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Factors affecting the adoption of Data Management as a Service (DMaaS) in Small and Medium Enterprises (SMEs)

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Abstract

The study explores factors affecting the adoption of Data Management as a Service (DMaaS) in Small and Medium Enterprises (SMEs). The study conducted a systematic literature review of published articles during the period 2008-2020 to gain insights into the factors affecting the adoption of DMaaS in SMEs. The study used a quantitative content analysis study to explore factors affecting the adoption of DMaaS. The study adopted the TOE Framework as a lens to explore the factors affecting the adoption of DMaaS in SMEs. The study revealed that the security technological factor was the most highlighted factor affecting the adoption of DMaaS in SMEs. In addition, the study indicated that the cost organizational factor was the most highlighted factor affecting the adoption of DMaaS in SMEs. Lastly, the study showed that government regulations environmental factor was the most highlighted factor affecting the adoption of DMaaS in SMEs. Despite some limitations of the study, the study contributes to the body of knowledge on factors affecting the adoption of DMaaS in SMEs. The study may also catalyze to promote further research on factors that affect the adoption of DMaaS in SMEs.

Keywords: Digital Transformation; Data Management-as-a-Service n; Everything as a Service (XaaS); Big Data; SMEs; TOE Framework

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1. Introduction

Enterprises are adopting emerging digital technologies to create efficiencies in their business processes, reduce costs, retain customers, and maintain a competitive advantage over competitors [1]. In the past, companies that needed to acquire technology products, needed to have a huge budget and the contract agreements were not flexibility for enterprises to cancel unwanted services [2]. Since the emergence of Everything-as-a-Service (XaaS) platforms, this has made the acquisition of technology more flexible and affordable. XaaS platforms are an inexpensive option based on a pay-as-go service model. These platforms create efficiencies, reduces costs involving operations and hardware, and do not require functional staff, in-house experts, and technology infrastructure [3]. The advances in digital technologies have enabled the development of emerging technologies such as the Internet of Things (IoT), Artificial Intelligence (AI), Machine Learning, Big Data, and Cloud Computing. Despite technology acquisition being cheaper and offering enormous benefits nowadays, the rate of technology adoption amongst SMEs in South Africa has been extremely slow. This study investigates factors that affect the adoption of Data Management-as-a-Service (DMaaS) among 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

Small and Medium Enterprises (SMEs) are enterprises owned by one or more individuals and they play a pivotal role in creating employment opportunities and contribute to the economic growth in South Africa [4]. SMEs employ between 14% to 15% of employees in South Africa and their total economic output accounts for 22% of the country's Gross Value Added (GVA) [5]. A previous study revealed that 40% of new businesses fail in their first year of operating and several challenges contributing to the failure of SMEs in South Africa [6]. Lack of funding, management skills, and investments in the current technologies are ranked amongst the highest factors that contribute towards failure in SMEs in South Africa [7]. SMEs with limited funding are discouraged from hiring skilled technology experts and investing in the appropriate technologies. SMEs tend to employ generalists therefore the lack of knowledge and inadequate Information and Communication Technology (ICT) skills remains one of the major challenges affecting them [3].

2.2 The role of Big Data in SMEs

Big data refers to "the high volume, velocity, variety of information assets that require processing to provide unique insights that influence strategic decision making and business process optimization" [8]. Data has become easily accessible nowadays and several smart devices produce large quantities of data daily [9]. SMEs can gather data from a variety of sources including search engines, social media posts, smartphones, and much more. The effective use of Big Data can assist SMEs in maintaining a competitive advantage over their competitors. Big Data has changed the way that enterprises compete by transforming business processes and enabling innovation [10]. Big Data assist SMEs to understand customer behavior, identify important patterns and trends in the markets [11]. Despite many advantages and opportunities presented by the emergence of Big Data, SMEs have lagged in adopting new technologies when compared to larger enterprises [12]. SMEs predominately use basic technologies such as emails, web, and simple accounting packages as opposed to larger enterprises that can afford to acquire advanced technologies [11]. One of the obstacles to Big Data adoption is not only the lack of funding but also the lack of time and skilled resources [13]. The owners of SMEs who predominately manage the enterprises and influence the investments in technologies, often lack exposure to information on suitable big data technologies to invest in and the potential benefits associated with the technologies [14].

