relevant questions and check if the managers have gone past the persuasion stage and whether they have developed a positive attitude towards the innovation. Do they trust these new technologies, and do they want to continue investing in them? Are they knowledgeable and aware of these other emerging technologies that create new sources of information and the benefits that come with that in the form of relative advantage? Do they believe that facilitating conditions exist, in the form of organisational structure and technical infrastructure to benefit from these new sources?

These guided the interview questions. The main interview question posed to managers and consultants, was "What is your opinion on having a lot of interconnected systems and gadgets, do you think it is relevant to your operations to continuously add new systems as they emerge, does it add value, or it is now confusing?

The following is the summarised version of the interview extracts on managers' opinions on a number of emerging technologies. A table is provided in Appendix B19. The interview transcripts and the original audio versions are also available in Atlas ti.

5.5.4.2 Summary of findings: Opinions on adopting other new emerging technologies in the current environment.

Managers are aware that these days they are living in a digital world and they expect the internal IT department to lead the adoption process.

> *"…My plea to the Information Technology team is please lead us we can automate using our internal staff they can be able to lead the adoption of these new technologies" (Interviewee No 4, 7 March 2021).*

Managers are not confused about the abundance of new emerging technologies because they know that it is the new normal so they have to embrace these new technologies.

> *"…Confusing it may be yes but unfortunately we have to deal with that confusion definitely because the new world, unfortunately, demands that we have to work with a number of gadgets and not only the gadgets but systems and programs. We have to understand, if we don't understand, then we must at least have an appreciation of these technological interventions not only within your department but across all the departments because technology is now becoming not only a dilemma but a language if we speak the language then we progress*
>
> *Remember the idea is to enable us to make decisions that are accurate and fast so these gadgets are coming in to do that so no one will hate them as long as they are coming to help me, they are making my life easy they are removing stress so it's better to love them but if they are not bringing the intended benefits then they become a nuisance" (Interviewee No 8, 23 March 2021).*

They know that by investing in the latest technologies they will be equipped to make quality decisions and they can use the resultant information as a strategic tool to respond to competition. They know that they can no longer rely on one form of technology like the ERP system designed to cover the entire value chain for transactional purposes.

> *"…With a number of systems, we can get the information we want from various sources and that cements our decision-making. If you work in manufacturing like us and we can get data that we can turn into information from various sources, then we are best equipped to make good decisions for the benefit of the company" (Interviewee No 4, 7 March 2021).*
>
> *"So it is very important to explore as many systems as we can so that we are moving with the times" (Interviewee No 10, 24 March 2021)*

However, we should not just go by the wind to invest in each and every new technology that comes on board.

"…What is also more critical is not to follow what other people are doing but based on what value you get from those new systems. I think there is a tendency, especially in the IT sector to just go with time without necessarily getting value from those systems so I think the issue of a feed gap analysis is very critical" (Interviewee No 7, 18 March 2021).

5.6 CHAPTER SUMMARY

The chapter began by presenting the findings of the research study on sharing data with key stakeholders in the big data environment.

Section one focused on the benefits of sharing data and the challenges encountered when trying to share the data. This resulted in what the researcher called the "red zone" of data coupling and the requirement to pass through this red zone was stated. This was followed by the proposal to use procurement and sales and marketing as the two arms of interfacing with the outside world. The role assignment was discussed and the proposal was to use the highest level of executives to negotiate for external data sharing. The section concluded with findings on the proportion of external data versus internal data. Challenges of integrating the systems were also highlighted.

Section two covered the current, trusted, preferred, and other sources of data used by managers when making decisions to improve BI. It also covered why managers stick to using the ERP for analytics, the effort required and the limitations to design and develop BI reports. It also highlighted how developing economies differ from developing economies in a general sense. The section concluded with the effort required and limitations to design and develop BI reports.

The third section covered the managers' expectations, the need to verify data, and the role of those involved in the implementation and usage of BI systems such as BI consultants: both external and internal, the managers, and the IT department. The section also covered the benefits of using BI systems to tap into various sources of data.

The last section covered the preferred designer of BI reports, and opinions on using a dedicated person to do the analytics on behalf of managers. It also covered the requirements needed to improve the usage of BI systems. The section concluded with managers' opinions on adopting other new emerging technologies.

The next chapter is dedicated to discussing the findings in this chapter following the same sequence of main themes and sub-themes. The discussions appeal to the extant literature and the theoretical assumptions made.

CHAPTER 6

DISCUSSION OF FINDINGS

6. INTRODUCTION

This chapter discusses the findings of the results that were obtained from this research study and links them to findings in the extant literature. The discussions follow the same sequence of themes that emerged during data collection as they were presented in the previous chapter of data analysis. These are shown in the following figure 6.1.

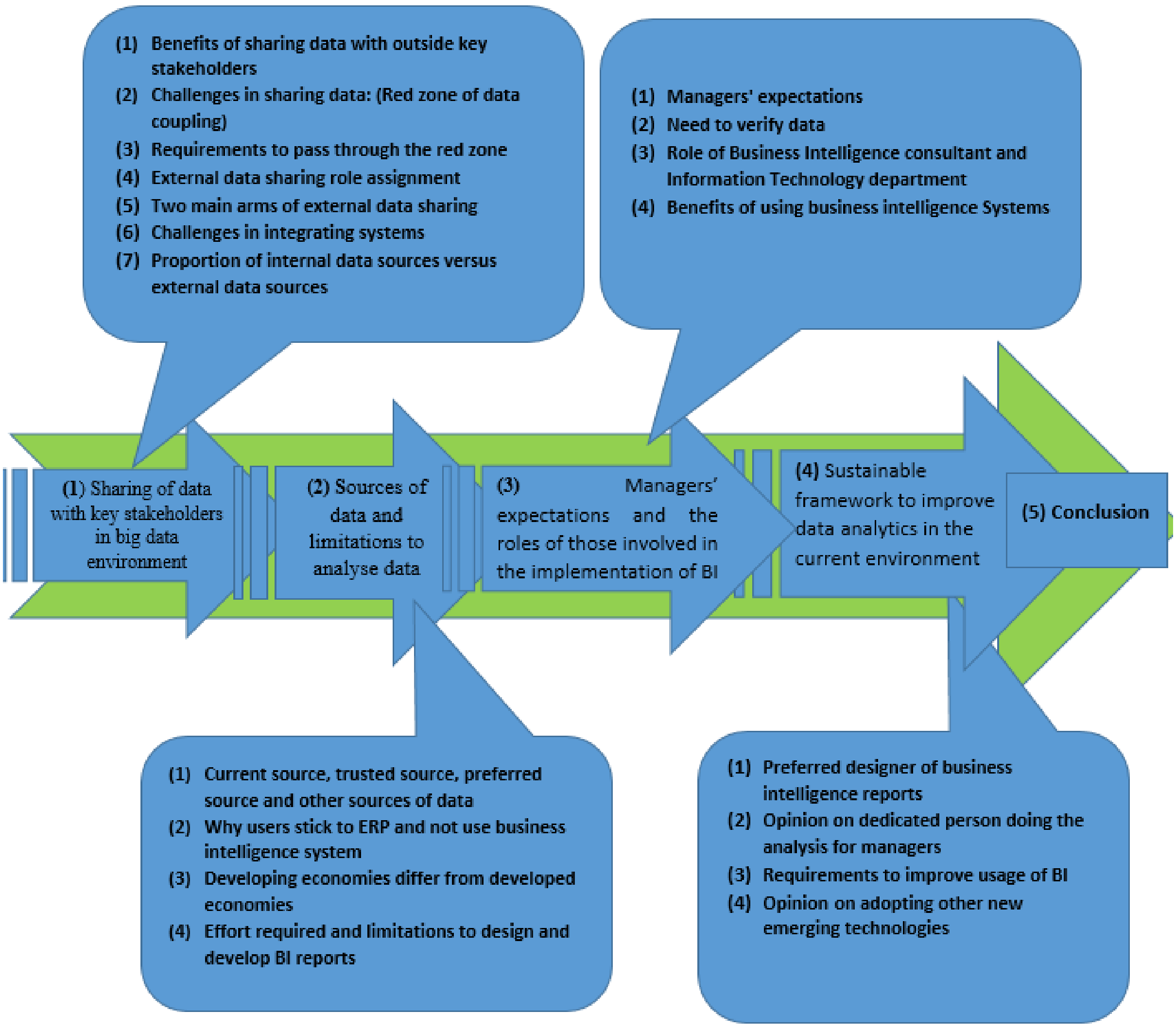


Figure 6.1: Discussion analysis map

6.1 Discussion of outcomes

The following adjoining sections will discuss the research study findings based on specific sub-themes that emerged from the research study.

6.1.1 Benefits of sharing data

The first theme was aimed at finding out whether the managers see any benefits in sharing data with key stakeholders such as strategic customers and suppliers via interconnected systems.

From the previous data analysis chapter under this theme, it was quite clear that the managers are aware of the benefits associated with electronically exchanging data with external key stakeholders such as suppliers and customers as well as in the big data environment. They all were urgent about this for planning purposes. However, they do have reservations about that, in that they want to limit whatever these partners can access for fear of exposing amongst other things their strategies. This introduces the notion of negotiating for whatever has to be shared.

New items that emerged here are that when dealing with the suppliers of materials the manufacturer is more than willing to share data because it is to the manufacturer's advantage to know the suppliers' capacity so that the manufacturer can plan effectively. This allows the manufacturer to electronically compare various sources so that it can service its customers more effectively. However, this depends on whether the supplier is the sole supplier of the materials. They suggest that this approach first be attempted with a few trusted trading partners before opening up the systems to a broader range of business intermediaries.

The three theories (UTAUT, DOI, and SET) used in this research study also placed benefits at the center of sharing data with key stakeholders as highlighted in the theoretical framework chapter.

The literature confirmed that the benefits are immense if the strategic and operative exchange of data in the big data environment is embraced by organisations along the supply chain. It results in cost reduction and value creation both upstream and downstream as well as the improved flow of products and services (Korpela & Dahlberg, 2017). However, many firms are still using old practises of managing costs (Bag *et al.*, 2021). If external data from suppliers and customers in the big data environment are incorporated into the budgeting process, it can be drastically changed for the better (Griffin & Wright, 2015; Valle-cruz, Fernandez-cortez & Gil-garcia, 2022). Sharing and accessing data via interconnected devices is at the center of any big data strategy in the big data environment. To leverage big data, there is a need to only share useful data that supports the vision and strategy of the organisation (Ng *et al.*, 2017). The first sub-theme was, therefore, derived from this very important aspect. Mckinsey Analytics predicted a borderless world where new ecosystems will replace traditional industries. These will become more visible as data sources that can allow companies to pinpoint critical data that creates value on points along the value chain. These ecosystems will vary by country and region depending on the pool of youths who are tech-savvy, consumers, and regulations (Henke & Kaka, 2018).

In his book Schmarzo (2016), divided the benefits following the value chain as follows: in procurement, there will be cost-effective supplies in stores, and there will be optimised inventory controls through predictive analysis. In manufacturing, there will be improved monitoring of machinery breakdowns, and in sales, marketing and distribution improved supply chain activities that rely on delivery tracking using geo maps (Ziora, 2015; Wamba *et al.*, 2020). An integral part of big data analytics is hinged on external data processing for sense-making (Kwon, Lee & Shin, 2014). In manufacturing, big data analytics improves supply chain resilience (Spieske & Birkel, 2020). Devlin (2016) adds that some managers are likely to miss the new benefits because they still think that big data are the most overhyped and abused term and thus not seeing the specific benefits that could accrue to their own business areas.

Given the above situation why then are managers not electronically sharing data with their key stakeholders such as customers and suppliers if they are aware of the benefits? This was the researcher's next point of focus.

The second theme sought to probe the managers further to find out what was limiting them to share their data with key stakeholders if they are aware of the benefits. The researcher wanted to find out if they are comfortable sharing data, the reservations they might have, and what then needs to be done to start sharing data with strategic partners. This is to align their position that it is key to tap into external data if the value is to be realised from the big data environment.

6.1.2 Challenges in sharing data: the red zone of data coupling

What emerged from this theme is that the managers are willing to electronically share just basic data in the big data environment. When it comes to how the business is taking its direction or aligning its mission and goals; then such critical data cannot be shared. Benefits are realized in a normal environment but in a competitive environment there is a higher risk and if the issue of risk is not addressed, they are hesitant to share their data.

In the literature, it appeared as if the data can just be easily accessed for analysis, but some authors highlighted that sharing the data and ethical considerations are still a big issue (Herschel & Miori, 2017). If rights are not observed properly, access to big data can be harmful to certain groups or individuals by infringing on their rights (Hilbert, 2016). It is quite clear that without first addressing ethical considerations, external data cannot be easily accessed for analysis because there are still big issues there (Herschel & Miori, 2017; Ogbuke *et al.*, 2022). Security measures must be addressed first before the organisation acquires the data and integrate it with its own internal data (EY, 2014).

Having identified the managers' reservations on exchanging key data with key stakeholders such as customers and suppliers the researcher's next focus was to probe them further on what then needs to be done to overcome these challenges hindering the exchanging of data because it's key stakeholders; if the value is to be extracted from the big data through analytics. The following theme was assigned to specifically find out what the managers want to overcome in terms of the challenges they highlighted.

6.1.3 Requirements to pass through the red zone

What became evident is that managers have to play a part by signing MOUs, NDAs, and service level agreements and negotiating for the data to be shared and only then form data value chains with key stakeholders. The issue of risk seems to be the major stumbling block though it's not talked about in the three theories used in this research study. The desire to electronically share data is there, however, there is no willingness to share data for fear of exposing the internal business strategies. These two elements emerged as key elements that were later incorporated into the framework.

Chapter 2 literature review highlights that: perhaps to overcome this problem, organisations may have to form partnerships, clusters, or common beneficial domains, with those willing to share the data for a common cause. Dealing with external data is still a grey area that must be addressed (Baesens *et al*., 2016). An almost similar principle that worked is the Australian urban research infrastructure where an e-infrastructure that encourages sharing of datasets was established in 2010. It resulted in improved service delivery and economic activities (Sinnott & AURIN-Technical-Team, 2016). Master data management has recently attracted a lot of attention and Gartner proposed a fundamental framework of MDM (Master Data Management). However, there is a need to guard against a single point of failure that can emanate from one single source and be catastrophic across the whole chain of activities. There is a need to only share useful clean data that supports the strategy of the organisation (Ng *et al.*, 2017).

The DOI theory determinant of observability which is “the degree to which the results of the innovation are visible to others” is very apparent here. It can be used to persuade others to change, (Robinson, 2009). The DOI theory was also reflected here through the organisation’s readiness to integrate its data with that of external stakeholders such as customers and suppliers. This has an additional effect in terms of placing organisations as innovators, early adopters, early majority, late majority, or laggards**.**

The facilitating conditions construct of the UTAUT which refers to the degree to which an individual or organisation believes that an organisational structure and technical infrastructure exist to support the use of the new technology is also visible. It can be used to check if an organization has facilitating conditions in the form of appropriate organizational structure, MOUs, and NDAs to facilitate the sharing of data.

Having discussed the external data sharing issues and identified the managers’ reservations the researcher decided to look at who then should be assigned the role of bringing the external data into the organisation. The following theme code was assigned to achieve this.

6.1.4 External data role assignment

Literature confirms the use of a person who is good at analytics, has a quantitative orientation, is quite versatile, and is also able to understand the whole business context. To derive value from big data, companies may need to invest in data scientists who can support traditional managerial functions (Sestino *et al.*, 2020). There is a suggestion to use a data scientist with the following three sets of skills required, (i) knowledge about data and analytics (ii) knowledge about tools and infrastructure (iii) knowledge about business products, services, and operations (Grossman & Siegel, 2014; Côrte-Real *et al.*, 2019).

However, this role is for analysing the data and the other aspect of negotiating for the data are missing. The attitude of such a person is also missing in the literature. Both the managers and consultants prefer this to be done at the highest possible level to allow for negotiations of the data to be shared. They suggest that the executives are better placed for that and if they are short of skills that they find someone to work with. They, therefore, emphasise risk and ethical considerations more than technical aspects. Considering that the executives are the ones who drive policies this could be the reason why adopting big data initiatives is lagging. Trading customers and suppliers may not be willing to deal with the data scientist to electronically share data.

The theories used in this research study seem to leave out the elements of risk and confidentiality as key moderators. These two emerged as new items that were further synthesised as contributions in chapter 7. The above discussed the role assignment and in the process identified procurement and sales and marketing as the two main possible arms of interfacing with external key stakeholders. The researcher decided to allocate the following theme code to closely look at these two as arms of business that interface with the external business environment.

6.1.5 Use of procurement, sales, and marketing as main arms of sharing data

The idea to use these departments as strategic data entry points emerged as a new item. The researcher then used this item as the basis for building the framework developed in chapter 6. Implementing a big data strategy anchored on these two arms because they bring more external data value to the organization than trying to bring the data via many departments. From this realignment, it became evident that managers are aware of the benefits of sharing their internal data with their key stakeholders such as customers and they see that exchange happening between these two arms.

In literature, it was highlighted that another way to define big data is to define them in terms of transactions versus non-transactions and internal versus external (Baesens *et al*., 2016). Sharing the data and ethical considerations are still a big issue even though it appears the data can just be easily accessed for analysis (Herschel & Miori, 2017; Ogbuke *et al.*, 2022). The focus is now shifting towards analysing both internal and external data but for years, it was on Information Technology focusing on internally generated data only. Therefore, external data must make sense before processing it (Kwon, Lee & Shin, 2014).

After discussing data sharing and the role assignment, the researcher then decided to find out from the BI consultants, if it is easy to integrate the systems and share the data. The following theme code was assigned to explore this aspect.

6.1.6 System integration

From the above explanations, it is quite clear that the challenges of integrating the systems are mainly technical and are mainly faced by the consultants. What the consultants said here is confirmation of literature where it was highlighted that when acquiring data from different sources organisations face three main challenges: (i) data challenges, (ii) process challenges, and (iii) management challenges (Sivarajah *et al*., 2017). Data cleaning was also highlighted as the major challenge by the consultants. Literature also highlighted data cleaning as a major problem that has always resurfaced to an extent that the industry has been forced to deal with it regularly (Rahm & Do, 2000; Sivarajah *al.*, 2017; Sandhu, 2022). The dire need to tap into the externally generated data, which comes from various disparate sources has caused the problem to be more pronounced now. Data cleaning is considered a major challenge now due to advancements in technology (Tang, 2014).

What was also highlighted by the consultants is the delay by other organisations to upgrade their systems making it difficult for those that have moved on, to integrate with such organisations. There is a suggestion that encourages organisations to choose known systems that integrate with key stakeholders' systems; which have their own set of challenges in the marketplace of vendors.

Having discussed the system integration issues mainly with the consultants, the researcher decided to conclude this section by checking the proportion of internally generated data versus external externally generated data. It was key to hear from the external consultants the usual proportion of data in the data warehouse as well as tapping into their experience in projects where they have implemented and supported BI systems.

The following theme code was assigned to this analysis.

6.1.7 Composition of internal data versus external data

What emerged from this theme is that, organisations put mainly internal transactional data into their data warehouses. An interesting concept of using the web portal to exchange targeted specific data also emerged. However, not all customers transact via the web portal. Companies could bargain to exchange data at the portal level where the portal could be used to tap into more data other than just for selling and purchasing only. The main challenge is that of replicating the same internally generated data from the ERP into the data warehouse. This could be the reason why organisations are not benefitting from big data and it confirms that sharing of data electronically is still a big issue.

Literature confirms the challenge of tapping into external data: The external unstructured data are scattered in different unrelated locations (Schubmehl & Vesset, 2014). Internal transactional data are easier to deal with compared to external non-transactional data (Baesens *et al*., 2016). For that reason, most of the data housed in organisations are internal historical data for regulatory and reporting requirements (Cognizant20-20Insights, 2011). There is a lack of skills, knowledge, and wisdom to convert this data into valuable intelligence (Villars & Olofson, 2011; Zhao *et al*, 2014).

This concluded the researcher's analysis of the seven sub-themes that were allocated to electronically sharing external data in the big data environment and role assignment.
The researcher then moved on to find out what is limiting managers from using business intelligence to analyze the data. It was important for the researcher to first understand the current source of data for analysis and then move on to find out what the trusted and preferred sources were. The main aim was to find appropriate answers to the main research study question: What is limiting managers from using BI systems to analyse data in the big data environment?

6.2 Sources of data

What emerged from this theme was that the managers' first preferred source of data is the ERP system. This is because the ERP system is real-time and enterprise-wide. It looks at information on a broader scale, therefore it is their number one preference. BI is their second preference because BI is usually, but not always, customized and looks at the business needs. In terms of what they need to see, it produces user-friendly reports allowing them to quickly understand the business context and make effective decisions. The managers are concerned when using the mobile platform and people as sources of data because these platforms are usually driven by what people upload.
The mobile sources are usually the WhatsApp (WA) of groups where they share information, the quality of which depends on what people share on those platforms. On WA the issues of both the integrity of the information, the source of the information, and the level of trust in the information arise; all related to affirming that they are getting the right information. Sensors and cameras in terms of trust levels are very high but they think they are also limited in terms of what they can give them because they are designed to sense or to pick specific pieces of information and not necessarily across the business. Overall they would want to have a high breed of all these platforms to feed into their ERP system so that at the end of the day the ERP system gives them the final result. All these platforms are useful across all levels of business but within a certain context. The data from WA referred to by managers above is part of those other sources that breed unstructured data and managers confirmed that they do not rely on it

too much not because of the structure of the data, but because of the untrusted source which constantly needs verification.

Variety is considered to be the main dispute challenge to data analysis (Banumathi & Aloysius, 2017). The bulk of data in the big data environment is unstructured making it difficult to put it into a relational database thereby complicating the role of data analysts and managers (Ishwarappa & Anuradha, 2015)It is believed that processing real-time moving data has more value than processing historical batched data (Hashem *et al.*, 2015). The bulk of the data in the big data environment is unstructured data making it difficult to put that data into a relational database thereby complicating the role of data analysts and managers (Ishwarappa & Anuradha, 2015). By this, literature concentrates on the technical aspects of tapping into this data, leaving out the element of trust as the key attribute. The transactional systems used by the organisation for daily operations produce data through postings and logs from sensors and equipment (Dijcks, 2013)

From the above extracts, it was very clear that managers' trusted sources of reports, in order of preference, are:

(1) Machine sensors and cameras: If it senses hot it's hot and if cold it's cold, but currently the managers are not using them. The same exists with cameras they trust; if a camera sees red it will be red, and if blue it will be blue. They currently use cameras only for isolated incidents like theft and misconduct.

(2) ERP: As the primary source because that is where the transactions take place, access is controlled and data there talks to other departments unless the error is emanating from original postings.

(3) BI systems: As a secondary system, it may sometimes differ from what is in ERP depending on how the reports have been developed and whether they have been synchronised because at times the reports are not accurate due to poor configuration at inception. They work well once corrected.

(4) People: There is a need for verification due to the risk of human errors and the risk of manipulation, to suit individual needs so the information may not be on record, and with people, there are things that always get lost in translation.

(5) Mobile devices via social media: They see this as a grey area with some element of truth and sometimes get high-risk information so there is room for manipulation; thus verification is needed

(6) External source data needs to be scrutinized further.

This confirms that the data analysed in the BI system, for now, is a replica of information in the ERP system. Therefore, whenever there is a slight difference, the managers always revert to the ERP.

The literature highlights external sources as the ones hiding the much-needed value from the big data environment. Filtering the most important data from all the data collected by the organisation is the only way of creating value from the big data (Kata, Wazid & Goudar, 2013) In this research study, the managers placed external data at the last. This confirms that they have to negotiate for this data to get clean data which is almost similar to that in the ERP and BI systems. In literature, it was highlighted that data can be misleading if it is incorrect and outdated, especially if it is coming from unreliable, conflicting sources (Gandomi & Haider, 2015). The next generation of systems must produce real-time data. This is needed to avoid misinterpretation and manage veracity and also discover the truth from facts, not distorted information (Berti-equille & Ba, 2016).

The researcher assigned the following theme to look at why managers stick to using the ERP for analysis, and the following is what emerged:

6.2.1 Why managers stick to using the ERP for analysis

From the above, it is quite clear that managers have various reasons for sticking to using the ERP system as the main system for analytics. Top on the list is the fact that if the reports in any system, such as the BI, do not reconcile with other departments, then it will require the managers to refine the reports in the BI system by revisiting the ERP continuously to refine them and that process is tiresome. In such a case the managers will revert to using the ERP system for analytics.

What the managers said above when linked to the literature is a clear testimony that if the BI system contains mainly transactional data without external data and the systems do not reconcile with each other; then the managers will revert to using the transactional system. The managers want the BI system to contain information relevant to business which is also the same across all the departments.

The literature highlighted that: big data are a by-product of business transactional systems such as data from the ERP data from machine sensors, vehicles stationary, and in motion (Matti & Kvernvik, 2012). Internal transactional data are easier to deal with compared to external non-transactional data hence managers find it easier to analyse these data (Baesens *et al*., 2016). In most cases, the data housed in organisations is internal historical data for regulatory and reporting requirements (Cognizant20-20Insights, 2011). For that reason, there is no effort to analyse data from other sources, and data in BI end up being a replica of the ERP system. The transactional systems produce data through postings and logs from sensors and equipment (Dijcks, 2013). By reverting to using the ERP managers may leave out data of potential value from other sources.

The managers also raised another very important issue about the difference between developing economies versus developed economies. The researcher thought that this nuance was a valuable factor regarding the context of the overall topic and allocated a specific code to explore it further. The following are the outcomes.

6.2.2 Developing economies differ from developed economies

Developed economies also use ERP systems like developing economies, however, they have gone to the extent of linking it to equipment in the factory to confirm production volumes, management utilities as an example. They can do this because the general infrastructure level for those developed economies tends to facilitate such high levels of integration. There is a minimum level of automation that is required in a factory to achieve this level of integration in a specific type of economy. All these are investments and in developing economies the organization might not be at that level yet but could be with the purchase of specific equipment for that interface to happen. However, in most cases management would want to cover all the aspects of the factory and not specific machines; that in the context of a developing economy could be a huge problem. In that context, it is better to try it on specific equipment on a trial basis to see how the system works as the technology level can be scaled up. In advanced economies, everything can be automated from inbound materials up to the dispatch of the products, because of the magnitude and scale of investment in the macro business environment in that country and that of the specific organization operating there.

As an example when supply chain pallets are taken out of the system, they are automatically counted as pallets and updated in the ERP system. Where there is no high-level automation capability, the information has to be manually inputted into the ERP system. If a mistake is made, it has repercussions throughout the entire value chain as well as on the final reporting. Naturally, managers want integrated systems like what advanced economies and their competitor organizations have because without them they will remain in either low-value operational segments in the market or cease to exist.

Resources are not adequately available to pursue certain projects to support either the infrastructure, software or hardware as well as the training of personnel. Business intelligence systems require well-trained personnel and the training may be for a period of three to five months which may not be feasible to allow too many people to be away from core business operations at one time. The business may not be capable of financing such a long training commitment.

In chapter 2, the literature highlighted that the organisation's actions are not only driven by the organisation's goals but shaped by external factors such as political and social factors and the pressure from customers, trading partners, and government with industry leaders spearheading the change agenda (Sun *et al.*, 2018). Some of the factors that affect them such as infrastructure development have a direct link to the extraction of value and they are beyond the organisations' control. The resources are not evenly distributed and this affects access to information and communication technology. More than half of the world's population does not have basic access, for example, there is more fibre in Europe, Asia, and North America than in Africa (Doong & Ho, 2012). The international telecommunications union uses two indicators, (i) access and (ii) skills, which are the main drivers of digital preparedness ranging second from infrastructure and opportunity (James, 2012). This shows that the infrastructure in developed economies differs from that in developing economies quite substantially.

Having established why managers stick to using the ERP for analysis only instead of using the whole ERP functionality, the researcher decided to allocate themes to find out if there is an effort required, or if the managers do not have time to design the reports themselves. The following codes were assigned to look at this important aspect. This was done in this manner to identify factors limiting them to develop BI reports.

6.2.3 Limitations to design BI reports

Literature confirms the lack of technical skills and the lack of knowledge of business processes but is silent on the time component. A report by McKinsey global research institute indicated a huge shortage of managers with deep analytical skills required to analyse data in the big data environment (Chen, Chiang & Storey, 2012). A special committee in digital skills set-up in the UK also acknowledged this shortage in its second report of the 2016-17 session, and highlighted big data, as the main cause (British Government, 2017). McKinsey Global Institute, (2013) identified key enablers needed to deal with big data as (i) data analytical skills (ii) advances in technologies, and (iii) the use of visualisation such as charts and graphs. The main challenges are data modeling, integration, aggregation, and interpretation. Management mainly lacks skills to analyse the data, data sharing, data governance, cost, and data ownership (Sivarajah *et al*., 2017). Many authors assign the role of designing reports to a data scientist. They do not consider the manager's time suggesting that maybe they assume that the managers should not be involved in the designing and development of BI reports. It is therefore very clear that for organisations to adopt a big data analytics strategy through the effective use of BI systems they have to give enough attention to time, skills transfer, and knowledge dissemination. There is a need to make sure that the managers are either involved in the designing of reports or they are capable of designing the reports themselves.

This concluded the findings and discussions of the limitations of using BI systems to analyse data in the big data environment theme. The researcher moved on to the next theme to find out the managers' expectations, the roles played by those who drive the BI agenda, and what they think are the benefits of having a BI system in place.

6.3 Managers' expectations

In Chapter 2 under the literature review, it was clear that many scholars have devoted a lot of time to this subject. Many BI maturity models have been developed to help organisations to evaluate themselves and see how far they have gone as far as adopting BI is concerned. The managers' wishes in this section are in line with what business maturity models say, which is also key when helping organisations to adopt big data initiatives. Hribar (2010) analysed the following models: the business information model by Williams & Thomann (2003), the TDWI BI maturity model by Eckerson (2007), the BI/performance management maturity model by AMR research company the BI maturity hierarchy, the infrastructure optimisation maturity

model, Gartner's a five-stage BI maturity level and the ladder of business intelligence (LOBI) model.
However, some of these models are too narrative, some focus on technical aspects while others focus on business only. This leaves managers without a clearly defined path to adopt big data strategies and this has been the main point of failure in addition to, no appreciation of dirty data, lack of skills, and unengaged sponsors (Chuah & Wong, 2011). There is a need to involve other aspects and also take data and access to the data as a starting point, because without the data and the managers, there is no BI to talk about (Cardoso and Su, 2022).

What became visible is that the managers want automation, however, they think they should not be involved in the designing of the reports. They want the automation to be done by those who are technically well-versed in these technologies. For that reason, they sit down and prepare the reports in excel that way they know that the reports are correct. The managers said they want to verify the reports first before they are certified as correct and forwarded.

The issue that remained as the grey area was the verification of information. The researcher wanted to know which system they use to verify the information and under what circumstances they verify the information. A code was assigned and the following is what emerged.

6.3.1 The need to verify data

It is quite clear that managers want clean data when making decisions hence the need to verify the data. The managers expect perfect reports and this can only be achieved if they are involved in the designing of the reports so that when there are variations they can quickly pinpoint the source of the variance. Whatever the managers said here is in line with what was highlighted in the literature, data cleansing was mentioned as one of the key requirements of adopting the big data strategy, and it should be given special attention similar to data analytics and data mining. Several international conferences on big data such as the one held in the USA in 2020, divided big data into some focus areas, big data storage, big data security, big data cleaning, big data modeling, big data applications, big data mining, and big data analytics (Jerryzeng, 2020).

