Nature and Extent of Energy Sector Management System with Regard to Electrical Fire Disaster in Kisumu County, Kenya

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DOI: 10.29322/IJSRP.12.08.2022.p12837
http://dx.doi.org/10.29322/IJSRP.12.08.2022.p12837

Paper Received Date: 18th July 2022
Paper Acceptance Date: 03rd August 2022
Paper Publication Date: 16th August 2022

Abstract: Quality Management has become essential in many organizations with aim of capitalizing on the sources for improvement through quality goal setting and measurement. Deficiency in exploring quality management systems in utility power transmission and distribution systems, are described along with their observed vulnerabilities to electrical fire disasters in Kisumu County. The perfect Quality Management System is not adhered to in energy sector, power lines design, electric equipment, and systems planning doesn't meet specific prescribed quality standards. The paper therefore examines the nature and extent of energy sectors quality management systems with regard to electrical fire disaster in Kisumu County. The study adopted Cross-functional management model and Crosby Theory of Quality theories. A descriptive research design was used in the study. Purposive, census and stratified random sampling techniques were used to select a sample size from the energy sectors; Kenya Power and Lighting Company, Kenya Electricity Transmission Company, Kenya Energy Generating Company and customers connected to electricity grid. The structured questionnaires, interviews guides and observation methods were used to collect data. Findings indicated that lack of electrical fire disaster planning, design of power equipment and power line design were factors contributing to electrical fire disasters. Poor quality power equipment were factors hindering quality service provision. The paper recommends that Kenya energy organizations should foster coordination for quality service delivered. Energy sector to create awareness of departmental procedures on how quality management should be implemented to its customers, ensure electrical fire disaster planning and adapt effective power line designs to prevent electric disasters.

Key Words: *Quality Management Systems, Power distribution systems, Power transmission systems*

1. INTRODUCTION

Quality Management is described as an approach that seeks to improve quality and performance which will meet customer expectations. This can be achieved by integrating all quality-related functions and processes throughout the company. Globally, utility power transmission and distribution systems are described along with their observed vulnerabilities to natural and man-made hazards (Sioshansi, 2011). For instance, earthquakes destroy transmission and distribution systems, including cables, towers and utility poles.

Sioshansi (2011), argues that restoration of this infrastructure and the services it provides take very long periods of time. Further, electrical equipment belonging to consumers can be swamped with water, posing the risk of electrocution, and therefore loss of lives (Krishnamurthy and Kwasinski, 2013). This means that power equipment must meet the required standards to ascertain qualities in considerations of type of hazard.

Kisumu County which is in Kenya, approximately 40% of the load is supplied via 33/0.433 kV secondary distribution transformers. However, transformers at Kisumu, Kegati 132/3 3 kV substations are overloaded in the existing system under peak load conditions. Further, voltage and loading issues are evident on the Kondele feeder supplied from Obote Road primary substation. This is due to low thermal rating of conductors as a result of inadequate sizing. Several line sections feeding a large proportion of the load are of conductor type 25mm2 ASCR causing an effective "bottleneck".

Sinei (2013), argued that planning guidelines provided by KPLC have not been applied during the extension of a spur from the main feeder. Thus, some of the electric gadgets are not standard which causes outages. That the manual recording, he argues, result in erratic values that may not represent the true load behavior.

Voltage and loading issues are evident on the Kondele feeder supplied from Obote Road primary substation. This is due to low thermal rating of conductors as a result of inadequate sizing. In this region, many substations have either un-calibrated or non-operational metering on some feeders. Additionally, the measurements at the substation transformers are seldom recorded. At peak hours, the load is high such that power is lost in some parts of this region. Sometimes, it takes long to restore power. The power supply doesn't meet demand, and therefore, power fluctuations are a norm (Greenwire *et al*., 2008). Secondary transformers do not guarantee stable power supply, and therefore, power fluctuations would lead to electric disasters such as outages.

1.2 Statement of the Problem

Kenya Energy Sector is making loses as a result of poor quality management systems. These electrical disasters are at company and consumer levels. These losses are electric induced fires that lead to destruction of property and loss of lives. For example, Kenya Power and Lighting Company have made economic losses due to an amount of electricity lost during transmission from generation plants to consumers (Vanya, 2015).

