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ABSTRACT

Purpose: The study sought to examine the relationship between technological factors and UID system's adoption among MDAs in Uganda.

Methodology: A positivist paradigm and cross-section design were adopted with a sample of 97 MDAs generated from a population of 130 government MDAs. MDAs were stratified and randomly selected from each stratum. The heads of department and permanent secretaries/CEOs formed the unit of inquiry that was purposively selected. Self-administered questionnaire with closed-ended questions aided data collection. Pearson correlation and hierarchical multiple regression techniques were used for data analysis.

Findings: It was established that technological factors are positively associated with the adoption of the UID system among MDAs in Uganda. The study recommends MDAs to address all technological factors to enhance the adoption of the UID system.

Contribution to policy and practice: The study significantly contributes to a large body of knowledge in the adoption of information systems in the public sector that has been less investigated in developing countries like Uganda.

Keywords: *Technological Factors, UID system Adoption, MDAs in Uganda*

INTRODUCTION

Technology is defined as knowledge that enables tasks to be done with ease and less costly procedures (Adam and Fazekas, 2018). Technological factors are enablers that support tasks to be accomplished with ease, improving a certain situation to a desirable one while incurring less time, costs, and labour (Gerald et al., 2019). Technological factors include technology resources an organisation owns such as internet connection and information communication (ICT) infrastructure, National information infrastructure, information technology (IT) standards, concurrency, social presence, the immediacy of feedback, perceived usefulness, perceived ease of use, and collaboration (Heeks, 2002 and Freeman, 2001). The trend of the digital identification era has been embraced more in the developed world than in the developing world (Carlson, 2017; Wajcman, 2015; Lin, Young, and Zhou, 2015). Identity is key and among the strategic development goals 2030 as proposed and supported by the United Nations (UN) and World Bank. In the developing world, respective governments have made numerous efforts to adopt unified systems but have succeeded in independent identity systems and with noticeable challenges in integrating their systems (Franklin, 2018; Fazekas; Skuhrovec, and Wachs, 2017). Much as developed countries have managed to overcome some of the challenges that hinder successful integration of the unified identification systems, it has not been the case for the developing countries like Uganda (McGrath, 2016, Ahamed et al., 2017).

Elaborative studies from scholars like Carlson, 2017; Wajcman, 2015; Lin, Young,and Zhou, 2015 clearly articulate the myriad of opportunities and benefits associated with adoption and implementation of a Unified Identification System (UIDS) that include improvement in service delivery (Giri, Shakya and Pande, 2018), cheaper ways of doing business (Seo, 2017), support government policies especially in the provision of high-quality services at a relatively low cost (Mensah, 2020), and high-level security to personal details (Digital Single Market, 2016). Besides, unified systems enable the respective governments to promote transparency, accountability and partnership with the private sector in service delivery through public-private partnership (UN e-government Survey, 2016).

Studies from early adopters like Denmark, Estonia, Germany, India, and Finland revealed that through the deployment of the UIDS, there has been an improvement in service delivery, proper data management, reduced duplication, and reduced operation costs and quality of life (Schuppan, 2009). Nationals of such countries can now access public services with ease regardless of their location (Digital Single Market, 2016). As noted by Tornatzky and Fleischer (1990) and Venkatesh and Bala (2008), the decision to adopt an Information system innovation is influenced by the available technology's fit for the organisation (its compatibility), how easily it can be integrated into the existing technology landscape and the extent to which the technology is used within the organization, its perceived usefulness and ease to use.

This study was premised on the Diffusion of Innovation (DOI) theory in assessing how technological factors influence the adoption of the UID system among the MDAs in Uganda. This theory as propounded by Rogers in 1993, suggests that the intensity of diffusion is determined by three key constructs, which include; compatibility, complexity, and relative advantage (Schuppan, 2009). In this case, complexity refers to the extent to which the new system is understood or taken to be cumbersome or difficult to use (Rogers, 1993). In a study by VanSlyke (2004), it was

established that complexity has a positive effect on users' attitudes to buy goods and services while using the internet. Similarly, in a study by Carter and Belanger (2015), a significant positive relationship was found between the complexity of the DOI and the perceived ease of use of the technology.

