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## Factors affecting the Adoption of Big Data as a Service in SMEs

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### Abstract

Big Data as Service (BDaaS) provides an alternative solution to overcome the challenges when a business embarks on adopting and implementing a big data strategy. Although BDaaS provides a viable alternative for SMMEs, there is limited research on the specific factors that affect the adoption of BDaaS in SMMEs. The study aims to explore the factors that affect the adoption of BDaaS in SMMEs. The study adopted the TOE framework as the lens to explore the technological, organizational, and environmental factors affecting the adoption of BDaaS in SMEs. The study results indicate that SMMEs need to consider technological, organizational, and environmental factors when adopting BDaaS. The study contributes to the body of knowledge on factors that affect the adoption of BDaaS in SMEs based on the study results. Despite the limitation of the study of not being empirical (used secondary data), the study contributes to the body of knowledge on factors affecting the adoption of BDaaS in SMEs. In addition, the study may stimulate further research on factors that affect the adoption of BDaaS in SMEs using other research methods.

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*Keywords:* Digital Transformation; XaaS; Big Data Adoption; BDaaS Adoption; SMMEs; TOE Framework.

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## 1. Introduction

The concept of digital transformation is generally related to the desire to leverage new technologies to gain and sustain a competitive advantage in a digital age, where products and services are required to be delivered both online and offline [1]. The digital transformation implemented successfully requires not only the acquisition and deployment of technological resources, but it is a managerial aspect too including matters such as the re-design of processes in the business, training, and investing in resources such as organizational capabilities and human resources [2]. Due to businesses' newly discovered asset, big data, businesses now build their transformation models focusing on leveraging the organization's big data. Through the adoption of Big Data, SMMEs can generate value from their data insights and as a result, gain significant competitive advantage, generate increased profits, and increased operational efficiency. Big Data as Service provides an alternative solution to overcome the challenges when a business embarks on adopting and implementing a big data strategy. BDaaS vendors utilize cloud platform solutions to provide to businesses for cost-cutting and efficiency in managing the business' big data [3]. The study explores factors affecting the adoption of Big Data as a Service in SMEs. The structure of the rest of the paper is as follows: Section 2 Literature Review, Section 3 Research Methodology, Section 4 Study Results, and Section 5 Conclusion.

## 2. Literature Review

The third industrial revolution which is also known as the digital revolution is a platform built and centralized on mobile, social, cloud, and big data technologies [4]. The concept of digital transformation is generally related to the desire to leverage new technologies to gain and sustain a competitive advantage in a digital age, where products and services are required to be delivered both online and offline [1]. To further simplify and explore the concept of digital transformation. The process of digital transformation is the ongoing and deliberate evolution of an organization, idea process, business model, or methodology, strategically and tactically [4]. There are several benefits for digital transformation and one of the most important benefits lies in value creation. Value creation in an organizational context is generated in numerous ways such as business models that are enhanced, obtaining competitive advantage, stakeholder relationship improvement, differentiation, and ultimately, customer service improvement [5]. As organizations become digitally transformable, there are emerging technologies trending within the digital transformation space such as social media, big data, mobile technologies, and cloud computing [6]. This study focused on Big Data related technology adoption in SMMEs.

### 2.1 Big Data-as-a-Service (BDaaS) model in Organisations

Due to the shift in the ICT paradigm, several emerging technology trends shaped by Big Data and Cloud Computing can be identified by different "as-a-Service" models [7]. The concept of providing Everything-as-a-Service (XaaS) promotes a world in which service-orientated architecture and the design thereof supports the deployment and development of software applications as services [8]. The Big Data-as-a-Service (BDaaS) model is a step in the right direction to assist organizations in innovative business strategies and gaining intrinsic value from its big data [9]. There are advantages relevant to SMMEs adopting BDaaS as it operates in the cloud and is, therefore, more cost-efficient and makes managing big data infrastructure easier [10]. This is relevant to SMMEs as an entity as they have fewer resources available both financially and in terms of infrastructure.

