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Exploring the Determinants of Advanced Big Data Analytics Adoption in Zimbabwe's Telecom Sector: A TOE Framework Analysis

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Abstract

The way in which organisations conduct business has been revolutionised by Big Data Analytics (BDA). Several organisations have experienced improved productivity and effectiveness from the insights resulting from BDA which in turn impacts economic development. The adoption and use of BDA in the Zimbabwean telecommunication industry was limited. The aim of the research was to identify the factors limiting the adoption and usage of BDA within the Zimbabwean telecommunications industry. The objective of the research was therefore to pinpoint impediments which would then inform recommendations to improve the adoption and use of BDA in the Zimbabwean telecommunications industry. The study adopted critical realism and the Technology Organisation Environment (TOE) framework to identify the causal forces limiting the adoption and use of BDA. The findings indicate that IT infrastructure, service quality, senior management support, skills and expertise, financing, government policy, and economic conditions are the primary factors affecting BDA adoption.

Keywords: Big Data Analytics, technology adoption, Telecommunications, Technology Organisation and Environment, IT infrastructure, Government policy

1. INTRODUCTION

1.1. Big Data Analytics

The fourth industrial revolution has brought marked technological innovation which has seen big data being exploited for sustainable development [1]. Big data (BD) can be defined as the collection and consolidation of large datasets [2]. [3], on the other hand, define BD in terms of its size, speed at which data is generated or delivered and variety also known as the three V's (volume, velocity and variety). Variety refers to how the data is structured, volume is the quantum of data in bytes [4], and velocity refers to the rate at which data is generated [5]. Big Data Analytics (BDA) is the process of gaining meaningful insights or hidden correlations from BD for decision-making.

Due to the massive gathering of data, BDA is now trending with several industry players due to the potential insights that they can gain from that data which would help in solving problems in fields like healthcare, cybersecurity, farming and finance [6]. There are several opportunities that come with BDA adoption such that it has drawn the attention of several sectors of Industry [7], [8], [9]. The introduction of healthcare ICT systems in sub-Saharan Africa (SSA) implies acknowledgment from sub-Saharan countries of the improved service delivery opportunities that come with the systems and BDA [10].

Songwe, (2020) asserted that Africa needs digitalisation to enable the successful implementation of the sustainable development goals (SDGs) and Africa's agenda for 2063. This will drive the adoption of technologies like BDA. BDA is crucial in the service industry as it differentiates the quality of experience of consumers [12]. BDA is critical in the educational sector as it provides insights that improve the learning experience [13]. [14] wrote that BDA has the potential to assist an organisation in coming up with strategy or running operations which in turn affects its competitiveness and the economy large. [10] in a study on healthcare in Zimbabwe stated that increased adoption of BDA leads to data-driven decisions, which positively impacts operational efficiencies and the quality of care provided. The benefits derived from using BDA will go a long way in assisting the achievement of SDGs.

BDA has revolutionised the way of doing business through the benefits it provides. It leads to better operational performance [15], [16], improved consumer satisfaction [17], [18], and data-driven decision-making [1], [19]. Performance within organisations is improved through product development that is aligned with customer expectations [15]. Consumer satisfaction is achieved through BDA as seen in automation systems deployed in insurance where action is taken without human intervention when an event occurs [18]. BDA through predictive or prescriptive analytics provides insights that lead to informed decision-making which positively impacts operational performance [20].

Big data analytics (BDA) adoption is quite complex and should not be seen as something an organisation can throw money at, collect big data and hand it off for the information systems teams to experiment with [21]. The digital transformation required to become a data-driven organisation requires careful planning and implementation [22]. BDA is sophisticated therefore a good strategy is necessary to get past potential challenges [23]. Performance gains associated with BDA adoption can only be achieved through the development of a future roadmap and implementation of a clearly laid down strategy [21]. Therefore, the successful adoption and use of BDA requires careful planning, taking into account different constraints within a specific environment.

1.2. Theoretical Frameworks

There are several theoretical frameworks that have been used in articles on opportunities, challenges and drivers of BDA adoption, which include but are not limited to, the Technology Organisation Environment (TOE), the Diffusion of Innovation, Resource Based View (RBV), and the Human-Organisation-Technology-fit (HOT-fit). A review of the literature using the Scopus database on these from 2018 to 2023 shows that TOE has been the most favoured.