On the other hand, compatibility refers to the extent to which an innovation remains relevant, providing the same benefits and values over a period of time with respect to its use (Schuppan, 2009). In the electronic governance context, it is the nature in which the users conceive electronic governance to be relevant with their day to day undertakings and their way of life. In a study by Carter and Belanger (2015), it was established that compatibility has a significant effect on the nationals/citizens' attitude to use electronic governance services. In contrast, relative advantage is the extent to which a new system is taken to be better than the notion it follows (Rogers, 2013).

The government of Uganda through the National Information Technology Authority (NITA) developed a data Centre, installed fibre optic cables across the country, built 71% websites coverage in Ministries, Departments, and Agencies (MDAs), enacted IT security regulations to enable the integration process that was meant for the unification of all MDAs on the Application platform interface (API) (NITA, 2019). Despite these government efforts to have a unified identification system (UIDS), a mild 8% of the MDAs have accessed the service modules on the National Integration Platform (National IT survey report, 2018). If the remaining 120 (92%) MDAs stay uncooperative in the integration process, it may impede the achievement of Uganda's vision 2040 and the achievement of sustainable development goals by 2030. Although the review of extant literature attributes this challenge to technological factors (Ciarnienė and Stankevičiūtė, 2015, Davidovic et al., 2015, Majeed and Yusoff, 2015; Holeman, Cookson and Pagliari, 2016), they covered the developed world, and little is known in the Ugandan context, hence a need for this investigation. Therefore, this paper sought to examine the extent to which technological factors affect the adoption of the UID system among MDAs in Uganda to bridge the existing research gap.

LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Different authors have advanced different technological factors, such as relative advantage, trialability, compatibility, complexity, observability, perceived ease of use, perceived usefulness, network coverage, technology transfer and changes in information technology as predictors of adoption of an information system (Rogers, 2013; Carter and Belanger, 2015). Empirically, several studies have been carried out to justify the relevance of technological factors on the adoption of IT innovations in different fields. Among other fields, studies have been carried in electronic commerce (Mndzebele, 2013), electronic health (Smith, 2017, et al.), cloud computing (Sayginer and Ercan, 2020), agriculture (Wandji et al., 2012), electronic governance, load-bearing masonry (Ramli, Abdullah and Nawi, 2017), voting (Carter and Campbell, 2011) and Internet banking (Mansumitrchai, 2012).

Khan, Xitong, Ahmad and Shahzad (2019), carried out a study on factors affecting the acceptance and adoption of e-Health applications among African experts in China from the patient's perspective. This study employed an extended technology acceptance model. With a structured

questionnaire administered to more than 300 African expert respondents, they identified technological factors to include perceived ease of use, perceived usefulness, trust, and privacy. Results from their study revealed that perceived ease of use, perceived usefulness and privacy are significant in explaining electronic health adoption in china.

Furthermore, Mayoka and Kyeyune (2012) carried out a study on an Analysis of E-learning Information System Adoption in Ugandan Universities: a case of Makerere University Business School. A self-administered questionnaire was given to 200 respondents and the results were analysed using descriptive statistics. They found that relative advantage, compatibility and ease to use were significant in explaining the adoption of electronic learning in Ugandan public universities while curiosity was insignificant.

Additionally, a study by Zayyad and Toycan (2017) hypothesised perceived usefulness, belief, willingness, attitude, low literacy level and experience in using the e-health technology applications, lack of motivation, poor organizational and management policies as factors that explain the adoption of e-health technology in developing countries, a case of Nigeria. A cross-sectional approach with close-ended questionnaire was used to collect a sample of 465 randomly from health professionals in Nigeria. With the use of SPSS, correlation and regression analysis tests were run and results indicated that only perceived usefulness, belief, willingness, and attitude had a significant effect on the intention and actual use of electronic health applications. Relatedly, Wang, Shoujian Zhang, Yikun, and Deng (2019) conducted an empirical study on analysis of the factors affecting the adoption and diffusion of Green Building Technologies (GBTS) in the construction market. The study focused on developing green buildings and integrated technology acceptance model (TAM) and the innovation diffusion theory (IDT) and extracted technological factors to include perceived usefulness, perceived ease of use, and competitive advantage. Their analysis by structural equation model from the data collected by a questionnaire confirmed that perceived usefulness and ease of use influence GBTS adoption.