### 2.2 Big Data Adoption in Organisations

Big Data is defined as “data that exceeds the processing capacity of traditional database systems. The data is large in volume, moves at a speedy pace, or does not fit the organization's database architecture. To generate value from this data, an alternative manner has to be thought of and pursued” [11]. Organizations' functional areas are to an extent able to achieve their objectives easier whilst simultaneously having less of an impact on the environment by leveraging big data from numerous sources [12]. However, there is an existing number of big data challenges such as access and sharing of data, security and privacy, human resources, obstacles with analytics, and technical challenges [13]. While the list of advantages and opportunities of big data are endless, there is what is referred to as a “dark side” of big data. The misuse of social media, inaccurate algorithms, faulty modeling, automated decision-making, workforce

management that becomes oppressive, unreliable big data algorithms, and the dangerous lure of cost-saving all form part of the negative downside to big data [14]. When considering the various elements such as advantages versus disadvantages and opportunity creation, organizations need to choose the most appropriate service they aim to leverage to maximize the possible advantages and benefits for their organization while minimizing the disadvantage.

### **2.3 Adoption challenges related to SMMEs**

Organizations are faced with multiple challenges related to the adoption of ICT solutions within their organizations. SMMEs generally experiencing increased challenges in adopting ICT solutions due to a lack of strategy in adopting ICT solutions compared to larger organizations [15]. Challenges experienced are categorized into the following groups: resources, context, access, operations, attitudes, and capabilities [15]. The management and owners of SMMEs and their attitudes towards strategizing the adoption of ICT solutions within their respective organizations have been identified as a critical factor affecting the success of an organization's adoption as well as its competitive position [16]. If SMMEs adopted knowledge management strategies relevant to the fourth industrial revolution, it could enable survival during challenging times as strategies include digitization, flexible organizational structure, and thinking business models to enable a digitally transformed organization.

### **2.4 Theoretical Framework**

The TOE framework is an application-level framework for research from an organization level point of view which explains the three elements (technological, organizational, and environmental) of consideration in an organization's influence on the adoption decision-making process [17]. The technological element is inclusive of technologies relevant to the organization including both technologies in use by the organization and available for use to the organization that is currently in the marketplace [18]. The technology category of the TOE framework includes sub-categories such as compatibility of information systems, the complexity of information systems, relative advantage of information systems, security concerns, costs, technology competence, and technological resources [19]. The organizational element involves issues internal to the organization such as employees, management, products, and services [20]. The organization category of the TOE framework includes sub-categories such as organizational readiness, business size, financial commitment, infrastructure, top management support, and employee information systems knowledge [19].

Lastly, the environmental element refers to the industry's structure, the absence or presence of technology service providers as well as the environment in which the regulations are established. The environment category of the TOE framework includes sub-categories such as competitive pressure, vendor capabilities, the extent of adoption amongst competitors, the perceived success of competitor adoption, legislation barriers, external support, expectations of market trends, competitive pressure, and information intensity [19]. The framework is popular in conceptualizing the adoption of technology solutions within organizations and as such is used as the basis to conceptualize the factors affecting the adoption of BDaaS in SMMEs.

## **3. Research Methodology**

The study selected a systematic literature review (SLR) based on quantitative content analysis as the research design. A systematic literature review is a non-empirical study that makes use of secondary data and has a research question descriptive, which aligns with this study's research question [21]. Content analysis is defined as a replicable, systematic technique for compressing many words of text into fewer categories of content based on explicit rules of coding [22]. By conducting a content analysis, a researcher can sift through large volumes of data with ease in a systematic manner [23]. The study aims to provide a review of the factors that affect the adoption of BDaaS in SMMEs. The SLR with quantitative content analysis is the most appropriate research design. The content analysis research design is flexible as it is able for application to both qualitative and quantitative research methods. The content analysis research design allows qualitative data to be quantified, which was appropriate for the study to explore factors affecting the adoption of BDaaS in SMMEs.