A related fact is when the Energy Regulatory Commission (ERC) reduced the amount that KPLC can recover from consumers 14.9% down from 15.9%. Kenya's 14.9% recovery is still high compared to global average of 11%. Other challenges the sector face are a range of financial, technical and institutional challenges such as lack of access to capital, poor coordination across sectors and institutions, and high levels of poverty resulting in low ability to pay for services (Otuki, 2017).

Kisumu regions are known for heavy storms and strong winds. Power outages are common and electrical fire disasters related to the same are common. Approximately 40% of the load in the Kisumu region is supplied via 33/0.433 kV secondary distribution transformers. Secondary transformers do not guarantee stable power supply, and therefore, power fluctuations would lead to electrical disasters as a result of outages.

1.3 Objective of the Study

The objective of the study was to examine the nature and extent of energy sector management system with regard to electrical fire disaster in Kisumu County, Kenya.

1.4 Research Question

What is the nature and extent of energy sector quality management systems in regard to electrical fire disaster in Kisumu County?

1.5 Justification of the Study

1.5.1 Academic Justification

The study will provides a foundation for further research in the field of disaster management. The findings of the study will improve the academics in electrical fire disaster response among organizations, and how energy organizations should adopt use of quality management systems in daily running in their functions and beyond by increasing reference materials in academic institutions to act as training manual for corporates.

1.5.2 Policy Justification

The study have suggested policy change with regard to quality management systems such as design, planning and standards of electrical equipment that bring about electrical fire disasters as a result of natural or man-made hazards. Thus, policy makers in the energy sector can improve on quality of electric equipment, management of power lines and how to prepare, respond and recover from electric disasters.

2.1 Quality Management Systems

Hoyle and David (2005), defines quality management system as a formalized system that documents processes, procedures, and responsibilities for achieving quality policies and objectives. It spells out that a Quality Management System (QMS) helps coordinate and direct an organization's activities to meet customer and regulatory requirements and improve its effectiveness and efficiency on a continuous basis. Therefore, it is the international standard specifying requirements for quality management systems in any organization.

According to Garvin *et al* (2007), there are benefits of quality management systems to any organization or company. First is the implementation of a quality management system which affects every aspect of an organization's performance. For example, benefits of a documented quality management system are such that it meets the customer's requirements, which helps to instill confidence in the organization, in turn leading to more customers, more sales, and more repeat business. Secondly, it meets the organization's requirements, which ensures compliance with regulations and provision of products and services in the most cost- and resource-efficient manner, creating room for expansion, growth, and profit. This means that with quality management systems such a company rarely runs losses (Hoyle and David, 2005).

Further, these benefits offer additional advantages, such as helping to communicate a readiness to produce consistent results, preventing mistakes, reducing costs, ensuring that processes are defined and controlled, and continually improving the organization's offerings. However, the elements and requirements of a quality management system of an organization vary but each element of a quality management system helps achieve the overall goals of meeting the customers' and organization's requirements (Garvin *et al*., 2007).

There are basic steps to implementing a quality management system. First is the design and build portions serve to develop the structure of a QMS, its processes, and plans for implementation. Secondly, senior management should oversee this portion to ensure the needs of the organization and the needs of its customers are a driving force behind the systems development. Thirdly, the deployment is best served in a granular fashion by breaking each process down into sub-processes, and educating staff on documentation, education, training tools, and metrics. Fourth is control and measurement are two areas of establishing a QMS that are largely accomplished through routine, systematic audits of the quality management system (Talib, *et al.*, 2013).

According to Wickramasinghe (2012), the specifics vary greatly from organization to organization depending on size, potential risk, and environmental impact. The goals are to determine the effectiveness and efficiency of each process toward its objectives, to communicate these findings to the employees, and to develop new best practices and processes based on the data collected during the audit.

From this review, it is clear that QMS put in place by a company determines the kind of service or product that the end customer gets. If not well planned, implemented, assesses and shared by everyone in the organization through education and training, the end product or service can be disastrous or simply put, does not meet expectations. The following section looks at the concept of Disaster.