The data cleaning problem has resurfaced on many occasions to an extent that the industry has been forced to deal with them regularly (Rahm & Do, 2000). It is considered the main challenge due to the increase in volume, variety, and velocity (Tang, 2014).

There is a need to first understand the data and then clean it, before formulating the problem, and analysing it (Lin & Ryaboy, 2016). Gartner's maturity also mentions it at the level 4 strategic stage because business objectives drive BI and senior managers get involved in the deployment of enterprise-wide data that will result in the construction of a data warehouse. At the level of Gartner's BI maturity model, a group of people collaborating at the department level form alliances to deal with data cleaning and alignment issues signaling the beginning of enterprise-wide usage of analytics software (Shaaban *et al.*, 2011). This shows that managers also play a major role in data cleaning leaving a gap as to who should spearhead the data cleaning process; the managers or the technical people.

From the preceding discussions, it is quite clear that we are faced with a situation where managers lack time and technical skills but they have to be involved and internal consultants lack technical skills, and external consultants also additionally lack knowledge of the business as well. This leaves a big question, on the role of the IT department in an environment where they have to work with external business intelligence consultants and line managers. The following code was assigned to look at this and the following is the outcome.

6.3.2 The role of the information technology department and consultants

Literature talks mainly about the lack of skills and places the IT department to overcome that challenge and other scholars place a data scientist (Grossman & Siegel, 2014; Côrte-Real *et al.*, 2019) as the solution. It was highlighted in the literature that the IT department has to work extra hard to bridge the skills gap (McAfee & Erik, 2012). However, what emerged from this theme is that when an organisation embarks on a journey to analyse data in the big data environment using a BI solution all three aspects, the (i) managers or their representatives (internal consultants), (ii) the external consultants as implementers or representatives of the owners of these solutions and (iii) the IT department have to work extra hard for the BI solution to yield results. The roles have been defined and it emerged clearly from this section and other preceding sections that BI is not a plug-and-play solution. The researcher decided to find out some of the perceived benefits of using BI solutions and allocated the following theme code for the purpose.

6.3.3 Benefits of using business intelligence and interconnected systems and devices

From the above, it is quite clear that managers want to work in an environment of interconnected systems; however other factors in the environment interfere with trying to interconnect the various systems.

The extant literature highlights that if strategic and operative exchange of data is embraced by organisations along the supply chain, the benefits are immense as it results in an improved flow of products and services as well as cost reduction and value creation both upstream and downstream (Korpela & Dahlberg, 2017). *UBER* and Tesla have done it in the motoring industry. Big data have also been used in various sporting disciplines to get strategic insights from opponents; for example, in soccer, on 08 July 2014 when the German soccer team beat Brazil 7-1. It was followed by an announcement by SAP AG on 11 July 2014 that they had entered into a partnership with the German football association to deploy and use their BI system to turn big data into smart informative decisions to come up with an improved performance of players (Yin & Kaynak, 2015b). The benefits differ from industry to industry, easier to adopt and apply to operations aimed at improving operational efficiencies (Roden *et al.*, 2017).

Very few big data initiatives repeat themselves, leaving managers reluctant to adopt them on assumption that these initiatives deliver once only benefits (Braganza *et al.*, 2017). Besides all the benefits associated with it, big data remains on the radar of most organisations' boardrooms (EY, 2014). This concludes section 3 on how organisations can effectively use business intelligence and data mining software in the big data environment to improve performance and predictive analysis. The section covered the managers' expectations needed to verify the data and how the data is verified, the role of external consultants as the implementers of the BI system, the role of the internal consultants as the managers' representatives, the role of the managers and the role of the IT department. Then finally the benefits of using BI and interconnected systems and devices.

Having exhausted this section, the researcher decided to move to the preferred designer of BI reports and what managers must do to improve the usage of BI reports, and the view on using a dedicated person to do the analysis.

6.4 Preferred designer of business intelligence reports

From the above, it appears the last option is the one currently being used by many organisations where the designing and development of the BI reports is delegated to either the IT department, data scientist, or some lower-level managers.

In Chapter 2, the literature highlighted the Ladder of Business Intelligence (LOBI) model by (Williams & Thomann, 2003) which created 3 process areas namely technology, process, and people across six levels (facts, data, information, knowledge, understanding, and enabled intuition) as one of the most widely used models to create the IT plan. Top management ends up delegating the adoption of big data strategies to the information technology department. The department is then given the mandate to do whatever it can to create value from the data, which then forces it to take the technical route. However, big data issues are mainly centered on management than technology (Ernest *et al.*, 2011). A closer look at the BI maturity models reveals, that, management plays a critical role in adopting big data analytics.

Other scholars do not talk of time but rather other issues like lack of technical skills and propose using the data scientist as an alternative. However, this seems not to be working hence the need to involve managers and executives in the designing of the reports. As the users of the reports, they must be involved to avoid a situation whereby they continue with their old ways of analysing the data and request IT to suggest a solution. The IT and other lower-level managers design reports that may never be consumed by the executives and senior managers.

The outcome was that if executives have enough time then they should be trained on how to design the reports, however, if they do not have the time they have to delegate that responsibility to senior managers and if those senior managers do not have the time as well they should find someone who can work with the consultant. However, the danger is if all the levels of management are not involved then the person given the responsibility may end up designing report formats that do not serve a purpose. The ideal situation is where all of them are involved (i) the executives (ii) managers (iii) internal consultants and the (iv) the external consultants

In the preceding sections, the different roles played by all those involved in setting up a well-functioning BI solution were identified and it was established that the managers play a major role because a BI solution is not a plug-and-play solution.

It was also established that the best scenario is where the managers design and develop their own reports since BI is used by managers to improve the decision-making process through improved analytics. The researcher's next focus area was to further explore the opinion to have a dedicated person doing the analytics on behalf of the managers.

6.4.1 Opinion on using a dedicated person

From the above, it is clear that managers are divided on the issue of having a dedicated person to do data analysis for them. Some believe that it all depends on the size of the organization or department while others argue that a dedicated person is not needed. They argue that managers should be trained to analyse the data on their own. The issues of time and training dominated the discussions.

Literature suggests the use of a dedicated person in the form of a data scientist or at least a manager with the technical skills, or using the IT department. To overcome the skills shortage, there is a need for data scientists. These data scientists are deployed using three models: In one model they are centralised by being placed in a pool to pursue a common goal, with each data scientist representing his/her own department's information needs. The other is the decentralised model where they remain in their respective departments, however, this has the disadvantage of not achieving a coordinated common goal of the business and sharing of knowledge sharing. The third model is where only critical data scientists are centralised and the rest are left to work in their respective departments. The main idea of this third model is to tap into various islands of data and silos of analytics that exist in departments to refine the information (Grossman & Siegel, 2014; Côrte-Real *et al.*, 2019). However, in some cases, the task is given to the IT department (McAfee & Erik, 2012). The UTAUT and the DOI theories used in this research study indicate that if there is an effort required in this case in the form of time required then the technology may not be accepted.

The research study moved on to the last theme to find out if the managers regarding what managers need to do to improve the usage of the BI system.

6.4.2 Requirements to improve the usage of BI

The outcome was that there are a lot of requirements needed to improve the usage of BI systems. There is also a need to focus on data because without the data there is no BI to talk about (Cardoso and Su, 2022). However, most of the business intelligence models are too narrative, they focus on technical aspects they do not show how organisations should move to the next level (Chuah & Wong, 2011). Many organisations just found their way out and are now adopting computer-based intelligence to improve efficiency and make fast decisions (Kester & Preko, 2015). Some authors argue that big data in cases where these initiatives have not been adopted the managers think that big data and BI analytics are the most over-hyped and abused terms (Devlin, 2016). Most of the scholarly articles have not given attention to well-structured coherent processes for adopting these initiatives (Braganza *et al.*, 2017). The roles of the OCM consultants and a clearly defined automation agenda are missing. In this section, the managers and consultants clearly stated what they think should be done to improve the usage of these systems.

6.4.3 Opinion on adopting other new emerging technologies in the current environment

What became evident from this theme is that managers are not confused by the number of emerging technologies. They are aware that emerging technologies bring benefits, however, they think that they do not have a major role to play in choosing new technologies apart from financing. They believe that it is the duty of the IT department to lead them in the choosing and adoption process. What is critical to them is not to just go by the wind to invest in each and every new technology that comes on board but to invest in technologies that are relevant to their operations.

Chapter 2's literature review highlights that: In most cases, the task involving emerging technologies is given to the IT department (McAfee & Erik, 2012). This is evident that managers do not have a clear plan for adopting these new technologies and expect the IT department to come up with one. This has been the main point of failure that has been slowing down the adoption of new technologies as managers think that they do not have a major role to play. There is a need for the departments to collaborate and share knowledge about emerging technologies (Tiwari, 2022).

The outbreak of COVID-19 was a wake-up call as it sent shock waves resulting in accelerated haphazard adoptions of technologies (Snyder & Barnakova, 2020). It has been proven that capturing value from emerging technologies requires far more than a customary IT department (Weigert, 2017). Organisations that have successfully implemented big data strategies move analytics from the IT department (Davenport, Barth & Bean, 2012). Most organisations invest in technologies due to social pressure from the boards and they pass that pressure to the IT department to do whatever it takes to have the latest technologies.

6.5 CHAPTER SUMMARY

The chapter discussed the findings following the same sequence of themes and sub-themes generated in the findings in chapter 5. The discussions were done comparing the findings from the field with findings from the literature. New items were highlighted and theories were used as lenses to look at certain issues. These have been synthesized to develop the frameworks and contributions to theory modification. The following chapter 7 is dedicated to that.

CHAPTER 7

DEVELOPMENT OF FRAMEWORKS AND CONTRIBUTION TO THEORY

7.1 INTRODUCTION

This research study's main objective was propose suitable frameworks that can be used by managers to analyse external and internal data in the big data environment using business intelligence (BI) analytics systems to create a competitive advantage. This chapter presents the frameworks that can be used by managers to improve analytics.

The approach was to briefly introduce the findings and discussions in chapter 5 and then elaborate on them by interpreting the outcomes of the researcher's context and then provide a framework.

7.2 Exchanging data with external stakeholders in the big data environment

According to Zhao *et al* (2014), another way to define big data is in terms of internal versus external (Baesens *et al*., 2016). The literature highlighted a lot of issues with external data that include data acquisition, cleaning, and modeling because external data are often unstructured. External data have been said to be the ones that bring potential value in the big data environment. Literature talks about them in generic terms as just external data. from social media and networks such as Google, Facebook, Twitter, and LinkedIn (Baesens *et al*., 2016).

Though external data are said to be scattered all over, what emerged in this research study is that much of that external data already resides in the organisation's key trading partners. However, they are not at liberty to share the data for fear of being exposed to competition. Data are the organisation's greatest competitive advantage. There are very few organisations that are at liberty to share data with key trading partners even though the ERP and BI systems have the facilities to integrate systems. Therefore, any organisation that requires data has two options; either to hunt for the data or to negotiate for the data from existing and potential trading partners.

However, it is pointless for a manufacturing company to start hunting for data from its suppliers of materials and the consumers of its products from the internet, instead of just engaging them and negotiating with them to share the data. When data are hunted, they become so elusive and this is why they have remained on the radar for a long time. A manufacturing firm would not negotiate for data that has no value to it; only for data that adds value to its operations.

External data are classified into two forms (i) free external data and (ii) negotiable external data. Free external data are the data that come from Geo maps, Google, Twitter, and Facebook as examples. In the literature, it was highlighted that these are mainly unstructured. The negotiable external data are usually already structured where it is stored since most suppliers and customers of the manufacturer use either an ERP system or some other transactional system. The organisation has to build trust relationships to tap into these reasonably accessible data sources needed in its operations. This is possible because the firm and its trading partners are already in a relationship.

The managers believe, once data are negotiated for and agreed upon, it will result in the formation of smart partnerships that will allow them to make quality decisions by analysing external data the same way they do with internal data. This in theory will result in a seamless flow of information and the formation of value chains that will result in the eradication of mistakes enabling either part to plan more effectively.

The manufacturing company can make its plan knowing what the suppliers have in stock and the lead times. This also creates efficiencies and effective reorder patterns. The same is true with customers who can see the manufacturer's plans and that way there will be a reduction in bureaucracy and paperwork. There will be a reduction in personal visits to customers, especially during this period when we are faced with the aftermath of the COVID pandemic. These kinds of initiatives can help to improve business-to-business interaction without physically having to meet. They will improve the business intelligence maturity level of the manufacturing company because analytics would have been inserted into business processes.

Gartner's five-stage BI model highlighted that an organisation at stage 5 *pervasive level* of business intelligence maturity level is seen by extending BI to customers and suppliers as as shown in the following figure 7.1.

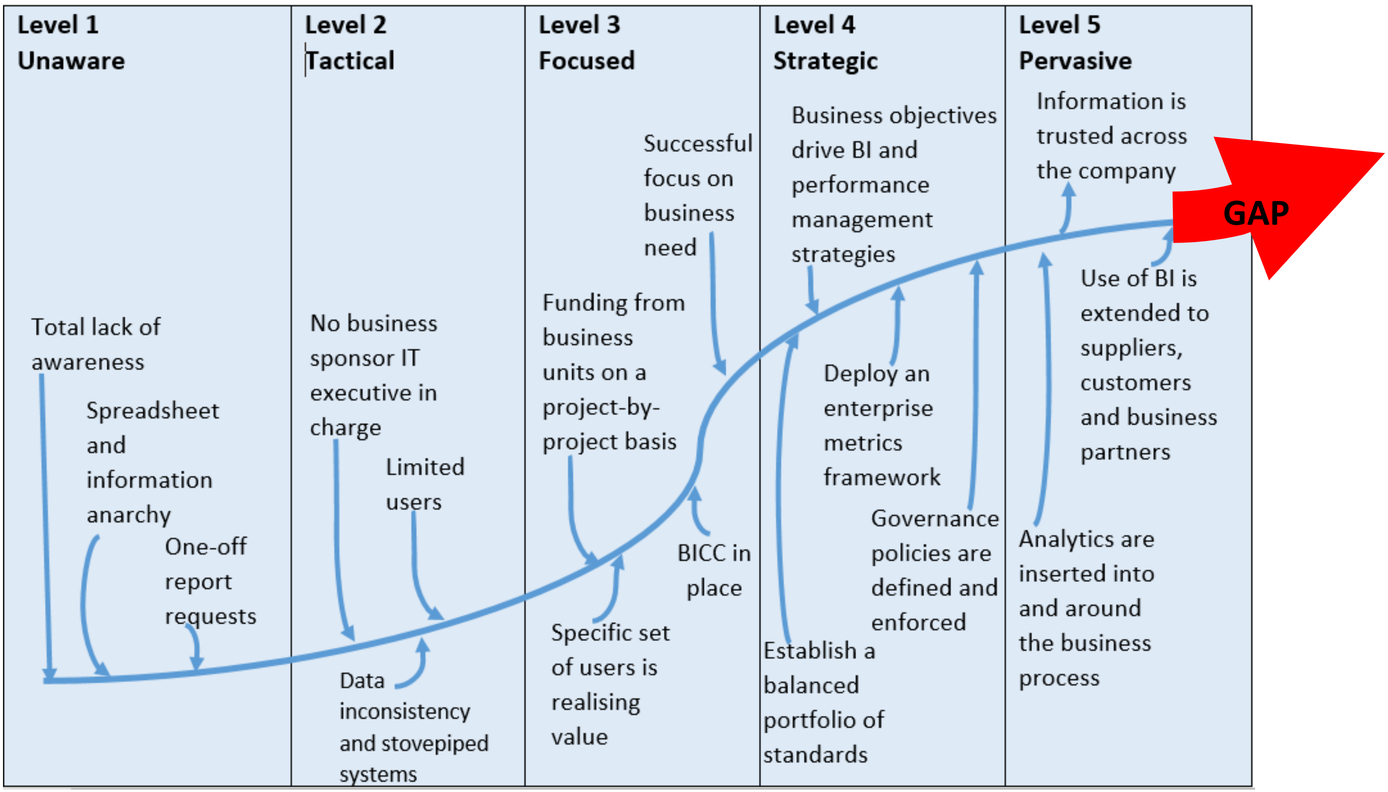


Figure 7.1: Business intelligence maturity level

Source: (Shaaban *et al.*, 2011, p.3)

However, like many other business maturity models highlighted in the literature, it does not provide a path to assist organisations to get there.

The managers see sharing of data as a breakthrough in terms of improving planning and business intelligence to make quality decisions. However, they also see it as a very sensitive area that has to be handled with care. The researcher decided to call it the red zone of data coupling. To pass through the red zone and tape into the external data, there is a need to discuss sharing of data with key stakeholders (customers and suppliers) for everyone's mutual benefit. The managers suggest a need to first agree on what has to be shared and they propose signing a Memorandum of Agreement (MOUs), the service level agreement (SLA), and Non-disclosure Agreements (NDAs) before sharing the data which are their strategic tools for competition. They believe that these agreements and collaborations should be conducted at the highest possible level of the organisation.

They also suggest first having security mechanisms in place such as firewalls to guard against ingress and cyber-attacks, and clearly defined controls to limit access to what was agreed to be shared before any connection is approved. After connection they also want audit trails to show what has been accessed. The exchanged data has to be encrypted. The fear is that data may end up in the wrong hands or competitors may see an opportunity to tap into the data because some of the suppliers of materials are also owned by competitors. These pose very real strategic risks to the business.

Therefore, there is the predominantly the red-zone of data coupling where managers still want certain issues to be addressed before interconnecting systems to share data. If these issues are not addressed and data are shared, the business will be compromised. The grey zone is one where the technical side (IT) has made strides, and systems can now easily be integrated. Cloud computing ensures that there is a high possibility that the data for trading partners will be in the same data center. The following framework tries to provide a mechanism for negotiating to have external data from trading partners through interconnecting systems. The focus is on sharing the data as opposed to hunting for that data. The following figure 7.2 shows the proposed framework.

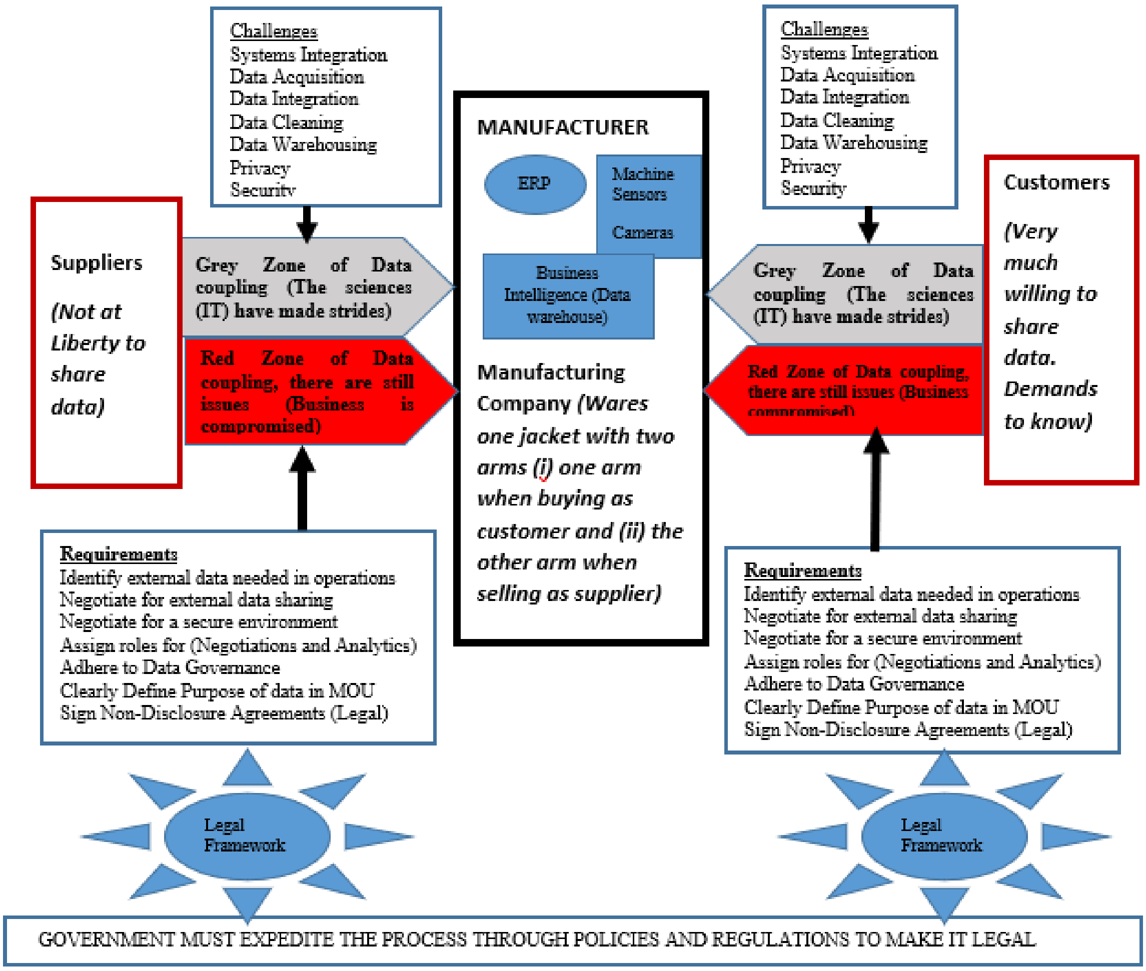


Figure 7.2: Pervasive level of sharing negotiable data in the big data environment (framework). ***Source:*** *Author's construct*

In most cases, the two main arms of interfacing with the external world are, suppliers and customers. Therefore, the exchange of data mainly happens via two arms of the organization, namely, procurement and sales and marketing. Usually, suppliers are not very willing to share data for fear of exposing weaknesses, but customers are more than willing to share as they demand better service.

Two zones exist before the data, can be shared electronically:

(i) The grey zone has challenges but they can be overcome, technically. The challenges in this zone involve systems integration, data acquisition, data cleaning, data warehousing, data mining data aggregation, data integration, data analysis, data modeling, data interpretation, and security. An organization can overcome them using advances in technology, hence the researcher called it the grey zone.

(ii) The red zone requires management/ the organization's intervention to pass through it. The Managers must first identify the data they need in operation, then negotiate for a secure environment, assign the negotiation role to executives (usually sales and marketing and procurement) as the two main arms, adhere to data governance, and clearly define the purpose of data in the MOU, sign the MOU or sign the NDA.

The responsibility to negotiate through the red zone of external data coupling should be done at the executive level. Therefore, if there is an engagement with suppliers those sensitive issues highlighted in MOUs and NDAs should be discussed at the executive level, and then implemented at the management level by those in procurement. Engagement with customers should be the responsibility of the commercial and marketing executive.

One reason why the responsibility of sharing data should be at the executive level is because of the sensitivity and complexity of the issues. They know the direction the company wants to take and set the objectives for the rest to follow. They also know what data can be shared and what data to keep confidential.

The role can be delegated but it will have to be someone who has a fair understanding of the whole business with a holistic view of it to create value for the organization. Highly experienced and competent individuals who have a firm grasp of the business environment are the ideal candidates. The individual ideally should be someone with IT experience, business experience, and BI systems experience who can make linkages between key business variables. Someone who knows that if one of the companies along the information value chain is struggling to produce product A, it is going to affect the other company's production schedule, and if there is a change of formula in product A, it will affect outputs further down the line. It is that kind of data sharing that enables one to almost read ahead of what the implications would be, then incorporate it in the designing of the BI reports, so that an effective and informed picture is drawn from the data.

In terms of defining what has to be accessed, it also has to be done at the highest possible level; which is the executive level, so that it is clear what data can be shared and what cannot be shared so that whatever competitive data the organization has is protected. The IT executive should have an overall responsibility to ensure data security.

To benefit from the big data environment, key trading partners should then be allowed to look for the data they want and put it in their data warehouse. They can also create their own reports using their own BI systems that point to the manufacturers' systems or receive BI reports from the manufacturer's BI systems with the information they require to service the organisation efficiently. On the other hand, the manufacturer will also be able to properly plan for the data it requires for analysis and then engage its strategic partners mainly suppliers and customers to negotiate for such data and do the same.

7.2.1 External data negotiation scenarios

When negotiating for data with suppliers the manufacturer will be wearing the customer's jacket. When the manufacturing company has produced the goods it automatically assumes the role of a supplier and it would not be at liberty to share its data for the same reason that it may fail to fulfill the promises it made to the customers and expose itself.

Therefore, when negotiating and bargaining to access external data from its suppliers and customers, the following four scenarios exist at any given point:

(i) First scenario: Where the supplier sees no perceived benefits, such as, if the supplier is the sole supplier of certain key materials that are in short supply and that supplier has bargaining power. That supplier may not be willing to share data for fear of exposing its strategy. The customer (manufacturer) will see benefits and will be very much willing to share to get insights but the supplier will not be willing to, in that case, the manufacturer should initiate the negotiations.

(ii) Second scenario: Where the customer (manufacturer) sees no perceived benefits in sharing data because as the customer, can get the materials from several other sources. In this case, the customer has bargaining power but this time around the supplier will be willing to share and should initiate the process.

(iii) Third scenario: Where the bargaining power is almost equal (50/50) and both parties have both the desire and the will to share the data (the likes of *UBER* transportation service provider where both the customer and the taxi benefit if they share data because the customer wants to travel and the taxi wants the business to make money)

(iv) Fourth scenario: Where the organization does not have to bargain for any data because of the nature of its operations where the data are freely available (The likes of Tesla are applicable here, where the data are mainly from Geo maps to sensors or in-factory where data are from machine sensors).

Diagrammatically it will be as shown in the following figure 7.3:

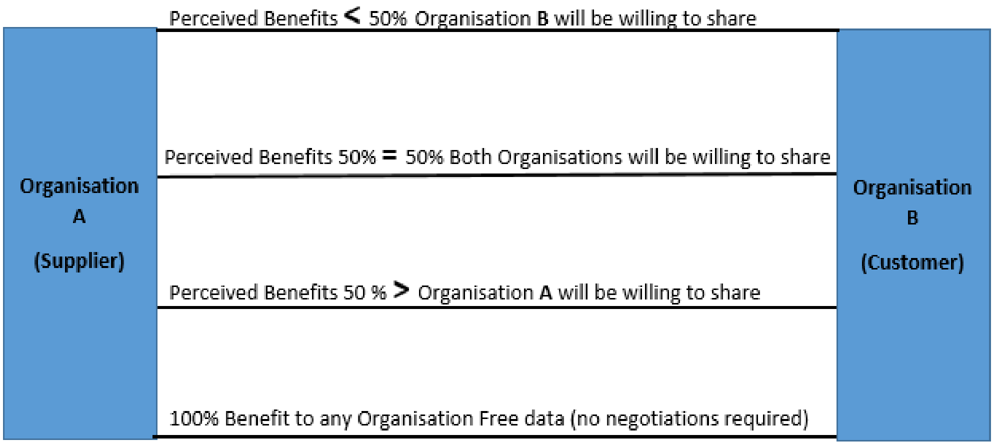


Figure 7.3: Big data bargaining gate

Source: Author's construct

The social exchange theory was used to anchor the big data bargaining gate in figure 7.3. Organisations negotiate to necessitate the formation of exchange relationships and the parties of exchange may also negotiate rules in the hope of reaching beneficial arrangements (Cook, 1977). Exchange theory has the advantage of bringing power as the capacity to exploit the other party (Cook & Emerson, 1978). Agreements tend to be more explicit and *quid pro quo* than reciprocal exchanges and elements of exchange differ in that they may continue beyond short-term agreements. Also, they may or may not be bound by legal or contractual sanctions and are often part of economic transactions" (Cropanzano & Mitchell, 2005, p.7). Though the theory is for social sciences it was borrowed and applied here to look at the framework because exchanging of data electronically also emanates from social beliefs.

Trust also emerged as one of the other major components that drive the sharing of big data willingness with key suppliers and customers so it cannot be left behind. Therefore, electronically the exchanging of data with key stakeholders depends on two main variables, expected benefits, and trust. The big data bargaining gate in figure 7.3 was further synthesized to produce the following trust benefit framework.

The following figure 7.4 explains this. It is the Trust benefit framework to electronically share data with key stakeholders (customers and suppliers) in the big data environment.

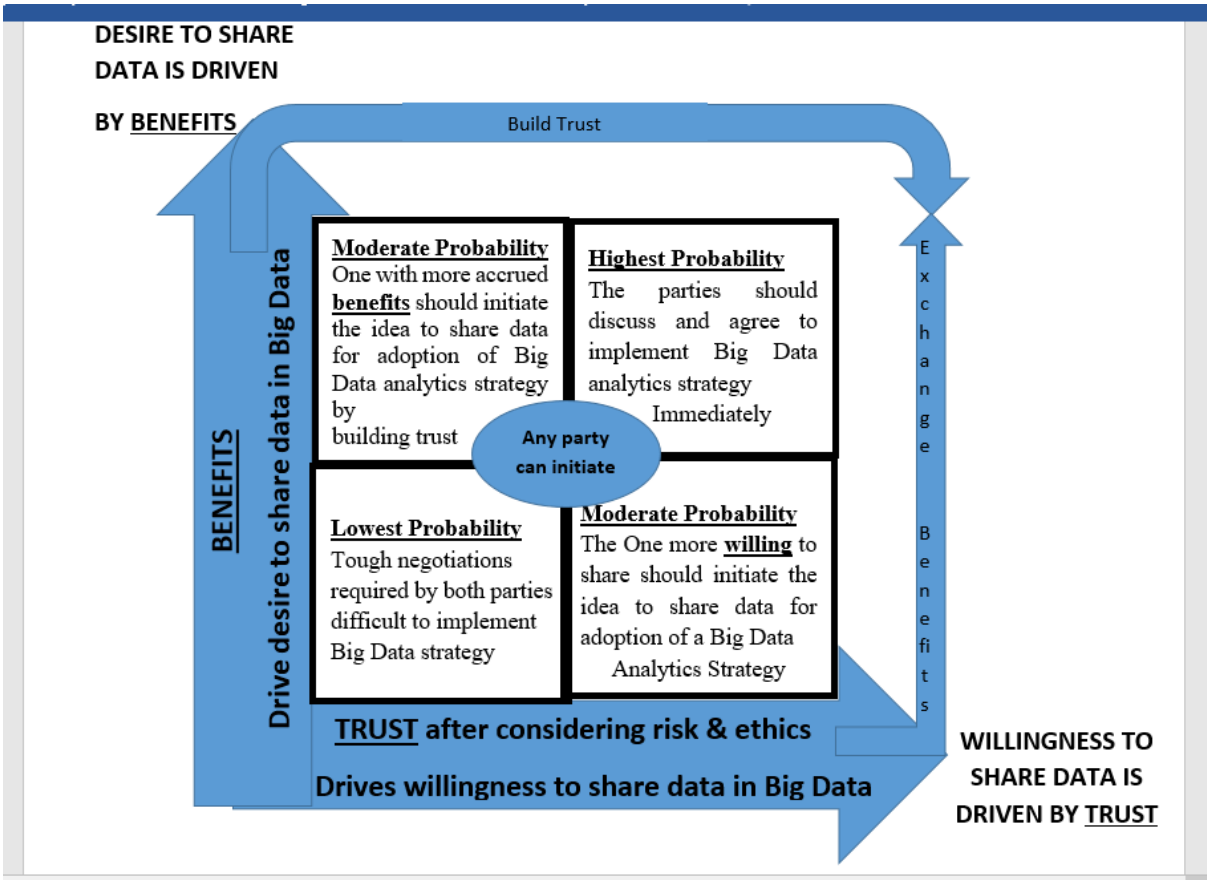


Figure 7.4: Trust benefit framework of sharing data

Source: Author's construct

The framework in figure 7.4 explains that the desire to electronically share data with key stakeholders is driven by benefits. The willingness to electronically share data is driven by trust, after careful consideration of risk and possible ethical violations. An agreement is easy to conclude when both trust and benefits are very high. Trust is built over time and benefits also accrue over time. Although it can take time for these two to merge, in organisations where some form of a relationship already exists, merging the two can be immediate.

