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INFLUENCE OF TECHNOLOGY ADOPTION ON WATER SERVICE DELIVERY IN LAKE VICTORIA SOUTH REGION, KENYA

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Abstract: *Water is undoubtedly a very important resource for mankind. Several intervention measures have been undertaken to improve the water service sub- sector in Kenya. However, provision of clean and safe drinking water is still a major challenge in the country. Empirical studies have indicated that of the current population in Kenya, about 17 million people (43 percent) still lack access to clean and safe drinking water.*

Objective: *The objective of this study was to assess the influence of technology adoption on water service delivery in Lake Victoria south region in Kenya.*

Significance*: The study aimed at building on the existing knowledge about the potentials of using technology in water service sub- sector in Kenya, to improve efficiency in water service delivery. This is because it was considered that using technology would accelerate the sub- sector towards a more sustainable service delivery.*

Findings*: The study findings revealed that the level of technology adoption has a positive significant influence on water service delivery. The study recommends that to address most of the challenges in the water service sub- sector, water service companies should up- scale investment in developing, acquisition and deployment of appropriate modern technologies which can drive transformation in water service provision. This would improve the business operations of the water utilities and also make the water infrastructure to operate optimally.*

Keywords*: Technology adoption, water service providers, service delivery, technological infrastructure*

I. INTRODUCTION

Technology Adoption

For the last one decade, service organizations have used technology to increase their performance. When an organization acquires and deploys a new innovation or invention, with a view to improving service delivery or quality of a product then it is considered to have done technology adoption (Kelley, 1989). Kelley observes that service industries are becoming keener on acquiring and deploying new technologies as a result of the changing nature of their operating environments. He further notes that organizations which have adopted technological- oriented strategy basically invest in establishment of a more robust research and development departments.

According to Walker and Craig- Lee (2002), when technology is applied in the delivery of services, it has the potential to be useful to all the players in the firm. However, the manner and purpose for which it is put in use has the potential to inconvenience the customer. Walker and Lester (2006) supported this position by stating that the acquisition and application of any technology should therefore be done with the key stakeholders in mind.

Rhee, Park and Loe (2010) advice that organizations which choose to adopt or invest in technology to improve their operations should start by investing in research and development so as to evaluate the advantages and attendant costs before making the decision on the technology to adopt. Baradwaj (2010) observes that technological choices can only be relevant when they are in tandem with the organization's readiness to operate the new technology. Therefore adoption and usage of the technology must be in tandem with the organization's capacity to nurture and operate the technology.

Khalaji (2014) is of the opinion that technological interventions play a significant role towards achieving competitive advantage. When organizations fully computerize all their business operations, it is expected that there would be positive impact on their operations. Business operations like record management, on line querying of bill and payments, accounting processes among other, would actually ease work procedures. Therefore, to a greater extent, this improves service delivery. As such organizations should make deliberate efforts to improve their ICT infrastructure as well as put in place modern equipment, which are regularly updated from time to time.

The rapid growth in technology has resulted in many notable ICT investment, innovations and applications in different sectors in Kenya. The country has at national level, applications used in commerce and governance, such as *M-Pesa*, the Integrated Financial Managements System (*IFMIS*), National Integrated Identity Management System (*NIIMS*) or Huduma Namba, National Education Management Information system (*NEMIS*) or student number and *Ajira Digital*, which is a youth job search portal (Oluoch, 2019).

Ndaw and Mwangi (2015) conducted a desk review study whose aim was to document Kenyan experiences in the use of information communication technology (ICT) to provide services in the water and sanitation sub-sector. They investigated the effectiveness of six ICT applications currently in use by some of the key water service sub- sector institutions. The applications were; Maji Voice, Jisomee Mita, WARIS, Mmaji, Mobile field Assistant and WASPA MIS tools.

The study revealed that ICT applications have been largely embraced by key players in the sub- sector, including water service providers and regulating agency. It was also observed that evolution of information communication technology applications in water sub- sector is still on-going hence there is likelihood that some more will be invented. The study however established that of all the applications, the uptake of Jisomee Mita was the most successful since it addressed the critical needs of majority of the customers who were inhabitants of informal settlements.

Joseph, McClure and Joseph (1999) studied the impact of technology on the quality of service delivery in the Australian banking sector. They noted that the state of technology of any firm has the ability to significantly influence the quality of production of either goods or services. Since the use of technology is becoming increasingly prevalent, there is likelihood that it can change hence its use should be well managed.