The literature databases used for sourcing the data consisted of the following: Google Scholar, Francis & Taylor Online, SAGE Journals, Elsevier, Springer, and Science Direct. The literature sourced from these databases using the specific search terms was analyzed and relevant literature between the period 2014-2020 was selected for the research study. The study used convenience sampling to select the most appropriate sampling technique based on articles availability and accessibility [24]. The process involved a literature search making use of the selected keywords for the research study, which are as follows: “Digital Transformation”, “XaaS”, “Big Data Adoption”, “BDaaS Adoption”, “SMMEs” and “TOE framework”. The process also entailed carefully selecting articles relevant to the research study from the literature search published in the period 2014-2020. The forty articles collected from the literature search subjective interpretation of factors relating to the TOE framework. The process involved manual coding in an Excel spreadsheet of relevant TOE factors. The qualitative data collected was manually coded using an Excel spreadsheet and transformed into quantitative data. The quantitative data were analyzed using SPSS software to produce the statistical results.

## 4. Study Results

This section presents the results from the analysis conducted on collected from the literature on the factors affecting BDaaS in SMMEs published between 2014 and 2020. The structure of the section is as follows: sub-section 4.1 presents the demographics variables frequency results of the study and section 4.3 presents the frequency results of the TOE constructs variables.

### 4.1 Demographic Data

#### 4.1.1 Articles published by year

Figure 1 presents the frequency results of the year of publication of articles. The results indicate that 2019 had the highest number of published articles on the factors affecting BDaaS in SMMEs at 25%, followed by 2014 at 20%, followed by 2016 at 18%. The results show a decrease and an increase of published of articles on the factors affecting BDaaS in SMMEs. The lowest publication was in 2017 at 5% of the published articles for the period 2014-2020.

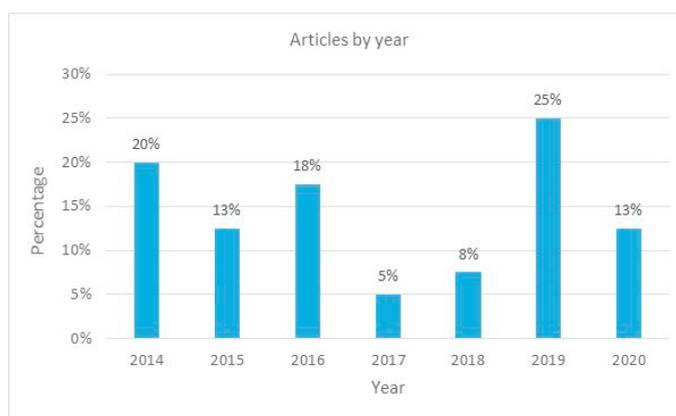
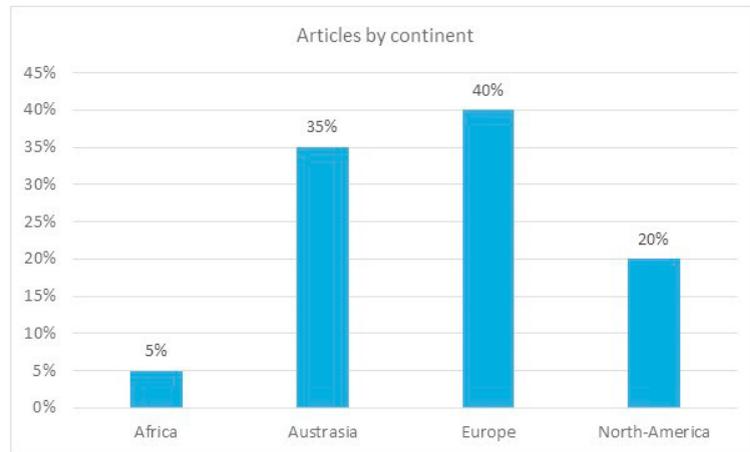