The identified benefits and willingness to share data will never occur on their own without initiatives. Though negotiating for the data is the starting point, data monetization can be used to create benefits. Therefore, there is also a need to build trust and take the initiative to electronically exchange and share the benefits.

(i) If both trust and expected benefits are at their lowest (bottom left quadrant), then negotiations to electronically share data with key stakeholders (customers and suppliers) will be tough. For example, in rivalries like political parties and competing companies.

(ii) If expected benefits are high, and trust is low (top left quadrant) then there is a need to build trust and initiate the idea to share data. The one with more accrued benefits should initiate negotiations to electronically share data with key stakeholders (customers and suppliers) by communicating the benefits and building trust. For example, a big retail company in Zimbabwe might install cameras to monitor activities in its shops. In such a case the leader of a manufacturing company that supplies these shops with products can approach them and negotiate for data from the cameras to monitor product availability and how customers are behaving instead of getting such a report from a sales representative. The executive will be able to monitor all the retail shops across the country from the comfort of his/her office without having to physically visit the shops. When the chief executive of the manufacturing company has access to such data then planning and monitoring will be very easy.

(iii) If trust is high, and benefits are low then there is a need to identify benefits and initiate the negotiations to electronically share data with key stakeholders (customers and suppliers) by looking for benefits after thorough consideration of risks and possible ethics violations. Data monetization can be used.

(iv) If both trust and expected benefits are at their highest, then there is a very high probability of electronically sharing data with key stakeholders (customers and suppliers). It will also be easy and possible to implement for example, what happened in the transportation industry with *UBER*.

7.3 Proposed contribution to theory

The effort expectancy construct of UTAUT refers to the perceived ease of use of the new system in other words the degree to which the prospective user expects the new system to be free of effort. Most managers believe there is a lot of effort needed to start sharing data with key stakeholders, hence sharing of data to tap into the big data remains on the radar of most organisations' boardrooms.

The complexity determinant of the DOI theory refers "to the degree to which an innovation is perceived as difficult to understand and use" and is used to measure the complexity of sharing data using interconnected systems.

Two new key moderators not mentioned in the theories emerge here (i) risk and (ii) confidentiality. These two were emphasized by the managers and play a critical role in influencing the managers to accept exchanging key data electronically with key stakeholders. The UTAUT theory must take these two elements that influence the adoption of technology into account as we move into the Fifth Industrial revolution.

There was also confirmation of theoretical assumptions on the performance expectancy construct of the UTAUT, the relative advantage of the DOI. It also proved that it is worth it to exchange data, however, the cost of doing that may be prohibitive due to the risk associated with that and the ethical considerations. Both literature and the managers confirmed that there are benefits in sharing the data. New items emerged in the form of risk, trust, desire, and willingness to share the data. The desire to share data is there but they are not willing unless the issues to do with trust, risk, and ethical considerations are addressed first because these threaten to wipe out the expected benefits of sharing data.

These elements of risk, trust, and ethical considerations dominated the interviews to an extent that the researcher had to take a closer look at the two theories, the UTAUT theory and the DOI theory that the researcher used. The researcher felt that for the adoption of big data analytics, the UTAUT theory should at least use these three moderators as indicated in the following figure 7.5.

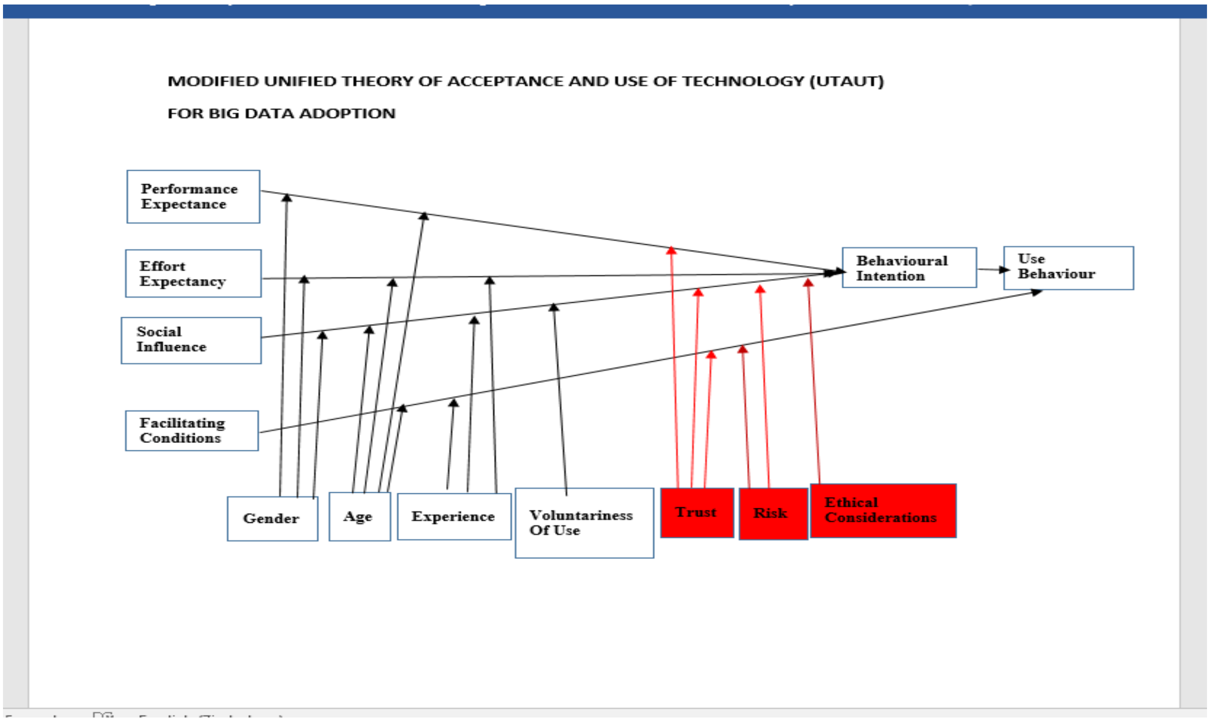


Figure 7.5: Modified UTAUT theory for big data adoption

Adapted from Source: (Williams, Rana & Dwivedi, 2015, p.444)

The additions in red are amendments suggested by this author. From the Interviews and literature, it was quite clear that trust, risk, and ethical considerations play a critical role in an organisation adopting big data analytics, therefore these three could be added as the fifth and sixth moderators to the UTAUT or replace the gender and age moderators. Risk can moderate facilitating conditions such as the tools and systems used when exchanging data in the big data environment like BI and firewalls. Risk could also be used to moderate social influence and ethical considerations could be used to moderate the pressure coming from the boards of companies, customers, and suppliers under social influence.

This concludes my findings on the electronically exchanging and sharing of external data by organisations.

7.4 What is limiting managers from using business intelligence systems to analyse data in the big data environment

What is limiting managers from using business intelligence systems to analyse data in the big data environment?

The researcher also wanted to establish the current system used by managers for analytics and the effort required to use BI and then subsequently examine whether the increase in sources now affects the way they analyse data.

In chapter two, the literature identified the sources of big data as a by-product of business transactional systems (e.g. ERP), data from machine sensors, vehicles stationary and in motion (Matti & Kvernvik, 2012). Also, data produced by public service institutions (administrative data), data from social media and networks such as Google, Facebook, Twitter, and LinkedIn as examples; comprise non-transactional and transactional sources that breed unstructured, semi-structured, and structured data (Baesens *et al*., 2016).

Currently, the managers receive their information mainly from the ERP transactional system and they also receive pre-configured BI reports which they complement with Excel reports. The external data do not enter the organisation through officially installed systems.

There are reasons why managers stick to using the transactional system or ERP system for analysis instead of using BI:

(i) They are assured that when they are dealing with data from the ERP or transactional system, they are dealing with data from trustworthy data sources because it is the source system where transactions emanate from.

(ii) The data in the ERP or transactional system reconcile with other departments or modules as the transactions happen and they always balance because it is real-time. To the managers, that is very important and one of the most features of an ERP system that any other system should have for it to be accepted. With BI, the reports may not be real-time and may also not seamlessly reconcile with other departments due to incorrect configurations.

(iii) If the BI system contains only data from the internal systems, then it becomes a replication of the transactional or ERP system with just a better layout and managers may then revert to using the transactional or ERP system. But if it contains external data from suppliers and customers at least there will be new data to be analysed and they will be forced to use it because they cannot get that data anywhere else in the transactional system.

(iv) Most of the managers have been using the ERP system for years and they are accustomed to using it. When the BI system was introduced, the only difference they saw was the change in the layout of the same reports that they were accessing in the ERP system. Since the BI system is not being used for predictive and prescriptive analytics, they always reverted to using the ERP because they are mainly dealing with historical data.

In the conceptual framework, the researcher highlighted two main sources of big data as internal sources and external sources. It was also indicated that many organisations replicate the data warehouse with what is already in the ERP transactional system. The researcher gave reasons why the external source is difficult to get as mainly risk and handling of ethical issues.

To analyse the data managers must have facilitating conditions in the form of tools to use such as the BI system and the data to analyse coming from both external and internal data. These data come from a number of sources such as the ERP transactional system. Currently, the bulk of the data come from the ERP system. There is potential to tap into suppliers' and customers' data, however, the managers are not at liberty to share their data as they see them as a source of competitive advantage and a strategic tool. Similarly, their customers and suppliers also view their data as a source of competitive advantage and they are also not at liberty to share their data.

The proportion of data available for analysis using the BI system that has been put in the data warehouse comprises mainly internal data from the transactional system such as the ERP. The challenges leading to this scenario are mainly due to what the researcher highlighted in the red zone of data coupling.

The managers' trusted source of reports in order of preference is as follows and it is important to note that order is in terms of preference:

(1) Machine sensors and cameras: If they sense hot, it will be hot and if they sense cold then it will be cold, however, managers are not using them. Same with cameras they trust them if they see red, it will be red and if they see blue, it will be blue though they use them only for isolated incidents like theft and misconduct.

(2) ERP: As the transactional system (primary source), they know what is in there is correct because that is where all the transactions take place. Also, access is controlled and data there talk to other departments unless there is an error emanating from original postings.

(3) BI systems (for now) are a replication of the ERP transactional system, though with a better presentation. But if it contains external data, it automatically seizes to be a replica of the ERP. This increases the chance of using it for analytics. For now, as a secondary system, it may sometimes differ from what is in the ERP transactional system. This depends on how the reports have been developed and whether they have been synchronised because at times the reports are not accurate due to poor configuration at inception but work well once corrected.

(4) People: There is a need for verification due to the risk of human errors and manipulation of figures to suit individual needs so the data may not be on record. With people, things get lost in translation.

(5) Mobile devices via social media: Are ranked last because the managers see them as a grey area with some element of truth and sometimes they get wild information so there is room for manipulation and verification is always needed. Therefore they do not make decisions 100% based on information from them.

From the above, it is clear that the managers' preferred and trusted source is not always the current source due to some limitations that include a lack of technical skills, and lack of time.

When the researcher approached this section of the research study the assumption was that perhaps managers are confused by the increase in the number of interconnected systems and gadgets. Surprisingly the managers see this as an added advantage and a welcome development that brings more benefits.

the reasons that are limiting managers from using BI systems to analyse data are mainly:

(i) Managers do not have time to be involved in the designing and development of their own reports including predictive and prescriptive analytics though it is their wish to do it themselves
(ii) Lack of technical skills
(iii) When they delegate this to internal consultants or the IT department, they also lack technical skills and in addition knowledge of the business processes and facilitating conditions and the managers will be a distance away.
(iv) When they try to delegate this to external consultants, they also lack knowledge of the business process, and facilitating conditions and managers will be very far away from it.

Facilitating conditions are needed to effectively use BI. Included here are the existence of the BI infrastructure and the IT department which is responsible for choosing the right BI system for the organisation. There must be a BI consultant who is responsible for developing the semantic layer to provide business objects in BI. The business objects are more technical and the external consultant should also train the internal consultants to transfer this knowledge to them. On the other hand, all levels of management including the executive level must make time to directly interact with the BI consultants and be involved in the designing of the reports whether paper-based or some simpler system. The literature highlighted the shortage of skills and suggested using a data scientist or a manager with the required skills to overcome this challenge as shown in the following figure 7.6 (Grossman & Siegel, 2014; Côrte-Real *et al.*, 2019).

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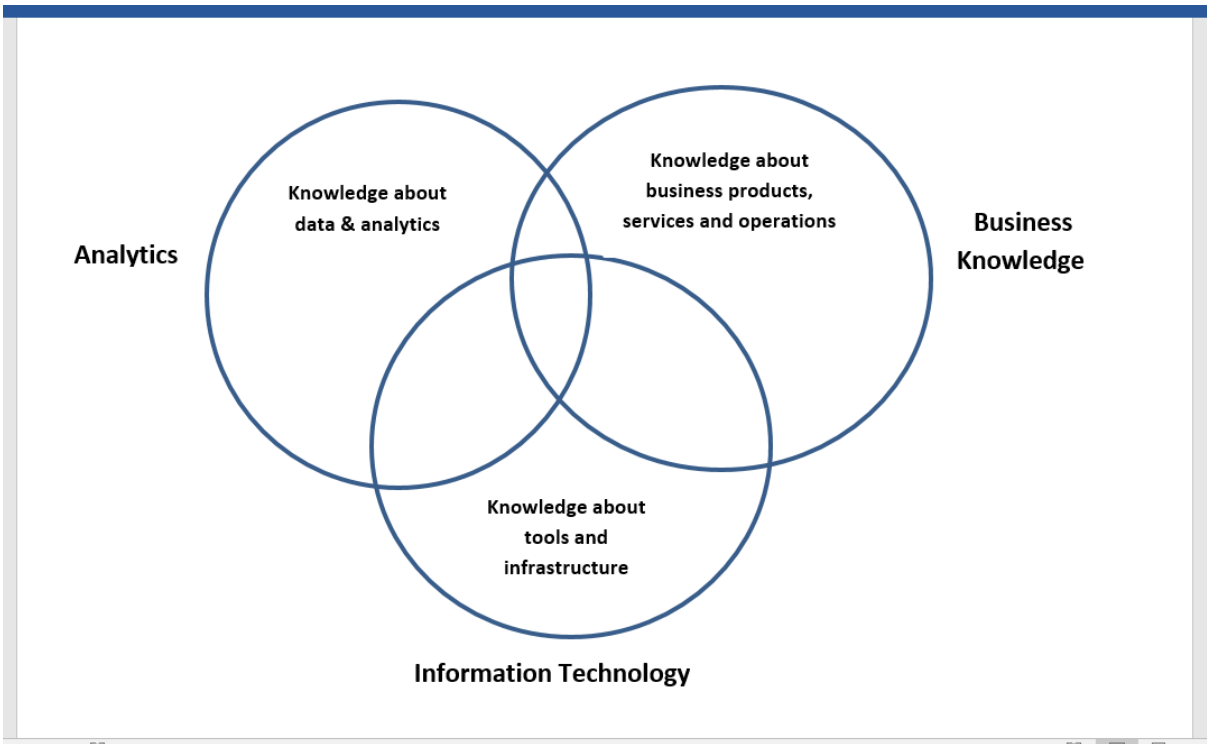

Figure 7.6: The knowledge required by data scientist

Source: (Grossman & Siegel, 2014, p. 21)

Grossman and Siegel (2014) sought to integrate analytics, business knowledge, and Information technology and suggested that without using a data scientist with the above combination of skills, analysing data in the big data environment will remain a challenge. They suggested revisiting the organisation structure to place data scientists centrally or decentralised to do the analytics on behalf of the managers (Grossman & Siegel, 2014; Côrte-Real *et al.*, 2019). Research study by the Mckinsey research institute showed that managers with analytical skills are in scarce supply (Baesens *et al.*, 2016). A special committee in digital skills set up in the UK also acknowledged this shortage in its second report of the session 2016-17 (British Government, 2017). It has to be noted that, it can take another generation to have the required skills all in one person. Literature is silent on time.

The findings in this research study propose using the following framework that can assist organisations to move there quickly rather than waiting to have such a skill set in one person.

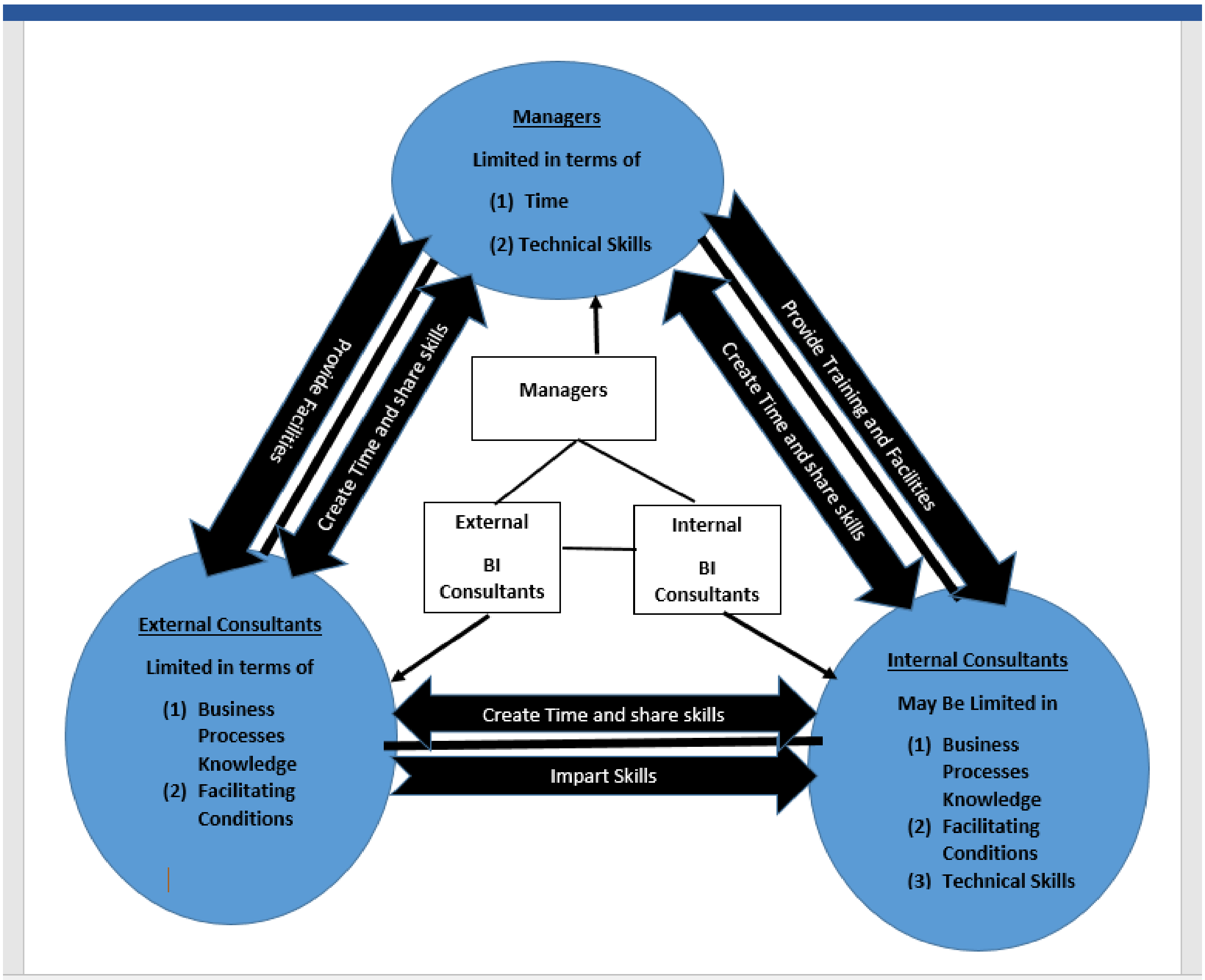

Figure 7.7: Proposed big data skills imparting framework

Source: Author's construct

From figure 7.7, it is clear that lack of time, technical skills, knowledge of the business process, and facilitating conditions in the form of needed infrastructure and training play a critical role when an organisation decides to pursue an analytics agenda using BI systems.

Both the managers and internal and external consultants have a role to play to adopt the big data analytics strategy. For a successful implementation, they have to complement each other.

(i) The managers are the owners of the business processes therefore they know the kind of intelligence they need and are aware of any improvements needed on the BI system for them to achieve their goals. However, they may lack the technical skills to design the BI reports plus they do not have the time due to operational commitments. Therefore, they can make use of the internal consultants by providing training and facilitating conditions as well as creating time to impart business process knowledge to these consultants.

(ii) The external consultants are the agents or owners of the BI systems however, they lack both knowledge of the business processes and facilitating conditions. The managers should provide both the facilitating conditions and the knowledge of business processes. The external consultants have an opportunity to learn business processes from both the management and also from the internal consultants.

(iii) The internal consultants are the representatives of management (usually from the IT department or from within the department) but they may lack knowledge of business processes and technical skills. They may also lack facilitating conditions in the form of infrastructure and time. These must be provided by the managers, who should also organise to send them for training. The internal consultants must therefore create time to work with the external consultants for technical skills. They should also share with the external consultants the business process skills they got from the managers. To the external consultants, this is a great opportunity because they will be interfacing with both the internal consultants and the managers to tap into the knowledge of the business processes. The internal consultants can learn business processes from the managers and also share with them the technical skills they would have learned from the external consultants. The internal consultants will then play a crucial role when the external consultants have left after the project is completed. It will be costly for the organisation to regularly call external consultants because they charge hourly rates. Internal consultants can also fill in the gap where managers may not have time to design further reports. The managers should therefore make sure that the internal consultants get the time and are adequately resourced.

The same framework can also be used when implementing BI to develop and design reports to share and analyse external data where the outer triangle may be represented as follows: (i) management may be represented by the identified two arms of interfacing (a) procurement executive and (a) sales and marketing executive, then internal consultants may be represented by the (ii) IT executive while external consultants may be represented by the (iii) external consultant for high-level deliberations to map ways of sharing external data securely. This is achieved by signing MOUs, NDAs, and other legal agreements with suppliers and customers since managers feel that dealing with external stakeholders is a sensitive area.

There are implications if an organisation tries to work without one of the three nodes: For example, using the external consultants only and eliminating the internal consultant may be costly. This is because when the project has been closed, hiring external consultants regularly to design reports and attend to emerging issues results in costs since the consultant charges per hour and may be committed to other engagements. However, COVID-19 has changed this as most of the consultants are now able to work remotely on several projects. The only challenge will be prioritising and learning business processes and supervising external consultants when they are working remotely.

Using the internal consultants only requires the organisation to invest heavily in training the internal consultants to be always up to date with the latest BI technologies and reach the level of an agent of the BI system. There is also a high possibility that they may leave because there is a huge shortage of managers with such skills.

Eliminating the managers does not work at all because BI systems are for managers, such a move will result in delegating the IT (internal consultants) to work with the external consultant and may result in the designing of fancy reports that are not used by managers and this is the current scenario with some organisations. When the managers delegate the designing and development of BI reports to lower-level managers to work with internal consultants, it raises issues. These issues may be about improvements needed on the BI system to match the company strategy which may not be communicated to internal consultants. The managers may view that as incompetence and this can be supported by the external consultants. The external consultants may also become defensive and no improvements are made to the system and this becomes the root cause of the blame game.

Some organisations may try to use the data scientist as mentioned in the literature who would not have been exposed to the knowledge of business processes. A good data scientist would be someone with knowledge of internal business processes who would have also played the above part at some time as either an internal or external BI consultant for that particular organisation. The remaining internal consultants may continue to impart that knowledge and when most of them or most managers have left, that process of involving the three key players should be repeated again for rejuvenation and continuity.

7.5 How to effectively use BI to improve performance

From the preceding sections, it was quite clear that big data analytics involves the managers (business processes) and the technical side (technology).

The focal point is the manager because the manager already has knowledge of the business process and is the one who should do the BI analytics. However, managers are different some may have the technical skills and the time while others may lack one of these:

(i) If the manager has both the technical skills and the time, then that manager can design and develop BI reports (no need for other nodes).

(ii) If the manager lacks technical skills but has time, then that manager can decide whether to work with an internal or external consultant or a data scientist (either of the nodes)

(iii) If the manager lacks time but has technical skills, then that manager may decide to use either the internal or external consultant (either of the nodes)

(iv) If the manager lacks both skills and time, then that manager should work with both the internal and external consultants (all the nodes will be ideal).

What follows are the findings on how organisations can use BI systems to improve performance.

The technical side is more affected by the characteristics of big data (volume, variety, velocity, value, and veracity). In this research study, the managers were asked to give their opinions on having several interconnected gadgets. The data revealed that managers see benefits in a lot of interconnected gadgets. In the world of managers, they are more concerned about risk, trust, and ethical considerations. At the end of the day, managers want to see the use of automated reports that are auto-generated by interconnected gadgets. This is because it will eliminate human intervention which is prone to errors and fraudulent activities. They also want to reduce the number of people doing non-value-adding processes, because most of the work the systems are already doing. They believe that if the BI and ERP systems are automated to do everything for them then this will eliminate errors, improve accuracy and timelessness and the reports will be produced faster for decision-making. For this to happen they have to be personally involved in the designing of the reports for them to trust them, then allow these gadgets to generate the reports and report to them directly.

A close look at this scenario shows that the technical side has made strides and moved with speed to develop tools such as BI systems to enable managers to analyse voluminous data from different disparate sources. However, in the process, they have left the managers behind. We can equate this to a situation of car manufacturers, where cars were designed and the owners were taught how to drive them and how to use the correct gears. If that was not done drivers would still be trying to drive 500 kilometers engaged in first gear and would have rejected using cars thinking that cars were not worth it. The scenario that we currently have with BI systems is that managers are aware of the tools such as BI systems that have been developed to help them analyse data but they have not been taught how to use (drive) these tools.

The technical people know how to drive these tools but the tools are not meant for them, therefore there is a need to close this gap. Considering that most managers are now techno-savvy because of the advances in technology and the fact that many know how to operate computers. Maybe an introduction of a BI driver's license could be initiated by the organization's executive management to encourage their managers to use analytics software, for both historical, predictive and prescriptive analytics. If this was done in the car industry and it worked, it can also work with BI analytics. In Europe, the European computer driving license (ECDL) also known as the international computer driver's license (ICDL) in non-European countries was introduced to enhance digital skills (Bieber, 2019).

Managers want a situation where gadgets and BI systems report to them directly instead of getting the reports from humans for fear of manipulation of figures. What managers want to see at the end of the day is automation of source data collection, e.g., measurements in the lab could be directly linked to the system rather than getting that from the technicians. In production, machine failures could be recorded automatically so that at the end of a period the failure record and report can be generated to facilitate decisions about when to service machines or when to replace them because the cost of maintenance is prohibitive. Currently, managers are relying on manual records. There is a need to train the managers on how to create their own reports in BI because currently the reports are done by the IT department at the request of users.

To achieve this level, managers should create time and be trained to work with the gadgets, machines, and systems to design perfect reports because the gadgets will now be reporting to them directly. The process is like creating a machine's balanced scorecard and then measuring the performance of these gadgets at the end of a period. There is a need to train potential users on how to create their own reports. They need to spend the time to close the gap between knowledge of business processes (possessed by managers) and the technical skills (possessed by the external consultants) so that the managers themselves have these skill sets and not only the data scientist. The following figure 7.8 explains how the knowledge gap can be closed.

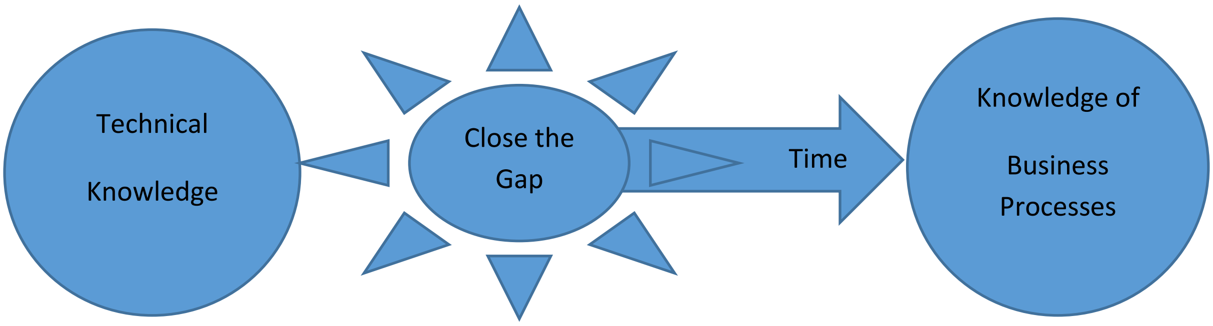

Figure 7.8: Closing the knowledge gap

Source: Author's construct

The managers believe that given a chance with time and properly trained they will be able to close this technical gap so that they will be able to define their reports. Once they have defined them, those reports should be automatically generated by the BI system and hit their mail or their phone wherever they are. When they are looking at it they will be confident because they would have defined what they want upfront, therefore, there will be no further interpretation from anyone because they would have agreed that they need the information that way. If the information is formatted that way, they will be able to make quality-informed decisions. We are now moving into a modern world where interconnected gadgets and machines will now be reporting to managers.

Managers cannot delegate this very important requirement, if they do that it will be like fraudulent transactions and reports can be configured to the detriment of the organisation.

Three suggestions emerged in this research study.

(i) All of them should be involved in the designing and development of BI reports but executives should superintend over everything.

(ii) Managers are better placed to be involved in the designing and development of BI reports because they have one arm that speaks to operations and the other arm that speaks to executives

(iii) Managers are busy with operations while executives are busy with meetings therefore, they should find someone (maybe a lower-level manager) who then works with consultants to design and develop the BI reports.

The first scenario is:

All of them should be involved in the design and development of BI reports

Both the executives and the managers are the ones who know exactly what kind of data they require and what kind of BI they require or would want. They should design the reports as well. However, both the managers and the executives usually do not have the time because of the nature of their jobs where they are rooted in operations and strategic meetings. To add to that, they may be limited technically to design and develop their own reports in the BI system. They need internal and external consultants who are experts in that field. On the other hand, the experts cannot work on their own because they are not the consumers and users of these reports.

It is like a cycle with initial pre-configured reports that come with the system itself designed by BI consultants as the first circle. The executives should be the first to have a look at these. . This is very important because it will help them to pick something they may think is currently not being done in their organisation that they may then want to incorporate into their analytics. It may also help to change how analytics was being conducted in the organisation. The belief is over ally the executives should superintend the designing and development of the reports because BI is mainly for them and their lower managers when they are analysing data to make informed decisions. This scenario will be represented diagrammatically as shown in the following figure 7.9.