Table 1. Research distribution by theoretical framework

Theory	Authors
Technology Organisation Environment (TOE)	[5], [9], [13], [16], [24], [25], [26], [27], [28], [29], [30], [31], [32], [33], [34]
Diffusion of Innovation (DOI)	[5], [13], [16], [25], [27], [31]
Human-Organisation-Technology-fit (HOT-fit)	[13]
Motivation-Opportunity-Ability (MOA)	[35]
Decision-Making Trial and Evaluation Laboratory (DEMATEL)	[35]
Interpretive Structural Modelling (ISM)	[36]
Technology Acceptance Model (TAM)	[7], [33], [37]
Motivation Theory	[37]
Resource Based View (RBV)	[16], [25], [30]
Dynamic Capabilities Theory (DCT)	[28]
Theory of Perceived risk (TPR)	[29]

[38], [39] stated that TOE looks at how technology, the organisation and the environment affect adoption of technology. The key determining factors of the adoption of technology in organisations fall under technology, the organisation and the environment [40]. Technology refers to technologies that are at an organisation's disposal, the organisation refers to the make-up of the organisation and the environment refers to the market or industry characteristics, laws, and government relations [38], [40].

1.3. Factors Influencing BDA Adoption and Use

Several factors have been identified to impact the adoption and use of BDA within organisations over the years. Technological factors identified were complexity, security [13], [16], perceived usefulness and IT infrastructure [14]. Complexity is the degree of difficulty faced when adopting technology. The effort required to adopt an innovation is inversely proportional to the probability of adoption [16]. Perceived usefulness is the extent to which a technology is deemed to be useful. If an organisation sees something useful, they are more likely to adopt it. BDA relies on IT infrastructure for implementation therefore, organisations need to have the correct hardware and software for successful adoption [41].

The organisational factors identified by several authors were top management support, [25], [30], skills and expertise, and financing [13], [35]. Top management informs the organisational strategy hence the successful implementation hinges on them as they control resource allocation [41], including funding. The rollout of any technological venture requires the correct skills and expertise, more so for complex technologies like BDA [36], [42]. There is a deficiency of digital skills in Sub-Saharan African countries as it only accounts for about 50% of the world average [43]. Additionally, Zimbabwe was negatively impacted by skills flight as they looked for greener pastures due to poor economic conditions within the country [44], [45].

The environmental factors identified were government policies [13], [26], and uninterrupted electricity supply [42]. Africa is falling behind on BDA development owing to restricted access to data or the unavailability of policies that provide access to data [46]. Data jurisdiction laws have impacted the adoption and use of BDA in Africa as some tools reside on the cloud [47]. The affordability and availability of electricity impact BDA adoption [48] and Africa is trailing behind in terms of access to electricity [49]. The Zimbabwean economic conditions led to a shortage of foreign currency, which impacted their ability to pay for the importation of electricity [50], [51]. The unavailability of electricity affects real-time data collection and transmission to processing centres.

1.4. The Telecommunications Industry

Zimbabwe's telecommunications industry struggles with economic instability, poor national infrastructure, and regulatory hurdles, which hinder the adoption of advanced technologies like Big Data Analytics (BDA). There has been considerable transformation within telecommunications driven by the everchanging needs of consumers and changes within the technological landscape hence telecommunication service providers have to continually innovate [52]. The drive has been to sweat telecommunications assets in Europe, Middle East and Africa hence providers have entered into infrastructure sharing initiatives to gain more

revenues. Growth has become a necessity to compete hence there telecommunications industry has been characterised by several merges and acquisitions [53]. The telecommunications industry in Zimbabwe also engaged in infrastructure sharing initiatives to sweat existing assets and minimise spend due to shortage of foreign currency [54]), a symptom of poor economic conditions in the country. There has been significant privatisation of telecommunication companies with African coastal countries having been affected the most sitting at 70% which has been driven by lack of funding [55].

The telecommunications industry is regulated by the Post and Telecommunications Regulatory Authority of Zimbabwe (POTRAZ). The Telecommunications sector in Zimbabwe is made up of Internet Access Providers (IAPs) and the major ones are Liquid Intelligent Technologies, , Powertel, TelOne and Dandemutande according to the [56] report on market share for internet bandwidth. The second main category of the Telecommunications industry consists of Mobile Network Operators (MNOs) namely Telecel, NetOne and Econet Wireless [56]. Telecommunication service providers in Zimbabwe have been affected by poor economic conditions and increased pressure on revenues owing to taxes [57].