Bardi, Raghunathan and Bagchi, (1994) stated that the level of technology adoption is measured by how far a firm matches her tools, machines and equipment to the requirements of the new strategy and changes in

technology in the market. It is also measured by the extent to which the firms funds and conducts research and development, availability of efficient ICT infrastructure, and technology spread across departments.

In his study, Adewoye (2013) reached a conclusion that Nigerian commercial banks stood a chance to operate optimally if they adopted the use of mobile banking. He suggested that the banks should consider recruiting skilled manpower and computer experts to enhance security by preventing fraud through hacking and pilferage. In addition, they should consider putting in place technological infrastructures which support the functions of mobile banking.

Adekunle, Olumoko and Ajemunigbohun (2013) established that most clients in insurance companies in Nigeria were not keen on using online services while engaging with the insurance companies, despite the fact that the companies reported increased efficiency after adoption of information technology in their operations. The study recommended that firms dealing with insurance administration should make deliberate efforts to optimally invest in information technology in order to improve the quality of their services. Studies by Ilo, Ani and Chioke (2014) revealed that technology innovations enhances service delivery in commercial banks in Nigeria, since acquisition and use of ICT by some banks resulted in improved customer satisfaction and retention.

However, some empirical studies have tended to highlight the major drawbacks of using technology in organizations. For instance, Mick and Fournier (1998) stated that the impact of technology on service delivery can be useful or harmful to the organizations' operations. They cautioned that organizations which are customer- oriented consider the needs of the customers so that they do not grow hostile towards application of the technology. Boxall and Purcell (2000) argued that since technologies are quite dynamic, they tend to become obsolete quite fast. As such, organizations should plan for their constant up grading or replacement so as to achieve optimal operations.

Tony (2006) stated that technologies generally affect people's ability to think critically thereby decreasing their skills levels. Most people tend to have overdependence on technology to do their work to the extent that they their own skills development is neglected.

Water Service Delivery

Euromarket (2003) defines water services as all services that provide water for public institutions, households, as well as economic activities geared towards livelihood improvement. According to UNDP (2006), efficient water service delivery, implies that the Water service providers (WSPs) supply water in the appropriate quantity and quality, at any time it is needed by the customers, and continue remaining operational for period of time it will be required. Therefore, the key indicators which measure the performance of water service providers in water service delivery are; reliability of water (hours of supply), water quality (physical attributes of water, like color, taste or turbidity) and distribution or water coverage (percentage of population served by the WSP in relation to the population living in the service area).

While looking at Water service delivery in Kenya and Ghana, Bellaubi and Vesscher (2014) concluded that intervention measures taken by stakeholders in the water service sub- sector has resulted into changes in many organizations in both Kenya and Ghana, yet the overall performance in water service delivery has remained at all times low. Wutich (2007) also notes that low access to Water Service Delivery (WSD) is a common occurrence in urban areas in Sub-Saharan countries. He further describes how low efficiency and access in water service delivery determine social vulnerability of the poor who are 'disconnected' from water networks depend on informal water providers (such as water vendors and tankers). Obosi (2017) established that in

water service companies where there is public- private partnership arrangements, improvement in water service delivery has been witnessed, to the extent that such water service utilities have realized increased service delivery when compared to those who are not in any partnership arrangement.

Statement of the Problem

Despite many interventions in the water sector, close to half of the Kenyan population has been unable to access clean water (United Nations-water, 2006). The Government enacted Water Act 2002, which herald major reforms by addressing policy formulation and implementation. The Water Act of 2002 was later repealed which culminated into enactment of the new Water Act 2016, whose provisions are now in line with the legal framework of devolve government structures (Government of Kenya, 2016). But even today, operations of water utilities are still characterized by frequent shortages and wastages, poorly maintained infrastructures, high Non- revenue water (NRW), unauthorized connections, misuse funds from paid water bills, non-remittance of collected revenue from clients and non- reading of operating water meters. What appears rather paradoxical is that although general progress is reported in this sub-sector, available statistics indicate that major water utilities still struggle to meet their operational targets as their services are characterized by high levels of inefficiencies. For instance, water coverage has increased by a mere 4% in the last five years, with many underperforming utilities continuing to operate on non- cost reflective tariffs.

However, no empirical study was found to have examined the relationship between technology adoption and water service delivery in Lake Victoria South region in Kenya. This existing research gap is what this current study sought to fill by assessing the relationship between the level of technology adoption and water service delivery in the region.

