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Influence of End User Skills Matrix on Adoption of New Technologies among Utility Firms; A Case of Kenya Power and Lighting Company, Nakuru, Kenya

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Abstract : *The Kenya Power and Lighting Company (KPLC) plays a critical role in the economic development of the country through supply of electricity for both domestic and corporate customers. In order to execute its mandate efficiently, the company has embraced new technologies such as a modern robust and integrated Distribution Management System (DMS) as well as different types of sensors on feeders, transformers and distribution substations. Other measures include smart metering of transformers and feeders to enable energy balancing amongst a host of diverse new technologies in its operations. Adoption of technology expected to reduce power losses, operational cost savings, lowered peak demand, new or increased revenue streams, improved long-term growth prospects and improved customer satisfaction. Despite, the potential benefits of new technologies usage within KPLC, there is evidence showing low adoption levels of diverse introduced technologies at KPLC. Examples in this context include poor adoption levels of live line handling technology, as well as cable joining and termination technology amongst others. This study therefore seeks to examine influence of the influence of End User Skills Matrix on adoption of new technologies at Kenya Power and Lighting Company, Nakuru, Kenya. The theoretical framework of the study was based on the Unified Theory of Acceptance and Use of Technology (UTAUT). The descriptive research design was used for the study as the phenomena characteristics were examined on the ground without any manipulation of variables. The target population is the 274 Kenya Power and Lighting Company staff in Nakuru. The sample size of 73 for the study was calculated using the Nassiuma's formula. The stratified random sampling was used as the sampling procedure.*

Keywords: *Adoption of New technologies, End User Skills Matrix, End User, Utility Firm*

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I. Introduction

Across the globe, there are diverse factors leading to the need for new technologies amongst utility firms such as water and sewerage firms, as well as energy firms. These factors include an increasing population, urbanization effects, an increasing middle class, industrialization effects, and increase in development across diverse countries (Apulu, Latham, & Moreton, 2011). Within the energy sector, there are different technologies that have been adopted across the world based on their specific needs.

In the United States of America, the New York Power Authority., (2014) noted that there is need to embrace technologies in energy sector with a view of achieving diverse objectives. In this context, the New York Power Authority 2014-2019 strategic vision cites the objectives for new technologies adoption as clean generation of electricity, meet the needs of energy driven economy, creation of a stronger and resilient electricity grids, and strengthening environmental protection.

On the other hand, the New York Independent System Operator which is concerned with operations of New York's bulk electricity grid, noted the need for technology in order to counter emerging threats as well better contain the old ones (Jones, 2015). Amongst the needs for new technology adoption include the need to evolve and strengthen the physical and cyber security mechanism to protect the grid from ever-changing threats.

Saibu (2016) undertook a study on Macro determinants of renewable electricity technology adoption in Nigeria. The study identified the need that led to a need to adopt renewable energy technologies as increase in energy consumption levels, and fossil related fuel carbon dioxide emission. In the context of the carbon dioxide emissions, the fossil related fuel carbon dioxide emission stood at 86.40 million metric tons in 2012 making it amongst the highest carbon dioxide emitting countries in Africa (Saibu, 2016).

On the other hand, in terms of electricity energy consumption, the electricity consumptions levels had increased to 23.11 billion kilowatt-hours by 2011 and continue to rise due to industrialization levels of the country. Similar to Nigeria, South Africa is facing the challenge of high carbon dioxide emission leading to adoption of new technologies in cleaner energy generation.

In Uganda, Electricity Regulatory Authority., (2015) notes that the Government of Uganda seeks to improve technology use in energy sector with the view of improving efficiency. In its strategic plan for 2014/15-2023/24 financial years, the Electricity Regulatory Authority underscores the need for the adoption of emergent technologies in the industry in order to achieve efficiency. However, there are diverse challenges that face energy sector in utilization of new technologies. According to Uganda Electricity Transmission Company., (2014), its service provision has been undermined by the difficulties in adopting new technologies. These difficulties have been attributed to fast evolving technologies, inadequate training of staff, high staff turnovers, and existing organizational structure (Uganda Electricity Transmission Company., 2014).