1.5. Research Problem, Aim and Objective

Africa is falling behind on BDA adoption owing to government policies and data access restrictions [46]. The use of Big Data (BD) in AI and smart city initiatives has led to economic growth [58], [59], [60] however Zimbabwe's economy has been suffering from stunted growth [61], [62]. BDA adoption is lacking in the Zimbabwean telecommunications industry owing to inadequate skills and expertise, inadequate electricity supply and the absence of enabling government policies[42], [45], [48], [50]. The world is profiting from the fourth industrial revolution however Zimbabwe is falling behind and is economically deprived. The underutilisation of BDA implies, there will be inefficient delivery of services, depressed economic development, and limited participation in the digital economy. Regardless of the potential benefits of BDA, its adoption in Zimbabwe's telecommunications sector remains limited. This research seeks to identify the underlying factors contributing to this limited adoption. The primary objective of this research is to identify and analyse the technological, organizational, and environmental factors that limit the adoption and use of BDA in Zimbabwe's telecommunications industry.

1.6. Conceptual Framework On BDA Adoption and Use In Telecommunications

Figure 1 is conceptual framework in figure 1 was developed from literature in a bid to understand and find explanations to the determinants of BDA adoption and use

within the telecommunications industry in Zimbabwe. Previous literature on factors impacting the adoption and use was used to come up with the framework. The framework illustrates the interplay between technological , organisational and environmental factors on BDA adoption and use and the mediatory role played by the socio-economic conditions.

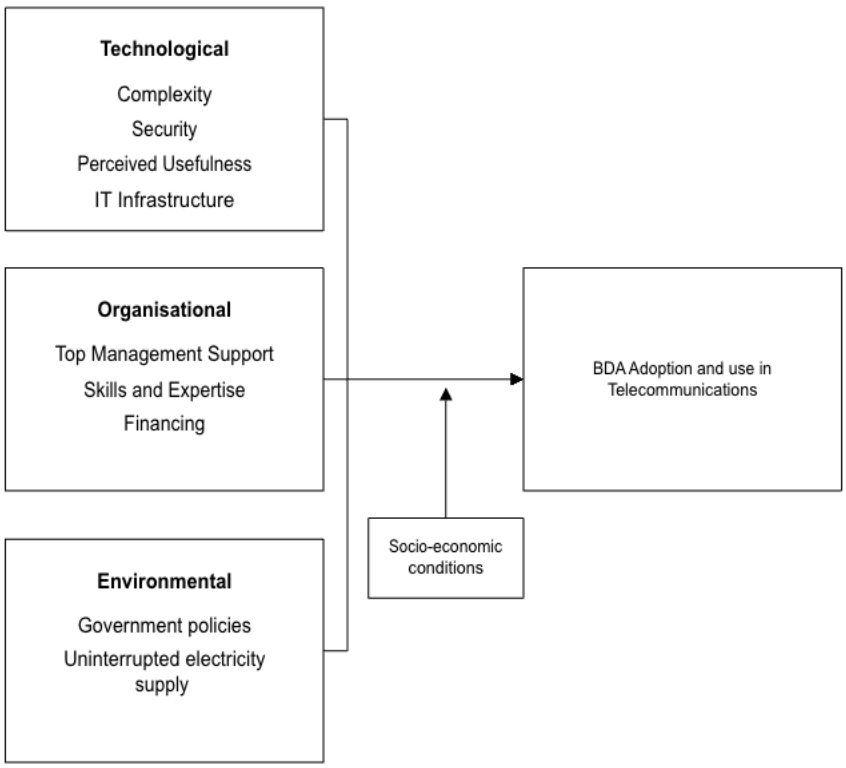

Figure 1. Conceptual framework on BDA adoption and use in telecommunications

1.7. The Research Gap

There have been several studies on BDA adoption including [63], [29], [34], [5], and [32] however these studies were carried out in Europe, Asia and America. According to the author's knowledge, there have been limited BDA adoption studies in a Sub-Saharan African country like Zimbabwe which has been undergoing economic turmoil since the 2000s. The economy has been negatively impacted by mismanagement of resources, low foreign direct investment and inflation that has been as high as 240% in December 2022 [64]. The gold backed currency in Zimbabwe lost half of its value within 6 months of launch [65], [66].