2.3 Data Management

Data management is defined as "a group of activities relating to the planning, development, implementation, and administration of systems for the acquisition, storage, security, retrieval, dissemination, archiving and disposal of data" [15]. Globally, SMEs gather and store data for reporting, and analyze vast volumes of data every day for decision-making. Data management is an important asset to any enterprise because it supports effective business management

[15]. Coleman [16] argues that knowledge, resources, and data management are three components that create resistance towards big data adoption in SMEs. Traditional data management technologies and methods are inefficient, expensive, and not equipped to handle, store and process large growing volumes of heterogeneous data [17]. Since the emergence of Big Data, enterprises have had the undying need for lots of data but the traditional approach of storing data is proving to be expensive and a deterrent for SMEs wanting to invest in data management strategies.

2.4 Data Management-as-a-Service (DMaaS)

Data Management-as-a-Service (DMaaS) is an element of XaaS that offers centralized storage for enterprises with different data sources [18]. Similar to XaaS, DMaaS operates on a pay-per-use business model, which does not require enterprises to purchase or manage infrastructure for data management. DMaaS can provide SMEs with opportunities to ingest, store and process data from new sources in a cost-effective manner. With traditional data management approaches, enterprises manage their data internally, which requires investment in an on-premises data center and skilled data engineers to manage the infrastructure [19]. The advent of DMaaS allows SMEs to focus on their core business and rely on industry experts to manage and protect their most valuable assets. Having a centralized data source helps to eliminate wasted storage and ensures that the enterprise has the same version of the truth. The adoption of DMaaS reduces capital expenditures (CAPEX) and costs are treated as an operational expenditure (OPEX), thus making the service more affordable for SMEs [20].

2.4 Theoretical Framework

There are several theoretical frameworks and models used to study the adoption of technology in organizations, which include Diffusion of Innovation and Technology, Organization, and Environment (TOE) framework among others. The study found the TOE framework developed suitable for the study. The TOE framework was developed to examine how a firm's context influences the implementation and adoption of innovation in organizations [21]. The framework splits the firm's context into three aspects namely: organizational context, technological context, and environmental context. The Technological context includes technologies that are existing in an enterprise as well as adopted technologies. The main emphasis of the technology context is to examine how features of existing technologies in the enterprise can drive adoption [22].

The organization must consider both internal and external, technological factors [21]. The technological factors usually comprise factors such as complexity, availability, scalability, cost, and security [23]. The ICT infrastructure budget regarding hardware and software is part of the technological context. The organizational context focuses on all characteristics of an enterprise that can discourage the adoption of technological innovations [22]. The characteristics of an enterprise such as skills, company organogram, company values, ICT strategy, and executive management support are all important factors that influence a technology adoption culture [21]. The environmental context focuses on all external factors such as government legislation, competition, external stakeholders, and the ability to access external resources, which can influence innovation within an enterprise [22].

3. Research Methodology

The study adopted a systematic literature review (SLR) to explore the factors affecting the adoption of DMaaS in SMEs. A systematic literature review is defined "as a systematic, explicit, comprehensive and reproducible method for identifying, evaluating, and synthesizing the existing body of completed and recorded work produced by researchers, scholars, and practitioners" [24]. The systematic literature review (SLR) was based on quantitative content analysis. Content analysis is defined as "a research technique for making replicable and valid inferences from texts (or other meaningful matter) to the contexts of their use" [25]. Content analysis can be qualitative or quantitative. This study adopted quantitative content analysis where qualitative data (text from literature sources) was analyzed quantitatively [26].

A content analysis matrix was used to structure existing articles were used as different literature sources. The content analysis matrix helped to identify existing concepts from the literature on factors affecting the adoption of

DMaaS in SMEs. A literature search was conducted to find relevant articles using keywords such as "Big Data", "Data Management-as-a-Service Adoption", "Data Mining-as-a-Service" and "TOE Framework". Seventy relevant articles were selected, which were published during the period 2008-2020. The relevant articles were collected from search engines of selected scientific databases such as Google Scholar, Elsevier, Springer, and Sage publications. The study adopted a thematic content analysis to analyze the data to factors affecting the adoption of DMaaS in SMEs. The content was categorized and subjected to manual coding in an Excel spreadsheet to transform the qualitative data into quantitative data that can be subjected to quantitative data analysis. The quantitative analysis helped to explore factors affecting SME adoption of DMaaS.

4. Study Results

This section presents the results of quantitative data analysis from the published articles on factors affecting the adoption of DMaaS in SMEs during the period 2008-2020. The quantitative analysis helped to explore factors affecting SME adoption of DMaaS. The structure of the section is as follows: sub-section 4.1 presents the frequencies of the demographic variables (year of publication and publication region) of the study, sub-section 4.2 presents the TOE framework constructs variables frequencies on factors affecting the adoption of DMaaS in SMEs during the period 2008-2020.