In a related case, Talukder (2012) carried out a study on technological factors affecting individual employees' adoption innovation. In this study, the theory of reasoned action (TRA) and the technology acceptance model (TAM) were chosen for theoretical grounding. Survey questionnaires were used to collect data from an Australian organisation on the hypothesised factors. The findings indicate that perceived usefulness and managerial support are the two dominant variables in explaining adoption. However, much as the above studies used a combination of theories of DOI and TOE (Sayginer and Ercan, 2020; Oliveira et al., 2014; Zhai and Liu, 2013; Alatawi, Dwivedi, and Williams, 2013) to study the adoption of IT innovations, no study is known to the researcher that has employed DOI to study the impact of technological factors on adoption of the UID system among MDAs in Uganda. From the above debate, the current study hypothesised as follows;

H1: Technological factors are positively associated with UID system adoption in Uganda

METHODOLOGY

The study adopted a positivist paradigm and a cross-sectional research design (Sekaran and Bougie, 2010). A population of 130 Government MDAs (22 ministries, 58 departments, and 50 agencies) was considered (NITA-U Report, 2018). Using Krejcie and Morgan's table (Krejcie and

Morgan, 1970), a sample of 97 MDAs were selected. These were first stratified by their respective categories (i.e., Ministries, Departments, and Agencies) and then selected randomly from each category. The study considered the head of procurement, IT, Accounts, HR departments, and the Permanent secretaries as key respondents. Respondents were purposively selected due to their small numbers and their strategic roles in adopting the UID system among MDAs, thus giving appropriate feedback. The study employed a self–administered, close-ended survey questionnaire to collect data because it was economical and gave respondents freedom and space to work at their own pace and anonymously (Saunders, Thornhill and Lewis, 2007). Technological factors and UIDS adoption were anchored on a five-point Linkert scale of 1 (strongly agree) to 5 (strongly disagree) to create a middle point to cater for respondents who were indifferent to the study variables (Creswell, 2006). Technological factors were measured in terms of relative advantage, compatibility, and complexity while adoption of the UID system was conceptualised as a univariate variable (Ajay, Mandalika and Manish, 2019; Rasha and Othman, 2016)

To minimize the risk of common methods bias, the study considered protecting respondents' anonymity by not indicating their names on the questionnaire and improving scale items through their careful construction (Podsakoff *et al*, 2012). As highlighted by Richardson, Simmering, and Sturman (2009), item ambiguity is the most common problem in the comprehension stage of responses. Consequently, the study defined unfamiliar terms, avoided vague concepts, provided their examples, and kept questions specific, simple, and concise (Tourangeau, Rips, and Rasinski, 2000). Besides, the study conducted a validity test where it was confirmed that the content validity index (CVI) for all constructs was above 0.7, as recommended by (Field 2009). Likewise, convergent validity with average variance (AV) above 0.7 and discriminant validity with average variance extracted (AVE) above 0.5 confirmed construct validity for all constructs (Straub *et al*, 2004). Reliability was confirmed given that all constructs yielded Cronbach's Alpha Coefficients above the cut-off point of 0.7 (DeVellis, 2003).

Furthermore, exploratory factor analysis was conducted to test for the unidimensionality of the measurement scales (Hair, Black, Babin, and Anderson, 2010). Principal component analysis (PCA) and varimax rotation were performed to identify the cluster of the study variables and reduce the measurement items to a manageable set of factors. Consequently, all constructs yielded Kaiser-Meyer-Olkin (KMO) above 0.6 and with a significant ($P < .001$) Bartlett's test of sphericity, hence indicating a good model fit to the data (Field, 2009). In the same vein, parametric assumptions of normality, linearity, homogeneity of variance and independence of errors were confirmed, forming the basis for Pearson correlation and hierarchical multiple regression as the key analytical techniques in testing the hypothesis (Field, 2009).