Objective of the Study

The study was done in line with the following general research objective:

1. To assess the influence of technology adoption on water service delivery in Lake Victoria south region in Kenya.

Research Hypothesis

The study tested the following null hypothesis

$H0_1$; There is no significant relationship between the level of technology adoption and water service delivery in Lake Victoria south region.

II. RESEARCH METHODOLOGY

The study used descriptive approach with a survey research design. The study population was made up of 195 management level employees from the contracted- urban based water service providers. Using Cochran formula, a sample size of one hundred and twenty nine (129) was determined through simple random sampling. Self- administered questionnaire was used to collect primary data from the respondents. A pre- test of the questionnaire was conducted to identify and correct any anomalies. The validity and reliability of the study instrument was determined by using content validity index and Cronbach's alpha coefficient, respectively. Data was analyzed through a combination of both descriptive and inferential techniques. Quantitative data was processed using SPSS version 20.0 and presented in summary statistics such as mean, percentages and standard deviation.

III. RESEARCH FINDINGS AND DISCUSSION

Descriptive Analysis for Technology Adoption

Descriptive analysis was based on the primary data generated from the respondents. The data was summarized to provide meaningful interpretation and description of the study results. In the presentation and data analysis, the scale for the questionnaire items and a decision rule were used. The scale was a 5- point Likert scale with corresponding responses as follows; 5- Strongly Agree, 4 Agree, 3- Neutral, 2-Disagree and 1-Stongly Disagree. On the other hand, the decision rule was that: If mean is equal to or greater than 3, then the respondents are in agreement, while if the mean is less than 3, then the respondents are not in agreement.

Nine item questions were designed in the questionnaire to determine the influence of technology adoption on water service delivery. Results of the analysis are as shown in Table 1.

Table 1: Responses to Technology Adoption items

Research Statements	N	Min score	Max score	Mean	Std Dev
The company considers technology as one of the most critical resources.	107	2	5	3.97	0.783
The organization has a system for replacement of obsolete technology	107	1	5	4.08	0.826
The company uses modern technology to receive payments from customers.	107	1	5	4.24	0.685
Company uses modern technology to manage disruptions in water supply when they occur	107	2	5	4.28	0.698
Company uses modern technology to respond to customer concerns and problems.	107	1	5	4.21	0.801
The company has adequate funds to adopt technological advancements.	107	1	5	3.98	1.124
The company uses modern technology to monitor flow of water.	107	1	5	3.96	1.149
The company uses modern technology to manage customer information.	107	1	5	4.12	0.929
Company uses modern technology to manage human resource information.	107	2	5	4.08	0.702
Mean of means				4.10	

The analyses of the results as indicated in Table 1 show that majority of the respondents were in agreement with the following statements with regard to level of technology adoption by the water service companies. That the companies considered technology as one of the most critical resources (mean score, 3.97), that the organizations had systems for replacement of obsolete technology (4.08), that the water companies used modern technology to receive payments from its customers (mean score. 4.24), that the companies used of modern technology to manage disruptions in water supply whenever it occurred, (mean score, 4.28).

It was found that the organizations used modern technology to respond to customer concerns and problems (man score, 4.21), that the companies has adequate funds to adopt technological advancements, (mean score,3.98), that the use of modern technology to monitor flow of water was practiced by the organizations (mean score, 3.96), that companies used modern technology to manage customer information (mean

score,4.12), and lastly, that the organizations used modern technology to manage human resource information (mean score, 4.08). Since the mean of means was calculated as 4.14, it implies that there was convergence of opinions by majority of the respondents that acquisition and deployment of the new technology enhances the operations water service providers in the delivery of water services.

Descriptive Analysis for water service delivery

Descriptive analysis was performed on the responses to various questions which were asked in relation to the dependent variable, water service delivery. The study findings are presented in Table 2.