2.2 Quality Management Systems with Regard to electrical fire disasters

According to Sioshansi (2011), whilst BCP are a growing area of attention for many companies, experience from recent major disasters suggests that more needs to be done. For example, in 2005, the Japanese government's Disaster Prevention Basic Plan suggested that all companies should develop a BCP, and recommended a target that all large-scale companies in Japan develop and implement such a plan by 2018. By 2011, 70 % of large-scale Japanese companies and 35 % of middle-scale companies had prepared and/or were in the process of planning BCP, when the Great East Japan Earthquake struck.

However, most of the BCP did not work as planned, and lack of electricity supply was a critical factor in the process of post-disaster recovery. Following this massive disaster, 271 companies were surveyed regarding the impact of the disaster. Of these companies, 106 claimed they faced significant IT system problems after the earthquake, and 137 companies did not have a BCP. Among the Japanese companies surveyed who did have a BCP, only one company replied that their plan had worked as designed. In analyzing the gap between the disaster that ensued, and the continuity plans originally developed, it is clear that long grid outages, collapse of supply chains that might affect electricity supply, or the loss of critical infrastructure, were rarely foreseen (Blyden and Lee, 2006).

Given the complexity of electricity systems and the growing popularity of distributed generation and related energy technologies in customer's premises, a new continuity plan specifically focused on electricity supply resilience and restoration is needed in many organizations. So-called ECP will specifically consider how to rapidly restore electricity supply to a particular site, based either on outside supply or internal provision (Marnay *et al.*, 2008). Thus, preparedness against disaster will never be perfect without appropriate operational strategies. Installation of a back-up system or microgrids (i.e. ECS is considered to be an investment in hardware) reinforce the preparedness against disaster. The hardware will demonstrate its full performance when it is combined with appropriate software.

In contrast to BCP, unique electrical issues that should be considered by an ECP include: Alternative generation sources – the use of local back-up generation; dependencies outside the electrical equipment that may affect electricity supply – for example, the availability of fuel for back-up generators and identification of particular electrical loads, their priority for business functions, and their energy requirements (Heavey *et al*., 2014).

When preparing an ECP there are a number of key steps to determine the particular threats to electricity supply and steps to mitigate these risks for a given facility. For example, when preparing an ECP, it is critical to identify the risks that the various types of natural disasters may pose to a particular facility. Currently, there is no standard method to classify particular types of natural disaster and their potential impact on a facility. Similarly, there is no way to compare facilities – to determine whether one facility (or design) is more resilient against a certain disaster than another (Krishnamurthy and Kwasinski, 2013).

Whilst there will always be significant unforeseen disasters, the most common disasters causing electric outage in a geographical area can often be anticipated. It is reasonable to assume that earthquakes will continue to plague areas around the Pacific Rim. Similarly, geographies prone to large storms or flooding will continue to be at risk. In order to plan, one must begin by classifying disasters by type. As a consequence, a number of metrics are likely to be available for comparing likely impacts of the disaster versus the resilience measures in place (Blyden and Lee, 2006).

Blyden and Lee (2006), further notes that electrical fire disasters impact depends on the country, geography and infrastructure. Thus, the ECP metrics need to be carefully selected and assessed in terms of the insight they offer regarding the likely impact on electricity supply. The ultimate aim to standardize the way of measuring and comparing potential natural disasters is critical.

Krishnamurthy and Kwasinski (2013), argues that once an understanding of likely disasters and their severity has been established, a facility can then start to evaluate to what extent it is prepared against each disaster. The goal is to design a standard set of metrics that can indicate a facility's preparedness against disaster and loss of energy supply, effectively allowing the level of preparedness of each facility to be compared to one another. The preparation of metrics to measure disaster preparedness or resilience will be a complicated exercise. This work will need to grapple with how to measure a facility's resilience against a very wide range of potential natural disasters and how this can be distilled into a number of common metrics.