There were some studies on BDA usage in Zimbabwe like Wadesango et al. [67] where the study aimed to assess the impact of using BDA to gather audit evidence, Shereni et al. [68] where the study aimed to determine how BDA could be used in the hospitality industry and Batani et al. [10] where the study aimed to look at challenges and benefits of using systems that are driven by data in the in healthcare. These studies, however, did not focus on factors influencing the adoption and use BDA, and also, there are no known studies according to the author's knowledge of the telecommunications industry. Telecommunications fall under ICT hence, factors that impact technology adoption in ICT companies may differ from those of other industries as the organisational characteristics differ from those studied before. Organisational characteristics impact technology adoption as per studies by Taylor [69] ,Maroufkhani et al. [16] and Lutfi et al. [27].

2. METHODS

This section outlined the research philosophy guiding the thinking on BDA as a research phenomenon, and ultimately, an investigation of its adoption in Zimbabwe. It further outlines a research process followed, including sampling methods, data collection and analysis, as well as the reporting of findings as guided by Saunders et al [70].

2.1. Research Philosophy

Ontologically, BDA is a social construct that can be observed through subjective logic, referred to as subjectivism. Mostly, because the knowledge sought was concerned with explaining the adoption of BDA or lack thereof from the perspective of economic growth as informed by activities carried out by humans and their opinions. Subjectivism posits that value is created from a social actors opinion of an object. [71; 72; 73]. Consequently, critical realism emerged as an appropriate epistemology to guide an investigation into the research phenomenon of BDA adoption by the telecommunications sector in Zimbabwe [73], [74], [70] The goal of critical realism is to understand certain phenomena by focusing on what is achievable within a given context [75]. Critical realists argue that the reason for research is to attain information on causal mechanisms [76].

Critical realists argue that the world is arranged into layers in addition to its diversity [77]. The layers include the real , the actual and the empirical [78], [79], [80]. The real consist of entities with properties that facilitate the activation of causative mechanisms. The actual includes incidents and their consequences resulting from stimulation of causative forces whereas the empirical the consequences of events that are observable or can be experienced [81]. Critical realists believe that reality cannot be limited to what is known by humans as their knowledge of it is limited [76].

Critical realists believe surroundings and circumstances shape observation and research [82]. The empirical domain consists of observations and experiences which are a consequence of incidents in the actual however the causative forces and structures in the real cannot be directly perceived [83]. The nature of reality implies that what is experienced is influenced by the context of the experience [82]. The perception of the world by humans is influenced by social and cultural background or experiences [84]. Critical realism was selected on the basis that it enables an in-depth understanding of the underlying mechanisms and causal forces affecting BDA adoption in the unique socio-economic context of Zimbabwe.

2.2. Research Approach

The endorsed inferential technique for critical realism is retroduction [79], [80]. Retroduction is a technique where causative forces are unearthed as they are usually concealed and cannot be gauged empirically [85]. It can also be seen as a mode of inference that reveals the features and parts of the causal structures and mechanisms of incidents [83]. This is also consistent with the writings of McEvoy et al. [76] who acknowledge the need of retroductive reasoning when working with critical realism to explain certain phenomena. Critical realism promotes the constant assessment and critique of relationships between variables through its cyclical retroductive process [82]. The use of retroduction enabled the unearthing of forces that resulted in the adoption or lack thereof owing to the in depth understanding of the interplay between the three domains of reality namely, the real, the actual and the empirical.

To review the determinants of BDA adoption in Zimbabwe the study made use of the TOE (technology-organisation-environment) framework by Tornatzky and Fleischer [86]. The TOE framework enabled the researcher to take an in depth look into the technological and organisational factors within telecommunications organisations and the external environmental factors impacting BDA adoption and use. The study observed what was occurring at the empirical level of reality whilst making use of the TOE framework as a lens to assess the structures and causal forces to the adoption and use of BDA within the Zimbabwean Telecommunications sector. This approach enabled the study to look extensively at technological adoption from endogenous factors within Telecommunication companies and external issues within the industry and economy.