There are several factors that influence the adoption of new technologies in utility firms. According to Kukafka, Johnson, Linfante, & Allegrante, (2003), there are three groups of factors that affect the adoption of new technologies in utility firms; organizational level factors, group level factors and individual level factors. The organizational level factors include aspects relating to the organization that affect the individual users of new technologies within the organization (Buabeng-Andoh, 2012). These factors may include organizational structure, organizational culture, policies and procedures of workflow amongst other factors. The group level factors include aspects such as professional values and culture. On the other hand, the individual level factors include aspects that touch on the individual user attributes that impact on their use of new technologies such as attitudes, user satisfaction, and user involvement amongst other factors (Graziano, 2014).

In Kenya, the Kenya Power and Lighting Company (KPLC) is involved in transmission, distribution and retail of electricity connection. The Kenya Power and Lighting Company was formed in 1922 as the East African Power and Lighting Company (EAP&L) (Oginda, 2013). EAP&L rebranded to KPLC in 1983 involved in both the generation and supply of electricity. Changes in the energy sector in 1997 and 2008 led to the formation of Kenya Electricity Generating Company(Ken Gen) and Kenya Electricity Transmission Company (KETRACO) respectively (Aketch, 2015). The company is divided into twelve major divisions; network management, Information and Communication Technology, Supply Chain Management, Customer Service, Business Strategy, Infrastructural Development, and Internal Audit. Others are Street Lighting, Connectivity, Finance, Human Resource and Management, and Company Secretary, Legal & Corporate Affairs.

The Kenya Power and Lighting Company (KPLC) plays a critical role in the economic development of the country through supply of electricity for both domestic and corporate customers (Kenya Power and Lighting Company., 2017). In this context, the energy sector is listed as one of the ten pillars of the country's Vision 2030 pillars in which more electricity connection, and efficiency in electricity consumption amongst other aspects need be achieved (Vision 2030 Secretariat, 2017). The country is also facing an increasing electricity demand at the moment from a peak demand of 899 MW in 2004/2015 to 1,585 MW in 2015/2016 year with an increase of customer base from 735, 144 to 4, 890, 373 in the same period. In its operations, KPLC faces challenges such as challenges in reliability of power supply to diverse customer base and other network changes. The company therefore targets in its 2016/17-2020/21 network strategic plan to adapt diverse new technology in its supply of electricity (Kenya Power and Lighting Company., 2015). These measures include Installation of a modern robust and integrated Distribution Management System (DMS) as well as different types of sensors on feeders, transformers and distribution substations. Other measures include smart metering of transformers and feeders to enable energy balancing amongst a host of diverse new technologies in its operations (Kenya Power and Lighting Company., 2015).

II. Literature Review

Theoretical Review

The theoretical review examined the Unified Theory of Acceptance and Use of Technology (UTAUT).

Unified Theory of Acceptance and UTAUT

The UTAUT conceptualized by Venkatesh in 2003 and was derived from the important concepts of various existing models. UTAUT borrows from concepts of theory of reasoned action, technology acceptance model, motivational model, theory of planned behavior, and TAM amongst others (Krysa, 2010). UTAUT has four major factors that influence the ability to adopt new technologies including performance expectancy, effort expectancy, social influence, and facilitating conditions (Kinanga, 2013). The performance expectancy refers to the degree in which the user believes that the new technology will assist in job performance. The effort expectancy relates to the ease associated with using the new technology while social influence relates to the individual user perception of importance placed on his use of the new technology by the peers. Finally, the facilitating conditions relates to the presence of a support system to aid the new users in adoption of new

technologies. The study is applicable to this study in the context that it demonstrates the relationship between demographic factors and adoption of new technologies. This is in tandem with the objectives of this study.

III. Objective of the Study

To examine the influence of end user skills matrix on adoption of new technologies at Kenya Power and Lighting Company, Kenya.