RESULTS

Descriptive Results

Going by exception, the results indicated that the majority (30.7%) of the respondents were between 31-40 years and, most of them were masters' holders (56.4%), followed by post-graduate diploma holders (29.9%). This indicates that respondents were mature enough and highly educated to comprehend the research questions, thus giving accurate responses. The heads of procurement (42.8%), Human resource (27.7%), and IT (20.1%) departments dominated in the study. This means that respondents were well-positioned to understand the dynamics of UID system adoption

among MDAs as they are involved in decision making. On the side of the MDAs, most of them had spent more than 30 years (43.0%). Lastly, the majority of them were government departments (46.7%) and government agencies (36.9%), with a mild 16.4% comprising of government ministries. This means that most MDAs that participated in the study were mature enough and well placed to have experienced the effects of adoption or lack of it in their operations, thus giving more accurate answers. Furthermore, with substantial mean scores for technological factors (Mean=3.13), it was established that all respondents agreed that these factors highly influenced adoption of UIDs among MDAs. From the results, respondents concurred that if MDAs address technological factors such as perceived relative advantage, compatibility and complexity of the UID system, its adoption would be high among MDAs.

Pearson Correlation Results

As recommended by Field (2005), Pearson's Correlation analysis was conducted to measure the association between technological factors and the UID system's adoption among MDAs in Uganda. Results are indicated in Table 1 below.

Table 1: Pearson Correlation Analysis for Technological Factors and UID System Adoption

		1	2	3	4
1	Relative Advantage	1			
2	Compatibility	.75**	1		
3	Complexity	.31**	.29**	1	
4	Adoption of UID System	**.32****	**.26****	**-.17****	**1**

Note; ** $P < 0.01$ level (1-tailed), $N = 97$

Source: Primary Data (2020)

The Pearson correlation results in *table 1 indicate* a positive, significant relationship between technological factors and the adoption of the UID System among MDAs in Uganda (r =.18, p <.01). Congruently, all dimensions of technological factors yielded a positive correlation with the adoption of the UID system. Consequently, relative advantage yielded r = .32, p<.01 and compatibility, r = .26, p <.01. However, unlike other dimensions, complexity exhibited a significant negative relationship (r = -.17, p <.01) with the adoption of UIDS. These results mean that a change in technological factors such as relative advantage, compatibility and complexity significantly relate to a change in the adoption of UIDS among MDAs. Besides, the above results imply that in deciding on whether to adopt UIDS, MDAS significantly rely on whether the system is better than the previous systems, is compatible to operations thus in case the system is perceived as more beneficial and compatible to operations compared to others, it will be highly adopted. On the other hand, a negative association between complexity and adoption of UIDS implies that once a system is perceived as being complicated or cumbersome in its functionality, there will be less adoption by MDAs. This, implies that the hypothesis that technological factors are positively associated with UID system adoption (hypothesis H_1) was supported.

Hierarchical Regression Results

The study made an effort to establish the predictive power of technological factors in adopting the UID system among the MDAs in Uganda. The study employed a hierarchical regression technique to determine the extent to which each technological factor predicted variability in the adoption of UID system among MDAs. Following the recommendation of Field (2005), hierarchical regression was chosen due to its ability to specify each predictor's contribution at the various stages of the regression model. This enabled the study to point out the relative contribution of each technological factor to the model sequentially. These results are indicated in table 2.

Table 2 Regression results on the elements of technological factors and Adoption of UIDS

	Model 1			**Model 2**			**Model 3**		
	B	**SE**	**β**	**B**	**SE**	**β**	**B**	**SE**	**β**
(Constant)	2.149	.169		2.122	.175		2.618	.182	
Relative Advantage	.340	.045	.324**	.310	.068	.296**	.376	.066	.359**
Compatibility				.037	.065	.037**	.077	.062	.077*
Complexity							-.258	.037	-.302**
R		.324			.325			.433	
R Square		**.105**			**.106**			**.188**	
Adjusted R Square		.103			.102			.183	
R Square Change		**.105**			**.001**			**.082**	
F-Statistic		56.971			28.610			37.263	
Sig F-Statistic		**.000**			**.000**			**.000**	
F-Change		56.971			.327			48.917	
Sig. F Change		.000			.05			.000	