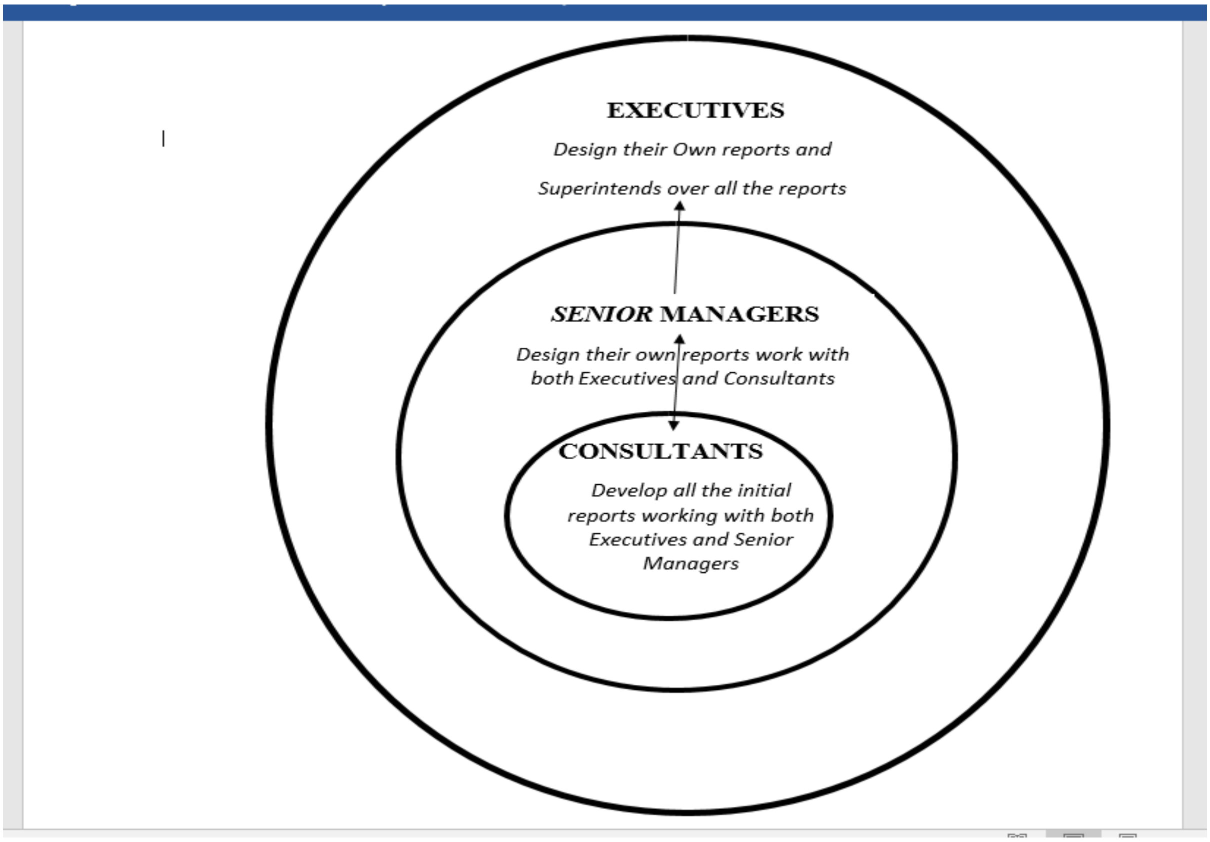

Figure 7.9: Executives as designers of BI reports

Source: Author's construct

The scenario in figure 7.9 is the most ideal and is the one the researcher recommends, however, it is not found in most organisations because Executive managers do not have time. If an organisation adopts and implements this kind of approach it may become an organisation driven by analytics.

Somebody that believes that the senior and middle managers are better placed to be involved in the designing and development of BI reports.

The belief is that the managers have one arm that speaks to operations and the other arm that speaks to executives therefore they are better placed to design the reports, they are also closer to the source of the data and know what the executives want to achieve strategically. The executives work more on a sort of strategic level they get information from the different members of the departments who are managers or supervisors so they get the information and the strategic decision is made. The managers are more on the day-to-day operations of what is happening daily and they make a report and give it to the executive. The manager also works with supervisors who are very close to the operations on the ground and who know how the speed of a certain issue affects production, packaging, and transporting efficiencies.

This can be represented diagrammatically as shown in the following figure 7.10.

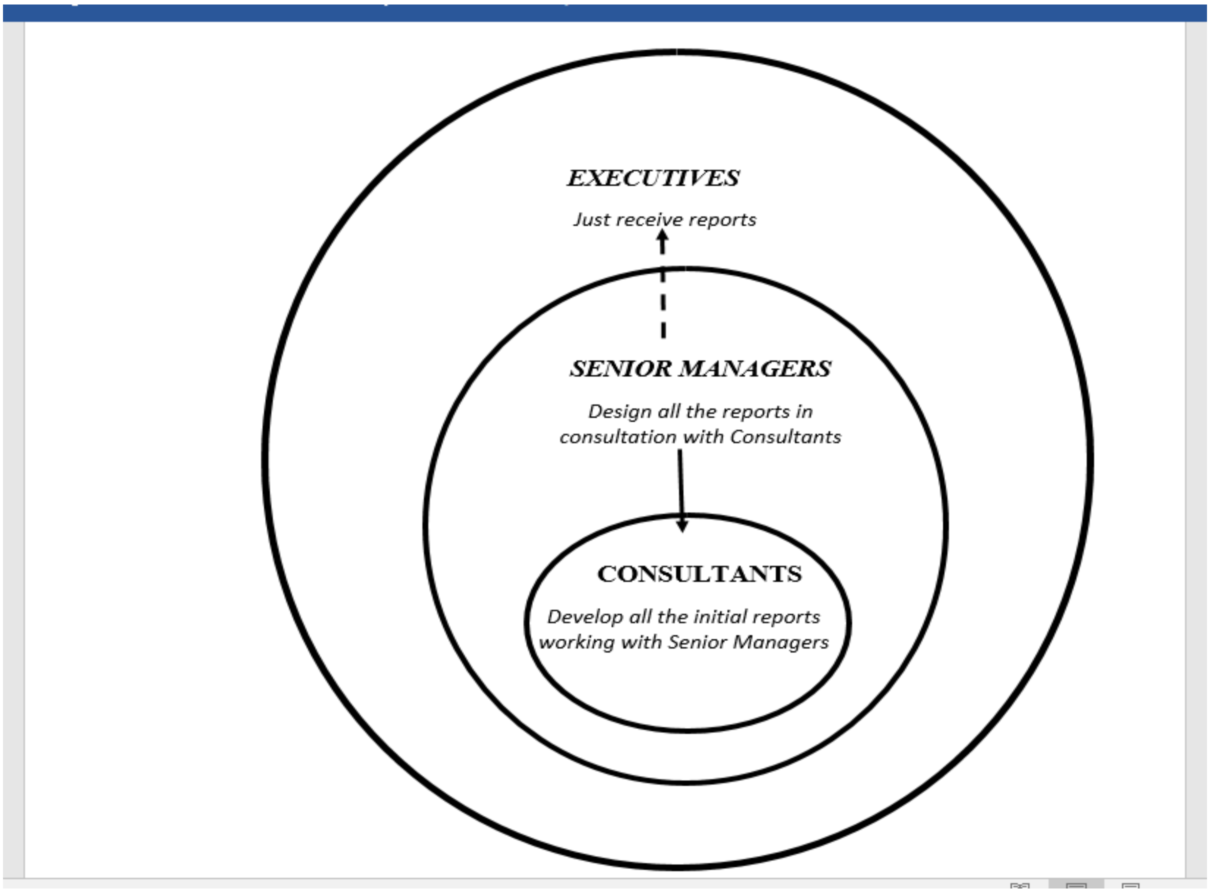

Figure 7.10: Middle managers as designers of BI reports

Source: Author's construct

A person that believes that managers are busy with operations while executives are busy with meetings therefore they should find someone (maybe a lower level manager) who then works with consultants to design and develop the BI reports.

As much as senior managers and executives may have the capacity to design reports they do not have time; most of the time they are busy with strategic issues of the organisation and at that level designing BI reports may be a challenge. At that level of management, they have many meetings both external and internal. This is the reason why consultants prefer to work with lower-level managers because developing BI reports may sometimes become too technical and time-consuming. The following figure 7.11 depicts this scenario.

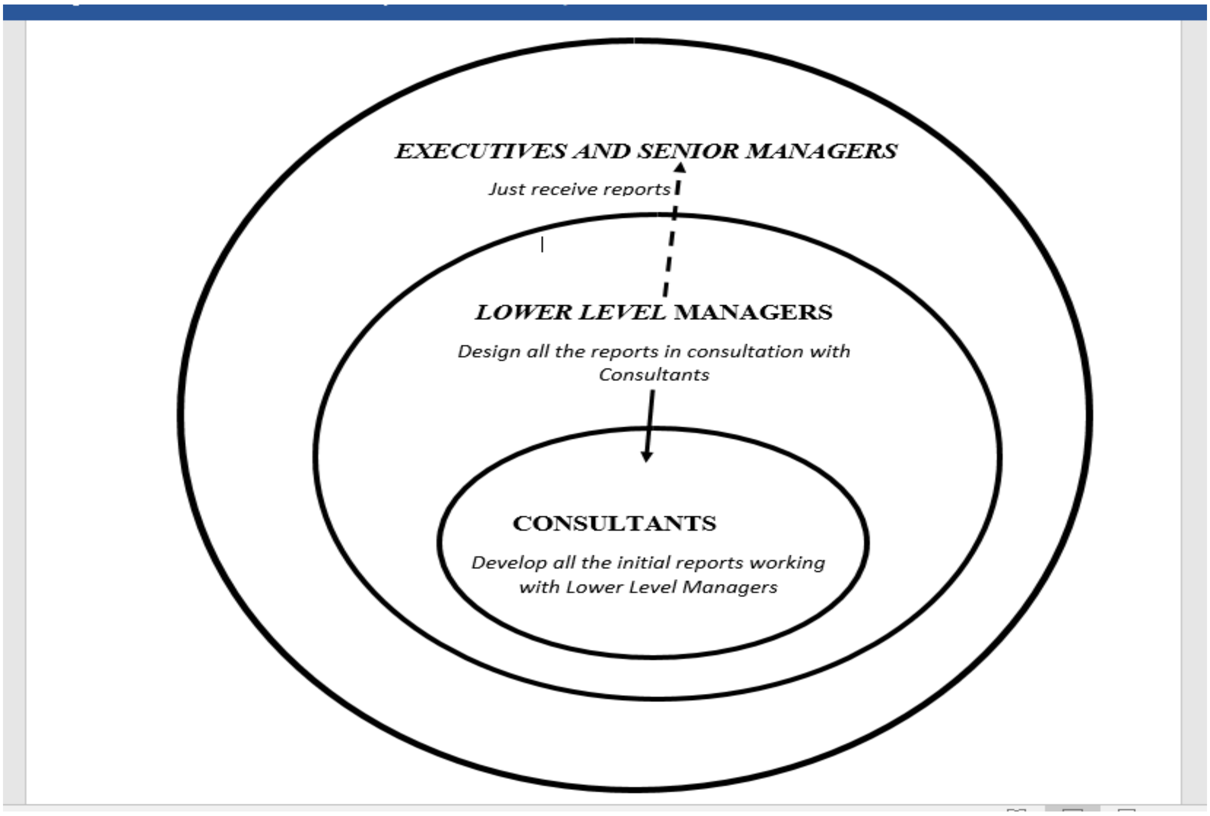

Figure 7.11: Junior managers as designers of BI reports

Source: Author's construct

The scenario in figure 7.11 is what mainly prevails in organisations because senior and executive managers do not have time, they are usually busy with operational issues and lower-level managers do not have access to them. The argument is, in as much as executives may have the capacity to design reports they do not have time, most of the time they are busy with strategic issues of the organisation so at that level designing BI reports may be a challenge. It will be as good as asking them to do operational duties.

Business intelligence consultants indicated that they prefer to work with junior managers as in the last option and the researcher posed the following question to one of the consultants: *Why do you prefer to work with low-level managers instead of working directly with the senior managers and the executive managers?* The answer was educative:

> "*…The low-level managers are more hands-on, and with BI, some staff might get a little bit technical and the executives might not have the time and know-how to develop an in-depth report and the patience to spend a bit of time researching technical issues" (Interviewee No 15, 28 April 2021).*

When this happens the reports that are designed and developed do not address what the managers need and BI is rejected. What then suffers is the analysis of business data in the big data environment to make quality decisions because everyone will be looking at productivity to meet the targeted volume outputs.

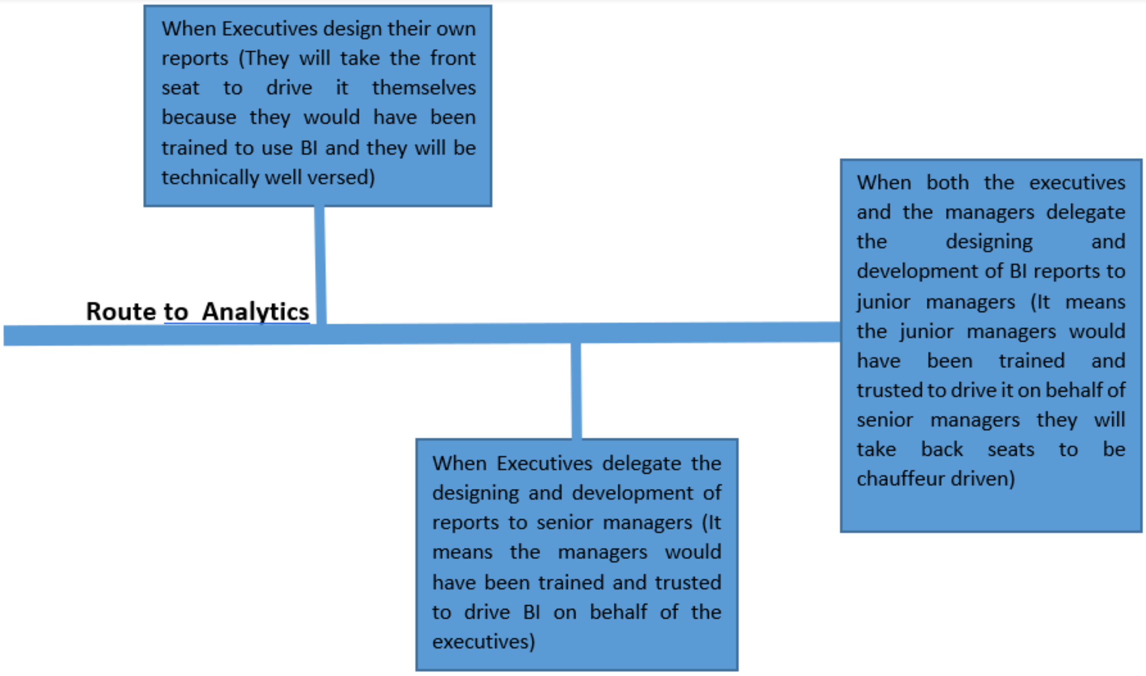

Figure 7.12: Managers' route to analytics

Source: Author's construct

A closer look at figure 7.12 shows that it is very easy for the executives and senior managers to just delegate the design of these reports to subordinates and then give them deadlines. These junior managers will then work on the requested reports, but at the same time, they will also remain responsible for other operational issues. This leaves a room for lack of commitment because the development of BI reports will become a secondary duty, yet the reports are there to assist the managers in the decision-making process.

What emerged clearly from this research study was that for organisations to adopt a big data analytics strategy through the effective use of BI systems, they have to give enough attention to time, skills transfer, and knowledge dissemination. There is a need to make sure that the managers are either involved in the designing of reports or that they are able to design the reports themselves.

The suggested solution is, if managers really cannot create time to be trained due to time and operational commitments then they should find a dedicated person to overcome this challenge. Two suggestions emerged:

(i) Those in support of the idea of having a dedicated person doing data analysis

(ii) Those who do not support the idea of having a dedicated person doing data analysis

Managers have to assess their organization and the departments to see what suits them and then adopt the appropriate option.

Those in support of the idea of having a dedicated person doing data analysis argue that:

(a) That person is required if executives and managers do not have time to be involved in the designing and development of reports so the person will work as a personal assistant and also handle confidential issues when dealing with external data from customers and suppliers. That person is likely to produce reports which are reliable since he/she will be dedicated to that type of job only and will do the job perfectly.
(b) The person should be able to drive the agenda of the business information system in that particular department. There is a need for someone who has a fair understanding of the whole operation to provide a holistic analysis of the business with the correct attitude for analytics. The person must be good at figures, versatile, with that extra eye to see what is happening in the business to continuously spearhead business processes whether they are manufacturing processes, sales processes, finance, HR e.t,c. to drive the department in terms of technological development issues within the department
(c) A dedicated person will be fully utilized if that person is doing what he/she should be doing. The problem only arises when that person realizes that whatever reports are produced no one is looking at them then. The dedicated person will stop doing those reports and will begin to be under-employed. However, in terms of business, there is a lot of work coming from that office.

Those who do not support the idea of having a dedicated person doing data analysis argue that:

a) If the executives and senior managers have time and are willing to be trained or are technically versed with the BI technology they may not need a dedicated person to do reports for them. Some managers argued that a system is for the users therefore, everyone should use it. Once you dedicate one person to analyse data for the whole department, others in that department will shun the system for him/her to do the analysis. They further argue that, once you assign one person to do the analysis, only that one person will know the system and the reports.

b) Most managers are tech-savvy and can mine the data from the system and do the analysis. A dedicated person would not add value.

7.6 Suitable general framework that can aid managers to start mining, the 'new oil', in the form of data through analytics in the current environment

What came out from this research study is that for managers to use BI in an effective way and extract value from data they have to tap into a number of data sources. The current fourth industrial revolution is characterized by a number of other emerging technologies. What emerged from this research study is that, due to these emerging technologies, an organisation can no longer rely on one form of technology like ERP systems though they are designed to cover the entire value chain for transactional purposes. A good data analytics strategy requires collaboration from all the departments along the value chain. It is more than a customary IT department. There is now a clarion call for managers to be innovative and automate all processes along the value chain from the available new technologies. An organisation must develop a firm-wide strategy for it to extract value from big data (Gupta & George, 2016).

Technology will never stop emerging and those who do not embrace it will be left on the sidelines. Managers are aware of this aspect. There is a need for managers to always scan the environment for new emerging technologies. They can seek the help of the IT department for further clarification but the focal point should be the manager because the manager knows the pain points in operations. They are also knowledgeable of the internal business process to guide innovation. Following the value chain concept, managers should be given the chance to look for the best solutions and pick their preferences from those available.

7.7 Proposed general framework for adopting data analytics strategy

The researcher came up with the "bucket of emerging technology" concept that can allow managers to scan the bucket to choose the appropriate technologies they require in their operation. Seven steps are involved.

1. The manager must first interrogate the current processes to identify processes that can be automated.

2. Scan the bucket of emerging technologies to choose the appropriate technologies that suit their operations. If the manager cannot find the technology, they must be innovative to develop one by seeking help from the developers.
3. A decision must be taken to consume the technology on the premises or from the cloud.
4. Source for an implementation partner plan to integrate with existing technologies and budget to implement.
5. Implement the new technology and integrate it with the existing ones.
6. Scan the bucket of emerging technology again to choose the best available data analytics system/software which may as well make use of a data warehouse or analyse from the source.
7. Implement the data analytics software.

The above processes 1 to 7 are repeated regularly to implement new emerging technologies or replace the existing ones because new technologies will never stop emerging. The following figure 7.13 shows the proposed framework that can be used for adopting a data analytics strategy using the scanning the bucket of emerging technologies concept.

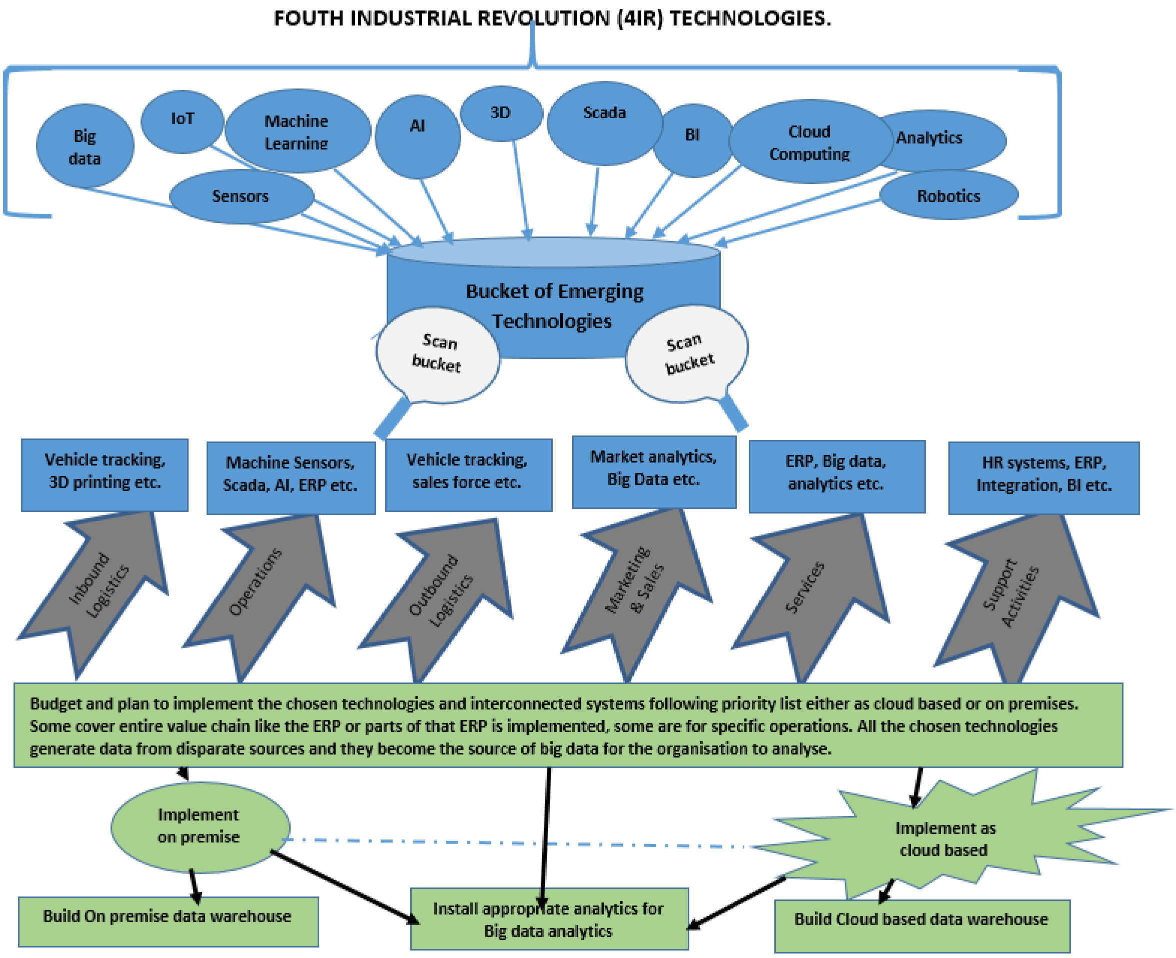

Figure 7.13: General framework for adopting data analytics strategy in the current environment

Source: Author’s construct

The literature identified big data as a by-product of business transactional systems such as ERP (McDonald & L’eveill’e, 2014). Data from machine sensors, vehicles stationary and in motion (Matti & Kvernvik, 2012). Data produced by public service institutions (Administrative data). Data from social media, and networks such as Google, Facebook, Twitter, and LinkedIn. (McDonald & L’eveill’e, 2014). Data from sources that breed unstructured, semi-structured to structured data (Baesens *et al*., 2016).

We can now summarize it by saying big data are a by-product of emerging technologies. Hence, by implementing solutions from the bucket of emerging technologies an organization will be creating its own big data environment which becomes the basis of data analytics. Managers should then budget to implement the chosen technologies in their operational budgets. Those technologies that cover the entire value chain like ERP systems and BI analytics, should be budgeted for under the organization’s consolidated master budget. A decision should then be made to either implement the solutions on the premise, in the cloud, or hybrid. Enough time should be spent on choosing the best solutions and the best implementation partners for the projects to be successful. The best solution can fail if the implementing partner is not good.

The final phase is to scan the bucket of emerging technologies again to look for very good data analytics systems like the (BI) system, audit analytics, and financial analytics systems, then choose the best, implementing partner.

7.8 Chapter Summary

This chapter synthesized the findings in previous chapters and then provided frameworks that can be used by managers to share and analyze data in the big data environment to gain a competitive advantage. It started by providing them with a framework to tap into external data hidden in customers and suppliers. A path to move to the pervasive level of business maturity was provided. This was followed by assessing what is limiting managers from analyzing data before providing the skills-imparting framework to overcome the skills challenge. This was followed by how they can improve the use of BI systems where the concept of a BI driver's license was proposed. The chapter concluded by highlighting what managers need to do before providing a framework to adopt a data analytics strategy. The next chapter concludes the research study by providing a summary and an overview of this research study as well as giving recommendations and a roadmap for future research studies.

CHAPTER 8

CONCLUSIONS AND RECOMMENDATIONS

8.1 INTRODUCTION

This final chapter begins with an overview of the research study, followed by a summary of the key findings that stemmed from this research research study, which are presented in relation to the research study questions. This is followed by a reflection on the theories used to frame the research study, implication, and recommendation of the research study. This chapter will end by offering conclusions and recommendations for further research study.

8.2 An overview of the research study

This research study focused on how managers can analyse big data using business intelligence systems to create a competitive advantage. The preceding chapter discussed and synthesised the findings of this research study. The findings indicated that adopting a big data analytics strategy is feasible, however, it does not happen on its own. Management is at the center of it and has a big role to play. Frameworks have been provided to that effect.

The aim of the research study was to explore the value to be derived from data analytics application to improve business intelligence in the manufacturing sector. The ~~aim~~ main objective was, therefore, to propose suitable frameworks that can be used by managers to analyse external and internal data in the big data environment using business intelligence (BI) analytics systems to create a competitive advantage.

This main objective-was based on four specific objectives:

1. Explore whether external data in key stakeholders' systems can be accessed and analysed the same way internal data are analysed without compromising ethical issues in the big data environment.
2. Examine the effect of current systems of analytics on how managers analyse data and the effort required to use BI in the big data environment.
3. Establish the ways in which managers can effectively use business intelligence systems to improve performance and predictive analysis.
4. Develop a sustainable framework for improving the use of business intelligence systems to make data driven-decisions in an environment characterised by a number of other emerging technologies.

The aim, main objective, and subsequent specific objectives translated into the following research study questions, which framed and guided the research study process.

1. What factors promote the effective exchange and usage of data with external stakeholders in the big data environment?
2. What is limiting managers from using Business Intelligence systems to analyse information in the big data environment?
3. How can organisations effectively use business intelligence systems to improve performance and predictive analysis?
4. What framework would aid managers to analyse data, "new oil", using business intelligence systems?

8.3 What factors promote the effective exchange and usage of data with external stakeholders in the big data environment?

The following is a summary of the key findings in relation to Research study Question 1 (stated above) and Research study Objective 1

Objective 1: Explore whether external data in key stakeholders' systems can be accessed and analysed the same way internal data are analysed without compromising ethical issues in the big data environment.

Benefits, trust, risk, and ethical considerations emerged as core when sharing data in the big data environment. They call for a revisit and amendment of the associated theories used in this research study. What emerged is that there are no clear policies or frameworks for integrating systems to share data with key stakeholders. The extant literature talks about big data in broad terms as mainly unstructured, free, external data that comes from Geo maps, Google, Twitter, and Facebook. What also emerged from the current research study is that, for a manufacturing company, the bulk of the data are negotiable, and external data are hidden in existing suppliers and customers; they might not be at liberty to share this data for fear of exposing their strategy. The concept of free and negotiable data emerged as an important concept in the process of data analysis. Negotiations for sharing data should be done at the executive level.

8.3.1 Recommendations on promoting the effective exchange and usage of data with external stakeholders in the big data environment.

Executives must sign MOUs, NDAs, and SLAs to address legal and ethical issues. They must also ensure that the platforms to share the data are secure. It is ideal to use procurement and sales and marketing as two main arms of interfacing because they talk to suppliers and customers. There is an urgency to build trustworthy relationships that are beneficial to mitigate risk and ethical considerations.

To plant an automation agenda, managers must identify external data that they need in operations by negotiating with key stakeholders instead of hunting for it. For example, a big retail company in Zimbabwe might install cameras to monitor activities in its shop. In such a case, the executive from a manufacturing company that supplies these shops with products can approach them and negotiate to share data from the installed cameras to monitor product availability and customer behaviour instead of obtaining this report from a sales representative. The executive will then be able to monitor all the retail shops across the country from the comfort of his/her office. The sales representative of the manufacturing company will be more focused knowing that the executive is monitoring the situation.

If trust is high, then the one with more trust should initiate negotiations to electronically share data.

It is quite clear that sharing of data in the big data environment hinges on top management's involvement. Junior managers may be knowledgeable, but negotiations must be done at the highest level of the organisation for an organisation to start sharing data. Any engagement to integrate systems to share data with key stakeholders should take place at the executive level with the procurement executive, and with the sales and marketing executive leading the process.

A framework for sharing data with key stakeholders in the big data environment was presented in chapter 7 together with the big data bargaining gate. A policy framework proving a path to reach the pervasive level where business intelligence is extended to customers and suppliers was also presented in the same chapter. This framework can be used as a basis of crafting a law for sharing data with key stakeholders in the big data environment as we move into the Fifth Industrial revolution.

8.4 What is limiting managers from using Business Intelligence systems to analyse information in the big data environment?

The following is a summary of the key findings in relation to the above research study question (2) which is aligned with Objective 2: Establish the current systems used by managers for analytics and the effort required to use BI then examine whether the increase in data sources now affects the way they analyse data.

The findings indicate that the managers' preferred source of data for analysis is not always the current source, due to certain limitations. Managers prefer auto-generated reports and their trusted sources of reports in order of preference are:

> (1) Machine sensors and cameras: Currently they are not using sensors. They are only using cameras for isolated incidents like theft and misconduct.
> (2) ERP system: It is the primary source of information and where the transactions take place. Access to it is controlled, and postings are published by trained users. The data in it speak to that of other departments except for errors emanating from original postings.
> (3) BI systems: As the secondary system to ERP, information in it may not be accurate. Therefore, it may sometimes differ from what is in ERP depending on how the reports have been developed and the time of synchronisation with ERP.
> (4) People: There is a need for verification due to the risk of human error and the risk of manipulation to suit individual needs. The information may therefore not be on record and with people, things always get lost in translation.
> (5) Mobile devices via social media are seen as a grey area as there is room for manipulation. Verification is required.
> (6) External source: Because of a lack of trust, data from external sources need to be scrutinized.

Usually, when a new system is introduced for analytics, users stick to the old system, and in this case, it is usually the ERP system. The main reason is that in the ERP, during the daily activities of capturing, costs are automatically reflected in real-time in other departments such as finance and P&L. Any activity in one department will affect other departments. It is a very important feature of the ERP system. Managers expect this feature in any new system for them to accept it.

The literature highlighted a lack of skills as the main limitation for managers to use BI systems. Managers, the research study found, are limited in terms of technical skills and time. Time emerged as a major limitation. In as much as some managers may have skills, they might not have time. It was also clear that both the external business intelligence consultants and the internal consultants have limitations. The external consultants are limited in terms of knowledge of internal business processes. The internal consultants or IT department may be limited in terms of both internal business processes and technical skills.