According to Heavey *et al* (2014), most facilities do not indicate other important factors, such as length of the outage, dependencies on outside fuel supplies. The goal is to standardize a way of measuring a facility's preparedness against a variety of disasters, to allow internal evaluation and comparison of different facilities. He argues that when classifying a facility's resilience against an electrical outage, it is critical to have a detailed understanding of the loads in the facility. Different loads can accommodate different levels of power quality, and/or length of supply failure, without having significant economic effect.

There is currently no standard method to specify a load's electricity supply requirements. Such classifications may be based on individual pieces of equipment, where classes of load are introduced based on metrics such as: Acceptable supply interruption duration; acceptable supply frequency range and acceptable supply voltage range (Krishnamurthy and Kwasinski, 2013).

Therefore, classifications both by type of operation facility, and equipment, are possible. For example, a medical facility has critical loads (such as a respirator) and non-critical loads (such as an entertainment system for patients). On the other hand, an office building has no critical loads, but the computer systems are very important for business continuity. Dwellings usually have no high priority loads unless a resident uses a home medical care system (Basir *et al.*, 2011).

2.3 State of power supply between substations (Nairobi and Kisumu County)

Within Nairobi Region, ASTM (2014), acknowledges that, the network configuration differs from that of the other KPLC regions. The region is supplied from the transmission network via several 220/66 kV and 132/66 kV transmission substations or bulk supply points (BSPs). A number of 66 kV feeders emanate from each BSP and each 66 kV feeder supplies one or more primary (66/11 kV) substations. Each primary substation supplies a number of 11 kV feeders, which in turn supply 11/0.433 kV distribution substations.

According to Final Energy report Kenya (2018), larger customers may be supplied at 11 kV or 66 kV. The Nairobi network is interconnected both at 66 kV and 11 kV, with normally open points to allow transfer of load across BSPs or primary substations respectively. The 66 kV feeders are mostly overhead using single and double circuit wood-pole construction. The 11 kV feeders are also mostly overhead using single circuit wood or concrete pole construction. In Nairobi city centre, where there are space constraints or issues with clearances, underground cables are used for 11 kV and a few for 66 kV. There are a few 66/33 kV substations on the outskirts of Nairobi, which supply neighboring areas via long 33 kV feeders.

In Kisumu County, The distribution network suffers from poor reliability and quality of supply, which is generally due to under-investment. Some of the key issues identified during the study are that many parts of the distribution network are supplied over extremely long, radial 33 kV and

11 kV feeders, with no alternative source of supply. In some cases, 33 kV feeders may be hundreds of km long, with many spurs, resulting in a total length (in extreme cases) in excess of 1000 km supplied from a single source (Final Energy report Kenya, 2018). A fault on such a long feeder will have wide-spread impact, be difficult to locate and therefore will result in a long restoration time.

These parts of the network are not surprisingly subjected to frequent and prolonged outages. Due to excessive feeder lengths and use of undersized conductors, voltage levels on feeders, particularly outside of the urban areas are typically poor and significantly under the required standard. Automatic voltage regulators (AVRs) have been installed on feeders in the past, however many of these have failed and have subsequently been bypassed (Sinei, 2013).

2.4 Conceptual Framework

Wasike and Odhiambo (2016) discuss the role of theories in guiding the thrust of academic studies. They emphasise the importance of theories in offering compelling and incisive causal explanations with calculated precision. They buttress their argument by quoting Smith (1996) who asserts that theories play the role of predicting, prescribing and evaluating socio-political phenomena hence they cannot be ignored.

2.4.1 Cross-functional management model

Juran cross-functional management approach comprises three legislative processes:

Quality Planning: a process that involves creating awareness of the necessity to improve, setting certain goals and planning ways to reach those goals. This process has its roots in the management's commitment to planned change that requires trained and qualified staff.

Quality Control: a process to develop the methods to test the products for their quality. Deviation from the standard will require change and improvement.

Quality Improvement: a process that involves the constant drive to perfection.

According to Juran (1992), Quality improvements need to be continuously introduced. Problems must be diagnosed to the root causes to develop solutions. The Management must analyze the processes and the systems and report back with recognition and praise when things are done right.