Table 2: Responses to Water Service Delivery items

Research Statements	N	Min score	Max score	Mean	Std Dev.
The company has capacity to supply water to all the customers in its designated service area.	107	1	5	3.68	1.256
Water supply is available to the customers on a 24 hour basis.	107	1	5	3.52	1.291
The company has an adequate storage facility to meet consumers' demand.	107	1	5	3.76	1.235
The company has a mechanism for identifying and reporting of breakdowns.	107	1	5	4.21	0.919
The company has adequate funds to maintain and rehabilitate its water distribution infrastructure.	107	1	5	4.15	0.919
Machines at the head works are working at full capacity	107	1	5	3.94	1.273
The distribution system uses the latest technology for water leak detection and worn out pipes.	107	1	5	3.93	1.049
The company relies on external technical assistance to respond to water supply breakdowns.	107	1	5	4.02	0.981
Mean of means				**3.90**	

The analysis of results revealed that the majority of the respondents were in agreement with the following statements. That; the company had capacity to supply water to all the customers in its designated service area (mean score, 3.68), that water supply is available to the customers on a 24-hour basis(3.52), the company has an adequate storage facility to meet consumers' demand (3.76), that the companies had mechanisms for identifying and reporting of breakdowns(4.21), the companies had adequate funds to maintain and rehabilitate its water distribution infrastructure(4.15), that the machines at the head worked at full capacity (3.94), the company uses the latest technology for detection of water leaks and worn out pipes in the distribution system (3.93), that the company relied on external technical assistance to respond to water supply breakdowns(4.02). Since the mean of means is 3.90, which is >3, it implies that majority of the respondents agreed that the research statements made with regard to water service delivery were largely positive.

Correlation Analysis

Pearson moment correlation coefficient *(r)* was employed to show the strength and direction of the relationship between the technology adoption and water service delivery. The results are presented in Table 3.

Table 3: Correlation coefficients for technology adoption

		Technology Adoption	Water Service Delivery
Technology Adoption	Pearson Correlation	1	.588**
	Sig. (2-tailed)		.000
	N	107	107
Water Service Delivery	Pearson Correlation	.588**	1
	Sig. (2-tailed)	.000	
	N	107	107

**. Correlation is significant at the 0.01 level (2-tailed).

The findings presented in Table 3 indicate that there exists a moderate positive relationship between technology adoption and water service delivery in Lake Victoria south region, $r = 0.588$, p- value< 0.05. The result implies that at confidence level of 95%, an increase in the level of technology adoption enhances water service delivery.

Regression Analysis

A linear regression analysis was performed to establish the extent to which technology adoption predicted water service delivery. Ordinary least square method (OLS) was used in the analysis, where all the study variables were considered. The analysis was executed using SPSS computer package and the results presented in a regression model summary as shown in Table 4.

Table 4: Regression Model Summary

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.851[a]	.724	.710	3.03597	1.746

a. Predictors: (Constant), Technology Adoption
b. Dependent Variable: Water Service Delivery 2

The results as presented in Table 4 reveal that the multiple correlation coefficients *(R*) is 0.85, meaning that there is 85.1% positive correlation between the independent and dependent variables. R square (R^2) represents the multiple determinants of coefficients, which is the percentage variation in the dependable variable being explained by the changes in the independent variable. Given that $R^2 = 0.721$, it shows that 72.1% of the changes in the delivery of water services is due to changes attributed to the independent variable. The remaining 27.9% are explained by the variables not included in this study.

Hypothesis Testing

A null hypothesis also formulated to guide the study was as stated below;

(*H_{01}*), There is no significant relationship between the technology adoption and water service delivery in Lake Victoria south region.

An analysis of variance (ANOVA) was performed to determine whether there is any significant influence of technology adoption on water service delivery. The results of the analysis obtained were summarized and presented as shown in Table 5.

Table 5: ANOVA for Technology Adoption

ANOVA

	Sum of Squares	Df	Mean Square	F	Sig.
Regression	1449.726	9	161.081	8.136	.000
Residual	1920.443	97	19.798		
Total	**3370.168**	**106**			

As indicated in Table 5, the results of the calculated F- distribution on table show that F= 8.136. However, the table value of F- distribution is 1.96 which is < 8.136. Therefore the null hypothesis (H_{01}) is rejected since the calculated value is greater than the critical values obtained from table values. Following the rule of thumb, it is concluded that at 95% level of confidence, technology adoption has significant influence on water service delivery in Lake Victoria south region, Kenya.

To further confirm the extent of the relationship, regression coefficient (ß) for technology adoption was calculated and results presented in Table 6.

Table 6: Regression coefficient Results

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	7.029	3.365		2.089	.039
Technology Adoption	1.035	.145	.349	7.126	.000

Dependent variable:Water service delivery

The results presented in Table 6 show that technology adoption has an unstandardized coefficient value of (ß=1.035, p<0.001). The coefficients can be substituted in the regression equation $Y = \beta_0 + ß\ X_1 + \varepsilon$ to show the extent of the relationship between the variables.