2.3. Research Design and Methodology

The study was cross sectional due to the limited time factor and explanatory as the objective was to unpack the determinants of BDA adoption and use within the telecommunications in Zimbabwe. The cross-sectional design was chosen to capture a snapshot of the current state of BDA adoption in Zimbabwe's telecommunications industry, while the explanatory approach helps in

understanding the causal relationships between the identified factors. The survey strategy was employed to gather considerable data in a costs effective and timely manner, using questionnaires and open ended interviews [75; 88]. The researcher came up with an interview guide based on technological, organisational and environmental factors that were identified in previous studies as impacting technology adoption.

Participants were selected using the purposive sampling technique among major organisational stakeholders in the country capital, Harare, Zimbabwe [88]. Purposive sampling was chosen for the study as the researcher was looking for participants with relevant expertise and experience on BDA adoption. The sample size of ten participants from five telecommunication service providers and four from government ministries was determined based on the need for diverse perspectives and practical constraints.

2.4. Data Collection and Analysis

Semi-structured interviews were conducted in-person with key stakeholders, focusing on questions related to network and national infrastructure, skills and expertise, government policies, and economic conditions. The interview questions were designed to elicit detailed responses that would provide insights into the factors affecting BDA adoption in the Zimbabwean Telecommunications industry. To attain the objective of critical realism researchers should engage with participants because their unique experiences play a significant role in gaining knowledge on the varied aspects of reality [89]. In the true critical realist fashion as suggested by Danemark et al. [84], the first step included the collection of data through interviews. Then the transcription of interview audio recordings.

The researcher used ATLAS.ti for data analysis. The first stage involved the importation of interview transcripts after removal of any information that could be used to identify the study participants. The second step in the Danemark et al. [83] was that research delineation, using the research aim as map to identify the determining factors to BDA adoption and use within the Zimbabwean telecommunications sector. This involved carrying out thematic analysis using ATLAS.ti, through the identification of themes that were emerging from the data also known as demi-regularities as guided by Boost et al. [89]. Thematic analysis is a way of extracting, putting in order, and illustrating salient patterns in a particular set of data [90]. Interview transcripts were coded to identify recurring themes and patterns related to the technological, organizational, and environmental factors affecting BDA adoption. The descriptive codes were categorised into code groups based on their commonalities. The code groups were then later aggregated to come up with emergent themes that then facilitated a comprehensive analysis to address the research aim.

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3. RESULTS AND DISCUSSION

3.1. Research Findings

The objective was to assess based on literature review the extent to which different Technological, Organisational and Environmental factors impacted BDA adoption and usage. The results indicate that inadequate IT infrastructure, poor service quality, lack of top management support, skills attrition, insufficient financing, restrictive government policies, and poor economic conditions are the primary factors limiting BDA adoption.

The third step of the critical realist research process entails interpreting and redescribing particular elements of an occurrence, also referred to as abduction [83]. Abduction can be seen as inferring to the most probable explanation which implies studies should consider multiple explanations [91]. The goal of the fourth step in the critical realist research process is to develop ontological insight [85]. Ontological depth would aid in the explanations of the relations between the causal forces in the real, structures in the actual and that which is seen or not in the empirical levels of reality. The third and fourth steps are indistinguishable in practical research [83]. The Figure 2 shows the primary factor impacting BDA adoption in the Zimbabwean Telecommunications sector.

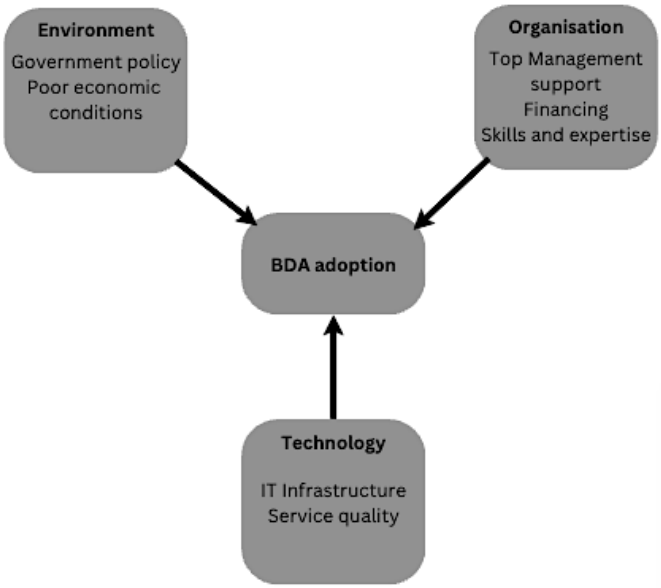

Figure 2: Primary factors impacting BDA adoption

The study made use of the TOE framework as a theoretical lens for explanation of the research findings in the following sections.