Basing on his work, he viewed that organizations progress depends on implementation of strategies basing on; structured on a regular basis with commitment and a sense of urgency, building an extensive training program and cultivate commitment and leadership at the higher echelons of management if they are to achieve high quality.

Quality by design incorporates modern tools to pre-emptively control variation (Juran, 1992). These tools and methods begin by measuring and understanding the variation that exists by using historical data, testing, and modelling to help forecast, analyze, and eliminate the deleterious effects of variation using standard statistical techniques. Process control consists of three basic activities: Evaluate the actual performance of the process, compare actual performance with goals and take action on the difference. The final activity of the quality by design process is to implement the plan and validate that the transfer has occurred.

2.4.2 Crosby Theory of Quality

Crosby's principle, Doing It Right the First Time, was his answer to the quality crisis. He defined quality as full and perfect conformance to the customers' requirements. The essence of his philosophy is expressed in the Absolutes of Quality Management and the Basic Elements of Improvement (Creech, 1994).

2.4.2.1 The Absolutes of Quality Management

Crosby defined Four Absolutes of Quality Management, which are; The First Absolute: The definition of quality is conformance to requirements. The Next Absolute: The system of quality is prevention. The Third Absolute: The performance standard is zero defects and the Final Absolute: The measurement of quality is the price of non-conformance.

2.4.2.2 Zero Defects

Crosby's Zero Defects is a performance method and standard that states that people should commit themselves too closely monitoring details and avoid errors. By doing this, they move closer to the zero defects goal. According to Crosby, zero defects was not just a manufacturing principle but was an all-pervading philosophy that ought to influence every decision that we make especially energy sectors. Managerial notions of defects being unacceptable and everyone doing ‘things right the first time’ are reinforced (Crosby, 2012).

ISSN 2250-3153

2.4.2.3 The Quality Vaccine

Crosby explained that this vaccination was the medicine for organizations to prevent poor quality.

Integrity: Quality must be taken seriously throughout the entire organization, from the highest levels to the lowest. The company's future will be judged by the quality it delivers.

Systems: The right measures and systems are necessary for quality costs, performance, education, improvement, review, and customer satisfaction.

Communication: It is required to communicate the specifications, requirements and improvement opportunities of the organization. Listening to customers and operatives intently and incorporating feedback will give the organization an edge over the competition.

Operations: a culture of improvement should be the norm in any organization, and the process should be solid.

Policies: policies that are implemented should be consistent and clear throughout the organization.

Figure 1 showing the interaction of the variables.

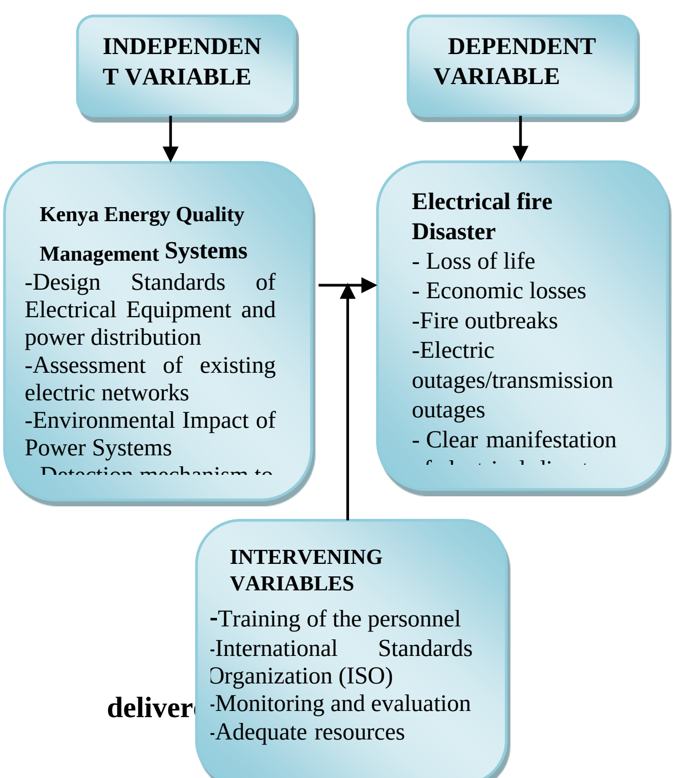

Figure 1: Conceptual Model

Source: Researcher, 2019

3. RESEARCH METHODOLOGY

3.1 Research Design

The study was qualitative in approach; with a single overall objective aimed to examine the effectiveness of energy sector quality management systems in response to electrical fire disaster in Kisumu County. Descriptive survey design was conducted in the selected areas of Kisumu County considered appropriate to enhance an apt determination of the state of quality management systems and their effectiveness in response to electric fire disasters.