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8.4.1 Recommendations on addressing the factors limiting managers from using Business Intelligence system to analyse information in the big data environment

The focal point is the manager because the manager already has knowledge of the business process and is best suited to do the BI analytics. If the manager has both the technical skills and the time, then that manager can design and develop BI reports. If the manager lacks technical skills but has time, then that manager can decide whether to work with either an internal or external consultant or a data scientist. If the manager lacks time but has technical skills, then that manager may decide to use either an internal or external consultant. If the manager lacks both skills and time, then that manager should work with both the internal and external consult (all the nodes will be ideal).

A skills-imparting framework was developed in this research study to overcome the skills challenge. In this framework, it is key for managers to ensure conducive conditions and create time to be trained. If the managers do not have time to design and develop BI reports because of operational issues, then they can designate a dedicated person to do the analytics. Otherwise, they should not delegate this very important function at all f they want devices to report to them.

8.5 How can organisations effectively use business intelligence systems to improve performance and predictive analysis?

The following is a summary of the key findings in relation to the research study question (3) which is aligned with Objective 3: Establish the ways in which managers can effectively use business intelligence systems to improve performance and predictive analysis.

Managers, external consultants, internal consultants, and the IT department have a role to play in effectively using a BI system in the big data environment. The managers are the owners of the business processes. Therefore, they know the kind of intelligence they need, and are aware of any improvements needed on the BI system for them to achieve their goals. This cannot be neglected in the development of reports. The external consultants are the agents or owners of the BI systems. The managers should provide them with facilitating conditions and knowledge of business processes for them to deliver effectively. The internal consultants are the representatives of management who play a major role when the external consultants are no longer there. The IT department plays a major role in choosing the appropriate BI tool for the managers. They prepare the infrastructure and monitor the BI solution when the external consultants are no longer on site. A suggestion that a dedicated person is assigned to do the analytics for managers was met with some scepticism. This might lead to all the other managers shunning the system.

8.5.1 Recommendations on how the organisation can effectively use the business intelligence to improve performance

There is a need to impart skills to the current managers in their current working environment. The idea is to close the technical gap and the knowledge of business processes. The managers' route to analytics was presented in chapter 7 where it was also highlighted that this route is a matter of choice for the manager. There is also a recommendation in this research study for managers to have a BI driver's license. Managers play a major role in advancing the change agenda. They must budget for training and also introduce the role of organizational change management (OCM) consultant whose role is to raise awareness. This role is missing in most BI projects.

8.6 What framework would aid managers to analyse data, "new oil", using business intelligence systems?

The following is a summary of the key findings in relation to the above research study question (4) which is linked to Objective 4: Develop a sustainable framework for improving the use of business intelligence systems and make data-driven decisions in an environment characterised by a number of other emerging technologies.

We are now living in a world characterised by a number of emerging technologies. Managers were asked about their opinion on these emerging technologies they intend to embrace these new technologies or whether they think the ERP and BI systems are enough for them. What emerged is that managers are not confused by emerging technologies as it increases the number of data sources. However, they think the IT department should lead and they follow. It was clear in this research study that adopting big data analytics is more than a customary IT department role. Improved collaboration between the managers and the consultants is needed. Currently, there is no big data analytics strategy to start mining the new 'oil'. Three suggestions emerged (i) all of them have to be involved (ii) Senior Managers have to design the reports and (iii) lower-level managers have to design the reports.

8.6.1 Recommendations on how to adopt emerging technologies and analyse the resultant data, “new oil”, using business intelligence system

Each manager should develop his/her own BI reports because the requirements and levels of intelligence gathering are different. A framework for adopting a big data analytics strategy was provided in chapter 7. The researcher introduced the concept of ‘scanning the bucket of emerging technologies’ introduced in the same chapter 7. It was highlighted that it is the manager who should scan this bucket of emerging technologies with the help of IT because the manager knows the pain points in operations.

8.7 Reflecting on the Theoretical Framework that framed this research study

Theoretically, this research study was underpinned by three theories, (i) the Unified theory of acceptance and use of technology (ii) The diffusion of innovation theory, and (iii) The Social exchange theory. The researcher believe that UTAUT and DOI theories provided me with conceptual and analytical lenses to explore and explain what is limiting managers from using business intelligence systems to analyse data in the big environment. This is particularly relevant to understand the relationship between the adoption and usage of business intelligence systems. The third theory SET was borrowed from social science and provided me with the lens to explore and explain sharing of data in the big data environment.

Big data is a new field of study with no known theories. Researchers seem to have agreed on the characteristics of big data as the 5 “V’s” but when it comes to the development of theory, they seem to take different directions. The scientific side seems to concentrate on volume, while the commercial side takes a keen interest in value. This has resulted in what professor Peter Grindrod termed “academic research study science versus commercial players”, or “big science versus big economic impact”. This encourages science not to compete with commercial opportunities but rather support them (Grindrod, 2017). The University College of London (UCL) has been organising annual workshops on the theory of big data since 2016. The purpose is to try and overcome the challenge of big data theoretical underpinnings by gathering experts from around the world (University College London, 2017).

8.7.1 Implications and Recommendations for theory

A theory for big data should take into account the factors that hinder the extraction of value from external data, and then incorporate factors using the concept of external data versus internal data. The recommendations in this research study are to include trust, risk, and ethical considerations as the additional key moderators to the UTAUT theory. The framework for exchanging data in the big data environment presented in this research study can be used as the basis for building a big data theory because the value of big data is hidden in external data.

8.8 Practical Implications and Recommendations for Further Studies

Whilst this research study focused on extracting value from the big data environment, the findings hold various implications for managers and policymakers, opening up possibilities for further research studies.

Policy frameworks are an important lever for ensuring that systems are integrated and data are shared between trading partners to boost economic activities and improve the equity of decisions. Further research study is needed to explore whether the fear of sharing data also applies in other, countries and regions.

Most of the research studies to date have produced BI maturity models that only measure the levels that can be reached; they do not suggest a path to get there. Further studies to test the provided paths/options are recommended. A quantitative or qualitative research study in the form of a case study using the frameworks and recommendations that emerged from the research study, to test if they apply in the broader world, is also recommended.

To really mine, the “new oil”, which is big data, further research study is needed to produce a big data theory based on the frameworks in this research study. Amendments suggested for current theories used in this research study can be tested in other contexts through replication studies. This will strengthen my theoretical contribution to the theory.

8.9 CHAPTER SUMMARY

This chapter concluded the research study. The chapter restated the aim, main objective and specifcs objectives of the research study used namely, what is limiting managers from integrating their BI system with those of key stakeholders to share data and using business intelligence systems to analyse data in the big data environment. It provided an overview of the key findings from the research study with the research study questions aligned with the relevant research study objectives. It also reflected on the theories underpinning the research study and provided implications of findings for executives, senior managers, external BI consultants, and internal BI consultants interested in using business intelligence systems to extract value from the big data environment. A significant finding of this research study is that BI systems are not plug-and-play systems; there is a need for improved collaboration between those who implement them and those who use them.

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APPENDICES

A – Interview Guide

- **A1- Executives interview guide**
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B – Interview extracts based on themes

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C – Ethical approval from UNISA
D- Informed consent form for individuals
E- Participant information sheet
F- Similarity index report (TURNITIN)

Appendix A1- Executives interview guide

1. Are you prepared to electronically exchange your strategic data such as in your budget; with strategic partners like (key suppliers and customers), via interconnected systems, and who do you think should be assigned that role in the organisation and why?
2. In your own opinion do you think your key strategic partners are also prepared to electronically interchange data for intelligence insights and predictive analysis via interconnected devices without issues? What may be the limitations to that effect?
3. What do you think needs to be done by organisations to improve the sharing of strategic data electronically?
4. Do you trust data generated from the following sources? SAP ERP BI system Mobile devices Machine sensors People Cameras External source May you please explain why you trust or do not trust some of them?
5. I understand you receive BI reports. In your own opinion as an executive manager, who do you think should design these BI reports, between executives, managers, and consultants and why do you think so, and what may be the challenge for the other group?
6. Currently there is data everywhere in computers, mobile devices, cameras, and machine sensors. Has this increase in volumes of data available for analysis brought in benefits or challenges to your decision-making process? May you please share your experiences?
7. What technological challenges do you currently face or wish should be addressed when gathering and integrating internal and external data for decision-making and budgeting?
8. May you please share your appreciation of the BI system do you think you will be able to use the system on your own to design reports without the help of a consultant and if you compare it to Excel which one do you prefer to use in your department and why.
9. What do you think should be done to improve the usage of BI systems?

10. What is your opinion on having one dedicated person doing just data analysis for each department, do you think such a person will be fully utilised?
11. What is your opinion on having a lot of interconnected systems and devices, do you think it is relevant to your business, or the current ERP system addresses all your requirements?

Appendix A2- Senior managers interview guide

1. I understand you receive BI reports, in your own opinion as a senior manager who do you think should design these BI reports between managers and consultants and why?
2. What is your opinion on having a dedicated person doing just data analysis for your entire department, do you think such a person will be fully utilised?
3. Currently there is data everywhere in computers, mobile devices, cameras, and machine sensors. Has this increase in volumes of data available for analysis brought in benefits or challenges to your decision-making process? May you please share your experiences
4. You know data are generated from a number of sources do you trust information generated from the following sources? SAP ERP BI system Mobile devices Machine sensors People Cameras External source May you please explain why you trust or do not trust these sources?
5. When preparing information requested by your executives which system do you prefer to use and why.
6. What do you think can be done, to improve the usage of BI systems in organisations?
7. In what way has technology affected the way you now prepare information for analysis and decision making

8. If you were, given a chance to change how data are analysed in your organisation what would you change and why
9. What kind of challenges or benefits do you currently experience with an abundance of data?
10. What is your opinion on having a lot of interconnected systems and devices do you think it is relevant to your business or it is something now confusing? Do you think the current (ERP and BI), systems address all your requirements?
11. What is your opinion on exchanging strategic data such as in your budget with external strategic partners (key suppliers and customers) via interconnected systems and who do you think should be assigned that role in the organisation and why?

Appendix A3- Consultants interview guide

1. In your own opinion as a BI consultant who do you think should design BI reports between executives, senior managers, middle managers, and BI consultants and why do you think so?
2. Do you think senior and executive managers can design BI reports on their own without the help of a BI consultant?
3. In organisations where you have implemented BI systems, what has been the role of IT, and at what level have other departments been involved?
4. In your opinion can data in organisations be, safely shared electronically for intelligence insights and predictive analysis without issues, what do you think might be limitations to such an initiative?
5. What do you think needs to be done by organisations to improve electronically the sharing of strategic data?
6. What do you think are the challenges of taping into the voluminous data from a variety of sources?
7. As a BI consultant what challenges do you face when integrating internal systems with other external systems?
8. Do you think managers are skilled enough to work with BI systems may you please explain why you think so?

9. In your own opinion what do you think can be done, to improve the usage of BI systems in organisations?
10. Do you see any need to have a lot of interconnected systems and devices, or the current ERP and BI system address all the organisation's requirements?
11. When building the data warehouse what has been the proportion of internal data sources versus external data sources and what challenges do you usually face?
12. What is your opinion on exchanging strategic data such as in budgets with external strategic partners (key suppliers and customers) via interconnected systems and who do you think should be assigned that role in the organisation?

Appendix A4- Focus group discussion guide

1. Do you think it is feasible for organisations to electronically share data with key strategic partners such as key suppliers and customers via interconnected systems for decision-making without issues and who do you think should be assigned that role in the organisation?
2. In your own opinion who do you think should design and develop reports in the BI system and why do you think that way?
3. Do you think managers have enough time and technical skills to design their own reports in the BI system, or they need an assistant to achieve that?
4. What do you think is limiting the analysis of data from a number of interconnected systems?
5. Do you think the BI systems are being used effectively in organisations? What do you think are the limitations and improvements needed?

Appendix B 1: Interview extracts on benefits of sharing data with outside key stakeholders:

Extract: Interview and probing questions	Extract: Interviewee's response
The Researcher: What is your opinion on exchanging strategic data with external strategic partners such as your customers? Are you prepared to share such data via interconnected systems? **The Researcher:** Ok, so if I am getting you correctly you are saying that it would be better for organisations to share data, but do you think it's easy, like in a setup in our country to say you give them access to your data and they give you access to their data?	**Transcript_Interview 4** "I think looking at it from a value chain point of view where our suppliers should know how much input we need for each product that we are running. For example, for A or Product B we will need so many cups for us to achieve our budgeted production output sometimes there is no merit in us not sharing with our valued suppliers what we need from them. "The positive side: if your key stakeholders know where you are coming from and where you are going, the supplier relationship management will be managed easily, and you will not have supply gaps because you would have shared what you are going to do and on the customer side as well, because those volumes or the key data which is the volumes that you are going to sell they are coming from the customer saying they want so much so it will be just confirmation from our side"
The Researcher: Data can be interchanged between organisations and certain information is very sensitive, and I want to hear your opinion, are you prepared to electronically exchange your strategic data such as in your budget with strategic partners such as key suppliers and key customers via interconnected systems?	**Interviewee 8:** If you have interconnected systems to share data about what the company intends to do, and those data are confidentially shared with key customers and suppliers, then planning on either side becomes much easier and faster. The supplier has less risk than the producer as in our case. Taking certain ingredients from a certain supplier there is not much that I can do If I know that the supplier's capacity is X even if that information I pass it on. Unless if the risk I can pass on that information to the supplier's competitor it could be, the risk in my opinion to the supplier is much less because they want anywhere their capacity to be known and declared so that when I deal with them I know they have the depth of producing when I require it.
The Researcher: Are you prepared to electronically exchange your strategic data in your budget with strategic partners such as key suppliers and key customers via interconnected systems? What I mean here is you are allowed to log into the supplier's system and they will be allowed to enter into your systems to see your plans and your budgets for easy preparations, do you think it is feasible?	**Transcript_Interview 9** If the sharing of that data is done with benefits to both companies and alternately the consumer and possibly anyone further down the value chain, then I think it will be a benefit There will be many benefits to sharing data with a few companies so again you would have to choose which company that has the required data. We use a lot of ABC materials and the companies that supply us with those products, sharing data might be much better for planning purposes

	I think the leaders of the organisations, well not to sound convent or anything, may need maybe to be educated in the possible benefits because when I first read this question I said NO we can't share the data NO! NO! then when I start thinking about it that's when I said if we share data with key stakeholders when there is no conflict of interest but for mutual benefit, it will work. So for the leaders of organisations it needs to be pointed out to them the possibilities of the benefits of consenting to share some of the strategic data for ease of planning. An example is Company X which is the mother company but they have a feed company they have a dairy company they have a pork company they have a chicken company all sorts of things like that and they have fast food outlets and they have a distribution network. Everywhere they have a bread company so everywhere on their value chain so if a company like that shares strategic data along that value chain everyone would benefit. So like Company X we can form our own value chain with our key stakeholders and do exactly the same with a similar system.
The Researcher: I understand when analysing your information you use internal data and external data, are you prepared to electronically exchange your strategic data in your budget with your strategic partners such as your suppliers and customers via interconnected systems? What I mean here is you will be allowed to log into your key customers' systems and see their planning and you allow them as well to log into your system maybe it's an ERP system or Business Intelligence System and then they can see your plans so that planning is made easier, what are your reservations to that?	**Transcript_Interview 11** Aha, thank you, ideally in a normal ideal environment we don't mind integrating our internal systems with our key stakeholders such as our suppliers and customers, why, that should help us, currently, we are doing it manually. An ideal system would be where we integrate our systems to let our key customers order automatically because where ever there is human interference there may be mistakes in capturing or documents get lost. Information will flow seamlessly and you know there are no mistakes, and it's accurate as long as the issues of confidentiality are addressed I wouldn't mind integrating our systems with our key stakeholders.
The Researcher: I understand you exchange information with your strategic partners such as your customers and your suppliers are you prepared to electronically exchange strategic data with your customers via interconnected systems? I am talking of a situation whereby you can log into your suppliers' systems and you can now easily plan and they can log into your system and plan for their deliveries to be done what is your reservation to that effect?	**Interviewee 13:** I think to enable either party to plan properly it is important that you are able to log on to our customers or our suppliers but I am looking at it from the angle that says if my customer wants to order products from us it would be easier if they were to have access to what is available in our warehouses and they can just place their order and then all we do is just to deliver. I think it is important but obviously, there have to be limitations as to how much more they can access in terms of them being able to view the stocks that we have and being able to place their orders through some interconnections. I think this will enhance the way business is done. The reverse is also true when we are dealing with our own suppliers and we want to place orders we need to be able to understand what they are also having in stock and also their plans if I am having some growth plans my suppliers should be able to know that I am growing and the things that I need so that they also plan for my growth so it is important for both parties
The Researcher:	**Transcript_Interview 14** I think it's critical in this global world you can't live in isolation we need to be connected to the world so that when we are dealing with customers and suppliers

Are you prepared to electronically exchange your strategic data in your budget; with strategic partners like (Key suppliers and customers), via interconnected systems?	it's easier. The specific customers or specific suppliers must know what they expect from you as forecasts so that information certainly you need to share so that they prepare for you in advance if you don't share with them then you will be surprised when you expect delivery because they did not know your intentions so your intentions must be known so that you know very well that they prepare for you
The Researcher: Are you prepared to electronically exchange your strategic data in your budget; with strategic partners like (Key suppliers and customers), via interconnected systems?	**Transcript_Interview 17** We only need to give them what is relevant for their purpose for example suppliers only need to know the number of goods we will require from them each month for the budget cycle. Customers need to know what we intend to sell to them and the expected revenue over the budget cycle.
The Researcher: Are you prepared to electronically exchange your strategic data in your budget with strategic key customers and suppliers via interconnected systems?	**Transcript_Interview 18** It creates efficiencies and effective reorder patens and there will be a reduction in bureaucracy and too much paperwork flying out. It also reduces personal visits to customers especially, during this period when we are faced with the COVID pandemic this kind of initiative can actually help to improve business-to-business interaction without physically having to meet.

EXTRACTS FROM FOCUS GROUP DISCUSSION
Focus Group Participant 1 Taking a cue from our plant maintenance module if we are able to connect to our suppliers' warehouses that offer spares and equipment for our packaging we can see what spares they have and at what locations and which site then we can get them at the shortest possible time. If we can also view their system and see the prices, then we can place orders not on our system but on their system, then they can quickly see our orders. We can also plan our service knowing what they have and then plan our activities, it takes a shorter time unlike when using phone calls.
Focus Group Participant 2 Like the electronic system for ordering fuel, it enables us to see their stocks if they have products that are available it enables us to place orders electronically without having to interact with them over the phone, we can see their price movements.
Focus Group Participant 3 Yes, I want to concur with Focus Group Participant 1 and Focus Group Participant 2. I think in terms of I will speak about finished goods if let's say we have interconnection with (Major customers for a manufacturing company in Zimbabwe) we won't have any problems with returns because they will just order what is there.
Focus Group Participant 4 I think the ease of doing business that even our current government is always talking about it would be very easy

Appendix B 2: Interview extracts on red zone of external data coupling

Extract Interview and probing questions	**Extract Interviewee's response**
The Researcher: what is your opinion on exchanging strategic data?	**Transcript_Interview 5** Obviously, there is a risk associated with that, you only want to share data that is critical between the transaction that you are doing and that's it.
The Researcher: You know data are now in abundance like in organisations they can be easily be shared. In your own opinion can data in organisations be safely shared for intelligence insights and predictive analysis?	**Transcript_Interview 2** Well, there are some other things that are meant to be public like financial statements which are published I think most organisations share such kind of information but when it comes to more of how the business is taking its direction or aligning mission and goals, different organisations have got different ambitions. So in a competitive environment no, because the competitive nature of business requires that certain data cannot be shared.
The Researcher: Then!! I understand you get data from outside and then you have your own internally generated data from ERP systems What is your opinion on electronically sharing data needed for planning with external customers, are you comfortable with that?	**Transcript_Interview 1** Yes! It's a very important aspect of business, however, it must be handled with care, especially in organisations that are in competition with each other where you have stiff competition, especially in underdeveloped countries where one company will be competing with that other company for the same market. You would want to protect your market share and by sharing your data with an organisation that is outside then you may have problems there is a need to manage that.
The Researcher: In your own opinion can data in organisations be easily and safely shared for intelligence insights and predictive analysis? What do you think might be the limitations to such an initiative to share data across organisations?	**Transcript_Interview 3** "It can be done if you are actually in secured environments whereby we are saying there is no hacking of information which will actually be exposed to the outside world.
The Researcher: Do you think it's easy in a setup like in our country to say you give them access to your data and they give you access to their data?	**Transcript_Interview 4** Looking at the competition, sometimes you will be saying the competition might end up knowing our strategies, yes that's another downside,

The Researcher:	Transcript_Interview 8
You have highlighted to say confidentiality and that word keeps on coming do you think at the moment organisations handle that confidentiality or it has to be done at some level in an organisation?	whilst it is very desirable the difficulty is that you have got a supplier who is also supplying your competitors so this is where you have a problem. You will have a situation where you have now shared what you are intending to do with a supplier and that same supplier is also supplying your key competitors, and there is no guarantee that the supplier will not share that at times not even deliberately but by an error that data can be found in wrong hands then you are in trouble because the competitive landscape will change yes that's the major limitation that I see. Remember what makes an organisation successful is its strategy and once the strategy is known by everyone it's no longer a strategy so there are two issues that should never be shared, trade secrets should never be shared this is why you can go to the extent of looking at compartments to say this trade secret will end there never to cross this lane and so forth
The Researcher: Are you prepared to electronically share your strategic data in your budget with strategic partners like key suppliers and key customers via interconnected systems?	**Transcript_Interview 9** I think it could be a good idea yes, however, specific data has to be shared with specific partners where there is no conflict of interest between the company's production and products, so yes but not everything.
The Researcher: What is your opinion on exchanging strategic data such as your budget with external strategic partners (Key suppliers and customers) via interconnected systems and who do you think should be assigned that role in the organisation and why?	**Transcript_Interview 10** I think it's a sensitive area but at the same time, it's important to share so that those that want to share must have a strategy of what to share because it can be a big strategy but I think there are components that you can take out from that strategy that is relevant to, whether the supplier or customer so it can be shared but it depends on the stakeholder per customer and then maybe there is an executive who is directly involved with the customer if it is a supplier so it should be done at the executive level. what I am saying is data in business is information that is sensitive, you might not know whose hands it may end up in so it may end up being abused by a competitor and they will know what you are planning and then counter-plan yes so it's a sensitive area and it needs to be done at a high level so that you can select which data will be shared
The Researcher: I know when analysing your information you use internal data and external data are you prepared to electronically exchange your strategic data in your budget with your strategic partners such as your suppliers and customers via interconnected systems and who do you think should be assigned that role in an organisation and why?	**Transcript_Interview 11** Things like margins things like stock holding are strategic issues those are confidential issues. The other tricky part is the relationships between some of our stakeholders and our competitors, for example, some of our suppliers of packaging are owned by some of our competitors so the question is where does the data end? If our supplier has got our vital data won't they share it with our competition since we are in the same group of competition, that is the reservation we have about sharing data. Ideally, that is what is required but the reservations will be on confidentiality now which may be a challenge

The Researcher: Ok, so in other words, if I am getting you correctly you are saying maybe the organisations have to sign some service level of agreement to exchange the data?	**Transcript_Interview 11** Even if we sign NDA (Non-Disclosure Agreement) with our key stakeholders where you agree on Non-Disclosure of the relationship but as long as your key stakeholder has other relationships of ownership with your competition because remember these people also do strategic meetings where they discuss with their customers and the big question is won't they discuss your plan with your competitor and then it becomes a weapon to attack you so it becomes trick
The Researcher: Companies exchange data, for example for procurement or for sales, what is your opinion on exchanging strategic data such as in your budget for them to know your plans, what are your reservations to such an initiative **The Researcher:** Ok, so you think even for marketing you may be exposing your strategies? **The Researcher:** Ok then what do you think organisations should do then to reach such levels?	**Transcript_Interview 12** I think (1) it has to be confidential (2) if it is to deal with the budget for example of suppliers or something I think the budget should be speaking to what that supplier gives to the company if it's aligned with what the supplier is giving that is the budget the supplier should see no other budgets. Yes! Yes! even to customers, I wouldn't really want to, I would rather just if they want to know what volumes I plan to do for the lines that they buy not other lines but the lines that they want to buy no I wouldn't want to expose everything. Such level! yes because for example, I would never want a supplier to be able to enter my system, you see what I mean so even if I am able to log into theirs I don't mind if I am just logging in to just see the materials that I want, yes, because the of confidentiality element, it's a bit tricky but on them knowing my budget and my plans then they can plan for the future for that particular product it's ok
The Researcher: Ok so if I am getting you correctly you are saying there is no problem with that, but do you have some reservations **The Researcher:** So if I am getting you correctly you are saying there is no problem in them connecting and you connecting but you would rather limit the kind of data that you exchange **The Researcher:** Ok but now as organisations are operating these days do you think they are doing that, or do you think there is an improvement that needs to be done for such things to happen or organisations are holding on to their data, they are hesitant to exchange them?	**Transcript_Interview 13** Obviously reservations to the extent that access has to be limited, there have to be limitations to how much data they can access otherwise they end up accessing proprietary information for my own detriment and use it to support my competitors or other people yes There should be proper controls in terms of what they can access otherwise you can then have people populate and corrupt your systems and take advantage to destroy you in terms of competition I think organisations are still hesitant so everyone is trying to protect their own territory but I think if designed properly with proper securities and authorisation levels it should work
The Researcher: Ok, then when building a data warehouse what has been the proportion of internal data sources versus external data sources and what challenges do you usually face?	**Interviewee 16:** Yes it is necessary but it is difficult you rarely find customers, that are willing to disclose information like that

The Researcher: Ok, why do you think they are reserved and do not want to share strategic data? **The Researcher:** Ok so you mean they would rather not share and they are not at liberty to share?	Because sometimes those data are very sensitive you know sometimes businesses might not want to give the public the impression that their business is not doing well, so by sharing the data it might make it very obvious that their company is struggling and that might end up scaring away potential customers. Exactly it's rare to find a company that gives you proper access to their data for you to get information about their business apart from the basics like their address and their bank accounts just that
The Researcher: In your own opinion do you think your key strategic partners are also prepared to electronically exchange data for intelligence insights and predictive analysis via interconnected gadgets without issues?	**Transcript_Interview 17_Answered_as_a_Questionnaire** Yes, but I think they too will limit the data to what is necessary, for example sharing their growth projections and expected pricing movements. They would like assurance that their data are secure and only used for the intended purpose.
The Researcher: Are you prepared to electronically exchange your strategic data in your budget with key strategic customers and suppliers via interconnected systems?	**Transcript_Interview 18** Whilst it may have benefits in terms of sharing data between us and our key stakeholders, which are our customers and suppliers I think there are also associated risks that come with that especially given the environment where it has become very competitive and in our strategic documents and strategic budgets you will find that there may be competitor information and we may find ourselves opening up to competition by giving out too much data which may not necessarily be beneficial to the stakeholders. The data may end up in the wrong hands, especially given that we are a listed company we may end up pre-emptying the information that may not yet be ready for publication in the public arena.

EXTRACTS FROM FOCUS GROUP DISCUSSION

Focus Group Participant 4

Well, I think it depends on how long you have been operating with those suppliers or customers because if they are new in the field I think what might probably happen is that the supplier will not be very sure if you are a genuine customer who wants to understand what the supplier has got for the purposes of doing business or you are trying to get the data for other things.

It's a question of trust, let's look at it from a Zimbabwean point of view where I think issues of trust are very critical because we are living in a situation where there are a lot of bad things happening all over, so whether you are a supplier or you are a customer you wouldn't want a situation where any person would come into your system to just check whether you have the goods that he/she wants or not. You would rather have a situation where you sit down and discuss and tell him/her that you have got this and that. But in a world or an economy where trust is not a problem then I don't think it will be a problem for a person to just come into your system and check what he/she wants to buy.

Focus Group Participant 2

I would want to concur with Focus Group Participant 4, there but the limitations are similar to those of global trading or global sourcing, when you go out there they are saying Zimbabwe is a high-risk country so you pay first, now we are saying if we pay first are the goods going to be delivered then

we are afraid in engaging in such transactions so that comes into play when we say can we share our data with this new supplier then trust is key in doing business Focus Group Participant 4 raised a very important issue to do with trust because we are saying in all these dealings we want to know, do we trust the person we are dealing with because at the end of the day, we end up losing our money and we might end up jeopardised or losing company funds because of poor decisions that we would have done without taking into considerations the issue of trust.