Figure 1. Frequencies of articles published by year

#### 4.1.2 Articles published by Region

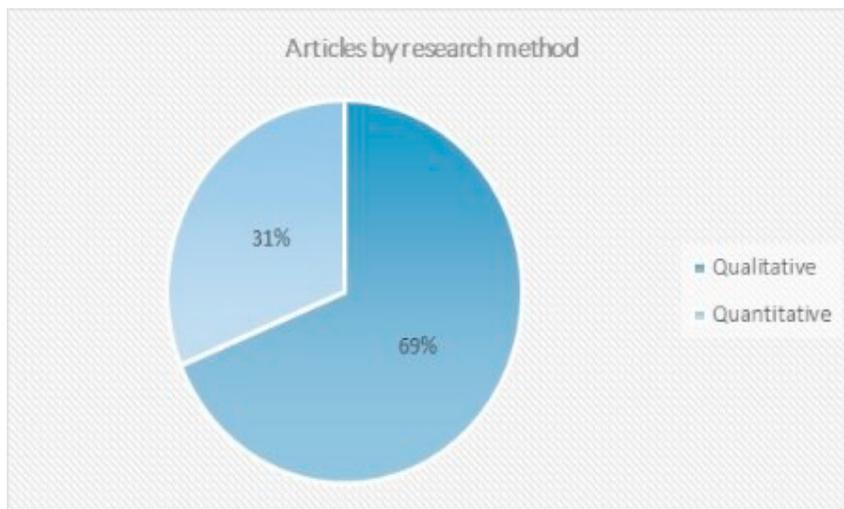
Figure 2 presents the frequency results of the year of publication of articles on the factors affecting BDaaS in SMMEs for the period 2014 - 2020. The results show that Africa had the lowest published articles at 2%. Whilst the European region had the highest frequency of published articles at 40%, followed by Austrasia at 35% and America at 20% of published articles on the factors affecting BDaaS in SMMEs for the period 2014 – 2020.



**Figure 2.** Frequencies of articles published by continent

#### 4.1.3 Articles published by research method

Figure 3 presents the frequencies of research methods used in articles on factors affecting the adoption of BDaaS in SMMEs, published during the period 2014-2020. The results indicate that 31% of the articles used quantitative methods whereas 69% of researchers used qualitative methods. The results, therefore, show that the qualitative method was the most used method on reviewed articles on factors affecting the adoption of BDaaS in SMMEs, published during the period 2014-2020.



**Figure 3.** Frequencies of articles published by research method

## 4.2 Frequencies of factors affecting the adoption of BDaaS in SMMEs

This section presents the frequencies of the factors affecting the adoption of BDaaS in SMMEs specifically focusing on the technological, organizational, and environmental sub-categories of factors.

### 4.2.1 Technological factors

Figure 4 presents the results of six technology factors that affect the adoption of BDaaS in SMEs, which include security, complexity, compatibility, costs, relative advantage, and technological resources. The study indicates the technological factor that was most discussed between 2014 and 2020 is security/privacy-related concerns at 65%. In addition, both technological factors cost, and technological resources were discussed in 55% of published articles. Complexity was the second-highest discussed technological factor with 60% of articles discussing this factor. Half

(50%) of published articles discussed relative advantage as a factor affecting the adoption of BDaaS in SMMEs. Compatibility was the least discussed technological factor within published articles at a low 40%.