3.2 Sample Size Determination and Sampling Procedure

A sample size of one hundred and sixty respondents drawn from energy sectors and customers connected to electricity grid clusters was used in the study. The sample size was drawn from the target population of 1865 by use of purposive sampling in which (30%) technique applied in selection of respondents from the identified five organizations; KEBS, Energy Regulatory Commission, KENGEN, KPLC and KETRACO. Customers connected to the electricity grid also formed part of the sample size.

3.3 Data Collection Methods

Both primary and secondary data collection was used to collect the relevant information. Primary data was collected from the field through structured questionnaires, interviews guides', observation checklist, focused group discussion and document analysis. The use of several data collection methods was enable the researcher to avoid the deficiency that springs from using one method of data collection method (Kothari, 2004). Secondary data was collected by analysis of publications such as electrical fire disaster journals, electricity/energy related legislations and government documents.

3.4 Data Analysis

The collected data was cleaned by listing, removed errors and checked extreme values and edited to ensure conformity. The group survey data was analyzed using SPSS Version 27. The variables were subjected to descriptive statistics. Quantitative data was analyzed using descriptive statistics such as frequencies and percentages. Findings were presented in form of frequency tables, pie charts, bar graphs and narratives.

4. Results

4.1 Coordination as an issue affecting quality of service deliver

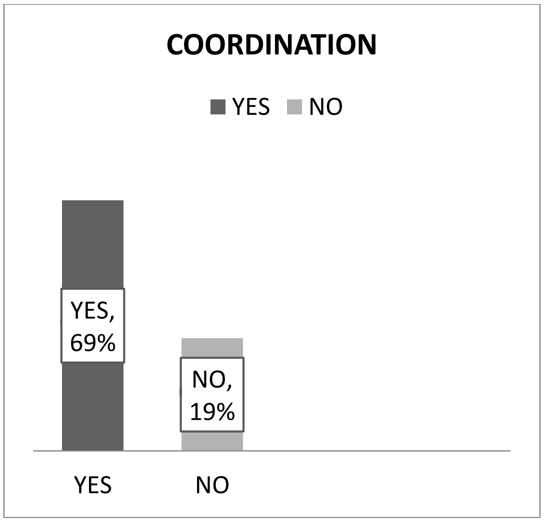

Figure 2. Coordination affecting quality of service delivered
Source: Field Data Analysis (2019)

Basing on the findings, the study indicated that out of 141 (88%) respondents, 110 (69%) of the respondents affirmed that coordination was as an issue affecting quality of service delivered while 31 (19%) of the respondents had different views stating that coordination was not an issue affecting quality of service delivered in energy organizations.

The research findings indicated that coordination was an issue affecting quality of service delivered in energy sector. The study findings corroborate (Ngure, 2012) who asserts that one source of complexity in emergency planning was the need to integrate several dimensions into the programmed emergency response. That there was always difference in hierarchical divisions, geographical divisions which indicated the spatial jurisdictions to which plans refer, and possibly also to questions of mutual assistance and difference in organizational divisions due to different agencies that participate in emergency responses.

Abdullah *et al* (2009), argues that strategic planning is essentially in that it helps in resources finding and ensuring that there is assemblage of response units, so that it meets the needs of the population affected by disaster. That the permanent emergency plan is a backdrop to activities. He suggests that it should neither be slavishly and rigidly followed nor ignored. That it should ensure that fundamental tasks are apportioned, responsibilities are clear, and appropriate action is stimulated. There were no coordinated emergency plans because all these organizations are in market industry thus competing for profit making. When one fails, the other organization celebrates.