4.1 Demographic Data

4.1.1 Article by Year

Figure 1 below presents the publication year frequency of articles on factors affecting the adoption of DMaaS in SMEs, published during the period 2008-2020. The results illustrate that 31% of the articles were published during 2008-2015 and the remaining 69% of the articles, were published during 2016-2020. The results indicate that there has been an increase in research output on factors affecting the adoption of DMaaS in SMEs. Furthermore, the lowest recorded research output occurred in 2009 and the highest research output was in 2019.

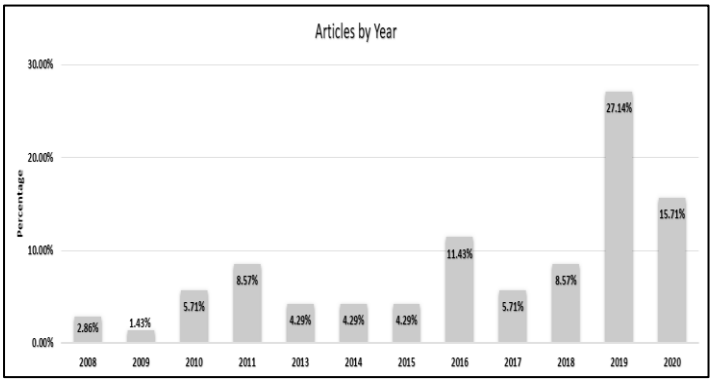

Figure 1: Articles by year

4.1.2 Article by region

Figure2 below presents the frequency of articles by region on factors affecting the adoption of DMaaS in SMEs, published during the period 2008-2020. The results indicate that America had the highest frequency of published articles at 47%, followed by Europe at 36%, Austrasia at 14%, and Africa at 3%. The frequency shows that t America accounts for nearly half of the articles on factors affecting the adoption of DMaaS in SMEs, published during the period 2008-2020.

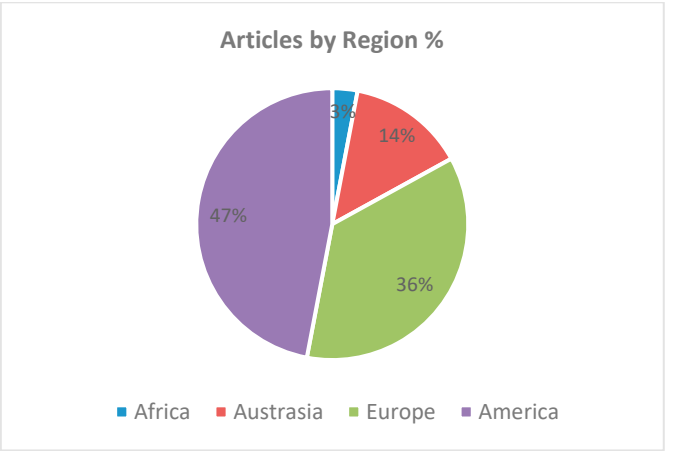

Figure 2: Articles by Region

4.2 TOE Framework Factors

This sub-section presents the TOE framework constructs variables frequencies on factors affecting the adoption of DMaaS in SMEs during the period 2008-2020. The sub-section presents the results of the technology, organizational and environmental factors affecting the adoption of Data Management-as-a-Service (DMaaS) in Small and Medium Enterprises (SMEs) based on the data collected from published articles from literature.

4.2.1 Technological Factors

Figure 3 presents the results of six technology factors that affect the adoption of DMaaS in SMEs, which include security, complexity, compatibility, network bandwidth, availability, and relative advantage. The results show that security was the highest mentioned technology factor that affected the adoption of DMaaS in SMEs at 80%, followed by availability at 60% and complexity at 44%. Furthermore, 19% of articles mentioned network bandwidth as an affecting factor, followed by relative advantage at 17%. Finally, compatibility was the least mentioned factor at 16% of the published articles.