3.1.1. Technological Factors

1) ICT Infrastructure

IT infrastructure is needed for data warehousing due to the high data volumes, compute resources for data processing and security systems to protect the data. The findings suggest that availability of adequate infrastructure was hindering BDA adoption and cloud services were not on the table due to data jurisdiction issues. Purchasing of required infrastructure was hindered by poor economic situation which was affecting ARPU, the cost of capital and foreign currency availability. The lack of IT infrastructure hinders the ability to store large datasets. This finding is consistent with a previous studies by Lufti et al. [27] and Juma and Kilani [14] where they stated that IT infrastructure impacted BDA adoption.

2) Service Quality

The findings suggest that there was inadequate service quality within the Zimbabwean telecommunications sector owing to insufficient electricity grid supply. Service availability was impacted in some areas leading to the need for telecommunication service providers (TSP) to invest in backup power. Low service quality hinders the transmission of data and real time analysis from different locations.

3.1.2. Organisational factors

1) Top management support

The successful implementation of any project within an organisation requires support from top management to ensure alignment amongst different verticals working together. Some organisations invested in BDA in form of tools and training however utilisation was limited which could the absence of a top management support. The absence of top management support results in no clear direction or oversight of strategic projects like BDA which hampers implementation efforts. This finding is consistent with previous studies by Behl et al. [36] and Giang and Liaw [24].

2) Skills and expertise

The findings suggest that the educational system in Zimbabwe was producing a lot of graduates with the knowledge on how to exploit fourth industrial revolution technologies like BDA. The resources were however being lost to other countries due to the Zimbabwean economic situation and replacing the lost experienced workforce was a challenge. The continual loss of skilled workforce meant the TSPs were always in a cycle of training which negatively impacted BDA adoption and

use. Skills attrition due to economic conditions leads to a continuous cycle of training impacting effective use of BDA. This finding is consistent with previous studies by Krieger et al. [32] and Shahbaz et al. [7] who stated the criticality of skills and expertise for BDA implementation.

3) Financing

The findings suggest that financing is key to the successful adoption and use of BDA within the Zimbabwean telecommunications sector. Financing was required in different areas including training, tools purchase, integrations with existing systems and IT infrastructure. The findings also suggest that the Zimbabwean market was lacking affordable financing options for projects which led to limited network reach. The high cost of capital was linked to poor economic conditions and the political environment. TSPs had limited financial resources owing to low ARPU resulting in little to no allocation of budget towards BDA initiatives. The insufficient financing hinders the purchase of necessary tools, infrastructure and other support initiatives for the successful implementation of BDA projects. This finding is consistent with previous studies by Wang et al. [35] and Reyes-Veras et al. [8].

3.1.3. Environmental factors

1) Government Policies

Government policies are crucial for the successful adoption of technology as certain legislation can impede innovation and corrupt elements may lead to delayed execution of adoption policies. The implementation of subsidies has proven to encourage technology adoption [92]. Some TSPs believed that legislation of the jurisdiction of data were impeding innovation. The emergence of cloud services which could be leveraged on without needing to invest capital on infrastructure could not be fully exploited. The findings suggest that there was lack of policy execution from government which could positively impact technology adoption. The ICT policy for Zimbabwe lacked agility as it was changed in five year cycles which meant any adjustments required due to technological changes mid-cycle would need to wait for up to five years. Restrictive government policies and lack of policy implementation hinder BDA adoption by stifling innovation and limiting investment in BDA. This finding is consistent with Baig et al. [13] and Anawar et al. [26] who mentioned the importance of enabling government policies for BDA adoption.