Figure 3. The dynamic hierarchy of emergency plans.
Source: Researcher (2019)

According to ASIS (2009), emergency planning should be a co-operative effort in which the users and beneficiaries of the plan are stakeholders who have an interest in ensuring that the plan works well. It is also important to create and maintain interoperability, so that emergencies that require large-scale responses do not lead to chaos and to groups of people working at cross purposes.

4.2 Aspects that contributes to occurrence of electrical fire disasters in energy sectors

Respondents were further asked to rate some of the aspects that were interconnected to occurrence of electric disasters in their respective organization and the response was captured in figure 4.6.

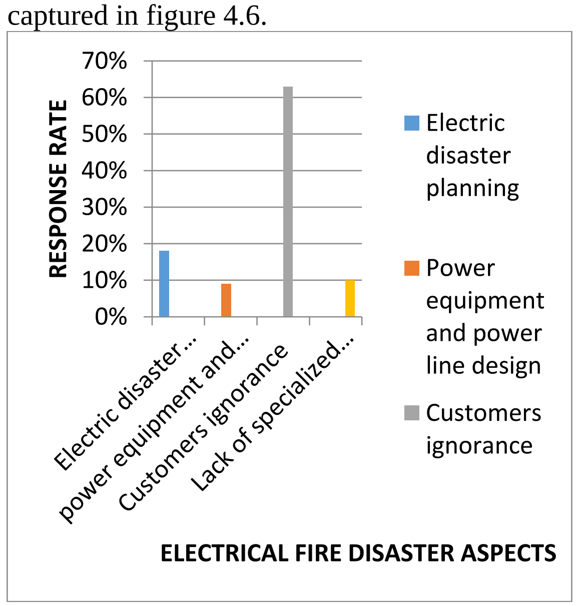

Figure 4. Aspects influencing occurrence of electrical fire disasters
Source: Field Data Analysis (2019)

According to the findings, customer's ignorance was identified as the most aspect which was related to occurrence to electric disasters. This was represented by a high response rate of 100 (63%) of the respondents. Followed by electrical fire disaster planning represented by 29 (18%) of the respondents. Low response rate was realized few specialized personnel wit response rate of 16 (10%) and power equipment and power lin design at 15 (9%) respectively. Basing on the findings, it wa clear that most of the respondents concurred that customer ignorance to issues related to electricity was the main challeng as an aspect contributing to electric disasters. The data correlate with data obtained from focus group discussion in which th respondents asserted that Electricity theft due to customer' ignorance on effects of electricity was the main challenge i relation to occurrence of electric disasters in their organization

Figure 5: Electricity bypassing by customers in Kisumu
Source: Field data (2019)

According toTan *et al* (1998), that electrical circuits were designed to handle a limited amount of electricity. Any overload occurring when you draw more electricity than a circuit could safely handle affected to the circuit which caused electric disasters. The electricity usage of each device when running adds to the total load on the circuit. Exceeding the rated load for the circuit wiring causes the circuit breaker to trip, shutting off the power to the entire circuit. If there was no circuit breaker in the circuit, an overload would cause the circuit wiring to overheat, which could melt the wire insulation and lead to a fire.

On power equipment and power line design, it was noted that the Kondele feeder supplied from Obote Road primary substation, there was low thermal rating of conductors as a result of inadequate sizing. Several line sections feeding a large proportion of the load were of conductor type 25mm2 ASCR causing an effective bottleneck. Evaluation suggested that the planning guidelines provided by Kenya energy sector had not been applied during the extension of a spur from the main feeder (KPLC, 2013).