IV. Research Hypothesis

H_0: Skills matrix of end user has no significant influence on adoption of new technologies at Kenya Power and Lighting Company, Kenya.

H_A: Skills matrix of end user has significant influence on adoption of new technologies at Kenya Power and Lighting Company, Kenya.

V. Methodology

The descriptive survey research design was used for the study. The target population was the Kenya Power and Lighting Company staff in Nakuru since the study sought to examine the influence the skills matrix of end users on adoption of new technologies at Kenya Power and Lighting Company, Kenya. There are 274 KPLC staff at Nakuru distributed in the regional management, design and construction, finance, supply chain, transport, technical services, security, information and communications technology, customer service, and human resources and administration departments (Kenya Power and Lighting Company, 2017). The sample size of this study was calculated using the Nassiuma's (2009) formula to derive the sample size as illustrated below;

Where

n = sample size

N =size of target population

C = coefficient of variation (0.5)

e = error margin (0.05)

Substituting these values in the equation, estimated sample size (n) were:

n = (274 (〖0.5〗 ^2))/ (〖0.5〗 ^2+ (274-1) 〖0.05〗 ^2)

= 73 respondents

Therefore, 73 respondents were used in the study as the sample size. Therefore, 73 questionnaires were distributed to the respondents and 69 questionnaires were found to be complete, which formed the basis of the data analysis in this study. In this context, the response rate for this study was 85.0% which was deemed sufficient for data analysis. The return rate was 94.5% which was deemed sufficient for the studies as it was above the 80% that is recommended by Mugenda & Mugenda (1999).

VI. Findings And Discussions

The study sought to find out which End User Skills Matrix have been instrumental in adoption of new technologies among technical skills, problem solving skills, proficiency in internet usage, basic computer trouble shooting skills, and ability to use self-help menus on a platform. The respondents were asked to choose the level that best explained their situation with 1=Strongly Disagree (SD), 2=Disagree (D), 3= Uncertain (U), 4=Agree (A), and 5= Strongly Agree (SA). A cumulative majority of 78.3% were of the opinion that technical skills have been instrumental in adoption of new technologies with those who responded with strongly agree and agree being 31.9% and46.4% respectively. Those who disagreed, strongly disagreed and were uncertain were 2.9%, 7.2%, and 11.6% respectively. The high percentage of respondents who indicated that technical skills were critical for the adoption of new technology can be attributed to the fact that most technologies are ICT based and technical in nature. Therefore, possession of technical skills becomes critical in the adoption of the new technologies.

Table 1; Frequency Distribution of End User Skills Matrix

	SA Freq. (%)	**A Freq. (%)**	**U Freq. (%)**	**D Freq. (%)**	**SD Freq. (%)**
Technical Skills	22 31.9%	32 46.4%	8 11.6%	5 7.2%	2 2.9%
Problem Solving Skills	20 29.0%	37 53.6%	10 14.5%	2 2.9%	0 0.0%
Proficiency in internet usage	22 31.9%	34 49.3%	6 8.7%	6 8.7%	1 1.4%
Basic Computer Trouble	14	38	11	5	1

Shooting Skills	20.3%	55.1%	15.9%	7.2%	1.4%
Ability to use self-help menus on a platform	17 24.6%	34 49.3%	13 18.8%	4 5.8%	1 1.4%

In response to whether problem solving skills have been instrumental in adoption of new technologies, most of the respondents affirmed that they were, with 53.6% choosing the agree prompt while 29.0% chose the strongly agree prompt. None of the respondents gave a strongly disagree response. The problem solving skills are critical in the adoption of new technologies due to the fact that there is a learning curve associated with adoption of new technologies. These skills are critical in the solving of emergent challenges in the process of adoption of new technologies.