2) Economic conditions

The Zimbabwean economy has not been performing well as corroborated by two changes in currency within half a decade. The current Zimbabwe Gold depreciated by fifty percent within six months of introduction [66]. The lack of production within Zimbabwe has led to a high demand on forex requirements leading to its shortage. The TSPs highlighted forex shortages as one of the factors limiting projects like BDA adoption and capacity upgrades. The findings also suggested that the economy was negatively impacting electricity grid availability, skills flight and the cost of capital. Poor economic conditions hinder BDA adoption through shortages in foreign currency for IT infrastructure and tool purchases, inadequate electricity supply and skills attrition.

3.2. Interplay between the TOE factors

Based on the Technological , Organisational and Environmental discussion above the researcher proposes the below depiction. It shows how Environmental factors are impacting both Technological and Organisational factors, as shown in Figure 3.

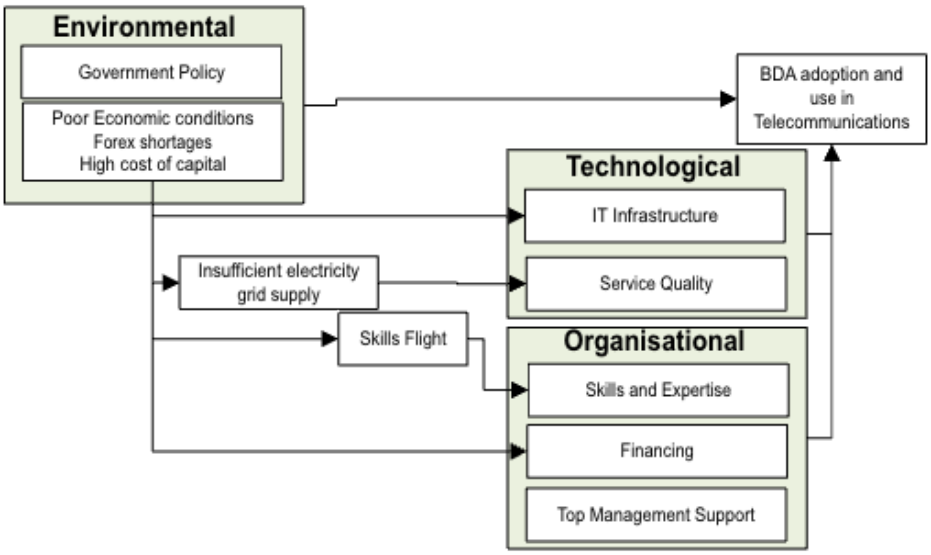

Figure 3. TOE determinants for BDA adoption and use

3.3. Discussion

The study hypothesised that the causal forces that determine the BDA adoption for productivity and effectiveness were Technological, Organisational and

Environmental. Based on the results from data analysis the Technological and Environmental factors were key to BDA adoption and use however another force was acting on these factors. The Technological and Organisational factors were being influenced by the Environmental conditions persisting in Zimbabwe. This is consistent with the critical realism writing from Fox [93] where the author stated that causal forces bring about certain results under a relevant context.

The Telecommunication sector in Zimbabwe produces substantial BD and this production requires IT infrastructure which requires sufficient electricity supply. The data produced requires transmission through good quality networks to avoid errors when transmitting the data to warehousing and processing facilities that have infrastructure for cleaning, storage and processing. Exploitation of the BD requires BDA skills, support from senior management for direction and resource allocations. Reasonably priced capital is also required for BDA projects to be a success. Enabling economic conditions and government policies are also key in creating an environment conducive for BDA adoption and use. BDA adoption and use would result in data driven decision making which would impact the telecommunications sector productivity and effectiveness.

The below figure shows the interplay between the three levels of reality, the real, the actual and the empirical. The adoption and usage of BDA for productivity and effectiveness is mediated by causal forces and relevant circumstances that activate events that are observable or not in the actual and what is seen and/or encountered in the empirical as productivity and effectiveness.