$Y = 7.029 + 1.035X_1$

From the regression equation, it can be seen that the value of constant parameter is 7.029, implying that water service delivery is constant at 7.029. This helps in explaining the fact that if all the explanatory variables are held at constant zero, then the efficiency in delivery of water services will increase by 70.29%. Similarly, when all other variables are held constant at zero, the unstandardized coefficients of the independent variable can be used to interpret the extent of relationship as per cent age changes in dependent variable per unit change. As such, the coefficient value for technology adoption is 1.035. This implies that a unit increase in technology adoption would predict a significant positive change in the water service delivery by 10.35%.

IV. DISCUSSION ON THE FINDINGS

From the study findings, it was revealed that level of technology adoption influences the water service delivery. This implies that if the level of technology is enhanced in the operations of the water service organizations, then the efficiency in service delivery will also improve. The study findings support the argument made by Kinot (2009) that use of technology has a positive effect on the performance of a firm. The adoption and deployment of technology in the operations of an organization act as an enabler to proper service delivery which can be beneficial to all the players in an organization. Similar position is also taken by Khalaji (2014)

who states that technological interventions play a significant role towards achieving competitive advantage, especially when organizations fully computerize all their business operations.

This position is also shared by Prasad (2008) who noted that those organizations which are focused on growth and improvement need to invest in technology as it has an impact on service delivery. This usually manifests itself in form of reliable services, timely delivery of services, effective means of communication, convenient customer feedback as well as improved quality of services. The findings are also in support of observations made by Baradwaj (2010) that technological choices can only be relevant when they are in tandem with the organization's readiness to operate the new technology. Therefore adoption and deployment of the technology must be in tandem with the organization's capacity to nurture and operate the technology. However, a contradictory position by Mick and Fournier (1998) who stated that the impact of technology on service delivery can be either useful or harmful to the organizations' operations. Hence precautions should be taken when introducing any form of technology in an organization.

V. SUMMARY OF FINDINGS

The study sought to assess the influence of technology adoption on water service delivery in Lake Victoria south region, Kenya. The analysis of the study was done using descriptive and inferential statistics. The descriptive results indicated that the study respondents agreed that water firms surveyed consider technology as crucial for improvement of water service delivery.

A Pearson correlation analysis was performed to determine the degree and direction of the relationship between technology adoption and water service delivery. The results revealed that at a confidence level of 95%, the correlation coefficient of 0.588 signified the existence of a moderate positive relationship between technology adoption and water service delivery.

A hypothesis test was performed through ANOVA, where the result of the calculated F- distribution was 8.136. However, given that the table value of F- distribution was 1.96 which is < 8.136. Therefore the null hypothesis (H_{01}) is rejected since the calculated value was found to be greater than the critical values obtained from table values.

The study employed a linear regression analysis to establish the extent to which technology adoption predicted water service delivery. Ordinary least square method (OLS) was used in the analysis, where the multiple determinant of coefficient was 0.721, meaning that 72.1% of the changes in the delivery of water services is due to changes attributed to the independent variable. This implies that about 27.9% of the changes in water service delivery are explained by variables not considered in this study. To further determine the extent of the relationship, regression analysis gave unstandardized coefficient (ß) for technology adoption as 1.035. When interpreted as a percentage change, it means that for one unit increase in technology adoption, the respective water companies would significantly realize a 10.35% increase in water service delivery

VI. CONCLUSIONS AND RECOOMENDATIONS

From the study findings it is noted that technology adoption is a critical element in enhancing the efficiency of water firms in delivery of water services. The level of technology adoption is measured by how far an organization matches her tools, machines and equipment to the requirements of the new strategy and changes in technology in the market. Organizations which up- scale investment in acquisition and application of modern technologies stand a chance of operating optimally as they will have improved performance. As such, when the water companies strive to match their technological capabilities to the changes in the environment and

requirements of the strategies being executed, they are likely to have increased efficiency in water service delivery.

Recommendations

The study recommends that to address a number of challenges experienced in the water service sub- sector, water service companies should up- scale investment in developing, acquisition and deployment of appropriate modern technologies which can drive transformation in water service provision.

Suggestions for further Study

Since the study was confined to Lake Victoria south region, it may be prudent to replicate it in regions served by other water service boards in Kenya, as this would provide an opportunity for either comparison or generalization of the study findings.

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