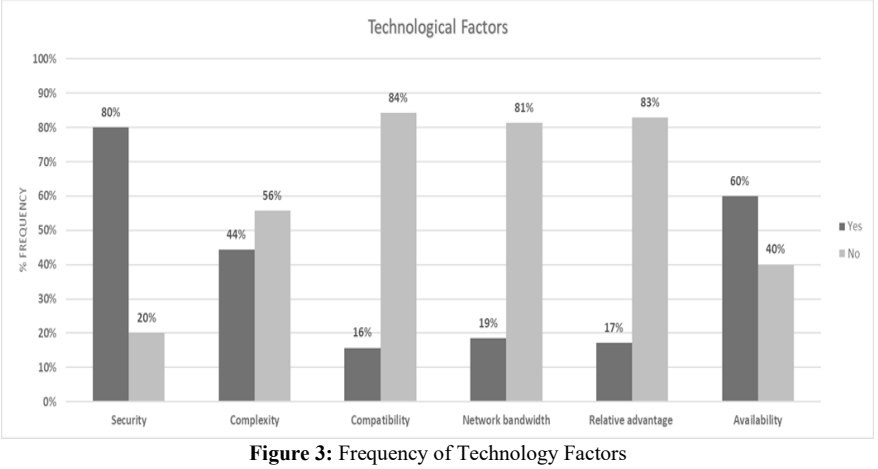

Figure 3: Frequency of Technology Factors

4.2.2 Organizational Factors

Figure 4 presents the results of six organizational factors that affect the adoption of DMaaS in SMEs, which include employee skills, fear of change, cost, support, infrastructure, firm size, and management. The study results show that cost was the highest mentioned organizational factor that affected the adoption of DMaaS in SMEs at 79%, followed by infrastructure at 64%, and support at 44%. Furthermore, 34% of the published articles mentioned employee skills

as an affecting factor, followed by management at 29%. Finally, fear of change at 4% and frim size not mentioned at 0% of the published articles.

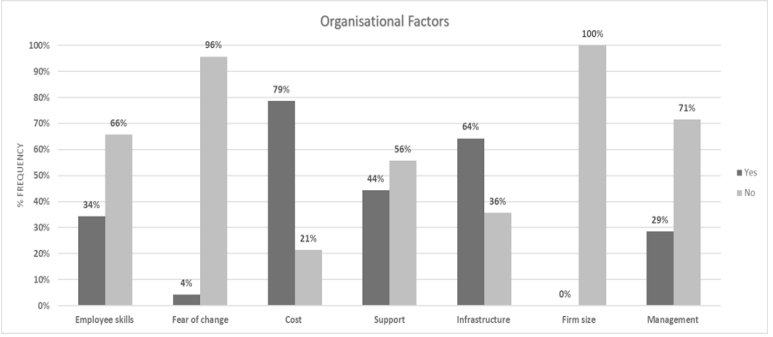

Figure 4: Frequency of Organizational Factors

4.2.3 Environmental Factors

Figure 5 presents the results of five environmental factors that affect the adoption of DMaaS in SMEs, which include factors such as competition, external pressure, customer demand, government regulations, and support. The results illustrate that government regulations were the highest mentioned environmental factor that affects the adoption of DMaaS in SMEs at 34% of the published articles, followed by customer demand at 21% and competition at 6%. Finally, external support was the least mentioned factor at only 3% of the published articles.

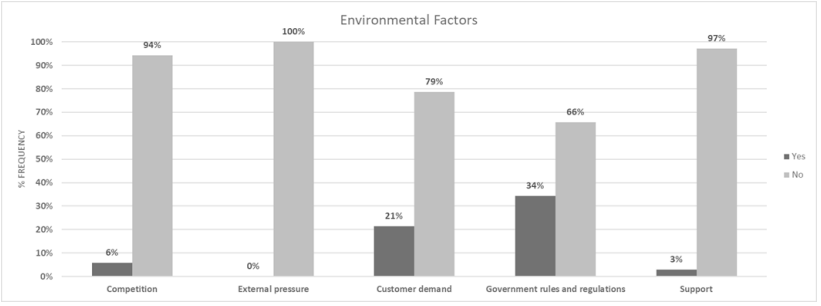

Figure 5: Frequency of Environmental Factors

4. Conclusion

The study used a systematic review to explore factors affecting the adoption of Data Management-as-a-Service in Small and Medium Enterprises (SMEs) during the period 2008-2020. The published articles were analyzed to gain insights into factors affecting SME adoption. The study results show that there was a general increase in research output on factors affecting the adoption of DMaaS in SMEs for the period under review. The results indicate that America had the highest frequency and Africa had the least of the published articles. The results show that security was the highest mentioned technology factor and compatibility the lowest factor that affects the adoption of DMaaS in SMEs. The study results show that cost was the highest mentioned organizational factor and firm size was the least mentioned factor that affects the adoption of DMaaS in SMEs. The study results indicate that government regulations were the highest mentioned environmental factor and external support was the least mentioned factor that affects the adoption of DMaaS in SMEs.

In conclusion, the study showed that the security technological factor was the most highlighted factor affecting the adoption of DMaaS in SMEs. In addition, the study showed that the cost organizational factor was the most highlighted factor affecting the adoption of DMaaS in SMEs. Lastly, the study showed that government regulations environmental factor were the most highlighted factor affecting the adoption of DMaaS in SMEs. It may be therefore worthwhile to

consider these factors when considering the adoption of DMaaS in SMEs. 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 DMaaS in SMEs. In addition, the study may catalyze to promote further research on factors that affect the adoption of DMaaS in SMEs.

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