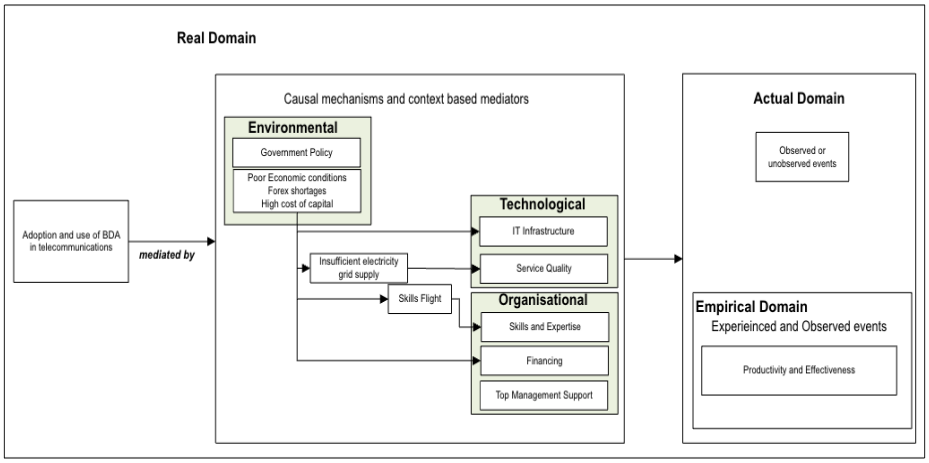

Figure 4. Stratified Interplay of events

This study sought to identify the underlying factors contributing to the limited adoption and use of BDA in the Zimbabwean telecommunications sector. The study identified the different factors hindering BDA adoption and use. The study's

findings align with the Technology Organisation Environment (TOE) framework, demonstrating that technological, organizational, and environmental factors collectively influence BDA adoption. The interplay between these factors, mediated by the socio-economic conditions in Zimbabwe, highlights the complexity of technology adoption in developing countries.

To enhance the level of BDA adoption and use within the Zimbabwean telecommunications industry it is critical that the hindering factors identified in this study be addressed. There is need to invest in infrastructure, enhance the quality of service offered by telecommunication service providers, ensuring that there is affordable financing and the implementation of enabling government policies. Since the adoption is also being influenced to a greater extent by the prevailing economic environment there is need for economic reforms which will see the Zimbabwean economy towards a path of recovery. The implementation of these measures will lead to the creation of an enabling environment for BDA adoption and use which would consequently lead to productivity and effectiveness in the telecommunications sector.

4. CONCLUSION

The study looked at the relation of TOE factors that determine BDA adoption and use in the Zimbabwean telecommunications sector for productivity and effectiveness. The aim of the research was to identify the factors limiting the adoption and usage of BDA within the Zimbabwean telecommunications industry. The objective of the research was therefore to pinpoint impediments which would then inform recommendations to improve the adoption and use of BDA in the Zimbabwean telecommunications industry. The insights provided by BDA for decision making could result in productivity and effectiveness in telecommunications. The researcher used a critical realist approach to determine the causal forces and relevant circumstances required to stimulate BDA adoption and use. The study found that BDA adoption and use in Zimbabwe's telecommunications sector is being negatively influenced by inadequate IT infrastructure, poor service quality, lack of senior management support, inadequate financing, restrictive government policy and harsh economic conditions. The study proved that technological, organisational and environmental factors mediated by the socio-economic conditions were impacting BDA adoption and use.

The research contributes to the increasing knowledge base on technology adoption by providing a better understanding on the determinants to BDA adoption and use in the Zimbabwean telecommunication sector. Through identification of these determinants the research gives different stakeholders including policy makers areas to concentrate on to improve BDA adoption. Addressing the identified BDA barriers through targeted investments in IT infrastructure, enhancing service quality, providing affordable financing, implementing supportive government

policies and economic reforms can significantly improve BDA adoption and usage. Through the use of critical realism the research also proposes how the approach can be used for the identification of causal forces in technology adoption studies.

A key constraint of the research were the amount of respondents identified for the research in some of the organisations. Regardless of the researchers intention to have three respondents per telecommunication service provider, consent was not provided by some potential respondents. More respondents in other organisations could have improved the researches level of detail through the potential unique insights they could give on BDA adoption and use. Even though the researcher was able to get three respondents from some of the providers a different way of engaging potential respondents could be considered to increase the number of participants for future research. Future research could also explore the impact of specific government policies on BDA adoption and investigate the role of emerging technologies in overcoming the identified barriers.

The data collected and the results from the analysis informed the recommendations to improve the adoption and use of BDA within the Zimbabwean telecommunications sector. To improve BDA adoption and use, it is essential to increase investment in IT infrastructure, enhance service quality, provide affordable financing, implement supportive government policies and economic reforms. These measures will create a conducive environment for BDA adoption, ultimately enhancing productivity and effectiveness in the telecommunications sector.

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