Proficiency in internet usage has been instrumental in adoption of new technologies as only a minority of 10.1% felt it was not (disagree= 8.7%, strongly disagree=1.4%). Respondents who were unsure were 8.7% while those who felt that proficiency in internet usage has been instrumental in adoption of new technologies were 81.2% (agree=49.3%, strongly agree=31.9%). Proficiency in internet usage is important in the adoption of new technologies in the context that a majority of technologies are web based in nature and prior proficiency of internet is thus useful. This is due to the fact that the end users may relate their experiences with the new technology with previous experiences on web based or internet based software.

Basic computer trouble shooting skills have been instrumental in adoption of new technologies with most of the respondents (55.1%) in agreement. The respondents, who were unsure, disagreed and strongly disagreed that basic computer trouble shooting skills have been instrumental in adoption of new technologies were 15.9%, 7.2%, and 1.4% respectively. The new technologies may to a greater extent involve the use of computer applications in their execution and thus basic computer trouble shooting skills becomes critical.

Table 2; Means of End User Skills Matrix

	N	**Min.**	**Max.**	**Mean**	**Respondents on average tended to**	**Rank**
Technical Skills	69	1	5	3.97	Agree	3
Problem Solving Skills	69	2	5	4.09	Agree	1
Proficiency in internet usage	69	1	5	4.01	Agree	2
Basic Computer Trouble Shooting Skills	69	1	5	3.86	Agree	5
Ability to use self-help menus on a platform	69	1	5	3.90	Agree	4
Aggregate mean				**3.97**		

In order to gain greater insights as to whether the End User Skills Matrix have had an impact on adoption of new technologies, the means were generated. The various metrics of the End User Skills Matrix whose means were generated were technical skills, problem solving skills, proficiency in internet usage, basic computer trouble shooting skills, and ability to use self-help menus on a platform.

Technical skills scored a mean of 3.97 while problem solving skills had a mean score of 4.09. Proficiency in internet usage had a mean score of 4.01, basic computer trouble shooting skills had a mean score of 3.86, and ability to use self-help menus on a platform had a mean score of 3.90. This implied that on average the respondents tended to agree that technical skills, problem solving skills, proficiency in internet usage, basic computer trouble shooting skills, and ability to use self-help menus on a platform had an impact on the adoption of new technologies at KPLC. The aggregate mean of 3.97 implied that on average the respondents tended to agree that End User Skills Matrix had an impact on adoption of new technology.

The results of this study are consistent with the reviewed literature. In the context of technical skills being useful in adoption of new technology, this study found that the respondents tended to agree (with a mean of 3.97) on its usefulness on adoption of new technology at KPLC. This is consistent with the findings of Mucheru (2013) study on factors influencing adoption of information systems. The study noted that users who are equipped with technical skills have better capabilities to handle arising challenges, display higher confidence level in their capability to handle new technologies and thus an overall positive attitude towards adoption of new technologies. These factors act to lead to a higher adoption levels of the new technologies.

The results of the study that proficiency in internet usage (mean of 4.01), basic computer trouble shooting skills (mean of 3.86), and ability to use self-help menus (mean of 3.90) had the respondents agreeing that these metrics impacted on adoption of new technologies. These results are consistent with the findings of Mandola (2013) and Muhangi (2012). In this context, Mandola (2013) in the examination of the adoption of Integrated Tax Management System (ITMS) in Kenya found a correlation between an individual's proficiency

in internet usage and adoption of (ITMS) amongst target users of the system. On the other hand, Muhangi (2012) in a study on the examination of the online filing in Uganda found that ability to use the self-help menus on a web based technology was critical in ensuring improvement in adoption levels of new technology. In this context, Muhangi (2012) notes that the self-help menus empower the user and hence reduce perceived ease of use.

The mean scores of the different metrics of the End User Skills Matrix were ranked from the highest to the lowest from 1 to 5 with a rank of 1 having the highest mean score and a rank of 5 having the lowest mean score. Problem solving skills ranked first as the metric with the highest mean of 4.09. This implied that in the context of end user matrix, problem solving skills were the most instrumental in adoption of new technologies. This was followed by proficiency in internet usage, technical skills, ability to use self-help menus on a platform, and basic computer trouble shooting skills which raked second, third, fourth and fifth respectively. The aggregate mean of the End User Skills Matrix was also determined by getting the average of the mean scores of individual metrics in the End User Skills Matrix. The aggregate mean score was 3.97 for the End User Skills Matrix which implied that the respondents on average were inclined to agree that End User Skills Matrix have been instrumental in adoption of new technologies.