Note: * p < 0.05; ** p < 0.01; N=97; Dependent Variable: Adoption of UID System

Source: Primary Data (2020)

Results in table 2 indicate that all the components of technological factors had significant beta coefficients at the 0.01 level, thus significantly predicting the adoption of UIDS among MDAs in Uganda. These results were not surprising considering that their collective contribution of 19% to the model's predictive power was significant (model 3). This means that besides other factors, the adoption of UIDs in government MDAs is influenced by technological factors collectively at 19%

as they are conceptualized in the form of relative advantage, compatibility, and complexity. In terms of the individual contribution of each technological factor to the predictive power of the model, regression results (model 1) revealed that relative advantage made the highest contribution of 10% (F-change 56.971, $p < .01$) with a significant beta coefficient ($\beta = .324$, $p < .01$). This means that a unit change in relative advantage leads to a significant variation in UID system's adoption by 0.324 units. This was followed by complexity that contributed a significant 8% (model 3) to the predictive power of the model (F-change 37.263, $P < 0.1$). However, complexity yielded a negative significant beta coefficient ($\beta = -.302$, $p < .01$). This means that the more the UID system is perceived as complex and cumbersome to use in operations, the lesser it will be adopted among the MDAs in Uganda. Thus, a unit increase in complexity results in a decrease in UID system adoption by 0.302 units. Additionally, compatibility made the least albeit significant contribution of 0.1% (model 2) to the predictive power of the model (F- change .327, $p < .01$) with a significant beta coefficient ($\beta = .037$, $p < .01$). This implies that a unit change in compatibility leads to a mild 0.037 units increase in the UID system's adoption among MDAs in Uganda. Thus, as a system is perceived to be compatible with the operations of MDAs, they are more likely than not to adopt it. From the results, it can therefore be deduced that technological factors individually contribute to the adoption of the UID system among MDAs in Uganda, with relative advantage playing a more critical role than complexity and compatibility. This further confirms the fact that hypothesis H_1 was supported.

DISCUSSION OF RESULTS

This study examined the association between technological factors and adoption of the UID system among MDAs in Uganda. Based on literature and in line with the diffusion of innovation (DOI) theory, technological factors were conceptualized in terms of compatibility, complexity and relative advantage. Thus, it was hypothesised that technological factors are positively related to the adoption of the UID system among MDAs in Uganda. Consequently, using Pearson correlation analysis, hypothesis H_1 was tested and confirmed by hierarchical regression analysis.

From the Pearson correlation results (Table 1), it was established that technological factors were positively and significantly related with the adoption of the UID system at the $p < .01$ level. This means that a system that is compatible with operations, advantageous in relation to other identical systems and less cumbersome to use in operations is more likely to be adopted by an organization. A deeper correlation analysis revealed that each of the technological factors identified was positively and significantly related with the adoption of the system. However, unlike other technological factors that had a positive relationship, complexity was found to have a negative relationship with adoption of the system. This points to the notion that a system that is perceived to be more cumbersome to use in operations will not be adopted by an organization. These results coincide with the hierarchical regression results (Table 2) where technological factors accounted for 3% of the variation in adoption of the UID system with a significant beta coefficient at the $p < .01$ level. Furthermore, it was observed that individually, each of the technological factors contributed a significant predictive power to the variance in the adoption of the UID system with relative advantage ranking first at 10%, complexity 8% and lastly compatibility 0.1% in terms of their contribution the predictive power of the model (Table 2). This means that before an

organization adopts a system, its relative benefits, the ease with it can be applied in operations and its compatibility with industry practice or values should be considered in a sequential order.

The above results are in agreement with prepositions of Tornatzky and Fleischer (1990) and; Rasha and Othman (2016) who opined that the decision to adopt an information system innovation is influenced by the available technology's fit for the organisation in terms of how easily it can be integrated into the existing technology landscape, the extent to which the technology is used within the organization, and its perceived usefulness and ease to use. In support of the above arguments, Heeks (2015) further denoted that if an organisation's employees have a perception that establishing information security mechanisms for a UID system is difficult, the skills required to secure a UID system are too complex and implementing a UID system with the current IT infrastructure is difficult, the system will not be adopted.