Appendix B 3: Interview extracts on requirements to pass through the Red zone of data sharing

Extract Interview and probing questions	Extract Interviewee's response
The Researcher: What do you think needs to be done when exchanging strategic data in your budget with external partners or suppliers and customers via interconnected systems?	**Transcript_Interview 5** You obviously need to have firewalls that guard you against the ingression of cyber-attack. As you scale up that technology where you link up with your customers or your vendors that has to be considered then sign MOUs with your partners to say, the data are for you only, you cannot share with other external people.
The Researcher: What do you think needs to be done for organisations to improve the electronic sharing of data? because if we look at it from a value chain point of view if a manufacturing company would present its budget to a retail company it would be easier to plan and improve operations.	**Transcript_Interview 2** I think there should be some service level of agreements to say if we share particular data then they should be able to keep it private. So I think there should be some privacy policies which should be there to guide and also there should implement tight security because with the cyber security breaches which happen when part of the data which will be intended to be shared with that particular organisation is to be found in the wrong hands. I think for every department there should be like head of the department as well as data stewards who will be responsible for data being shared to actually append signatures. The executives must be involved so that whatever happens it would have top-level approval, maybe from the CEO and Chief information officer.
The Researcher: What do you think needs to be done by organisations to improve this and change the mindset of sharing data because we are now in the digital world where it is now key to share such data for easy planning through interconnecting gadgets?	**Transcript_Interview 1** Within organisations at the senior management level, I think there is a need for interaction with someone who is neutral to bring these people together and then take them through the whole process so that they believe that it's not a program that is destructive but rather it is actually meant to enhance business operations.
The Researcher: Ok! What do you think now needs to be done by organisations to improve the sharing of data electronically because it's key for business intelligence to be working efficiently?	**Transcript_Interview 3** what I think is the organisation should first of all screen their sensitive data and then put on the public domain the data that they think is not of any security issues

	to their organisation so it's a matter of screening data which is for public use and the one which is sensitive should not be given to the public
The Researcher: Do you think it's easy to share data it's difficult?	**Transcript_Interview 4** what you need to guard against would-be your formulas, your recipes things like that
The Researcher: Alright, so what then do you suggest organisations should do to encourage the electronic sharing of data because it's key when it comes to business intelligence?	**Transcript_Interview 6** The best way to share data is usually via what I would say proper applications that are meant for that you do it via proper applications that are built to (1) provide interfaces that are secure and (2 allow the third party to access the data easily and (3) that is robust in terms of an audit trail to show what has been accessed
The Researcher: Do you think at the moment organisations handle that confidentiality or it has to be done at some level in an organisation. **The Researcher:** Alright, so you are saying to the supplier the risk is minimal compared to the risk of the seller, then what do you think needs to be done or what can you propose to say for organisations to share data they can do ABCD to improve sharing of data because it seems it's key and makes life easier in the way you have highlighted it to say it makes life easier for planning. **The Researcher:** Ok, Thank you! to take you slightly back to when you were talking about data sharing with outsiders do you think there are many departments that should share data with outsiders, or it's mainly procurement and sales?	**Transcript_Interview 8** All things being equal if there is serious trust between these stakeholders it may work but because of mistrust, it means that you have to treat the situation as confidential as possible. Well, I think the traditional way is where you have to sign confidentiality agreements, non-disclosure agreements, and trust agreements you know where you are saying if there is any conflict all those issues have to be declared upfront. Such agreements would have been signed so it's not easy to breach them. I am not sure if there is any other way that can be done electronically to enhance these kinds of agreements to ensure that they are not breached. It's not each and every department that should share the data I look at it that way even procurement it's not everything that you need to share you should share appropriate data at the right time
The Researcher: What I mean here is you are allowed to go into the supplier's system and they will be allowed to enter into your systems to see your plans and your budgets for easy preparations do you think it's feasible? **The Researcher:** Ok, then if I am hearing you correctly you once mentioned that you require some service level of agreement and confidentiality do you think that should be done at the senior level because now we have got a problem where the manager at the senior level might not have the expertise to designing that report so what do you propose then?	**Transcript_Interview 9** The data that needs to be shared needs to be with specific partners where there is no conflict of interest between one company's production or their products and your production. One would have to limit the amount of data mining that one company can do on another So basically a memorandum of understanding and a service level of the agreement should be signed by both companies which specifically states what data will be available from one company to the other company stating that we can give you these data we can share these data you can share those data that should be stipulated in your memorandum of understanding. Yes, discussions would have to be made at the beginning on what sort of data the executive or board would have decided that if we share ABC how would that benefit us if we then share D would that be an extra benefit or not so it needs to be very specific and that would have to be stipulated in the service level of agreement and confidentiality of that data

The Researcher: Ok, thank you so much then what do you think needs to be done by organisations to improve the sharing of data?	between the two companies must be paramount. That is very very important, you can put something there to indicate that there will be a severe penalty be it a legal penalty or financial one, or something that prevents confidentiality to be breached by one company or the other company. It would have to be more of sort of just the leader of one company going to the leader of the other one maybe a third one or fourth one and discussing the sharing of data to everyone's mutual benefit so that when they are planning for their raw materials it will be easy. To put it very simply you find other companies that would benefit us either up the value chain or down the value chain so there is a need to identify the value chain of companies and then go up and down the line and say this is what we are thinking would you be open to it this is our proposal by sharing strategic data. We can form our own value chain with our key stakeholders and do exactly the same with a similar system.
The Researcher: Ok so if I am getting you correctly you desire to have such a situation but currently, that's not the situation what do you think then are the limitations to this?	**Transcript_Interview 14** Database administrators should ensure that there is enough security on the systems. What I see is development does not take a day there is a need for the people to develop the systems themselves and it also takes time for people to remove the fear of sharing data with others so until we get there we still have to study the challenge where data are not easily accessible by the relevant partners to form smart partnerships you talk of supplier relationship management those issues they require that sharing of data electronically so that decisions are made easier yes
The Researcher: All right then in your own opinion can data in organisations be safely shared electronically for intelligence insights and predictive analytics without issues, what do you think might be limitations to such an initiative? **The Researcher:** Ok, then when it comes to the actual sharing of the data do they go full throttle to say we are sharing everything, or do they share selected data?	**Transcript_Interview 16** Once you publish it is recommended that your connection to that portal be secure yes if it is not a secure connection then yes the data might be compromised yes so any link that you publish has to be secure and for you to secure that data you have to buy a certificate that will make that connection an HTTPS connection so yes it is possible. The limitation to that is yes you have to fork out some money because that certificate is not free, it is not free sometimes subscription and you have to regularly pay that subscription for your connection to continuously remain secure and available on that public network Definitely, they share selected data there are some data that are very sensitive that are not shared with the public for example, payroll has very sensitive data that cannot be shared even if you go into the ERP right now the tables are encrypted that's the extent of how confidential the data are, so basically there are data that you share that are relevant to the public and there are some data that are kept private and the BI solution actually has authorisations that you can enforce so that people cannot see what they are not supposed to see
The Researcher: What do you think needs to be done by organisations to improve the sharing of strategic data electronically?	**Interview 17_Answered_in Writing** Investment in similar technologies that allow data communication between entities. We should be able to place orders to customers on their system by having access to their stock levels and placing orders once the re-order levels have been reached for instance.

Appendix B 4: Interview extracts on external data sharing role assignment

Extract Interview and probing questions	**Extract Interviewee's response**
The Researcher: Then who do you think should be assigned the duty of sharing the data because you have said it's a sensitive area?	**Transcript_Interview 4** I think it should be at the executive level and not at any other level therefore if there is an engagement with suppliers those sensitive issues should be shared at the executive level yes then implemented at the operational level
The Researcher: If you were to assign such a duty to an internal person which department and who do you think should assume that role?	**Transcript_Interview 7** I think you need somebody who has a fair understanding of the whole operations because at the end of the day, you want a holistic analysis of the business but now it depends on the attitude of that person, is the person analytical, good at figures, versatile, with that extra eye to see what is happening in the business to be able to understand the whole business.
The Researcher: Ok then who do you think should be assigned such a role?	**Transcript_Interview 8** Given the sensitivity of the issues it's better placed at the executive level because of the level of responsibility and the understanding of the intricacy of the matter, it's probably better handled at that level
The Researcher: who do you think should be assigned that role? **The Researcher:** So you are saying someone who has got business experience and at the same time knowledge of IT	**Transcript_Interview 9** Certainly, someone with IT experience, business experience, and experience in BI Systems and be able to make trends of how one thing can affect the other one or how one company can affect the other and vice-versa Yes, that's correct Someone who can read trends, someone who knows that if one of our partners was struggling to produce Product A which we are using it's going to affect our production if there is a change of formula in product A it can affect outputs further down the line it is that kind of data sharing one can almost read ahead of what the implications would be then incorporate that in the designing of the reports, something like that.
The Researcher: Ok if you were to exchange those data who do you think should assume that role in an organisation should it be done by middle managers, senior managers, or executives?	**Transcript_Interview 13** I think in terms of defining what can be accessed it has to be done at the highest possible level that is executive level so that executives decide what data can be shared and what cannot be shared so that whatever competitive data we have is protected so in terms of designing it has to be at the highest level
The Researcher:	**Transcript_Interview 16**

Ok, then who should assume the role of negotiating for the data to be shared between the Executives, Senior Managers, and Consultants?	It should be the Senior managers yes, they are more hands-on, on how things work so they can decide that this report is suitable for Executives it is summarised it covers this and these data are relative to the public they want to see our public financial statements so we can publish those these are for internal audit.
The Researcher: Who do you think should be assigned that role in the organisation and why?	**Transcript_Interview 17_Answered_as_a_Questionnaire** The IT Executive should have responsibility for data sharing with outsiders to ensure data security.

EXTRACTS FROM FOCUS GROUP DISCUSSION

Focus Group Participant 1

I think the responsibility of sharing data should always reside with the managers and the executives for accountability and transparency so that at least they know which data are confidential and which data should be shared so it should reside at that level, yes!

Focus Group Participant 4

I think I tend to agree with what focus group participant 1 has said just now that the responsibility should lie with the executives at the end of the day when we are doing whatever we are doing we have got the objective of the company at heart, and whatever objectives. The managers and executives know the direction the company wants to take and we all follow that. They also know what kind of data should be kept confidential that's why even at the end of the day in terms of company policy sometimes they don't want anybody or everybody to talk to the press about information for the company that is the issue of confidentiality that comes into play here.

Appendix B 5: Interview extracts on procurement and sales and marketing as the two main arms of external data sharing

Extract Interview and probing questions	Extract Interviewee's response
The Researcher: Ok, then who do you think should be assigned such a role should it be top managers, middle managers, or senior managers?	**Transcript_Interview 5** That exchange I see it happening between two entities, the procurement arm of the business and the sales and marketing arm of our business. Those are the two critical entities that have daily transactional data between vendors and us, retailers and us so naturally, their day-to-day activities of interactions with external people, external suppliers, and the people who sell our products that level of interaction should then be dedicated to the procurement executive and the sales and marketing executive. We need those two domains because they know the repercussions of any other data linking them to us.
The Researcher: What has been the proportion roughly of internal data sources versus external data sources are organisations operating half-half or more of internal data?	**Transcript_Interview 2** In this day and age where you are now looking at marketing there is a need to get more external data from social media so you find that in some instances some organisations are merging external data coming from Facebook, Instagram, and Twitter so that they will be able to do their marketing. So you

	find out that now organisations that want to market, and be felt on social media, use that platform as their strategic point of advertising.
The Researcher: Ok, thank you, to take you slightly back when you were talking about data sharing with outsiders do you think many departments should electronically share data with outsiders, or it's mainly procurement and sales?	**Transcript_Interview 8** Looking at your procurement systems surely you need now better collaboration with your suppliers because it must now become your best strategy to say if my supplier knows that I am going to require the following items and this is my probable production and so on and so on so it's not every department that should share data.
The Researcher: In your own opinion you have worked with your suppliers and customers, external people, do you think at the moment they are prepared to share data or we are not yet there?	**Transcript_Interview 9** To my department, it may not make sense but from the procurement side yes it makes a lot of sense. I do not think there will be many benefits to be share data in my department.

Appendix B 6: Interview extracts on challenges in integrating systems:

Extract Interview and probing questions	Extract Interviewee's response
The Researcher: What challenges do you usually face when Integrating Internal systems with other external systems?	**Transcript_Interview 2** The main challenges when integrating with other external systems are for example those Privacy policies it might take quite a long time to get approvals to say this system is now being opened and ports are now being opened and you can access those systems. The other thing is with the advancement of technology you find there are a lot of challenges when integrating an old system with the latest new system. You find that there is a lot of development that needs to be done for the applications to integrate so you have to build the APIs then if that API is not available then it becomes costly to do that. If you look at maybe banking systems, you find some are still using systems that were designed ways back using COBOL, and these days there is web development and now you need to design an API which might take time and in need of a resource, who can know COBOL system and the new software which has is used to design the modern system so those are some of the challenges which are there. Some of the issues that come are of unstructured data because most of the data that comes from external sources will be unstructured maybe from JSON files and all that so there is a need to now cleanse that data or format it and to use the models that are required within the data warehouse to come up with the proper data mats that you now need to work with that extracted data
The Researcher: Ok, thank you for raising such an important issue then what challenges do you face when you integrate internal systems with other external systems?	**Transcript_Interview 6** Mostly the challenges that we encounter are number 1 the drivers they could be issues to do with the type of connection that you want to use yes because your tool might not be integrating seamlessly with probably the ERP or the database that you want to connect to so you might need now maybe a third party which could become a cost to the organisation and the organisation might not be willing to invest in another solution when they have already decided to say we are going to use your tool but then you later tell them that no I can't connect to this other system maybe because it's an old system which

	the drivers are no longer there or it's a very new system of which drivers are not yet there so those are the challenges that we usually encounter
The Researcher: What I mean here is you will be allowed to connect to your key customers' systems to see their planning and you also allow them as well to connect to your system, what are your reservations? **The Researcher:** Alright, thank you so much, then regarding the other way round have you talked to them (customers and suppliers) do you think they are also prepared, do they also have the same reservations to share their data? **The Researcher:** What do you think then needs to be done by organisations to improve the sharing of strategic data electronically?	**Transcript_Interview 11** The challenge that we face also is how our systems interlink I think we have tried it before linking our system with one of the customers but they had a different system that was not linking properly with our system so it was not flowing properly and information was not accurate. Same reservations across the sector yes even our stakeholders but the thing that I see is generally resistant to change maybe it may be whenever there is a change of new technology the people who are there think they have been overtaken by events and feel threatened because generally, people think that Information Technology takes jobs from people so some of the resistance comes from the people who might see the value in the system but at the end of the day they ask so where do I come in will I be able to learn the system and be part of the system or systems will cut round they the people being employed I think the first point where we must improve is upon choosing systems I think we should choose standard systems that integrate those of key stakeholders. If we are running on a different platform with our suppliers we can then have four different systems and the process of integrating those systems might be a challenge, if possible I believe if all the stakeholders are running on platforms that can integrate then it's easier to integrate the systems
The Researcher: What challenges do you usually face when integrating internal systems with other external systems?	**Transcript_Interview 16** Ok, the biggest issue is data cleaning, definitely yes, data coming from different systems come in different formats. For example, the date should have year, month, and day, then maybe another system will have a different format like the date should have day month year time with times so if now you try to integrate those two dates you have to standardise them so basically you have to remove the time that is coming from that other system so that you join data from the ERP and secondary system so that the dates are in sync. This issue is even worse if that other system allows people to freely write things like their fields are not bound by certain rules yes if a field is a free text when we say free text basically that's a field where a user can input any field and it will be written successfully that is even a bigger problem because sometimes users make mistakes if a date field is configured as free text in an open-source system someone can put a date in a format they want so standardising that is painful.
The Researcher: Then in your own opinion do you think your suppliers are prepared to share their data or do they have some reservations?	**Transcript_Interview 18** I think there is a mixed bag, you have suppliers who largely are very corporatised, I think these will understand the impact of ERP solutions and they may be prepared to share the data. Then you have other upcoming small businesses who are still very cautious about

	their businesses, about how much they can share out there, you find out that these will be a little bit reserved in terms of their preparedness to share data but I think it's a worthwhile model or worthwhile concept to try in the market.

Appendix B 7: Interview extracts on the proportion of internal data sources versus external data sources

Extract Interview and probing questions	Extract Interviewee's response
The Researcher: What has been the proportion of internal data sources versus external data sources, are organisations operating half-half or it is more of internal data?	**Transcript_Interview 2** To be honest, in most cases it is more internal data, most organisations that do not outsource have internal data. I would say they use external data depending on the type of organisation, and how their infrastructure is set up.
The Researcher: In the data warehouse do you take data from different sources, or do you take mainly internal data? what has been the proportion of external data versus internal data where you have implemented Business Intelligence?	**Transcript_Interview 6** Of cause, the internal system's data are usually more in terms of volume than what we get externally, the reason is externally you only get targeted specific data you don't take everything you just say I want to get the risk compliance data about a customer you only take a small portion into your warehouse so in terms of volumes it is usually internal data that is more than external data
The Researcher: You have worked with the BI systems and the ERP systems, from your own opinion how much of the internal data vs external data has been analysed?	**Transcript_Interview 7** I think people analyse mostly internal data maybe serve for departments like marketing where external data are very critical for them to analyse competition so I think most people are analysing internal data not external data

The Researcher: In your case, you deal with suppliers I might want to know if they are prepared to share such data, or do you mainly deal with internal data? **The Researcher:** Then when building a data warehouse what has been the proportion of Internal data versus external data sources is it half-half or it is more internal data? **The Researcher:** And what do you think is the main reason for that?	**Transcript_Interview 15** Aha, we mainly deal with Internal data yes because in our case we mainly deal with extracting data from ERP. In my experience, it is more internal data because most organisations have both ERP and Business Intelligence. The ERP incorporates many modules and integrates many modules so when we then come in as Business Intelligence consultants it will be more of just one system whilst they have transferred their data to the ERP the proportion is more of internal data The external partners transact via the web portal that's where they do their transactions over the internet so that only specific data are then stored in a specific database
The Researcher: In the data warehouse, what has been the proportion of internal data sources versus external data sources and what challenges do you usually face?	**Transcript_Interview 16** Most of the data that we use is internal and we rarely use external data sources even in big organisations like Company X the one I am working on here. Yes! Yes! internal transactional data and a few external data, I think the only instances are when you try to get geological maps which are the external data that we bring into reports to try to bring geological locations and regions on the map to see the sales on a particular day and all that

Appendix B 8: Interview extracts on sources of data

Extract Interview and probing questions	Extract Interviewee's response
The Researcher: You know data are generated from a number of sources, they come from ERP, sometimes from BI systems, from mobile devices, machine sensors, and even from people. May you please explain which source of data you trust and why?	**Transcript_Interview 5** 90% of the data that I use to prepare my report which is an excel report comes from the ERP systems then obviously the other 10% is something that I source from somewhere. This is why I am saying it is very important that the data that is put into the ERP system be as accurate as possible because we use it to make reports and to aid decision-making and this requires as accurate data as possible. I was fortunate enough to have grown up using and also been a pioneer of the ERP system that we are currently using from 1999 up to date. This is 2021 so that's 22 years of using the ERP system and most of the reports are inside the ERP system so we have matured as a company in using the ERP system. I would really trust the data I get from the ERP system, on the social platform but now you have to

	serve that data and say do we really trust this data because on social media anyone can generate anything.
The Researcher: Do managers trust data from the ERP system or do they trust automatically generated reports, or data that come from people?	**Transcript_Interview 1** From my experience data generated from the ERP is more credible, Senior managers usually would want to rely on that data. Data coming from individuals usually they don't trust, but they trust something that is on record like the ERP
The Researcher: When you are preparing reports, which system do you trust most, may you please share your experience?	**Transcript_Interview 4** Usually, when I am preparing my reports I take all my reports from ERP and convert them to Excel either daily, weekly, monthly, or annual reports, yes all in the ERP system but when I am putting them forward to my superiors I convert them to Excel put in my comments, my suggestions, my recommendations on that Excel sheet. But I prefer auto-generated reports because for example if a machine is running I prefer the number of units that are counted by the machine than to get the number from a person who can make errors in counting which may be genuine or sometimes not genuine. So I prefer to get real-time data coming from the machine, indicating that I have produced so many units of this product, that way I am more comfortable. After all, I know that yes it is the real output that has come out there is no room for human error.
The Researcher: Data are generated from many sources such as ERP systems, BI systems, and mobile devices, and sometimes data come from people. From your own experience working with other managers, which source do you trust most?	**Transcript_Interview 7** I think it depends, when you look at maybe you want to analyse the quantitative you trust your ERP system because you trust the systems that get their input from the transaction data. I trust our ERP system but say executives want other qualitative data I trust things like your Facebook, and social media because normally people who comment there don't have a relationship with us so you get what you think it's balanced information
The Researcher: So if I am getting you correctly you are saying you prefer to get the information from the Business Intelligence System as long as it is accurate?	**Transcript_Interview 8** That's correct, I am assuming that when you talk of a BI system, this is an extraction of data which is in the ERP system extracted into the Business Intelligence system to make it easier which means the only error which we can deal with is the actual input at the instance when you are inputting the data into the ERP system a risk probably which can be dealt with at a certain stage but I am trying to avoid a situation where there is a possible error when you are inputting data into the ERP and then a possible error with extraction by the individual it means the data will be compromised at two stages
The Researcher: Data are generated from many sources, from the ERP system, from the Business Intelligence system that produces auto-generated reports and sometimes people prepare reports, which source do you trust?	**Transcript_Interview 9** The information that you draw from the ERP or BI from a computer is only as good as the data that is inputted so if there is human error involved in the input of data then there can be a problem down the line. Yes, So if you are to get information from any of the systems you see, like your Business Intelligence

	System or automated system where does it get that data from, the ERP and where is the ERP getting it from, from people who have inputted the data. Information from people yes, things will always get lost in translation
The Researcher: Which source of information do you trust most and why do you trust such a source?	**Transcript_Interview 10** I will go with the ERP and it depends on how the data has been captured and whether that person has been trained. They say garbage in garbage out so the model or the gadget or the program might be good and reliable but the data in it has not been captured by untrained people leads you to a wrong decision. So it's very important that anyone can use any source as long as you are assured that the data are well captured its real-time and have been captured by a trained person. Reports in an ERP system reconcile.
The Researcher: I understand you get your information from the ERP system, the BI system, and mobile devices including people, which source do you trust most and why do you prefer such a source?	**Transcript_Interview 11** I prefer information that I extract myself from the transactional system because as long as you instruct someone to prepare the reports for you humans may not interpret the instructions correctly, the systems are accurate but if someone now gives you wrong information there is bound to be a mistake. So I prefer to use something that is generated automatically from the system where I get into the system and extract the information myself.
The Researcher: Data are generated from a number of sources like the ERP you have just mentioned and the Business Intelligence systems and even sometimes mobile devices, and you have even connected sensors on machines and sometimes people provide you with information may you please explain, which source you trust most and why do you trust such a source? When the ERP and BI systems are different which system do you revert to?	**Transcript_Interview 12** Ok with me I use different sources but the one I very much trust is the ERP because that's where the transactions take place and that's where everything is put I also trust the BI system as well as long as they speak to other reports. because the BI is being fed from the ERP so I also trust the BI the mobile devices I trust the information that I get from the mobile devices especially the qualitative yes I get the qualitative data as people are producing or whatever is going on I get the information from mobile devices aha with machine sensors I trust, because of the fact that they tell me when things are going wrong I trust those, the cameras the CCTV's I trust those they will be showing where it's going wrong. From human beings not so much I don't trust people because they usually try to manipulate the information they might not always be trustworthy but I know if I get information straight from the system that's the final In such a situation I always revert to the ERP because that's where the data are being inputted. I revert to the ERP yes
The Researcher: These days data come from a number of sources including, ERP systems, BI systems, mobile devices, machine sensors, people, and cameras, may you please share your experiences? Which of these sources do you trust?	**Transcript_Interview 13** Obviously, I trust the ERP system as the primary source of one's information but that information can also be converted into a BI system and the BI system is easier to look at and go through because they are in a format that one requires. BI systems are more customised than your ERP but obviously, the ERP is the source. If properly configured auto-generated reports are more credible
The Researcher:	**Transcript_Interview 14**

Ok, then when information is being prepared the data come from a number of sources, part of them come from ERP systems, and part of them from BI systems, mobile devices, machine sensors, and even people who prepare information for you to make decisions. May you please explain why you trust or do not trust certain sources?	I use both the ERP system, the BI, and Excel systems for ease of manipulation and we can then do trends analysis from there and people can depict charts from that information so that executives can easily see and make decisions If you go to specific sources here, we have the ERP I can say there are enough controls related to the input people who are responsible for the input have access and that access is restricted so, only correct data are put in there so I rely on it I also rely on BI system because there are controls that are there when you are inputting the data and also when accessing the reports Mobile devices are a grey area there is some element of truth in some of the information that you get there but you can also get wild data that is not very correct so I don't rely very much on it to make decisions but I need a mobile device just to be informed on what is happening but not to rely on it Machine sensors yes because they should sense what is exactly before them and if they sense green it will be green and you are sure that is correct People: some people tell lies to try and hide something, and some give you correct information but you also now need to weigh and maybe use past experience to know that so and so tell the truth so and so you need to be very careful so that you also scrutinise it further. Cameras: they give it as is but at times you look at the angles the camera may have taken the pictures from, but certainly they give you the information as is and I tend to rely on them. External sources publications and so forth there is some reliability in some of the information so some of the information may not be very correct, you need to also scrutinise to say which information can be relied on for decision-making and which information may you read for your own information
The Researcher: Do you trust data generated from the following sources? ERP BI system Mobile Devices Machine Sensors People Cameras External Source May you please explain why you trust or do not trust data from any of these sources?	**Transcript_Interview 17_Answered_as_a_Questionnaire** ERP Yes as long as the data entered into the system is correct the system will regenerate what has been fed BI system Yes with cross-referencing. At times the reports are not accurate due to poor configuration at inception but work well once corrected Mobile Devices to a limited extent, I think there is room for manipulation Machine Sensors Yes People, not quite there is a need for verification due to the risk of human errors and the risk of manipulation to suit the individual needs Cameras yes External Source depends on the reliability of the source so past performance matters in deciding whether or not the data can be trusted
The Researcher:	**Transcript_Interview 18**

I understand you get information from various sources, from the ERP system, the BI system, Mobile devices, Machine sensors, people, sometimes cameras, and other external sources. Which source do you trust maybe you can give it in order of preference, taking into account that the trusted one may not be the one you are currently using, and giving reasons why.	My first preference will be the ERP system, the ERP system is enterprise wise and it looks at information on a broad scale and is real-time, therefore it will be my number one preference. BI is my second preference because BI is usually customised and looks at the business needs and in terms of what we need to see, I think that helps for friendly reports so that we can quickly understand business and make the right decisions. The mobile platform and the people source for me I am pretty much concerned because they are driven by what people put in them. The mobile sources usually are your WhatsApp kind of groups that you share so it depends on what people are putting on those WhatsApp pretty much I want to get from people the issues of trust can then arise to say are you getting the right data? Sensors and cameras, the trust levels are very high but I think they are also limited in terms of what they can give you because they are designed to sense or to pick specific data not necessarily across the business but overall I would say one then want to have a high breed of all these platforms together but feeding into your ERP system to give you your final result, so they are certainly all useful, across the levels of business.

Other Sources of data

Extract Interview and probing questions	**Extract Interviewee's response**
The Researcher: With the abundance of data from Twitter and Google you now have a lot of information that is surrounding you, are you having challenges in analysing such data and putting it into your report?	**Transcript_Interview 5** Like what I said the social media platform that we are on as executives and managers I think it's for updates and maybe urgent decision-making where everyone is informed of an issue and people make comments immediately at that point as opposed to having that kind of information in an ERP system, naturally when you are at home you are not looking at an ERP system yes so that information you don't have it at hand or over the weekend but maybe the social platform is where information is shared even at midnight yes you can have a look at your phone and it's like oho! ok, this is an issue that is at work how can I assist or this is an issue in our industry how can I assist ehee so yes I think the social platform right now it's probably doing us a bit of justice in terms of information dissemination within the confines of our management because we have various social groups with engineers e with manufacturing with the executive committee so yes it shares information for an urgent response which information you couldn't maybe share on an ERP system. Yes on an ERP system, you have to login in and extract whereas, on a social media platform, it just comes to you straight bang ! ! you see an issue you assist in resolving or you see the information you absolve yes I understand the issue yes

Appendix B 9:-Interview extracts on why managers stick to using the ERP and not use the business intelligence system for analytics.

Extract Interview and probing questions	Extract Interviewee's response
The Researcher: So, in other words, you are saying if we were to auto-generate reports you do not trust them without first verifying them in the ERP system?	**Transcript_Interview 5** Because already the ERP system is gathering data being input from sales, from the cost being generated in the factory from utilities being used it's compiling that information to tailor-made reports. It is those reports that we are going to extract the data so that we come up with our reports. I do trust the reports because I know they have been generated from the system through activities that are linked in the ERP system we do our activities here we capture costs they reflect in Finance, and generate P&L. I presume that's one of the most features of an ERP system or any other system that you may wish to have.
The Researcher: Ohh, ok, So you mean if we were to introduce another system and then it fails to accurately talk to other departments that system might face an impediment and people might reject it?	That linkage between systems where any activity you do on this side will have an effect on finance, I mean the synergies between data shared especially between one department to the other, for example, you might have a BI system in production that talks only to production activities.
The Researcher: Ok, as regards the interconnection of gadgets, now that there is this desire to connect a lot of gadgets like on machines so that they complement the ERP system you have talked about, do you see it as a benefit, or it is a challenge and something that makes life difficult?	**Transcript_Interview 5** Ummmm I am aware of maybe advanced economies who are using the ERP like we have who have gone to the extent of linking or hooking it to equipment in the factory for production volumes, for management of utilities, or that kind of thing because they are advanced economies but obviously, there is a level of automation that you require to have in your factory to be able to link them and it involves investment those are investments now and I don't think we are at that level, we could be at that level with individual- specific equipment which can allow that interface but I want to presume that you want to cover the whole aspect of the factory, not an individual. We could try on individual equipment as a trial to see how the system works as we scale up our technology but I know in advanced economies from your milk intake up to the dispatch of your product it's all automated in the system as the pallet is taken out of the system it is counted as a pallet and it updates your ERP system but for us, we have to count then go and sit down and input that data in the ERP system and if you make a mistake it has repercussions throughout the entire value chain and even on the reporting it has repercussions so naturally, you want integrated systems like what advanced economies have of which level we are not yet there considering where we are coming from as a country yes.
The Researcher: You have worked with Business Intelligence systems and you have implemented them in a number of companies but some companies seem not to use these systems after they have been	**Transcript_Interview 2** Change management is key you find that a lot of times people are used to their old ways of working and if you introduce something new they seem to be resistant, in most cases involving all the stakeholders. Team building which is usually set up by the change management team would help here.

implemented. What do you think needs to be done to improve the usage of these Business Intelligence Systems?	
The Researcher: Why do you trust information from the ERP system over other sources?	**Transcript_Interview 1** If you are dealing with information from the ERP system you know you are dealing with information that is traceable, because take for instance you are dealing with information regarding the QM module, QM module does not work in isolation, it works with MM Module and Finance module, so the moment you come up with a report that is related to Quality Management, the senior managers automatically know that that information has got an input of other modules like PP and MM modules and Finance modules so information coming from ERP they trust it. From my experience information generated from ERP is more credible, Senior managers usually would want to rely on that information
The Researcher: What is your opinion on having a lot of interconnected systems and gadgets, what do you think is limiting the adoption of these systems to complement the ERP system?	**Transcript_Interview 1** Yes ! in a developed country that is very relevant but in underdeveloped countries you will have issues to do with resources because resources are not always available and if we are to pursue a certain project you may find that there are not adequate resources to support either the infrastructure in terms of software, hardware or even the training of personnel. We don't have enough resources to come up with well-trained people, you may need to train people for a period of three to five months which is not feasible. Our setup does not allow us to have too many people employed by one organisation otherwise at the end of the day the business is not capable of financing such a requirement.
The Researcher: Ok! So what kind of challenges do you sometimes face?	**Transcript_Interview 3** The major one that I would want to put across is resistance to change most users resist using the BI system and they stick to the ERP in terms of reporting so in this case it will be like the BI system will save no purpose to the organisation so resistance to change is the main challenge.
The Researcher: Which system then do you prefer? You can share your experiences to say, maybe, I get data from ERP, prepare it in Excel, or I prefer the Business Intelligence system when I am preparing my reports.	**Transcript_Interview 4** There are some reports that are not yet in the Business Intelligence System, so usually when I am preparing my reports I take all my reports from ERP and I convert them to Excel either daily, weekly, or monthly reports or annual reports, yes all in the ERP system.
The Researcher: There is this challenge in most companies where Business Intelligence has been implemented, people always revert to using their transactional systems like the ERP than using the Business Intelligence system, what do you think might be contributing to that?	**Transcript_Interview 6** If your BI solution is not speaking to the business and if it's not giving accurate information in some cases may be your calculations are always wrong or it is difficult to provide the information that the business is looking for that is the source of many problems usually so like I said earlier about giving data to the executives your data objects should be easily accessible and understandable and accurate.
The Researcher: Why is it that they don't want to use the Business Intelligence system and prefer to continuously use the ERP system?	**Transcript_Interview 7** I think it is because the ERP is based on internal transactional information but BI is just coming in a certain format but you can still get that information from the ERP system.
The Researcher:	**Transcript_Interview 10**

I understand the Business Intelligence System was introduced after you have been using the ERP system for some time, Do you still prefer the ERP system, or do you use the Business Intelligence system for analysis?	Every new system has got its challenges in terms of acceptance but maybe for me, I can say Business Intelligence is good. However, I cannot fully rely on one source, I still need to verify so you find that in BI there are some reports when you go into the ERP they will be different so you still need to see whether these were configured correctly and the other information that is missing that need to be updated in BI so that they will talk to each other so if that is missing then I will continuously go back to the ERP
The Researcher: These days data come from several sources including ERP systems, BI systems, mobile devices, machine sensors, people, and cameras. Which source do you trust and why?	**Transcript_Interview 13** Obviously, I trust the ERP system as the primary source but that information can also be converted into a BI system and the BI system is easier to look at and go through because they are in a format that one requires. BI systems are more customised than your ERP but obviously, the ERP is the source
The Researcher: May you please explain why you trust or do not trust certain sources?	**Transcript_Interview 14** If you go to specific sources here, we have the ERP I can say there are enough controls related to the input people who are responsible for the input have access and that access is restricted so only the correct data are put in there so I rely on the information that I get from there
The Researcher: Ok thank you so much, then when building a data warehouse what has been the proportion of Internal data versus external data sources, is it half-half or it is more internal data?	**Transcript_Interview 15** Most organisations in our case they have both the ERP and Business Intelligence, they discard the other systems because the ERP incorporates many modules, and integrates many modules so when we then come in as Business Intelligence consultants. it will be more like they have transferred their data in the ERP into BI because Business Intelligence is an extension of the ERP since ERP generate generic reports and also has many modules like financial, Human Capital Management (HCM) payroll everything.