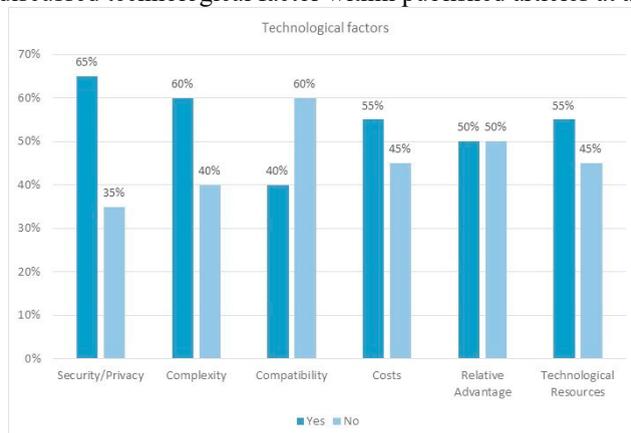


Figure 4. Technological Factors

#### 4.2.2 Organizational factors

Figure 4 presents the results of six technology factor variables that affect the adoption of BDaaS in SMEs, which include security, complexity, compatibility, costs, relative advantage, and technological resources. The study indicates that the security/privacy-related concerns had the highest frequency at 65% of reviewed articles published between 2014 and 2020. In addition, cost, and technological resources had both frequencies of 55% of reviewed published articles. Complexity had the second-highest frequency at 60% of reviewed articles published between 2014-2020r. The relative advantage had a frequency of 50% of reviewed published on factors affecting the adoption of BDaaS in SMMEs. Compatibility was the least discussed technological factor within published articles at a low 40%.



Figure 5. Organizational Factors

#### 4.2.3 Environmental factors

Figure 6 presents the results of six technology factors that affect the adoption of BDaaS in SMEs, which include competition, legislation, external pressure, vendor capabilities, market trends, and customer demands. The study results indicate that the most discussed environmental factors within published articles were legislation and vendor capabilities at 35% each. In addition, environmental factors such as competition, external pressure, and market trends each had a 30% frequency of published articles. The least discussed environmental factor was customer demand at 20%.

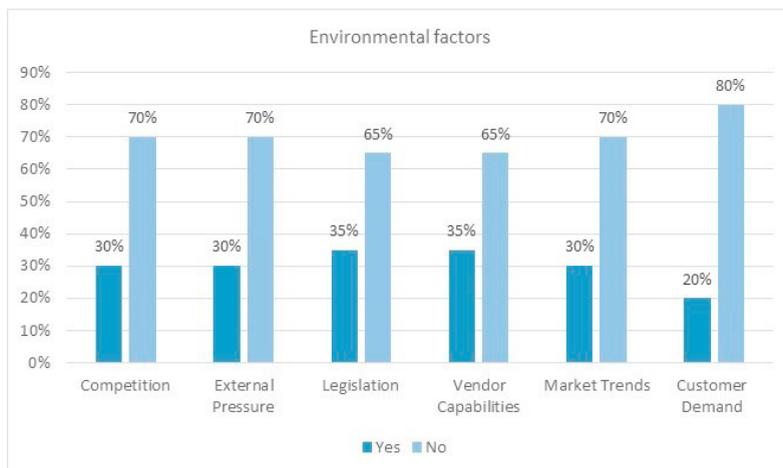


Figure 6. Environmental Factors

#### 4. Conclusion

This research study conducted a systematic review of the literature to explore and conceptualize BDaaS factors affecting adoption in SMMEs. The research objectives were to explore factors affecting the adoption of BDaaS in SMMEs. The results show a decrease and an increase of published articles on the factors affecting BDaaS adoption in SMMEs during period under-review. The European region had the highest number of published articles on the factors affecting BDaaS adoption in SMMEs. The qualitative research method was the most used method on reviewed published articles during period under-review. The study results revealed the most of the technological factors (security/privacy concerns, complexities, costs, and resources) affect BDaaS adoption in SMMEs. The study results indicate that organizational factors (organizational readiness, employee knowledge, financial costs, and infrastructure) affect BDaaS adoption in SMMEs. Lastly, the study results show that three environmental factors (legislation, vendor capabilities, and competition) affect BDaaS adoption in SMMEs.

The decision-makers need to consider the factors from the study when considering the BDaaS adoption in SMMEs. In summary, SMMEs need to consider technological, organisational, and environmental factors when adopting BDaaS. Despite the limitation of the study of not being empirical (used secondary data), the study contributes to the body of knowledge on factors affecting the adoption of BDaaS in SMMEs. In addition, the study may stimulate further research on factors that affect the adoption of BDaaS in SMEMs using other research methods.

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