4.3. Factors hindering quality service provision in energy sector

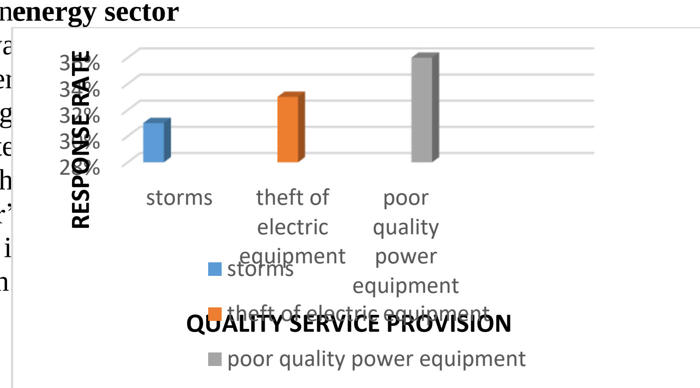

Figure 6. Factors hindering quality service provision in energy sector
Source: Field Data Analysis (2019)

Research findings indicated that out of 141 (88%) respondents, 52 (33%) of the respondents indicated that poor quality power equipment was the main factor hindering quality service provision in energy sector. Followed by theft of electric equipment with response rate of 47 (29%) and lastly storms with response rate of 42 (26%).

This response rate tallies with response obtained from focus group discussion from managerial and administrative positions from energy departments. This indicates that the results were reliable. The findings concur with Zaramdini (2007), on poor quality power equipment. That though equipment is regularly maintained and updated, problems normally occur from cables, connectors, transformers and switches require replacement and can trigger a power interruption.

In relation to research done in this field, the energy organizations were responsible for transmission and distribution of electricity. The accident frequency rate (AFR), which was an international standard had reached highs of 6.9 with the lowest having been recorded at 1.9 against an acceptable benchmark of 0.5. The fatalities had significantly reduced over the last two financial years, they were still at alarming levels by the end of the financial year ending June, 2009 (Krishnamurthy and Kwasinski, 2013). Vanichchinchai and Igel (2009), assert that Kenya Power customers experience power interruptions due to vandalism to electrical

equipment. This act jeopardizes the individuals' safety, the public's safety as well as the safety of Kenya Power employees. Damage to Kenya Power properties led to loss of electricity for entire communities including essential services such as hospitals and other emergency services and this affected the quality service deliverance to the customers.

On effects of storm, most power outages are caused by severe weather, high winds, lightning, rain or flooding. That during a storm power poles are vulnerable to lightning strikes while strong winds snapped off tree branches and down power lines and this affected the quality of service expected to be delivered to the customers (Krishnamurthy and Kwasinski, 2013).

4.4 Organization measures put in place to ensure quality management and provision of quality service

On assess if energy organizations had ensured that there are measures put in place to ensure quality management and provision of quality service and energy sector, the respondent's response was as in figure 4.9.

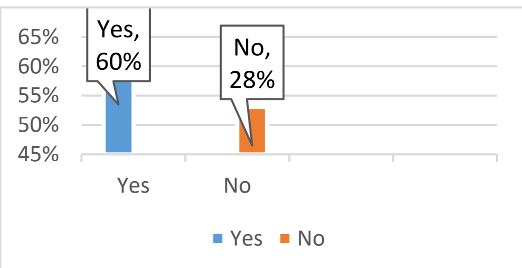

Figure 7. Organization measures put in place to ensure quality management and provision of quality service

Source: Field Data Analysis (2019)

From the data analysis, out of 141 (88%) respondents who participated, 96 (60%) of the respondents agreed that their organizations had measures put in place to ensure quality management and provision of quality service to the customers while 45 (28%) assured the researcher that there were no measures put in place to ensure quality management and provision of quality service in energy sector. 45 (28%) claimed that nowadays that Kenya power and lighting company sees the need to strategies and come up with measure to ensure quality management and quality service provision for retention of customers. But at the moment there is no strategies explored but are proposed, for instance to strategies on how to curb electricity outage through installation of alarm systems in electric equipment (Minik *et al*, 2003).

5. Summary and Conclusion

Findings indicated that lack of electrical fire disaster planning, design of power equipment and power line design were factors contributing to electrical fire disasters. Poor quality power equipment were factors hindering quality service provision.

6. Recommendation

Kenya energy organizations should foster coordination for quality service delivered. Energy sector to create awareness of departmental procedures on how quality management should be implemented to its customers, ensure electrical fire disaster planning and adapt effective power line designs to prevent electric disasters.

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