Furthermore, the present results are not unique to the empirical evidence in the existing studies. Ramli, Abdullah and Nawi (2017) carried out an empirical study of the perceived ease of use and relative advantage on load-bearing masonry (LBM) technology adoption. A random sampling technique was applied, and a questionnaire-based field survey was carried out to obtain the respondents' data. The findings revealed that perceived ease of use and relative advantage are related to the adoption of LBM technology. Additionally, Mairuri, Ngugi, and Kanali (2016) investigated the role of compatibility in technology adoption among automobile mechanics in micro and small enterprises in Kenya and found that adoption of various modern automobile technologies is influenced, among other factors, by the perceived attitude in terms of compatibility of a particular innovation. In the same vein, when Mahesh, Vijayapala and Dasanayaka (2018) investigated factors affecting the intention to adopt big data technology in Sri Lanka, their empirical findings revealed a significant negative association between complexity and organizational intention for big data technology adoption. They concluded that the more complex the Technology is, the less likely for the organisation to adopt it. Like the present study findings, Crespo, Sánchez, and Bosque (2013) carried out a study on the influence of users' perceived compatibility and their prior experience on B2C e-Commerce acceptance. With reference to the Technology Acceptance Model (TAM), the research sample was divided between those Internet users that have never purchased on the internet and those that have already purchased online in the past. The results indicated that perceived compatibility has a positive influence on attitudes towards e-commerce and on perceived usefulness and on ease of use of online purchasing for Internet users with and without prior experience with online transactions, thus enhancing adoption.

Additionally, the above results resonate with the diffusion of innovation (DOI) theory which suggests that an organisation's passion to adopt a system is determined by its compatibility, complexity and relative advantage. Likewise, the theory further puts that decision-makers should take into account besides other factors, technological factors before a system is adopted (Donaldson, 2001). From the above discussion, it can be concluded that MDAs in Uganda can increase their adoption of the UID system if they closely consider its relative advantage, compatibility to their operations and complexity in terms of the skills necessary to implement and manage its functionality.

Conclusion

Following the study hypotheses and the corresponding findings presented, the study concluded that the UID system's adoption among MDAs in Uganda is a function of technological factors such as relative advantage, compatibility, and complexity of the system. It was confirmed that these factors work in a synergic way with relative advantage playing a leading role. Thus, low adoption of the UID system among MDAs in Uganda stems from its MDAs failing to recognise and embrace these factors.

Recommendations

Develop modules that are compatible with the country's telecom infrastructure.

This study congruently suggests that the challenge of compatibility of Infrastructural development can be addressed through; 1) considering the current use of Technology in MDAs and benchmark on the past successes and failures, 2) Engage telecoms to offer the electronic transactions and connections, and 3) Also allow create competition among telecom through banning some regulations on digital technologies to increase their usage.

Standardising government systems to attain compatibility.

For the UID system's compatibility to be achieved in Ugandan MDAs, the present study recommends; 1) Providing the UIDS services through multi-channels such as mobile phones. This is because of the wider coverage of the mobile telephony and the portability enabling the anywhere and everywhere feature, 2) Adopt a shared IT infrastructure for all MDAs, and 3) identify and refine the regulatory structures that limit the integration process.

Policy and Theoretical Implications

The guidance offered to policymakers s focuses on technological factors, and the study findings have enriched us with the relevance of factors such as relative advantage, compatibility and complexity in an information system innovation. The system implementers should build trust for the users in the system to be in a position to align the philosophy of government services and UID management in Uganda and other developing countries at large to improve service delivery. Theoretically, the present study has deep-rooted the fact that adoption of the UID system among MDAs is explained by the technological factors. This implies that adoption of the UID system can be explained by integrating the constructs form Diffusion of Innovation theory and the Dynamic capability theory. From the perspective of this (DOI) theory, the study has unmasked that factors such as relative advantage, compatibility and complexity are complementary in influencing a successful adoption of an information technology innovation. This study, therefore, addresses the mixed findings in the existing literature as it affirms the relevance of a theoretical approach that involves the diffusion of innovation (DOI) theory in explaining the adoption of the UID system among MDAs in Uganda.

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