Appendix B 10: Developing economies differ from developing economies

Extract: Interview and probing questions	Extract: Interviewee response
The Researcher: What is your opinion regarding the connection of gadgets on machines in the factory to complement the ERP system as additional data sources, do you see it as a benefit or it's a challenge that makes life difficult?	**Transcript_Interview 5** I am aware of maybe advanced economies who are using the ERP like we have who have gone to the extent of linking or hooking it to equipment in the factory for production volumes, for management of utilities, or that kind of thing because they are advanced economies but obviously there is a level of automation that you require to have in your factory to be able to link them. It involves investment those are investments now and I don't think we are at that level, we could be at that level with specific equipment which can allow that interface but I want to presume that you want to cover the whole aspect of the factory not maybe an individual machine. We could try on individual equipment as a trial to see how the system works as we scale up our technology but I know in advanced economies, from your raw materials intake up to the dispatch of your product it's all automated in the system as the pallet is taken out of the system it is counted as a pallet and it updates your ERP system but for us, we have to count then go and sit down and input that information in the ERP system.

	If you make a mistake it has repercussions throughout the entire value chain and even on the reporting it also has repercussions, so naturally, you want integrated systems like what advanced economies have, of which level we are not yet there considering where we are coming from as a country.
The Researcher: What is your opinion on having a lot of interconnected systems and gadgets, what do you think is limiting the adoption of these systems to complement the ERP system?	**Interviewee 1:** Yes ! in a developed country that is very relevant but in underdeveloped countries, you will have issues to do with resources, because resources are not always available. If we are to pursue a certain project you may find that there are not adequate resources to support either the infrastructure in terms of hardware, software or even the training of personnel, we don't have enough resources to come up with well-trained people. To add to that, we may need to train people for a period of three to five months which is not feasible. Our setup does not allow us to have too many people employed by one organisation otherwise at the end of the day the business is not capable of financing such a length requirement.

Appendix B 11: Interview extracts on limitations to design and develop BI reports

Extract Interview and probing questions	Extract Interviewee's response
The Researcher: Ok! Thank you, do you think senior managers and executives can design business intelligence reports on their own without the help of a consultant? **The Researcher:** In your own opinion, who do you think should design Business Intelligence reports and why?	**Transcript_Interview 1** Mm!! In my own opinion, senior managers, as much as they may have the capacity, do not have time to design BI reports, most of the time they are busy with strategic issues of the organisation so at that level you may not have a good result coming out from the designed BI reports. You see, at that level of management, they are involved in so many meetings, external meetings, internal meetings, or even meetings related to the organisation at the corporate level. On the other hand, the internal consultants may lack the expertise but they really need to work with external consultants because the Internal consultants are more exposed to the requirements of the business and they have input that is quite relevant to assist the external consultants but at the same time senior managers within the organisation should create more time for internal consultants to allow them to work with the external consultants so that we have a properly configured system which is relevant to the business. The external consultants do not have insights into the relevant business requirements, so you may end up having a system that is not user-friendly at all.
The Researcher:	**Transcript_Interview 2**

Ok do you think managers need some expertise from technical experts, can they design Business Intelligence reports without some background, training, or in-depth knowledge of Business Intelligence systems? **The Researcher:** Ok! so you are saying maybe it might be difficult to implement the business intelligence working entirely with just the IT department without the involvement of the user departments?	Well, they can't really be able to do it, especially the senior and executive managers unless they have some technical know-how of doing it, but in this day and age where technology is moving fast where there is artificial intelligence and those other systems that are able to just generate reports, they can be able to just pause a question and the report will be generated automatically using machine learning and artificial intelligence. So yes with the use of new technologies, they will be able to do so. But without modern business intelligence tools, they would need to be taught or to go under training for them to be able to do so. **Transcript_Interview 2** That is very true! The IT department cannot work in isolation, especially because there are some business processes that the IT department is not aware of and that's now where the other departments come in and actually specify in detail to whoever is designing the business intelligence reports.
The Researcher: What do you think are the benefits of going the route of using internal consultants as compared to sourcing from external consultants because it's quite key what you are raising?	**Transcript_Interview 4** I think the benefits come in that, it will be a system that is coming from people who know how to operate the business which is tailor-made for the organisation and I am sure it can be done.
The Researcher: Ok, but currently do you think internal consultants will be able to design the Business Intelligence reports without the help of an external consultant?	**Transcript_Interview 7** I think it's possible for the internal consultants to design their own reports. Well, it all depends on the applications that they are working with, if they are quite conversant with them, I think they can design their own reports. The advantages of the internal consultants coming out with their own reports are, they know their business, they understand their requirements more than the external consultants who just work may be from a technical point of view.
The Researcher: You said, Business Intelligence System was introduced over four years ago, is it easy to use, what is your appreciation have you ever logged into it or you have delegated to have the reports done?	**Transcript_Interview 11** I get those reports daily initially like everyone else new systems seem complicated but I think with time you will get to know how to navigate your way out because remember at an initial glance it looks like too much work but with time, you will know which columns are important to you and that not everything is essential. You will see what you are looking for so over time you get used to it the same way we are used to the ERP system.
The Researcher: Comparing the Business Intelligence system with an excel system, which one do you think is easier to work with?	**Transcript_Interview 14** Excel is easier to work with because you start working with it from road mental levels even from home but for business intelligence, you have to be at the workplace while excel you can use it even if you are not at work
The Researcher: Do you think managers can be able to develop Business Intelligence reports on their own? **The Researcher:** Ohh ok, but in your opinion, do you think the external consultants can just develop the reports on their own without the knowledge of the internal business processes?	**Transcript_Interview 15** No!! unless they have an IT background **Transcript_Interview 15** No, they cannot develop on their own because they need input from the mmm! what can I say if you are developing financial reports you need input from the financial people in that organisation because they know the day-to-day processes

	and the organisation's processes so a consultant cannot develop reports on his/her own because he does not know the business processes of the organisation
The Researcher: All right but do they regularly call you back for support or do you train them adequately so that they no longer call you back?	**Transcript_Interview 16** It takes time for someone to know the entire BI solution. They do not call regularly but sometimes there are those scenarios where a very complex error comes out, in that event the external consultant is always ready to assist.
The Researcher: What do you think should be done to improve the usage of Business Intelligence Systems?	**Transcript_Interview 17_Answered_as_a_Questionnaire** Train the potential users on how to create their own reports. Currently, reports are done by IT at the request of users

EXTRACTS FROM FOCUS GROUP DISCUSSION
Focus Group Participant 1 The managers have limitations, they are more on strategic issues and making executive decisions, so to ask them to be involved in the designing of the reports will be more like asking them to do operational duties
Focus Group Participant 2 Yes, of cause the idea or the area of technicality may be a challenge that's where we would need a developer (Internal or External Consultant) to assist us but I think those who are working with the process or the people on the ground are the right people to be developing these reports
Focus Group Participant 3 The managers and executives can't really work on their own, they lack technical expertise but they should be involved in giving what they want as input.
Focus Group Participant 2 I think the major limitations are related to a lack of interest, sometimes we just want these systems running on their own doing all the stuff but when it comes to designing or giving our input like what exactly we want we might say our knowledge is limited. We are not interested in reading widely or in understanding how the system works we want something that is just easy for us to solve the immediate problems we don't want to foresee a situation whereby we are using Business Intelligence systems to create reports that will solve our day to day problem and this results in us doing most of the things manually that could have been put into the system.

Appendix B 12: FIRST THEME: Interview extracts on managers' expectations

Extract Interview and probing questions	**Extract Interviewee's response**
The Researcher: If you were to change how data are analysed in this organisation what would you change and why?	**Transcript_Interview 5** Every month-end I sit down to prepare a report in an Excel spreadsheet that I share with the executives. The COVID era has slightly changed the way we do things. If it were possible maybe to tailor-make a report in the ERP system or any other system to summarise what I do, by picking all the important issues and that report comes to me first so that I have a look at it and put maybe a few comments here and there before forwarding it to the executives, then that will be the improvement that I want because I spend 2 or 3 days of each month preparing

	that report pulling data from the ERP. Yes, that will be a good way of doing business then I will get more time to run around with the key operational issues.
The Researcher: As your closing remarks, What else can you suggest on all the things I have asked to say for the organisation to effectively use the Business Intelligence system, they need to do ABCD. In your conclusion.	**Transcript_Interview 4** My plea to the Information Technology team is the internallisation of projects, for example, we can automate using our internal people because I know that they are intelligent, and with the level of education they have reached I am sure they can be able to lead the configuration that can make the machines in the factory talk to our computers if they could. I prefer a system whereby for example away from my office I can check the production output from Factory A or Factory B or Harare. Then later on after production, I will obviously get another set from the ones that were running on the ground and compare the two. I would like that on an hourly basis and then compare it with the WhatsApp information which is coming from the production controller who is manning the line. I would like to get it directly from the machines where it is happening.
The Researcher: Thank you so much for highlighting that then as regards the preparation of the Business Intelligence reports I know executives are sometimes busy, what do you think is the best way of preparing Business Intelligence reports? **The Researcher:** Ok so you are suggesting that you have people in a department who do their normal duties but on top of that they should have some knowledge of technological advancement and then they assist in designing the reports?	**Transcript_Interview 8** Well, my idea is once I have defined my report it should be automatically generated by the system from the business intelligence system to hit my mail or phone, then when I am looking at that because I would have defined what I want. There should be no further interpretation that I get from anyone else because I would have agreed upfront that I need the information that way. If it is formatted in the way I want then I can make a decision to let the generation of the reports be automatic. **Interviewee 8:** Exactly! they are your key liaison persons when it comes to suggestions that you may want on systems. They give assistance, and they become the host otherwise you will have a problem where they are now designing fancy things that do not address what the department is facing, we must face the problem together, and they must be managerial.
The Researcher: Then what do you think should be improved for you to work efficiently with BI	**Transcript_Interview 11** My recommendation is there should be the integration of external and internal systems where you can be easily connected but for now, we are focusing on internal data ignoring external data. I have to look for these data and there is no platform where I can get the external data yet my department requires those external data. So external data are missing in BI.
The Researcher: Thank you so much what do you wish to see happening for you to use Business Intelligence and data analysis as a competitive advantage in this organisation?	**Transcript_Interview 13** If properly configured auto-generated reports are more credible. I think what we want to see at the end of the day is the use of automated reports that are auto-generated so that you eliminate human intervention which is prone to errors, and also reduce the number of people that are doing non-value-adding things because most of the time some of the work will not be value-adding because the systems are already doing it anywhere but if you have Business Intelligence and ERP

	system doing everything for you then eliminate that then improve on accuracy and timelessness then reports will be faster.
The Researcher: What technological challenges do you currently face or wish should be addressed to improve the usage of Business Intelligence Systems?	**Transcript_Interview 17_Answered_as_a_Questionnaire** Automation of source data collection e.g. measurements in the lab could be directly linked to the system rather than getting that from the technician. In production, if machine failures could be recorded automatically so that at the end of a period the machine failure report can be generated to facilitate decisions about when to service machines before they fail, or when to replace them because the cost of maintenance is prohibitive. Currently, we rely on manual records. Train the potential users on how to create their own reports in BI. Currently, reports are done by IT at the request of users.

Appendix B 13: SECOND THEME: Interview extracts on the need to verify information

Extract Interview and probing questions	Extract Interviewee's response
The Researcher: Ok! so in other words, you are saying, it doesn't matter where you get the information from but you always verify the information? **The Researcher:** OK, so you verify information from various sources whether from people or from another system.	**Transcript_Interview 9** Yes, you need to verify information from the different platforms. Correct Yes, yes a problem happened just last week I had to look for the person responsible and they had to look into the system and he said oh yes yes we have the delivery note here sorry for not entering that in the system so the error was solved but as I said the systems where we get information from is only as good as the data entered into them.
The Researcher: Ok, so in other words if I am getting you correctly you are saying if the information that you are getting from a certain system is not talking to other departments you don't trust such a system?	**Transcript_Interview 10** Yes, but still you can still verify because it is in the system it means someone used a document because there are documents that are used when capturing in the system so you can still verify it if you are not agreeing. If you have been working with these reports for a long time or you have been in operation for a long time you will have a trend, so when you see that this trend is an outlier then it can trigger to say may I verify this and this can be verified in physical documents and if someone is also far away they can scan or they can e-mail so that you are also satisfied with the information that is on the ground.
The Researcher:	**Transcript_Interview 11**

Ok so if I am getting you correctly you are saying even if you get Business Intelligence reports that are auto-generated you go into the ERP system and verify the information, you don't just assume that the reports are perfect?	That's correct I don't just assume I also drill down into the ERP to verify that information.
The Researcher: Thank you so much for raising such an important issue, then what is your opinion on having one dedicated person doing just data analysis for the entire department do you think such a person will be fully utilised?	**Transcript_Interview 12** At the end of the day, people input data but you need to also have someone who checks accuracy because sometimes the data will be inaccurate but this person will be able to assist and make sure that it is correct because the data are being input by people and people can make mistakes.
The Researcher: Ok so if I am getting you correctly it depends on the department, to say maybe some of the departments are information-intensive and others are not, so you are saying with other departments you might need someone who is dedicated to doing the analysis and checking the accuracy?	Yes, and not only the accuracy, but they can also check if whatever is being input is aligned with the Business strategies of the organisation.

Appendix B 14: THIRD THEME: Interview extracts on the role of the external BI consultant and the IT department

Extract Interview and probing questions	**Extract Interviewee's response**
The Researcher: Ok so do you think senior managers and executives can design business intelligence reports easily on their own without the help of business intelligence consultants do you think it's feasible? What is the role of the consultant then?	**Transcript_Interview 6** The purpose of a business intelligence consultant is to come up with a semantic layer of some sort that provides all objects in business intelligence in such a way that the objects can be used by all people in business operations for reporting. So if the semantic layer is properly defined and the objects are clear surely these days it's a matter of drag and drop and knowing which graph you want to put. You develop reports on the fly so yes it is solely dependent on how the semantic layer is built. If it is messed up then it's difficult for the managers and even senior executives to understand how to work with their data in transforming it into information.
The Researcher: Ok so if I am getting you correctly you are suggesting a situation whereby a company should have internal consultants and then those internal consultants work with the external consultants	**Transcript_Interview 12** It is not necessary if the internal consultants have been trained they will be able to work with the managers so that they come up with the reports the managers really want.
The Researcher:	**Transcript_Interview 16**

Ok thank you, do you think senior managers and executives may be able to design Business Intelligence reports on their own without the help of the consultant.	The role of the BI consultant and even lower-level managers and even the IT department is still relevant because the modeling part that's the technical part of the reporting that could require someone from IT or someone who is really hands-on with databases to model the information and then rename technical columns to use day to day terms. You know in databases, some of the terms are not written using our day-to-day language, a field for a date might be written in some numeric characters so it will be the role of the consultant or IT person to rename those fields so that when managers are viewing the objects, they will just see terms that they use daily in business.
The Researcher: Ok! When implementing BI systems what has been the role of IT and at what level have other departments been involved, I understand you usually implement via the IT department but business intelligence is usually for managers in other departments so how have they been integrated, at what juncture do they meet?	**Transcript_Interview 2** The IT department comes into play in terms of specifications and in terms of implementing those systems so it's more like the base of the business intelligence systems, that is the technical part, to say if we are to design a report how do we design it. It's more like visualising the analysis taking into account some of the complex data, so it plays that role.
The Researcher: Then, because it's now a combination of constructing reports for the benefit of the organisation so there is the IT department that you have mentioned they need to help technically and then there is the user department so at what stage do these two departments integrate.	**Transcript_Interview 3** The IT department should lead the user department on how to carry out the implementation of the BI or any other project in an organisation, for example, let's say we have in-house personnel from IT who are skilled in whatever area they will lead the other departments in producing the reports.
The Researcher: Ok in most organisations we have got the IT Department which usually plays a big role when it comes to systems and then we have got departments with managers that require the business intelligence system, so what role does the IT department play in the implementation of the business intelligence system?	**Transcript_Interview 6** IT department's main role is, for system selection, they are the ones upon consulting business would determine to say now depending on your requirements and your volumes of data and your strategic plan this is the best tool for you. They are also involved in setting up the environment or the infrastructure and they are also involved in the initial development of reports then over ally responsible for the management of the data warehouse from building it optimising it and maintaining it and all the other administrative work, including security.
The Researcher: Ok, so if I am getting you correctly you prefer the managers who report to the executives to be involved in the designing of BI reports whether on paper, and then they go to IT and say we want the report in this format	**Transcript_Interview 11** Yes, the IT department does the technical stuff but the contents must come from the managers who are the users of the reports
The Researcher: Ok thank you so much, when implementing Business Intelligence systems what has been the role of IT and at what level have other departments been involved	**Transcript_Interview 15** IT personnel is there for the administration of the servers that is the hardware and the authorisations. hey are the ones who give the authorisations because as external consultants we do not have authorisations or the liberty to do whatever we want on their servers
The Researcher: Ok, but do you think it is necessary to involve them in choosing the suitable Business Intelligence Systems	**Interviewee 15:** To some extent I think they are because business intelligence is for the Executives because it's for reporting.

The Researcher: When you are initially implementing Business Intelligence systems, what is the actual role of the IT department, are they there to choose the systems, and do you think they play an important role?	**Transcript_Interview 16** Usually, when the project kicks off we give them recommendations of the sizing of the server that we expect and it is the role of the IT department to make that server available for us to work in and if those resources are not enough it is up to the IT department to give us a configuration that we can work with. IT is the first line of support after the project has gone live and the consultant is no longer on site. At the end of the day when the project is done, IT has to own the solution as theirs and not the implementers of the solution and when the consultant leaves, it will be the role of the IT department to resolve any minor issues that might arise concerning connectivity or inaccessibility of the server housing the BI solution.

Appendix B 15: FOURTH THEME: Interview extracts on the benefits of using business intelligence systems and interconnected systems and devices

Extract Interview and probing questions	**Extract Interviewee's response**
The Researcher: Thank you so much, then what do you want to say to encourage the use of Business Intelligence systems? **The Researcher:** Ok, then you have raised an important point where you are talking about customers and you know these days you talk to them via Twitter, Google e.t.c and that's a lot of information what's your suggestion on tapping into that information? **The Researcher:** Ok, then do you prefer putting those data in the cloud or do you prefer to draw them and put them into your localised data warehouse what's your suggestion on that?	**Transcript_Interview 6** These days we are living in a world where all decisions are fact-driven. An organisation needs to have a Business Intelligence solution in place to enable them to do those fact-based decisions and predictions. This allows businesses to have insights into the current state of business, into the future, and the past. Sound decisions will be made that help the business to grow and operate optimally. So definitely organisations need a Business Intelligence Solution to have a competitive advantage by understanding how their competitors and customers are doing out there. Definitely, you need the solutions that tap into all those environments and push them back into your data warehouse for purposes of sentimental analysis because these days' sentimental analysis is a very crucial part of marketing so it's very very important to have such solutions in an organisation. **Transcript_Interview 6** These days I think it's best to cut costs, it's no longer necessary to have the on-premise infrastructure, you can have, your, add up environment yes and setup how to pledge there or in Microsoft Azure and you set up your data legs there and you still report and these days there are also reporting tools that report fairly good in the cloud.
The Researcher:	**Transcript_Interview 15**

What do you want to add or aspire to see happening in the field of Business Intelligence to improve its usage?	People should use BI because it increases the competitive advantage of the organisation. Executives will be able to make informed decisions and derive insights from information by visualising their data on dashboards and reports. It also has drill-down facilities to answer questions.
The Researcher: Do you see any need to have a lot of interconnected systems and gadgets or the ERP and BI systems address all your needs?	**Transcript_Interview 16** Sometimes it's difficult for an organisation to stick to only one solution so yes sometimes the ERP may not cater 100 % to the business needs, so you find that an Indian company may be hired to develop an internal solution that does one specific thing so yes sometimes it's inevitable that an organisation might have two or three solutions that do different things so the ERP can do a lot but it cannot do everything.
The Researcher: I understand you have got machine sensors on vehicles, are they adding value? what do you think are the limitations of using them?	**Transcript_Interview 18** They add very significant value for us especially when you are looking at the driver's behavior. You know drivers are people and one of the challenges with the drivers is that they are handling one of your most expensive equipment but they are taking that equipment out of sight. They are going to places where you may not know and you don't see them so the vehicle tracking systems using sensors become your only source of comfort and understanding their behavior, so it is a very valuable tool on vehicles to protect your equipment. It also creates cost servings, on issues to do with the performance of the trucks, the performance of your drivers, and your fuel performance for that it is very useful. The downside and risks associated with that are that in a country like Zimbabwe where technology is not at the level of the developrd countries, sometimes it's a problem when the drivers go to remote areas with your trucks, you cannot then track your them because those sensors become immobile. Then also secondly. you have the behaviour of the drivers whereby they can deliberately disconnect and then you cannot track them and so on and so on, so those are some of the problems associated with that, but generally, they are a good source of information for businesses.

EXTRACTS FROM FOCUS GROUP DISCUSSION

Focus Group Participant 1

It is key in this modern-day world to have interconnected systems so that the buyers and the engineers are connected. Taking it here home, companies are still afraid to open up their systems because they have no confidence in their security systems so they are afraid that someone can hack and be able to place factious orders or be able to withdraw stocks and not place invoices or not pay, that is the fear that the companies have.

We can overcome that if we get robust systems that we know cannot be hacked and prejudice the company, so I think that's the only fear that I am seeing with our local companies for opening up their systems

Focus Group Participant 2

We now have a fuel company that has introduced an e-fuel system for ordering fuel but with other companies, there is still that fear of the unknown, let me put it that way.

Appendix B 16: FIRST THEME: Interview extracts on the preferred designer of business intelligence reports

Extract Interview and probing questions	Extract Interviewees' response
The Researcher: I understand you receive Business Intelligence reports, in your own opinion, who do you think should design these reports between managers and Consultants, and why?	**Transcript_Interview 5** I will gravitate towards the managers, I mean they are the ones who know exactly what kind of information that they require and what kind of Business intelligence that they require, so naturally, they are the ones to design those reports within that aspect, yes some level of consultation can be done with the externals who are the data gurus in that field but at the same time the major input of that report should be from the managers within the company.
The Researcher: In your opinion, who do you think should design Business Intelligence reports between managers, consultants, and consultants and why? **The Researcher:** Do you prefer each individual to develop his/her own BI report, or do you prefer a situation whereby one person develops the reports for the entire department?	**Transcript_Interview 2** From my own experience all of them, the ones you have mentioned, the managers as the end-users should be able to also create Business Intelligence reports depending on what they want to achieve. Ok, I will start with the data administrator who is responsible for databases the source of data to make sure it is working and it is fine and in the correct structure. Then we come to the role of the data engineer his/her role now is to cleanse the data, and extract them from the source, so basically his/her involvement is coming up with the data warehouse. Then we now come to the business analyst who tapes into the data mats which have been created in the data warehouse by the data engineer to do visualisation, now it's more like designing the reports. From there, any person should be able to design and develop reports using tools that guide them.
The Researcher: In your opinion, who do you think should design Business Intelligence reports and why?	**Transcript_Interview 1** I think an external consultant working with an internal consultant should design the BI reports. Managers are busy! I mean being people working with subordinates it is very easy for them to just give their subordinates deadlines, 'Can you produce this report by midday tomorrow', so the subordinate is under pressure to produce that report.
The Researcher: In your own opinion, who do you think should design Business Intelligence reports and why?	**Transcript_Interview 3**

The Researcher: What is your opinion, on training internal people to design reports?	In my opinion, the designing of business intelligence reports should not be carried out by the executives. That is my thinking. I will suggest that the development of BI reports should be done by someone who is technical, a person who knows the database technology working in conjunction with BI end-users because the BI end-users know what they want and the BI developer will know the technical aspect of how to extract reports which are required by the end-users so he will guide them. If you have got personnel who are good at this technology of BI I think it can be done in-house but in case you do not know what to do as an organisation my opinion is, it is better to outsource this technology from outside so that these people will lead us in a very clear way on how to do our reports.
The Researcher: In your own opinion, who do you think should design these Business Intelligence reports between managers, consultants, and executives? and why do you think so?	**Transcript_Interview 4** I think these reports should be generated from within, that is from management who are involved in operational activities because the information will be helping the managers to come up with informed decisions and for future improvements. With the assistance of Internal Key process innovators for the particular function. When managers are involved in operations, they sometimes dwell too much on the operations and what suffers is the analysis of the business.
The Researcher: In your own opinion, who do you think should develop business intelligence reports and why?	**Transcript_Interview 6** In terms of designing, I think it's always key to give that job to divisional leads or team leaders of different operational divisions. The reason is, they have both an understanding of operational KPIs and strategic KPIs at the executive level so they are in the middle of key business operations and they have an understanding of the upper side and the lower side of the business so these are the best people to do that. It's a two-way process the manager should define what needs to go into the report and how it should come out if they have got someone to give the job to for the development then an internal person of their division can do that or they can develop them, themselves.
The Researcher: In your own opinion, who do you think should design these business intelligence reports between managers and Consultants? and why do you think so?	**Transcript_Interview 7** I think the requirements should come from managers to do their own design. Obviously, they will be limited technically to design their own reports so they may need the help of a consultant because the manager knows what he/she wants. They should design it using the tools that they are familiar with, maybe on a rough paper or even excel but they should at least have a design that they should put on paper for the consultant to be able to understand their requirements.
The Researcher: Ok, so if I am getting you correctly you are saying you prefer to sit down with the designer who may be the consultant then you design what you aspire to have?	**Transcript_Interview 8** That's correct, let me give you an example, I want to take a very simple example: I want to be monitoring my leave exposure as a way of managing the profit and loss of the organisation and I want to know anyone who has got

	more than 90 days classified, more than 60 days and those who are in 30 days category and so on. Once I have defined that, the Business Intelligence system must mine that information from the ERP every month. That report as I have defined it should simply come to my attention whether via e-mail or phone as configured and when I needed to see that I am able to make a decision, that's what I am talking about. That information as agreed must hit my e-mail.
The Researcher: Who do you think should design business intelligence reports?	**Transcript_Interview 9** Mmm! in my opinion I think it should be the managers, the reason being, they are closer to the source of the information and know what they want to achieve. The executives work more on a sort of strategic level ok they will get information from the different members of the department who are managers or supervisors and the strategic decision is made. The managers are more on the day-to-day operations they make a report and give it to the executives. The managers also will work with supervisors who also give them the information they will put together a summary that they give to the executives for them to make the executive decisions so the managers I think are better placed to design the reports, they know how the speed of this issue affect our production or how does this affect our packaging and transporting of our efficiencies solutions or not, can we change this system do I have people here do I need more little decisions like that. All that information may be coming from your key sensors which he/she will get into the computer they can then compile reports and design.
The Researcher: I understand you have got an appreciation of Business Intelligence and you receive some Business Intelligence reports in your own opinion, who do you think should design these business intelligence reports between Senior managers, excutives, and consultants and why do you think so?	**Transcript_Interview 10** I think managers should design reports and consultants can assist. The reason why I am saying managers, is because managers are the ones who know what they want, and how they want the information presented so it will be easy for them to tabulate and put all the information that they need. Consultants can always come here and there to assist and cover other gaps that the managers might need. Executives might not have enough time but they can spell out their thoughts on what they need and work with other people below them who can act as guides because, at the end of the day, they are also going to use those reports so there is a need for their input as well. So as much as they might not be hands-on but still they need those reports for decision-making at a higher level so if they delegate their construction to a lower level they might not capture other things that are needed at a strategic level of decision-making.
The Researcher: Who should design BI reports?, because, there is some designing that must happen so I want to find out who should be involved in designing those reports?	**Transcript_Interview 11** I will separately respond to your question, the person who is important in designing the report should be the user of the report, the user should give input first on what he or she wants the report to look like. After that I would prefer the consultant to design the initial reports then the managers, the internal people can now edit it as we go but I think the most important person is the user because that person knows what he/she needs because the required reports are different.
The Researcher:	**Transcript_Interview 13**

In your opinion, who should design Business Intelligence reports? should they be designed by consultants or by middle managers or by executives or senior managers?	I think it should cut across the whole organisation because different users have got different information needs therefore if I am an executive my information needs are different from a person at a lower level because our responsibilities are different so we should be able to say the executives define theirs because it's a higher level of information request which is different from a piece of detailed information that a lower-level person would require so I will suggest that it cuts across to meet the information needs of the different users So, Yes development can be done by the consultants or whoever but in terms of defining the information needs the executives should be able to define the layout and how the report looks like, I prefer that the executive actually work with the developing consultant
The Researcher: I understand you receive Business Intelligence reports. In your own opinion, who do you think should design these Business Intelligence reports between managers, consultants, and even the executives and why do you think so?	**Transcript_Interview 14** I think the reports should be designed by both of them, the people who want the reports, the end-users as well as the consultants. The reason why I say so is that the users or receivers of the reports know exactly what they want but they may not have the technical know-how of how to design the reports so they need now to bring the expert in the form of a consultant to make sure that those reports come up the way they must to be easily used by the managers,
The Researcher: In your opinion, who do you think should design Business Intelligence reports between executives, senior managers, middle managers, and business intelligence consultants and why do you think so?	**Transcript_Interview 15** Ok in the first stage of the project, I think business intelligence consultants should design all the reports but after the deployment of the project then the IT personnel can develop the reports, why because there are technical aspects of the development that cannot be handled by someone who does not have an IT background.
The Researcher: Ok, but why then do you prefer to work with low-level managers instead of working directly with the senior managers and the executives. I want to know maybe the reason.	**Transcript_Interview 16** The low-level managers are more hands-on. With BI some stuff might get a little technical and the executives might not have the knowledge to develop an in-depth report so what I would expect is yes an executive might make requirements, for example, I want to see my sales per region and then the low-level managers can develop that report and provide it to the executives.
The Researcher: In your own opinion, who do you think should design the Business Intelligence reports? because we have got internal consultants then we have got the managers and the executives who are the users of the reports?	**Transcript_Interview 18** I think from a designing point of view it should be the managers, remember these reports should be designed for a specific audience and the audience is the executives and the managers so they should be the initiators of how those reports should look, then the technical people, that is the consultants should then develop them based on what the managers want.