Table 3; Standard Deviations of End User Skills Matrix

	N	**Std. Deviation**	**Responses distribution around the mean;**	Rank
Technical Skills	69	1.00	Widely	1
Problem Solving Skills	69	0.74	Moderately	5
Proficiency in internet usage	69	0.95	Moderately	2
Basic Computer Trouble Shooting Skills	69	0.88	Moderately	4
Ability to use self-help menus on a platform	69	0.89	Moderately	3
Aggregate		**0.89**		

Technical skills had standard deviation of 1.00 implying there was no consensus ($\sigma_X \geq 1$) among the respondents on whether they were instrumental in adoption of new technologies. Problem solving skills had a standard deviation of 0.74, proficiency in internet usage had 0.95, basic computer trouble shooting skills had a standard deviation of 0.88, and ability to use self-help menus on a platform had standard deviation of 0.89. These standard deviations implied that there was moderate consensus that they had been instrumental in adoption of new technologies ($0.5<\sigma_X<1$).

The standard deviations were ranked from the lowest to the highest based on the standard deviation scores with the lowest standard deviation being ranked 5 indicating greater consensus while the highest standard deviation was ranked 1 indicating lowest level of consensus. Problem solving skills was ranked 1 giving the highest level of consensus from the respondents since it was closer to 0.5 (high consensus) than all the other metrics. This implied that there was comparatively higher consensus amongst the respondents that problem solving skills were instrumental in adoption of new technologies at KPLC Nakuru, Kenya among the metrics on End User Skills Matrix.

Technical skills were ranked number 5 (standard deviation of 1.00) implying that there was comparatively low consensus amongst the respondents in respect to its influence on the adoption of new technologies at KPLC.Proficiency in internet usage, ability to use self-help menus on a platform, and basic computer trouble shooting skills ranked 2, 3, and 4 respectively. The aggregate standard deviation was generated by getting the average of the individual standard deviations of the metrics on End User Skills Matrix. The aggregate standard deviation of the metrics on End User Skills Matrix was 0.89 which meant the responses were moderately distributed around the mean for all the metrics implying that there was moderate consensus that all the metrics on End User Skills Matrix have been instrumental in adoption of new technologies

Hypothesis Testing

Therefore, in order to test the hypothesis in respect to end user skills matrix influence on adoption of new technologiesat Kenya Power and Lighting Company, Kenya,the following null (**H_0)** and alternate hypothesis (**H_a)** were used;

H_0: Skills matrix of end user has no significant influence on adoption of new technologies at Kenya Power and Lighting Company, Kenya

H_a: Skills matrix of end user has significant influence on adoption of new technologies at Kenya Power and Lighting Company, Kenya

In respect to the decision making of whether to reject or accept the null (H0) and alternate hypothesis (Ha), the p value method was utilized. In this context, the p value for one way ANOVA for End User Skills Matrix was below 0.05 which led to rejection of the null hypothesis (H01). Therefore, the null hypothesis (H01) that skills matrix of end user has no significant influence on adoption of new technologies at Kenya Power and

Lighting Company, Kenya was rejected since p=0.049<0.05. Thus the alternate hypothesis that skills matrix of end user has significant influence on adoption of new technologies at Kenya Power and Lighting Company, Kenya was accepted.

VII. Conclusion

The study concluded there was high consensus amongst respondents in relations to the influence of the end user skills on adoption of new technologies at KPLC. Additionally, the study concluded that end user skills have significant influence on the adoption of new technologies at KPLC.

VIII. Recommendation

The study recommends that KPLC management enhances the problem solving skills of its employees through regular training and workshops. Additionally, on-the-job training should be emphasized so that KPLC employees can get a platform to share best practice.

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