EXTRACTS FROM FOCUS GROUP DISCUSSION

Focus Group Participant 2

I think you should have internal consultants doing the reports, especially with the background that they are in, they have more experience and they know the systems and the processes. They know what needs to come out from the reports because they know what needs to be reported they know the key result

areas so my opinion will be if the internal consultants those that are running the business units can produce meaningful reports. I think also the Executives should have the say in the reports that are generated because if no one is interested in those reports they won't have any effect but if the executives view the reports and also use them for their decision-making then the people who are working with these reports will also generate more reports
Focus Group Participant 3 I think in our case as a manufacturing company it should be the Key process innovators with the help of the developer because the key process innovator (Internal Consultant) knows the business processes of his/her section and the developer has the technicality of designing the reports using the BI system and the programming language
Focus Group Participant 2 I would like to concur with Focus Group Participant 3 like what he/she is saying. The user department those who do the operations daily those who work with the reports they know which kind of reports they want
Focus Group Participant 1 it will be done best by the internal consultant who can do the research work and also work with the developer so that the reports come out to their perfection
Focus Group Participant 5 What I think is, Yes, as much as they are executives and they are in the decision-making but for reports, they should also be able to have an input because for those reports to be effective and be more useful to them they should be having an input to say what do I want because they are the ones who would like the reports for decision-making so they should be working in the background and be involved
Focus Group Participant 3 Just like Focus Group Participant 5 has said I just wanted to say they should be involved

Appendix B 17: SECOND THEME: Interview extracts on opinion on using a dedicated person to do the analysis for managers

Extract Interview and probing questions	Extract Interviewees' response
The Researcher: What is your opinion on having a dedicated person doing just data analysis for the entire department, do you think such a person will be fully utilised?	**Transcript_Interview 5** Having seen the level of information that I can gather from the ERP and the reports it can generste and the fact that I can go in and look into the report, analyse various scenarios of the reports that have been created, so I am now thinking to have a dedicated person to do analysis again. Then most likely that person will not be fully utilised. It could be somebody who is maybe trained on how to further evaluate or surf through the data or understand more depth of that information may be, yes, in that aspect.
The Researcher: What is your opinion on having one dedicated person doing data analysis for the entire department, do you think such a person will	**Transcript_Interview 2** It depends on the organisation's financial standing I wouldn't mind having someone who does the checks and balances with the manager to see that what has been developed meets the required standard. So I would put two people: one a developer sometimes called the data analyst or a business intelligence person who

be fully utilised or do you prefer a situation whereby a manager creates and analyse his/her own reports?	is given the task to develop reports, after the developer is done then he/she sends the reports to that other person to check.
The Researcher: Ok ! so what is your opinion on having a dedicated person who can just do analytics for the entire department, do you think such a person will be fully utilised?	**Transcript_Interview 1** Yes! That person will be adequately utilised but the senior management or the executives are usually not very comfortable with that arrangement, they will always want to give such a person additional responsibilities. We have key people who are responsible for different modules but you will find that those key people are also looking after other areas within the very same department so the issue of generating reports becomes one of many other functions that person is pursuing.
The Researcher: What is your opinion on having one dedicated person doing just data analysis for the entire department, do you think such a person will be fully utilised or departments don't need such a person?	**Transcript_Interview 3** I think in big organisations that person is required because for decision-making he/she will produce reports which are reliable since he will be dedicated to that job he/she will do it perfectly.
The Researcher: Alright, thank you so much, so what is your opinion on having a dedicated person doing just data analysis for the entire department do you think such a person will be fully utilised?	**Transcript_Interview 4** Managers sometimes dwell too much on operations and what suffers is the business analysis, yes because people will be trying to meet targets so I think if we have got a dedicated person who is also driving the agenda of the business information system in that particular department the loop is complete.
The Researcher: what is your opinion on having one dedicated person per department to do the designing of the reports and data analysis, do you think such a person will be fully utilised or you do not need such kind of a person?	**Transcript_Interview 8** I think it may depend on the department, but I don't think it's really necessary to have a dedicated resource. What I think is, there must be a specific person who will over and above his/her duties be assigned the responsibility of continuously spearheading these processes, whether we are talking of the manufacturing processes, sales processes, finance, HR e.t,c. There must be someone good at systems within your department. However, that person should not be like your internal consultant but just an ordinary day-to-day user who understands the issues then assess the problem and then say no, what we are facing here, this is what we require so I would call that person a point person in terms of the department's technological requirements.
The Researcher: Thank you so much, then what is your opinion on having a dedicated person doing just data analysis for the entire department do you think such a person will be fully utilised?	**Transcript_Interview 10** It might depend on the department because departments capture different information depending on the structure of the organisation, manufacturing can be production, engineering, and quality. So those are heavy departments but you might also have other departments which might not have heavy information needs it's important to have someone who analyses, because they will dedicate time to look at those reports or that information. If you put it as any other duties it might not be given enough time as people interrogate other things. Information is captured daily so there is no way that you can say this person is not underutilised because you are getting information that is being captured by everyone on a daily basis so you won't have someone sitting on idle time.
The Researcher: Some departments have got dedicated people who actually do the analysis for the entire department and sometimes some people might	**Transcript_Interview 11** My thinking is a system is for everyone so once you dedicate one person to analyse information for the whole department all the people in that department will shun

not see value in such a person what is your opinion on having a dedicated person doing just data analysis for the entire department do you think such a person will be fully utilised?	the system for him/her to do the analysis and produce the reports. It also means you will be having only one person who will be knowing the system and the reports but my thinking is daily everyone in the department should get into the system to do the analysis.
The Researcher: Thank you so much for mentioning that, then what is your opinion on having a dedicated person doing just data analysis for the entire department do you think such a person will be fully utilised or you don't need such a person?	**Transcript_Interview 13** That person won't be fully utilised because some of the information that people in the department require can easily be automated so what will that person be doing, I think a full person no, but someone who is doing other responsibilities as well.
The Researcher: Then what is your opinion on having a dedicated person doing just data analysis for your entire department do you think such a person will be fully utilised or he/she will be underutilised?	**Transcript_Interview 14** If you have a database system as we have, it is easier for managers to do data mining from that database and it may not be very useful to then have someone who is dedicated to doing data analysis. So if the system is correctly configured reports must come out correctly and if the managers are taught how to mine the data from the database then you may not need that person who will be dedicated to just analysing data for the managers. The managers should be able to mine their own data from the system and do their own analysis.
The Researcher: What is your opinion on having one dedicated person doing just data analysis for each department, do you think such a person will be fully utilised?	**Transcript_Interview 17_Answered_as_a_Questionnaire** No, when a system is now fully operational as is the ERP, the requirements become fewer and the person may not be fully occupied apart from training new recruits and training for upgrades and changes. Perhaps they can be given other duties eg system monitoring to minimise unauthorised access and abuse as well as some improvements to enhance responsiveness.
The Researcher: What is your opinion on having a dedicated person doing data analysis for the entire department do you think such a person will be fully utilised or you do not need such a person?	**Transcript_Interview 18** I think they will be fully utilised if they are doing what they should be doing. There is a lot of analysis in the business and as long as we are using the information that is being utilised there will be a lot of work for that person. I think the problem arises when they realise that whatever they are analysing and whatever reports they are producing, no one is looking at them they stop doing those reports then they begin to be underemployed but in terms of business, there will be a lot of information coming from that office.

EXTRACTS FROM FOCUS GROUP DISCUSSION

Focus Group Participant 1

Taking a department like engineering as an example, they deal with breakdowns and plant maintenance so when dealing with breakdowns everyone will be running around like headless chickens to solve the problem. So in that department you need someone who just stands who will have a bird's view and not involved in the rush and running around to say yes there was this problem, next time for it not to recur let me take the work orders, analyse them and come up with a report. The engineers will now be doing operational work because for engineers the work is hands-on so one or two people should do data analysis then the rest should have their hands on deck to keep the company going.

Focus Group Participant 4

I think it's not necessarily about one person doing all the work for others but every person wherever they are so it's not about one person but all those involved so that we get the same goal that we want to achieve

Appendix B 18: Interview extracts on requirements to improve the usage of BI

Extract Interview and probing questions	Extract Interviewee's response
The Researcher: Have you ever logged into the Business Intelligence system to design reports, do you need some training to be able to achieve that?	**Transcript_Interview 5** We need the training to be able to achieve that kind of scenario. I speak on my own behalf I do not know the other senior managers, I have not navigated that system but I think some bit of training will help in that aspect, the same way we did with the ERP.
The Researcher: Some companies seem not to use the BI system after it has been implemented. What do you think needs to be done to improve the usage of these business intelligence systems?	**Transcript_Interview 2** The involvement of stakeholders is key and the role played by change management is also key. You find that sometimes people are used to their old ways of working and if you introduce something new they seem to resist. Team building will be able to help when you are doing the scoping and data gathering, make sure that you involve all the key stakeholders who know the business processes and that the KPIs are considered, especially when you are now designing reports.
The Researcher: What advice would you give to companies that are intending to implement business intelligence systems to make sure that these systems work?	**Transcript_Interview 1** It is a very good system but it also requires knowledgeable people who are properly trained and it also requires a lot of resources to be allocated. Management must ensure that issues to do with support are considered upgrading and put that in their budgets. From time to time there will be a need to upgrade hardware and software, you need dedicated people who are qualified and from time to time you need to send those people to refresher courses.
The Researcher: What should organisations do to incorporate business intelligence systems in their environments?	**Transcript_Interview 3** They need to conscientise the whole organisation of the benefits of BI before anything else, especially if it is the first implementation there is a need for proper education so that staff will be in a position to know the benefits of BI systems.
The Researcher: Then what do you think should be done to improve the usage of business intelligence systems in organisations since you work in that environment	**Transcript_Interview 4** It should be a top-down approach whereby it starts from the top supported by the highest offices because it involves some investment.
The Researcher: What do you think can be done to improve the usage of business Intelligence systems in organisations?	**Transcript_Interview 7**

	It depends on the manager's key result area. I have noted in functions like finance where figures are very key, they are more into designing their own reports but managers who are measured on qualitative data they would have problems when they want to design their own reports It also depends on the value that the organisation puts in information, you get into a meeting and people use their past experience which is not backed up with information, there is a tendency to ignore the information coming from those reports. Management should make it very clear in their policies to say don't just say something without information in your thought process. Everyone should back their argument with information from a credible source such as BI or ERP and even cite a source of information not basing it on experience without real facts on the ground then most people will be able to jump on and use the BI systems.
The Researcher: What do you aspire to see happening in this organisation to improve the usage of business intelligence systems?	**Transcript_Interview 8** I strongly believe that the success of any technological development does not start with sophisticated systems it should target what people cherish the most. What do I mean? if you want people to embrace business intelligence systems, new systems, and gadgets, start with what they require daily, this is how it works. For example, if you want to automate a travel and subsistence form where people want to claim their money just say if you are not using this gadget to enter your claim unfortunately we are unable to pay you effectively on time. It means you have planted an automation agenda for the lowest possible employee in your company that's how you embrace technology. They would want to do it, they would like, they have to do it, you see, then once they are now doing it, it means their mind has already been geared to better technological advancement and the organisation would need it, that's the approach that I think works.
The Researcher: Ok, so if I am getting you correctly you are saying the main reason why people are rejecting business intelligence systems is, sometimes they can get reports that do not reconcile to other departments and also do not relate to the ERP system. **The Researcher:** Thank you so much, so what else do you think should be done to improve the usage of Business Intelligence systems?	**Transcript_Interview 10** Yes, I have been involved in many system implementations, systems need dedication. They need time to mature so if people are not patient there will be a problem. Systems must be improved! improved! improved! until they are perfect so if any implementer is not patient, users will easily default and go back to their old ways even if they are time-consuming. So even BI needs time and people to dedicate themselves so awareness programs are important, to tell them how they will benefit. Secondly, systems need to be integrated so that they are not in isolation when they come in isolation that's when there is fatigue where people are managing system number 1, system number 2, system number 3, and so on and they end up saying these systems are too many and this is worsened if they are not reconciling to each other, definitely the other one will be neglected. Information Technology as a standalone department can assist with research we are going digital and technology is a new life and recently we have been in and out

	of COVID-19 lockdowns. We have no choice but to embrace technology so there is no way we can stick with what we are using because what we are currently using can become obsolete and can stop anytime.
The Researcher: What do you think then needs to be done by organisations to improve the usage of BI?	**Transcript_Interview 11** We need to give people a guarantee that Information Technology does not take over jobs from people. This will reduce the resistance to change, so training the people will make them understand and when there is a buy-in, they can work with it. What we want to avoid is the notion that is generally held to say that an Information Technology report comes from the IT department, as long as that notion where they feel forced to use the report is there they will not accept the system. A system uptake is as good as how people believe in it.
The Researcher: What do you think can be done to improve the usage of Business Intelligence systems in your department and even in organisations do you see some gaps where there can be some improvements?	**Transcript_Interview 12** If people don't see the value of BI they stick more to the ERP so I think if people get more training and more reviews yes I think that can improve the usage of the BI system yes, there is a lack of knowledge of the BI system so I think there is a need for knowledge dissemination.
The Researcher: Then when it comes to the usage of Business Intelligence systems what improvements do you wish to see?	**Transcript_Interview 13** I think the configuration of the reports must be simplified, you don't want it complicated because at the end of the day what you want is to get as much information as you want that gives you value. Customise it, I should be able to design my reports to say if I do this it will be like this.
The Researcher: What improvements do you think can be done to the usage of the Business Intelligence system?	**Transcript_Interview 14** When you are using excel and spreadsheets you can find your way out. So my own opinion is to train the people so that they can make use of this Business Intelligence system. Those in IT should provide the necessary training if the skills concerned are not in-house we should go outside for the skills and train the people.
The Researcher: In your opinion what do you think can be done to improve the usage of Business Intelligence systems in organisations because it appears there is low uptake of these systems?	**Transcript_Interview 15** I think most people do not know about it so people should be educated because Business Intelligence and data analytics improve the competitive advantage of an organisation so managers and executives should know that there is something called Business Intelligence and incorporate it into their organisations.
The Researcher: All right, what then do you think should be done to improve the usage of Business Intelligence Systems in organisations because it seems there is low uptake of these systems	**Transcript_Interview 16** To make it more secure there is this secondary encryption that banks do when they send you a bank statement. I think that secondary encryption is critical it is another layer of security that currently does not exist within the BI solutions once someone extract reports someone can view those reports but if we add the second layer of encryption to whatever is extracted that can help to secure the information even more The role of Organisational Change Management (OCM) consultant is also very critical but you rarely see OCM consultants on projects. The role is critical, OCM

	consultants hype up the client so that they get excited that there is a new solution coming on board, yes I think that's all I have to say.
Then what do you think should be done to improve the usage of business intelligence systems?	**Transcript_Interview 18** The companies that offer these solutions must go out there in the market and conscientise the rest of the business community of the benefits of going on to these platforms. They should link it to issues of costs, issues of efficiencies then obviously the issue around the impact of the COVID pandemic to say COVID should not stop business there are these solutions that can be used by our business partners without having to physically meet. There are a lot of benefits but because of where we are coming from we need to change the traditional way of doing business and the change management process needs to be consistent with training to encourage people to move away from the manual ways of doing things.

EXTRACTS FROM FOCUS GROUP DISCUSSION

Focus Group Participant 5

If managers just run here and there and are not privy or engaged in the reports, and data mining they will still be running around and nothing moves on. Every manager should have access to the information and be able to analyse it to lessen the burden of accountants, we want everyone to have an appreciation and understanding of how the business is performing

Focus Group Participant 3

I would like to say for Business Intelligence to function well both Business people and Technical people should work together for BI to function well

Focus Group Participant 4

Sorry I don't know whether it should be Managers only or it should be coming from almost everyone, the users, and the managers all coming together and agreeing on exactly what they want to design and design it well so that we have the buy-in from everyone.

Focus Group Participant 2

I think the managers should initiate, however, they should not be on their own but incorporate everyone and consult all angles and have input from the bottom to top such that everything is supported

Appendix B 19: Interview extracts on opinion on adopting other new emerging technologies

Extract Interview and probing questions	Extract Interviewees' response
The Researcher: What kind of challenges or benefits do you currently experience with this abundance of information from a number of systems? Do you think there are benefits brought by these systems or there are now	**Transcript_Interview 4** My plea to the Information Technology team is, please lead us so that we can automate using our internal people, they can be able to lead the adoption of these new technologies.

challenges when information is being generated in abundance like that?	We can then get the information we want from various sources and that cements our decision-making. If you are working in manufacturing like us we are thriving to improve on a day-to-day basis and if we can get data that we can turn into information from various sources then we are best equipped to make good decisions for the benefit of the company.
The Researcher: What is your opinion on having a lot of interconnected gadgets and systems because of late we have seen a desire to interconnect a lot of systems, do you think this brings confusion or it has got some benefits?	**Transcript_Interview 7** I think it's critical to also interconnect with other systems but what is also more critical is not to follow what other people are doing but based on what value you get from those systems. I think there is a tendency, especially in the IT sector to just go with time without necessarily getting value from those systems so I think the issue of a feed gap analysis is very critical.
The Researcher: People now want to connect a number of gadgets so many gadgets and introduce a number of systems what is your opinion on that is it confusing you or it's something that you are appreciating to get that kind of new technology?	**Transcript_Interview 8** Confusing it may be yes but unfortunately, we have to deal with that confusion definitely because the new world, unfortunately, demands that we have to work with a number of gadgets and not only the gadgets but systems and programs. We have to understand if we don't understand, then, to at least have an appreciation of these technological interventions not only within your department but across all the departments so that when issues that require decision-making are being discussed we have got resembles of appreciation which can help us to quickly understand what is being talked about because technology is now becoming not only a dilemma but a language if we speak the language then we progress. Remember the idea is to enable us to make decisions that are accurate and fast that's all, so these gadgets are coming in to do that so no one will hate them as long as they are coming to help me, they are making my life easy they are making it fast they are removing stress and so forth then it's better to love them it's like that, but if they are not bringing the intended benefits then they become a nuisance.
The Researcher: What is your opinion on having a number of interconnected systems?	**Transcript_Interview 10** It is very good to always explore as much IT information as you can so that you are moving with the times of technology, so I think it's very important.

Appendix C Ethics approval from UNISA

Graduate School of Business Leadership, University of South Africa, PO Box 392, Unisa, 0003, South Africa
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E-mail: sbl@unisa.ac.za Website: www.unisa.ac.za/sbl

SCHOOL OF BUSINESS LEADERSHIP
RESEARCH ETHICS REVIEW COMMITTEE (GSBL CRERC)

08 December 2020

Ref #: 2020_SBL_DBL_018_FA Name of applicant: Mr GE Gondo Student #: 43239366

Dear Mr Gondo

Decision: Ethics Approval

Student: Mr GE Gondo, (43239366@mylife.unisa.ac.za +263 778213684)

Supervisor: Prof L Holtman, (lbholtman2018@gmail.com , 073 365 4209

Project Title: Value Realisation of Big Data to improve Business intelligence in Manufacturing Sector for ERP and BI Implementers.

Qualification: Doctor of Business Leadership (DBL)

Expiry Date: January 2023

Thank you for applying for research ethics clearance, SBL Research Ethics Review Committee reviewed your application in compliance with the Unisa Policy on Research Ethics.

Outcome of the SBL Research Committee:

Approval is granted for the duration of the Project

The application was reviewed in compliance with the Unisa Policy on Research Ethics by the SBL Research Ethics Review Committee on the 08/12/2020.

The proposed research may now commence with the proviso that:

1) The researcher will ensure that the research project adheres to the relevant guidelines set out in the Unisa Covid-19 position statement on research ethics attached
2) The researcher/s will ensure that the research project adheres to the values and

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SBL GRADUATE SCHOOL OF BUSINESS LEADERSHIP UNISA

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principles expressed in the UNISA Policy on Research Ethics.

3) Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study, as well as changes in the methodology, should be communicated in writing to the SBL Research Ethics Review Committee.
4) An amended application could be requested if there are substantial changes from the existing proposal, especially if those changes affect any of the study-related risks for the research participants.
5) The researcher will ensure that the research project adheres to any applicable national legislation, professional codes of conduct, institutional guidelines and scientific standards relevant to the specific field of study.

Kind regards,

Prof R Ramphal
Chairperson: SBL Research Ethics Committee
011 – 652 0363 or ramphrr@unisa.ac.za

pp. A. Marrian

Prof P Msweli
Executive Dean (Acting): Graduate School of Business Leadership
011- 652 0256/mswelp@unisa.ac.za

Appendix D Informed consent form for individuals

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Informed consent for participation in an academic research project

Value Realisation of Big Data to improve Business intelligence in the manufacturing sector for ERP and BI implementers

Dear Respondent

You are herewith invited to participate in an academic research study being conducted by **Garikayi Emmanuel Gondo**, a student in the Doctor of Business Leadership at UNISA's Graduate School of Business Leadership (SBL).

The purpose of the study is to find out what is limiting the analysis of information in the big data environment then develop a model for how to benefit more optimally from this information.

All your answers will be treated as confidential, and you will not be identified in any of the research reports emanating from this research study.

Your participation in this study is very important to us. You may however choose not to participate and you may also withdraw from the study at any time without any negative consequences.

You will be requested to participate once in this research study either through completing questionnaire questions or booked for an interview or by participating in a Focus group.

If you choose to participate, please answer the questions in the attached questionnaire or interview or focus group as completely and honestly as possible. This should not take more than 15-30 minutes of your time.

The results of the study will be used for academic purposes only and may be published in an academic journal. We will provide you with a summary of our findings on request.

Please contact my supervisor, Professor Lorna B Holtman on E-mail lbholtman2018@gmail.com if you have any questions or comments regarding the study. Please sign below to indicate your willingness to participate in the study.

Yours sincerely

Garikayi Emmanuel Gondo — **16 November 2020** Date Signed

I, ________________________, herewith give my consent to participate in the study. I have read the letter and understand my rights with regard to participating in the research.

Respondent's signature ____________________ **Date** ____________________

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Appendix E Partcipant information sheet

Graduate School of Business Leadership, University of South Africa PO Box 392 Unisa 0003 South Africa
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PARTICIPANT INFORMATION SHEET

16 November 2020

Title: **Value Realisation of Big Data to improve Business intelligence in the Manufacturing Sector for ERP and BI Implementers**

Dear Prospective Participant

My name is Garikayi Emmanuel Gondo and I am doing research with Professor Lorna B. Holtman, an independent contractor for Professor Department of School of Business Leadership towards a Doctor of Business Leadership at the University of South Africa. We have possibility of getting funding from the bursary department for meeting the research study costs. We are inviting you to participate in a study entitled **Value Realisation of Big Data to improve Business intelligence in the manufacturing sector for ERP and BI Implementers.**

WHAT IS THE AIM/PURPOSE OF THE STUDY?

The aim of this research study is to find out what is limiting the analysis of information in the big data environment then develop a model for how to benefit more optimally from this information.

WHY AM I BEING INVITED TO PARTICIPATE?

As one of the managers with experience in data analysis and other supporting technologies working in one of the selected companies, your opinion and ideas will play a critical role in this research study as we try to unlock value from the big data environment. A total of 20 participants (6 Executives 7 managers, 7 Senior ERP/BI, Database/Hardware consultants), have been purposefully selected from each department along the value chain to participate in this research study from three companies and a focus group (1 Manufacturing Company, 1 BI Implementing Company, 1 Hardware and Database Company and 1 Focus Group). The contact details have been obtained from the Human resources departments of the selected companies.

G.E.G

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WHAT IS THE NATURE OF MY PARTICIPATION IN THIS STUDY /WHAT DOES THE RESEARCH INVOLVE?

The study involves Structured and semi-structured interviews, a questionnaire and a focus group. Some questions must be answered through written response questionnaire and some through interviews to have varied views. You will therefore, be requested to participate in this research study by either completing questionnaire questions or booked for an interview or participate in a focus group, to explore how you are currently interacting with big data and your experiences with it. The process of collecting data will last about five months with participants being subjected to different stages of data collection and analysis with some being subjected to early stages and others to late stages as we build and refine the model we intend to develop; however, you will only participate once.

CAN I WITHDRAW FROM THIS STUDY?

This research study is voluntary and there is no penalty or loss of benefit for non-participation therefore, you are under no obligation to consent to participation. If you decide to take part, you will be given this information sheet to keep and be asked to sign a written consent form. You are free to withdraw at any time before being interviewed or before completing and handing back the questionnaire or participating in a focus group, without giving a reason. The researcher will try all means possible to use non-identifiable materials and protect the identities of participants. However, if you decide to participate in this research study and submit the questionnaire or give answers to the interview they may not be withdrawn, as they will become part of the analysis and interpretation of the results that will feed into the model we intend to build.

WHAT ARE THE POTENTIAL BENEFITS OF TAKING PART IN THIS STUDY?

For years, information has been around us, but now information is everywhere: in sensors, mobile devices, computers, servers, etc. We need to identify what is limiting the analysis of this information and then propose a model for how to benefit more optimally from this information.

G.E.G

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This will benefit policymakers and experts wishing to adopt e-commerce initiatives in various fields by adopting big data driven strategies. It will also be useful to other sectors of the economy where analysis of voluminous data is a big problem.

WHAT IS THE ANTICIPATED INCONVENIENCE OF TAKING PART IN THIS STUDY?

Some of the questions in this research study may make you feel that you are being exposed to lack of appreciation of latest technologies, but that is not the intention, the aim is to come up with ways of working in the big data environment that will enable managers to analyse voluminous data. The researcher will try all means possible to avoid any harm by protecting your dignity, privacy, and confidentiality throughout this research study by not printing names. Documents with identifiable names will be locked in a cabinet at home and electronically generated documents with identifiable names will be edited to remove such names and protected by password to avoid any harm. The researcher will adhere to COVID-19 guidelines and also give you an option to choose how you prefer to be interviewed.

WILL WHAT I SAY BE KEPT CONFIDENTIAL?

Your name will not be recorded anywhere and no one will be able to connect you to the answers you give. Your answers will be given a fictitious code number or a pseudonym and you will be referred to in this way in the data, any publications, or other research reporting methods such as conference proceedings.

However, your answers may be reviewed by people responsible for making sure that the research is done properly, including a transcriber, external coder, and members of the Research Ethics Committee. Otherwise, records that identify you will be available only to people working on the study, unless you give permission for other people to see the records.

Since this research study is for academic purposes, the anonymous data may be used for other purposes, such as journal articles and conference presentations to add to the board of knowledge and for further research. A report of the study may be submitted for publication, but individual participants will not be identifiable in such a report.

G.E.G

I will do everything possible to protect identities and therefore I encourage you not to share personal information. In this research study a focus group, comprising of (1 Executive, 1 Senior Manager 1 ERP/BI Consultant and 1 Database/Hardware consultant) and the researcher as the facilitator will be used to discuss the topic. Every effort will be made to ensure that you will not be connected to the information that you share during the focus group discussion. While other participants in the focus group may not treat information confidentially, I shall, however, encourage all participants to treat information confidentially. For this reason, I advise you not to disclose personally sensitive information in the focus group.

HOW WILL INFORMATION BE STORED AND ULTIMATELY DESTROYED?

The researcher will store hard copies of your answers for a period of 5 years in the academic file, locked in cupboard/filing cabinet at home for future research or academic purposes; electronic information will be stored on a password protected computer. Future use of the stored data will be subject to further Research Ethics Review and approval if applicable. Hard copies will be shredded and electronically generated information will be deleted from the computer.

WILL I RECEIVE PAYMENT OR ANY INCENTIVES FOR PARTICIPATING IN THIS STUDY?

This research study is voluntary therefore; there is no payment or incentive for participating in this research study.

HAS THE STUDY RECEIVED ETHICAL APPROVAL?

This study has received written approval from the Research Ethics Committee of the School of Business Leadership (SBL), Unisa. A copy of the approval letter can be obtained from the researcher if you so wish.

HOW WILL I BE INFORMED OF THE FINDINGS/RESULTS?

If you would like to be informed of the final research findings or want to contact the researcher about any aspect of this study and any further information, please contact Garikayi Emmanuel Gondo on Mobile number +263 778213684 or email address garikaigondo@gmail.com. The findings are accessible for 5 years.

G.E.G

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Should you have concerns about the way in which the research has been conducted, you may contact my supervisor: Professor Lorna B. Holtman on email address lbholtman2018@gmail.com Mobile Number +27 733654209.

Thank you for taking time to read this information sheet and for participating in this study.

Thank you.

16 November 2020

Garikayi Emmanuel Gondo Date Signed

G.E.G

Appendix F Similarity index report (TURNITIN)

- NB: A similarity index of 4 % from single source refers to the conference paper from this work. It was based on information gleaned from the literature review and findings.

VALUE REALISATION OF DATA ANALYTICS TO IMPROVE BUSINESS INTELLIGENCE IN THE MANUFACTURING SECTOR IN THE BIG DATA ERA

ORIGINALITY REPORT

13%	6%	6%	8%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to University of South Africa Student Paper	4%
2	researchspace.ukzn.ac.za Internet Source	<1%
3	"Frontier Computing", Springer Science and Business Media LLC, 2020 Publication	<1%
4	docplayer.net Internet Source	<1%
5	"Big Data Analytics for Cyber-Physical System in Smart City", Springer Science and Business Media LLC, 2020 Publication	<1%
6	Submitted to Abu Dhabi University Student Paper	<1%
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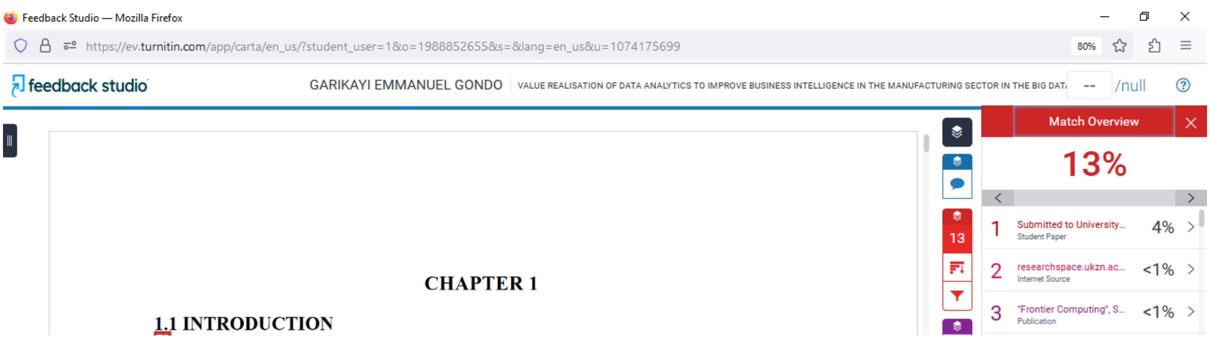

Appendix G Language editing letter

ResearchSmart cell:
082 374 7210
email: hiltonnaidoo@yahoo.co.uk

22 January 2023
Unisa: Research Committee

Dear Committee
Re: Editorial confirmation letter

This letter serves to confirm that the Thesis of Mr. GARIKAYI EMMANUEL GONDO, Entitled: VALUE REALISATION OF DATA ANALYTICS TO IMPROVE BUSINESS INTELLIGENCE IN THE MANUFACTURING SECTOR IN THE BIG DATA ERA, was language edited for appropriate English, grammar, punctuation, spelling, layout and style by myself, a native English speaker.

The research content and the author's intentions were not altered in any way during the editing process. However the author is free to accept or reject the suggested changes.

Should you have any concerns or questions about the edited document I can be contacted at the listed telephone or email address herewith.

Sincerely
H.A. Naidoo, M.Com

: