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MSc Programme in Urban Management and Development

Rotterdam, The Netherlands

September 2018

Thesis

Title: Influence of human resource and Electricity Tariff on Operation and maintenance in reducing power outages: case of TANESCO, Dar es Salaam

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Specialization: MFUI

UMD 14

MASTER'S PROGRAMME IN URBAN MANAGEMENT AND DEVELOPMENT

(October 2017 – September 2018)

Title

Influence of Human resource and Electricity tariff on Operation and maintenance in reducing power outages: A case of TANESCO, Dar es Salaam- Tanzania

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UMD 14 Report number: 1237

Rotterdam, September 2018

Summary

Developing countries need adequate access to reliable and modern energy to address the growing development challenge. Around 1.5 billion people have no access to electricity while nearly one billion people are subjected to unreliable electricity as well as frequent power blackouts. According to estimates by studies, energy-underperforming countries lose a growth potential of 1%-2% of growing potentials annually due to power outages. (Rosnes and Shkaratan, 2011)

Tanzania Electric Supply Company Limited (TANESCO) dominates electricity sector in Tanzania, which is a monopoly public organization responsible for the generation, transmission and distribution of electricity in the country. For a number of years TANESCO distribution network has been deteriorating day after day. The deterioration is worsened by ineffective O&M on distribution system as a result of low electricity tariffs and a range of human resources factors leading to increased number of power outages in the country.

This research therefore aims at explaining the influence of human resource and electricity tariff on TANESCO's operation and maintenance activities, and how, it is affecting power outages in Dar es Salaam. This study is essential, because it forms a bases for informing key decision-makers about the importance of asset management in improving power reliability. The study has applied modern management theories and strategic management approaches as building blocks of the research. Similarly, the conceptual framework for the study is based on the main research question which intent to know *"To what extent does human resource and electricity tariffs influence TANESCO's operation and maintenance activities in reducing power outages"*

This research used the single case study methodology, with both semi-structured interviews and questionnaires as data collection methods. Interview respondents were drawn from both within and outside TANESCO. The survey was administered to the regional management and heads of department in ILALA region. In addition, secondary data was used to verify the findings to increase study validity. Use of both interviews, questionnaires and secondary data served as a means of data triangulation to increased study validity and reliability. Qualitative data analysis for this study was done using Atlas TI and is presented in tabular forms. Similarly, quantitative data was analysed using the SPSS computer program, in which both descriptive and inferential statistics were carried out to arrive at consistent results.

Findings of this research reveal that both human resource and electricity tariff moderately affect utility operation and maintenance activities and consequently, operation and maintenance strongly influences power outages with a negative correlation. These findings explain that improvement in operation and maintenance lead to the reduction in power outages. Human resource factors that were identified to affect the utility operation and maintenance include; inadequate number of operation and maintenance employees, inadequate and outdated working tools.

On the other hand, low tariffs charged on electricity, delays in tariff adjustments and reviews, delays in procurement processes and less budget for operation and maintenance activities are identified to limit effective implementation of operation and maintenance. Similarly, use of corrective maintenance strategy, lack of maintenance plans, and the absence of a computerised maientenance system affect effective implementation of operation and maintenance activities leading to increased power outages. The study also identified other factors apart from tariff and human resources that influence the utility's O&M activities. These factors include; delays in procurement processes, aged distribution network, and poor quality of O&M materials supplied.

This research therefore, recommends that the utility should focus on addressing the identified human resource factors to bridge the existing maintenance gap. Moreover policy makers should ensure that the utility attains cost reflective tariffs inorder to improve its operational effectivenes. Finally the study recommends further research on other factors that influence operation and maintenance activities and how these factors if addressed can help reduce power outages especially in developing countries where power outages still a persisting problem.

Keywords

Human resource, Electricity tariff, Operations and Maintenance, Power outages.

Acknowledgements

Foremost, I would like to express my sincere gratitude to our creator and our almighty God, the source of knowledge and wisdom, who made this possible.

I dedicate this thesis to my lovely husband, Francis Ausoni, who has been an endless source of love, support and inspiration throughout my journey. Also, I dedicate this study to my lovely children Carys and Carrick; you always give me reason and strength to move on. May our Lord bless you and keep you safe.

To my family, my late parents (May your soul continue to Rest in Peace), my sisters and brothers thank you for your continuous support and prayers. May the almighty God bless you.

I am deeply grateful to my supervisor Dr Ogenis Brilhante (PhD) for his guidance, patience and support throughout the specialisation period and the research period. My sincere thanks goes to my second reader Raphael Smals for his valuable and constructive inputs which enabled the successful completion of this research.

Special thanks go to the Dutch Government for granting me a scholarship to pursue this Masters through the Netherlands Fellowships Programme (NFP).

My sincere acknowledgement to the Institute of Housing and Urban Development Studies (IHS) at Erasmus University Rotterdam that enabled the completion of my studies.

Lastly my sincere thanks to my employer Tanzania Electric Supply Company Limited (TANESCO) for permitting me to study at IHS and for providing me with valuable support and information needed to complete my thesis. I appreciate!

Philippians 4:19

Abbreviations

IHS	Institute for Housing and Urban Development
TANESCO	Tanzania Electricity Supply Company Limited
SSA	Sub Saharan Africa
EWURA	Energy and Water Utilities Regulator Authority
CM	Corrective Maintenance
RCM	Reliability Centred Maintenance
TBM	Time-Based Maintenance
CBM	Condition Based Maintenance
NEP	National Energy Policy
O&M	Operation and Maintenance
TZS	Tanzania Shillings
SADC	Southern African Development Community
MEM	Ministry of Energy and Minerals
R&M	Repair and Maintenance
PPE	Personal Protective Equipment
D&CS	Distribution& Customer Services
HRM	Human Resources Management
HOMA	Holistic Maintenance
USD	United States Dollar

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Chapter 1 : Introduction

1.1 Background

Energy is an essential component in urban development. Moreover, power in the form of electricity is a prerequisite for infrastructure development in any country (Kalra and Shekhar, 2006). The reliability of energy is also an essential pre-condition for the functioning of modern economies particularly in developing countries. Despite its importance, the electricity sector in Sub Saharan Africa (SSA) continues to encounter a number of challenges, which include persistent lack of generation capacity and unreliable electricity due to increased power outages. For instance, the total generation capacity in 48 SSA countries is 68GW, but one-quarter of this capacity is unavailable because of aging plant and poor maintenance (Rosnes and Shkaratan, 2011).

In SSA the average number of power outages experienced in a typical month can go to over 100 times (Abotsi, 2016). These constant power challenges in SSA further hinder maintenance, refurbishment and system expansion, which creates power crisis. The overall poor performance of the power sector also constrains the economic and social development of the region. Even though the levels of challenges differ among the countries, SSA has generally been lagging behind on the aspect of power investment and performance. (Rosnes and Shkaratan, 2011)

Africa is losing an approximately $8.24 billion per year due to various inefficiencies in the power sector. These inefficiencies are due to various hidden costs in the industry including system losses, underpricing of electricity and overstaffing. Losses from underpricing of electricity below the current prices (non-reflective tariffs) only account for 44% of the total sector inefficiency. Evidence available suggests that the average revenue collected from customers does not cover the operation costs of the utilities in Africa. Foster and Briceño-Garmendia, (2010) argued that the problem of underpricing is worst in Malawi, Tanzania, and Zambia.

Moreover, hidden cost in power sector is claimed to absorb revenue that could be used for the system operation, maintenance and expansion activities. System losses due to inefficiency accounts for about 18% of the sector inefficiency while overstaffing in the utility companies accounts for 14% of the total inefficiency. Data from the World Bank Climate Assessment (ICA) indicates that deficient power infrastructure and frequent power outages has been causing collapse and poor performance of businesses which results into losses in different enterprise firms. The losses are argued to be 6% of average turnover of the formal firm sector and 16% of the informal sector enterprise.

As addressed by different studies power supply in SSA is extremely unreliable and the overall economic performance due to power outages is significant. The estimated value of lost load, unserved energy and power outages in SSA constitutes an average of 2.1% of the region's GDP economy (Rosnes and Shkaratan, 2011). For instance, in the year 2007 Tanzania and Burundi experienced an average of 63 and 144 days of outages respectively. These frequent power outages result in different losses to the users as well as to the service providers. To reduce power losses and increase power reliability Sullivan, Pugh, et al., (2010) advocates for effective O&M activities. He further observed that effective O&M is the cost-effective way of guaranteeing power reliability.

Operation and maintenance are considered to be critical activities for the company to satisfy customer needs. O&M also contributes to the power reliability and the quality of service (Fernández and Márquez, 2009). It is known that maximum asset performance is among the

primary goals in power distribution networks. To attain this goal, effective operation and maintenance becomes a vital agenda aiming at increased reliability while maintaining the system at a rational cost while at the same time meeting customers and regulators demands. (Sullivan, Pugh, et al., 2010).

On the other hand, successful O&M programs require teamwork and involvement at all levels. It is essential for every participant involved in O&M activities to understand the basic principle and support it (Sullivan, Pugh, et al., 2010). Similarly, Esmaili (2012), explained the importance of qualified, skilled, and experienced employees for the proper implementation and organization of the O&M activities. Furthermore Liu, Combs, et al., (2007) established a strong relationship between organizational performance and human resources. The study advised on the importance of human resource management as a significant factor in attaining organization operations performance.

To address inefficiencies in the electricity sector, authors call for critical interventions that help improve utility operations by bringing tariffs to the level of long-run marginal costs. The authors also call for proper management of human resources for the better performance of the sector (Rosnes and Shkaratan, 2011).To achieve this while delivering the best value for money in managing physical assets, we should consider the trade-offs between performance, costs, and risks in all stages of an asset in delivering services (PAS, 2008). For example, expenditure versus performance level, planned versus unplanned availability or capital versus operating costs. Moreover, it is important for an organization to recognize that optimal lifecycle management of assets depends heavily on human assets and financial resources. All these have a significant effect on reputation as well as consumer satisfaction (PAS, 2008)

1.2 Problem Statement

For a long time the energy sector in Tanzania and other African countries has encountered persistent challenges that hinder the sector performance. The problems facing the sector include low private sector participation in large-scale power production, over-reliance on hydro energy sources, unreliable energy supply, overdependence on government subsidies, little access to modern energy services and inadequate skilled human resources. Furthermore, low tariffs charged on electricity have resulted in inadequate and delayed maintenance activities, which result in increased power outages. (United Republic of Tanzania, 2015).

In the power sector reform report of six African countries, the author addressed power outages as the main problem in Tanzania. Power outages in the country not only affect the household but also affect the industrial sector (Kapika and Eberhard, 2013). Studies by Abotsi (2016) revealed that the problem of power outages is worst in Angola, DRC, Ghana, Nigeria, Tanzania, and Zambia.

Currently Tanzania Electric Supply Company Limited (TANESCO) dominates electricity sector in Tanzania, which is a monopoly public organisation responsible for the generation, transmission and distribution of electricity in the country. The generation business unit is responsible for all power generating plants possessed by the company; it is also responsible for all national grid plants and off-grid power stations. Also, Tanzania uses standard transmission levels at 400kv, 220Kv, 132Kv, and 66Kv. All transmission lines are integrated to form a national grid system. Transmission business unit operates, maintains and controls all transmission lines throughout their economic life. Distribution and customer service is a wide business unit regarding geographical coverage. Electricity is distributed at medium voltage levels of 33kV and 11kV and 0.4kV. Together with other tasks, the distribution business unit distributes and sells electricity to all consumers and is also responsible for reducing distribution losses and power outages.

On the other hand, the Energy and Water Utilities Regulatory Authority (EWURA), regulates the entire energy sector in the country which comprises electricity, water, petroleum and natural gas. Together with other activities, EWURA is responsible for promoting the economic efficiency of the sector, protecting customer's interests, and protecting supplier's financial viability. Additionally, EWURA has the authority to award and approve different licenses, terms, and condition on the electricity sector. EWURA is also responsible for approving and enforcing electricity tariffs within the country. It is also a function of the regulator to examine trends in operation and maintenance activities as well as efficient delivery of the customer service by the provider. (United Republic of Tanzania, 2015).

The average number of power outages in Tanzania is 148 outages per year, which is quite high compared to other African countries. This positions Tanzania among the ten worst performing countries in Africa (Tallapragada, Shkaratan, et al., 2009). Among all the factors that influence the number of outages in the country, poor and deferred maintenance activities on the distribution networks is stated as the major factor influencing the increased number of power outages. (United Republic of Tanzania, 2015).

Company report to regulator in the financial year 2016/2017 claimed that the problem of continued deferred repair and maintenance is largely contributed by a non-reflective tariff and allocation of a constrained budget for R&M activities, which results into increased forced (unplanned) power outages in transmission and distribution networks. For instance, in the financial year 2013-14, TANESCO proposed a practical tariff increase to the regulator. The regulator agreed with the proposed tariff increase; however the final tariff approved was significantly lower than the proposed tariff by the service provider (Peng and Poudineh, 2016).

Low electricity tariffs often result into less fund available for operation and maintenance. This leads to deferred maintenance activities, which triggers a number of unplanned outages in distribution networks. For example, during the financial year 2016/2017 only 6% of the company revenue was allocated for repair and maintenance instead of 15% of the total revenue budget, which is the best industry practice when budgeting for O&M activities. Likewise, in the year 2014 TANESCO's actual expenditure in R&M expenditure was only 4% percent of the revenue (Tanzania Electric Supply Company Limited, 2016b). On the other hand, human capital is also mentioned to hinder the company's operations and maintenance activities resulting into poor level of customer services, increased number of outages, and increased customer complaints (Ministry of Energy and Minerals, 2014).

As a way to reduce the number of power outages Sullivan, Pugh, et al., (2010), identified effective operation and maintenance in distribution networks as the best cost-effective method in ensuring power reliability. The author further advocates power reliability as a traditional approach used to access effective maintenance programs. Moreover, Armstrong and Stephens (2005), in the book of modern management theory and leadership argues that building customer-centric culture, defining attitudes, skills, and behaviors to the customers is the best way of achieving a high level of customer service. It is therefore, essential for the company to focus on increasing customer satisfaction by investing in power reliability to build a customer-centric culture.

Based on the explained scenarios it is clear that the increased number of power outages in the electricity sector in Tanzania is a result of poor operation and maintenance activities on the distribution networks. As argued early, poor operation and maintenance activities in the company, is attributable to the low tariffs charged on electricity as well as a range of human resource factors. It is, therefore, the aim of this study to establish the influence of human resources and electricity tariffs on the operation and maintenance activities by the service provider and establish its effect on power outages.

1.3 Research Objective

Based on the problem statement this study, therefore, aims to explain how different human resource factors and the electricity tariff are influencing the operation and maintenance activities of the service provider (TANESCO) in reducing the number of power outages in Dar es Salaam. This research moreover aims at identifying and explaining essential factors of operation and maintenance, and their effect on the number of power outages in Ilala region, Dar es Salaam.

1.4 Research Question

Main research question

To what extent does human resource and electricity tariffs influence TANESCO's operation and maintenance activities in reducing power outages**?**

Sub-questions

- How does human resources influence O&M activities?
- To what extent do tariff limit the implementation of TANESCO O&M activities?
- How does operation and maintenance influence power outages?

1.5 Scope and Limitation

This study covers only distribution subsector at the medium voltage level outage of 33kV and 11kV. The research covers distribution subsector because this is the part that is directly linked with the customers. Moreover, the study will focus on one of the TANESCO operation regions in Dar es Salaam namely Ilala since the company extends its operation to the whole country.

From a customer's perspective, the study will then focus on assessing the quality of customer service in the face of unplanned power outages linked to the company's operation and maintenance activities. There are many factors considered to contribute to the ineffectiveness of the electricity distribution networks, but this study will be limited to electricity tariffs and the contribution of human resource to the operation and maintenance activities, to get a better understanding of their impacts on the quality of service to the customers in terms of reduced number of outages.

1.6 Relevance of the study

Sullivan, Pugh, et al., (2010) advocated that effective O&M is the cost effective way of guaranteeing power reliability. In order to build knowledge on relationship between O&M and power outages this research will therefore be significant in explaining the factors that contribute to the poor O&M and how this results into increased number of outages in the country with a particular focus on human resource and tariffs.

The research will further demonstrate to the utility that improvement in O&M of distribution networks will lead to reduction in power outages hence, improved power reliability. The study will also serve as a communicating tool to the external stakeholders responsible for setting and approving tariffs (Energy regulator and Ministry of Energy and Minerals), by addressing the challenges associated with low tariff charged and their effects on power reliability.

Finally, the study aims to add to the prevailing body of knowledge the significance of operation and maintenance on electricity distribution networks and its relationship with power reliability through human resources and electricity tariff. The study also intends to stimulate further research on other factors that influence the operation and maintenance activities and how these factors if addressed can help in reduction of power outages especially in developing countries where power outage is a persisting problem.

Chapter 2 : Literature Review / Theory

2.1 Introduction

Developing countries need adequate access to reliable and modern energy to address the growing development challenge. Around 1.5 billion people have no access to electricity while nearly one billion people are subjected to unreliable electricity as well as frequent power blackouts. According to estimates by studies, energy-underperforming countries lose a growth potential of 1%-2% of growing potentials annually due to power outages (Rosnes and Shkaratan, 2011). Consequently, Sullivan, Pugh, et al., (2010), suggested that to ensure the reliability of an equipment or system it is essential to enhance effective operations and maintenance activities. He further argued that effective operations and maintenance is the most economical way of ensuring system reliability and safety.

The previous chapter presented various problems encountered by the electricity sector in Tanzania. Problem statement specifically presented the challenge of constant power outages that are mostly contributed by operation and maintenance activities of the company. Moreover, in the main research question human resources and electricity tariff are identified as independent variables, which influence the company's operation and maintenance activities and have a significant influence in reduction of power outages. Operation and maintenance is determined to be the intervening variable while power outage is considered the dependent variable. Therefore, the following chapter will provide a literature review and theoretical background for the main variables identified in the study.

On the other hand, Armstrong and Stephens, (2005) defined "management as the process of deciding what to do and getting it done through the effective use of resources." (Armstrong and Stephens, 2005, P.4). Through management, the goals are set and resources determined (finance, peoples, systems) which are required to accomplish the goals. Therefore, this study will first describe management theory as its primary building block.

2.2 Management Theory

Different authors define management in different ways. Cole (2004), defined management "as the act of getting people and transformational resources together to accomplish desired goals and objectives. Management comprises planning, organizing, resourcing (encompasses the deployment and manipulation of human, financial, technological, and natural resources), leading or directing, and controlling an organization." (Cole, 2004 P.25).

Likewise, classical theorists defined management as "all undertakings required in planning, organizing, commanding, coordination, and control to ensure proper functioning" (Armstrong and Stephens, 2005, P.4). Human relation approach to management proposed by Professor Elton Mayo describes people's needs as the critical factors in achieving organizational effectiveness. On the other hand, system and contingency approach to management considers the organization as a complex system of people, tasks, and technology (Cole, 2004).

Similarly, the primary purpose of management in a business-oriented organization is to ensure the firm can make a profit and that goods and services are produced at reasonable costs and delivered to consumers while creating value for stakeholders. Providing satisfying employment and development opportunities to employees is also a primary purpose. For the public sector, the primary function of management is to guarantee provision of effective services to the citizens. (Armstrong and Stephens, 2005).

2.2.1 Modern Approaches to Management

In the late twentieth century, the management focused on the organizational effectiveness with the focus on strategic issues. It emphasized more on effectiveness and not only efficiency. Cole, (2004) defined effectiveness as doing right things while efficiency is about doing things right. Either the concern of modern approach to management has been lied in developing a strategic mission, establishing organizational values and promoting quality management to achieve organizational excellence through advocates for attaining organizational effectiveness. The primary focus is achieving organizational quality, enabling personal empowerment and improving stakeholder relationships (Cole and Kelly, 2011)

This modern approach to management is in line with strategic management such that both focus on organizational effectiveness and aim at customer excellence. Therefore, modern approaches to management and strategic management form the basis for this study. This is because the principal objective of this research is to attain customer excellence through reduction in the number of outages.

2.2.2 Strategic Management

Strategic management is concerned with the organization as a whole. It deals with the fundamental decisions on what the organization is now, and what is to be in the future. Furthermore, it provides a framework for making decisions about people, governance, clients, risks, funding, incomes, products, systems and technologies. Likewise, it is the determinant of the company achievements and the decision on what the company will or will not do. (Morden, 2016a)

The process of strategic management is used to create company mission, objectives, and strategies of the enterprise. Also, organization mission statements usually stipulate what the organization is about and what are the organization values while organization objectives are the statements which explain main goals that an organization aim to achieve. (Morden, 2016a)
Focusing on TANESCO, the company's vision is, "***to be an efficient and commercially focused electricity utility supporting the development of Tanzania and to be the powerhouse of East Africa,"*** while the mission is "***to generate, transmit and supply electricity in the most effective, competitive and sustainable manner***." The company also emphasizes core values, which include ***ethical, excellence*** and ***receptiveness***. To align this research with the company mission, vision and objectives the study has used modern approach to management and strategic management as the building blocks.

Furthermore, this study also considers the fact that the main aim of the service provider is not only to supply electricity to the customers but also to ensure effective use of resources, and create values to the government, donors, customers, employees and other stakeholders' while maintaining service excellence by improving power reliability through reduction of the number of power outages.

2.3 Human Resource Management

Human resource refers to the intangible assets that are integral to the continuous success of a company (Harel and Tzafrir, 1999). Human resource contributes to the maximization and increase of the company performance and abilities. Through a competent human resource, company employees become a valuable asset that cannot easily be copied or replaced and this eventually leads to increased competitive advantage.

Furthermore, Armstrong and Taylor (2014), described human resource management (HRM) as a philosophy which explains how people are managed in relation to their behavior and organization. HRM is concerned with how people can be used to ensure successful organization effectiveness. HRM also focuses on how workers should be treated based on agreements of the ethical values. HRM strategies include policies and practices of organization development, employee-resourcing, employee learning and development, as well as employee working environment which all together ensure the well-being of the employees and contributes to the organization performance (Armstrong and Taylor, 2014).

2.3.1 Human Resource, and, Operation and Maintenance

There exist a lot of questions whether human resources matters for organization operation performance. In the study by Liu, Combs, et al. (2007), based on 19000 organizations concludes that human resource management adds significant value to the organization. Moreover, the value added to the organization operation activities becomes stronger when human resource systems are emphasized rather than personal . Also when HRM decisions act as a strategy in the organization (Liu, Combs, et al., 2007). Furthermore, Esmaili (2012), argued that in delivering service to the customers according to the desired level it requires qualified, skilled and experienced employees to correctly implement O&M plans of the company. This study, therefore, aims to establish the main factors of human resources, which influence operation and maintenance activities. It also discusses the main factors of human resource management that affect organization performance as presented in the literature.

2.3.2 Staff Training and Knowledge

Staff training can influence work performance in an organization in different ways. First by improving skills and capabilities of the employee to a specific task. Also through the training of the employees, satisfaction in the job and work place is increased. (Harel and Tzafrir, 1999). According to Itika (2011), employees including line managers involved in an organization's daily operations should have enough general and specific knowledge, and skills of the tasks for acceptable performance in his/her individual, team, departmental or company responsibilities. Human resource managers are required to know and develop their staff capabilities that are important for the organization performance through organizing and conducting different carrier programs.

2.3.3 Working Environment

Proper/good working environment not only encourages positive attitudes towards work but also promotes interest and excitement among employees. Adequate working environments help workers to reduce stresses as well as identify the importance of social interaction. Effective leadership and proper design of job systems in an organization, does not only contribute to the worker's performance but also provision of suitable resources, working tools and information that enables the employees to perform effectively (Armstrong and Taylor, 2014).

Improvement of the working environment includes the employees healthy and safety in their day-to-day activities. Healthy and safety policy is universally accepted as a component in the management of an organization, as it ensures protection of workers from work related hazards. it is therefore essential for the company to ensure a safe working environment for the employees as well as provide public safety. Compliance with the health and safety legislation should be given priority in the organization as well as emphasis on training, coaching on health, and safety programs (Itika, 2011).

2.3.4 Utility Staffing

Appropriate staffing levels and efficient task allocation is still a key challenge to many service providers. It is therefore critical to consider the essential dimensions when analyzing utility staffing. Trimble, Kojima, et al., (2016), mentioned staff numbers, staff skills, attendance, and staff costs (salaries and benefits) as an essential dimension to be considered. The utility may appear to be adequately staffed, however, the productivity of a huge chunk of the employees on the payroll is not up to the expectation. The low human productivity has a negative effect on the overhead costs incurred by the company (Trimble, Kojima, et al., 2016).Utility staffing is further discussed in the following subtitles.

- **Number of employees**

Trimble, Kojima, et al., (2016), defined overstaffing as the excess number of employees when compared to the benchmark number of employees. Utilities in SSA had large number of employees per customers when compared to other developing countries. According to Foster and Briceño-Garmendia (2010), Labor redundancy is another source of utility inefficiencies. In the African power utilities, there is an over employment of 88% relative to the developing countries, which accounts for 413 connections per employee. This results into over employment by utilities, which results into utilities overspending in the range of 0.07% of the GDP. In SSA, Cape Verde is the only country that is understaffed. Gabon, Burkina Faso, Swaziland and Senegal have sufficient staff levels in SSA. Zambia is the worst performer in the overstaffing indicator since it is overstaffed by 70%.

Furthermore, according to Trimble, Kojima, et al., (2016), TANESCO is overstaffed by 2694 workers. Standard benchmark staff number is 3634 while the current number of staff in generation, transmission and distribution department is 6328. Therefore, this research will use customer/employee ratio to access the utility labor efficiency. Tallapragada, Shkaratan, et al., (2009), defined customers/employee ratio as the ratio which measures work efficiency of the utility. If the ratio is larger it implies the utility is well managed and efficiently operated.

- **Staff cost**

Staff costs represent a substantial portion in the operation and maintenance costs of the utility. Staff costs include employee salaries and all associated costs, health benefits and employee pensions. According to Trimble, Kojima, et al., (2016), the staff cost in SSA is approximately an average of $ 13,000 per employee annually except in South Africa. Approximately the cost of overstaffing in SSA could be reduced to 50% of the overstaffing level. Furthermore, the author suggests that the utility can choose to either adjust salaries or staff number. This can be done by reducing the staff number to an optimum level and increase their salaries to attract higher capacity employees. On the other hand, utility can opt to reduce the number of staff to a required level and keep salaries constant.This will reduce staff costs in proportion to staff reduction. Additionally, staff costs represent the lowest share of O&M expenses in Tanzania while it represents the highest share in Gambia (Trimble, Kojima, et al., 2016). Likewise, Tallapragada, Shkaratan, et al. (2009), suggested staff cost/total cost as an important indicator in the utility companies and it is a main factor in determining utility profitability.

2.4 Electricity Tariffs

Farvacque-Vitkovic and Kopanyi (2014) defined tariff as the price charged to consumer by utility after the provision of the service. Moreover, Brazilian National Electric Agent defined electricity tariff as the “composition of evaluated costs which represent each part of the investments and technical operations performed by the chain of production agents and the structure necessary for the energy to be consumed by the customers” (ANEEL, 2008, P.1). In the former regulatory frameworks, electricity tariff was used to run all the power sector costs

without a discrepancy between activities. In developed countries, domestic consumers partly subsides the large power users who in turn create more jobs and stimulate economic growth. In developing countries vice versa is common, large power users often subsidize domestic users who cannot afford electricity cost (Ortega, Pérez-Arriaga, et al., 2008)

2.4.1 Electricity Tariffs and Operation and Maintenance

Productivity in electricity sector will not only be attained by introducing competition in generation and commercial activities but also by the proper design of transmission and distribution tariffs which are economically viable (Ortega, Pérez-Arriaga, et al., 2008). According to Ortega, Pérez-Arriaga, et al., (2008), distribution tariffs if well designed is capable of altering consumption and generation patterns. Additionally, financial viability is a key foundation for a healthy power sector. Financially viable utility companies are more effective operationally because they are capable of financing maintenance activities timely. Attaining this goal requires electricity tariffs that are great enough to cover operation and maintenance costs (Foster and Briceño-Garmendia, 2010). This section therefore discusses different factors of tariff in relation to the implementation of organization O&M activities.

2.4.1.1 Operation and Maintenance Budget

Finance is an essential resource to an organization. An organisation can only undertake its activities depending on the available financial resources. Furthermore, finance is a key resource underpinning the operational capability of an organisation. This is because available budgeted funds govern what kind of assets and people as well as O&M activities an organisation can afford and therefore what kind of output is expected from the organisation (Morden, 2016a). Moreover, electricity tariff should meet the sector costs. The funds should also be sufficient to guarantee energy supply and assure sufficient funds for the utility to efficiently cover its operation and maintenance costs. This will also enable the utility to investment as well as guarantee desired quality services to the customers.(ANEEL, 2008)

Generally “operation and maintenance costs includes the costs of fuel, materials and replacement parts, energy purchases, supervision, personnel and overhead” (Peng and Poudineh, 2016 , P.74). Although the allowed O&M costs may not be the total of incurred costs, all costs should be carefully considered. In recent years, TANESCO has been spending only a fraction of its revenue for R&M activities. This is against the recommended expenditure of 15% of the company revenue in R&M. For instance in the financial year 2014 TANESCO expenditure on R&M activities was only 4% of the revenue. This continued allocation of less budgets for O&M led to deterioration of the company O&M activities, which are expected to increase unplanned outages in both generation, transmission and distribution networks (Peng and Poudineh, 2016).

2.4.1.2 Effective Tariff

Cost of producing electricity in Africa is high as compared to the cost in other regions. Average cost of producing a unit of electricity is $0.18per Kwh while an average effective tariff is $0.14 per Kwh. Higher production cost is related to rising oil prices, lower availability of hydropower sources and reliance on emergency leases (Foster and Briceño-Garmendia, 2010). Furthermore, according to Foster and Briceño-Garmendia, (2010) Tanzania is among the countries in Africa with operating inefficiencies. Among other reasons stated to be a source of inefficiencies is low tariff charged on electricity. Average revenue collected per unit of electricity sold is significantly lower than the average effective tariff charged. Effective tariff measures price of kWh of electricity according to monthly consumption level.

Moreover, the structure of tariff differs among different countries. While some tariff compose the fixed monthly charges that can be large, other countries may not have such charges. All tariffs include volume-based charge, which indicates the charge of each kWh consumed. In SSA countries effective monthly tariffs range from 2uscents/kWh to 36uscents/kWh. Tariffs at the

lower end are deemed unsustainable and cannot efficiently cover the utility costs. On the other hand, the affordability of the tariffs on the upper end is questionable given that many of the consumers in SSA fall within the low-income groups.

Basing on the residential tariff, Tallapragada, Samaritan, et al., (2009) distinguished four categories of tariffs in SSA countries as follows. The first type is in the countries with steep increasing effective tariff with the increase in electricity consumption. This type of tariff is argued to be efficient when perceived from an affordability point of view. Kenya and Chad are in this tariff category. The second type includes the slightly increasing effective tariff with the increase in electricity consumption. This type may be considered affordable, but its affordability is seen to be marginal when compared to the consumer's income levels. Madagascar, Cape Verde, Uganda, and Tanzania belong to this category. Third type of tariff includes the group of countries having a flat tariff, in other words, tariff does not change with the increasing electricity consumption. These tariffs do not offer any subsidies to the low energy consumers and are argued to be inefficient from the affordability point of view. Countries with this type of tariff include Niger, Congo, and Burkina Faso. The last category consists of the nations with effective tariff decreasing with the increased consumption. These tariffs are claimed to be counterproductive from the affordability perspective. Usually, these tariff comprise substantially fixed charges or are considered having a low level of volume- based part. Countries categorized under this group consist of Cameroon, Malawi, Zambia, and Senegal (Tallapragada, Shkaratan, et al., 2009).

2.4.1.3 Tariff Setting and Adjustment

In designing tariffs, there are various principles in each country. These accepted principles act as regulatory principles in setting tariffs. The regulative principles set boundaries and provide hints of the required action. In setting different tariff structures, the company or regulator should obey the tariff setting rules. Developed countries usually obey these rules while in developing countries the rules are overlooked, compromised and sometimes are unknown. The following are five main principles in designing electricity tariff as explained by Ortega, Pérez-Arriaga, et al., (2008).

- Sustainability: The tariff has to recover all allowed costs.
- Economic efficiency: The tariff should ensure maximization of the social wellbeing of both customers and distribution companies. This has not been the case because very little has been done to ensure efficiency on customers.
- Equity in cost allocation to the customers: Each service user should pay the cost as per the service use. Users should be responsible for how they use the service. In vertically integrated companies there is usually subsidies imposed across the company sub-sectors (transmission and generation) and across the different customer categories. Often in developed countries tariff are set up in a way that domestic consumers partly subsidizes the large power users mostly the industries as the industry provides jobs and supports economic growth. A different situation exists in developing countries where large electricity consumers subsidize the domestic power users.
- Additivity: for the vertically unbundled utility company final electricity tariff should cover the generation, transmission and distribution costs moreover for the unbundled company; each business unit should cover its own expense.
- Transparency: The tariff design should be a transparent process that will openly disclose the electricity prices to the society (Ortega, Pérez-Arriaga, et al., 2008).

Either the service provider or regulatory authority should ensure consistency and stability in designing the tariffs (Ortega, Pérez-Arriaga, et al., 2008).

According to Vitkovic and Kopanyi (2014) there are some problems that face developing countries in the tariff setting structures. He highlighted some of the challenges as follows.
First, initial investment and sometimes network expansion are often financed by the central government hence not accounted in tariffs hence the failure of the tariff to cover the operation and maintenance costs and therefore poor services to customers. Additionally, the service providers have no motivations for cost saving and service improvements which results in service unsatisfactory to both service providers and consumers. Secondly, the subsidies between those who pay and those who do not pay. Commercial and industrial customers often pay excessive tariffs since they can afford to pay. The author further argued that low tariffs may result in a subsidy of a different kind to a service provider including block grants, discretionary grants and finally resulting into unaffordability of tariff to some customers.

- **Tariff Readjustment and review (Times/year)**

Tariff readjustments and reviews are the mechanism used to change and adjust tariffs. These mechanism are determined in contracts to balance the economic and financial undertakings of utilities in accordance with the regulations. The main objective of tariff readjustment and review is to guarantee reasonable tariff to both the customers and the investors to ensure efficiency and quality in electricity supply services (ANEEL, 2008).

Section 23.2 of the Electricity Act in Tanzania states that, in approving the tariff adjustment, the regulator must ensure that any increment proposed by the service provider is able to guarantee price stability. Normally TANESCO requests automatic adjustments to cater for inflation, currency fluctuations and change in fuel prices. The adjustments are then applied to all customer categories and are supposed to take place on a quarterly basis. In addition tariff adjustments enable the company to fund its O&M costs, investments costs and adequately fund R&M budgets to ensure power reliability (Tanzania Electric Supply Company Limited, 2016b)

Consequently, tariff setting and adjustment per year has been used as an indicator to measure the utility's ability to review and adjust tariff structures to cover utility costs with revenue. For many service providers tariff decisions are usually political and not anchored on cost basis hence, the companies are not compensated for the resulting losses (Tallapragada, Shkaratan, et al., 2009).

2.4.1.4 Obstacles to Cost Reflective Tariffs

SADC defined cost reflective tariff as the" tariffs that reflects the true costs of supplying electricity, removing reliance on external subsidies to cover the variance between current tariffs and true cost of electricity" (RERA, 2016, P.11). In cost reflective tariffs, total costs are assigned to the electricity consumers, even though different factors affect the allocation of true cost to the consumers. These factors include consumption pattern, time of use, location and existing network system.

On the other hand the inputs that make up the electricity supplying cost are divided into fixed charges and variable charges. Fixed charges comprise the investment required to run the electricity system, these charges do not consider consumption patterns. Variable charges are charges that are affected by input costs and the user behavior. Cost reflective tariff includes both fixed charges and variable costs, as its purpose is to recover all the costs in delivering electricity to the different consumer classes (RERA, 2016).

Cost reflectivity has many benefits to the utilities. These benefits include increasing utility's ability to attract private investors, the financial viability of the utility company, and encouraging the suitable use of the existing resources including network and human resources. (RERA, 2016). According to Kapika and Eberhard (2013), the main objective for the cost-reflective tariff is to charge the customers according to the charges they impose to grid although this cost

reflective tariff for Tanzania is practically impossible in general use tariff category due to diverse customer groups and continuous variations in consumption patterns

Cost reflective tariff is on top of SADC members agenda as it is for the developed countries. According to RERA (2016), while some countries made a step towards cost reforms to reflect cost-reflective tariffs, tariffs in other countries remain low hence, high dependency on different forms of subsidies as a mechanism to cover the costs. Cost reflectivity is a necessary condition for the viability and sustainability of the Electricity sector. Although the rules are set the practice in developing countries, tend not to meet these criteria. The author argued that in developing countries there are different constraints in achieving reflective cost tariffs. One of the reasons that forces developing countries not to meet these criteria is the political interference by government officials. The failure to meet the criteria in developing countries has forced the utilities to have insufficient revenue for operation and maintenance activities, which results, into poor levels of service to the customers as well as continued deterioration of the assets (Farvacque-Vitkovic and Kopanyi, 2014).

2.5 Asset Management

Infrastructure includes all assets, which can deliver services. Example of infrastructure includes energy networks, water utilities, telecommunication networks, roads, and many more (Esmaili, 2012). Moreover Asset management is defined as "operating a group of assets over the whole technical lifecycle guaranteeing a suitable return on ensuring defined service and security" (Schneider, Gaul, et al., 2006, P.1). Likewise, The Institute of Asset Management defined asset management as "systematic and coordinated activities and practices through which an organization optimally and sustainably manages its assets and asset systems, their associated performance, risks and expenditures over their lifecycles to achieve its organizational strategic plans" (PAS, 2008). Asset management is important for the utilities that depend on the functions of physical assets in delivering services. The importance of effective asset management to an organization includes.

- Enhancement of customer satisfaction through improved performance and regulated service delivery to the desired standards
- Improvement of health, safety, and ecological performance
- Improvement of corporate reputation through enhancement of shareholder values, increased customer satisfaction and improved quality of services. (PAS, 2008).

According to Schneider, Gaul et al., (2006), in electricity companies, asset management plays an important role in economic success of the companies. Asset management should align its strategies and operations to meet stakeholders' standards and objectives, while, reliability, safety and financial components should not be compromise. Asset management includes technical activities as well as economic aspects such as investment, budgeting, and strategic planning issues. Moreover, asset management should be integrated and linked with the company's cooperate strategies (Esmaili, 2012). Furthermore, operation and Maintenance approaches are the crucial strategies and asset management techniques used by most of the utility companies in assessing the organization performance.

2.5.1 Operation and Maintenance

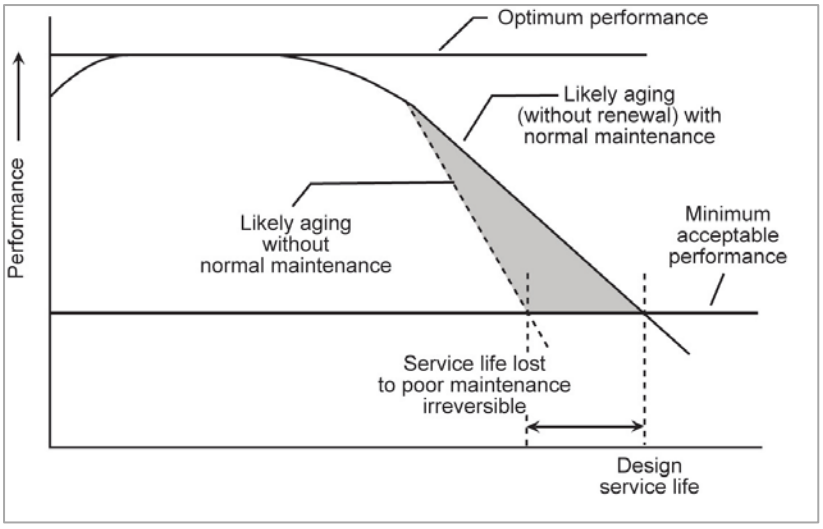
Operation and maintenance refers to all activities involved in controlling and up keeping of network/equipment. It includes a setup of procedures, schedules and work orders. It also involves performing planned and unplanned activities as a preventive or predictive measure which aims at avoiding equipment failure or deterioration. Furthermore, operation and maintenance aims at raising equipment output, reliability and safety (Sullivan, Pugh, et al., 2010).

According to Esmaili (2012), every equipment has a service life that determines the required quality and quantity of maintenance. Equipment service life is the "time of construction that the asset can perform its required functions for the owner or customer" (Esmaili, 2012, P.2). Equipment service time varies from one equipment to another. Factors contributing to the variation include the type of infrastructure, its intensity of use, operating conditions (environment) and technological intervention of the equipment. Moreover, proper planned maintenance elongates service life of an asset, however, for an asset which has attained its service life it should be entirely replaced.

Infrastructure assets do have finite lives, and they can fail depending on different factors such as level of use, soil conditions, infrastructure age, and general wear and tear. Therefore, it is of great importance to continuously undertake periodical inspection to monitor the asset condition (Esmaili, 2012).

Figure (2-1) below summarizes the impact of adequate and timely maintenance of an equipment's service life. As the figure (2-1) explains, proper maintenance on equipment/asset elongates its service life at the same time ensuring maximum performance. Likewise, poor maintenance on an equipment/asset is likely to reduce its service life and the equipment is likely to have early aging.

Figure 2-1: Effects of maintenance on equipment service life



Source: Adapted from (Sullivan, Pugh, et al., 2010)

2.5.1.1 Maintenance Strategies

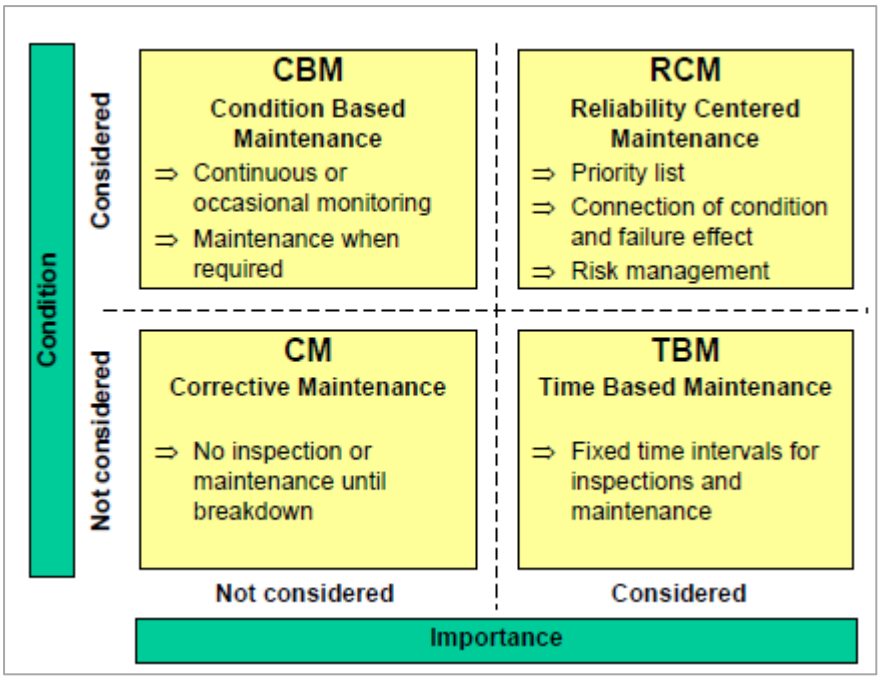
Schneider, Gaul, et al., (2006), noted that, maintenance strategies can be divided into various categories, through which maintenance expenses and quality can be determined. To categorize the maintenance strategy of an asset or network,one should consider both the condition of an asset and the importance of that particular asset. Maintenance strategy also considers the desired level of details and availability of appropriate information (Schneider, Gaul, et al., 2006).

Esmaili (2012) addressed two approaches to maintenance namely preventive maintenance and corrective maintenance. Preventive maintenance involves all routine or scheduled maintenance activities carried out on an asset or network to avoid failures or disruptions. Corrective maintenance is the maintenance carried out in response to the damage or disruption. Corrective maintenance can be done under emergency failure when the equipment is damaged or its service provision is threated or when an asset is in a dangerous condition to rescue its functions. Similarly Abu-Elanien and Salama (2010), categorized maintenance strategies for the utility

companies into two main categories preventive maintenance and corrective maintenance. Schneider, Gaul, et al., (2006) and Abu-Elanien, and Salama, (2010), further categorized preventive maintenance into three types namely Condition-Based Maintenance (CBM), Reliability Centered Maintenance (RCM) and Time Based Maintenance (TBM).

Figure 2-2 below summarizes the classification of maintenance strategies based on the condition and importance of an asset. Under corrective maintenance, neither condition nor significance of an asset or network is important. Contrary preventive maintenance recognizes condition and importance of an asset.

Figure 2-2: Maintenance Strategies



Source: (Schneider, Gaul, et al., 2006)

Under corrective maintenance, no maintenance is done on an asset until it shows the signs of failure. The team then decides whether an existing asset needs repair or replacement. Corrective maintenance strategy may results in more cost when compared to the preventive maintenance. Likewise, this strategy may interfere with the supply reliability, which can lead to additional economic impacts to the utility company. (Schneider, Gaul, et al., 2006)

On the other hand, preventive maintenance is used to prevent failures and damages to an asset or network as described in the following three types. In time-based maintenance (TBM), the utility fixes time intervals for inspection and maintenance activities of the particular asset depending on manufacturers' specification or network operator experience. This strategy is suitable where erosive or corrosive wear is likely to take place on an equipment. It is a strategy widely used in medium voltage and high voltage networks (Schneider, Gaul, et al., 2006).

Condition-based maintenance (CBM) involves inserting a condition monitoring system to an equipment or a system so that it can detect an emerging fault that is likely to occur. By this strategy, the risk of the total failure of the asset is reduced as the operator will be able to know the condition of the equipment and which type of maintenance is needed to reduce the risk of the failure. Condition based maintenance saves the unnecessary cost of additional inspections, reducing unnecessary shutdown of the system as well as reducing risks of the complete failure of the network. On the other hand, CBM needs a data communication system that is expensive

for many utilities and also less understood by the technicians and engineers (Abu-Elanien and Salama, 2010).

Reliability-centered maintenance (RCM) can be described as a maintenance strategy which combines more than one maintenance strategies. Under RCM, the degree of fault occurrence is identified by multiplying the chances of failure and consequences of occurrence. The implementation of the RCM is prioritized by considering the consequences of the equipment/system followed by the probability of occurrence. The advantage of RCM is utilization of optimal cost as the maintenance is based on the risk assessment, reduction of unnecessary shutdowns and risks and saving of unnecessary money and time for inspections. This maintenance strategy generally optimizes the maintenance plan based on risk assessment. This strategy has been assumed recently by different utilities and industries to change the regular TBM into RCM.

The drawbacks of this strategy include complexity in building the model, need for loads of information (data) such as failure rates, and the complexity posed to the technicians and engineers by the model. These complexities make adoption of the model difficult to many utilities (Abu-Elanien and Salama, 2010). Therefore, the maintenance strategy applied becomes an important factor in determining utility operational performance. It is therefore important for the utility to consider which maintenance strategy is optimal to its performance

2.5.1.2 Operation and Maintenance Plans

O&M plans are plans developed by the service provider to offer a written foundation of material that can be used for guidelines on operation and maintenance activities. They also provide complete reference for all tools necessary for the maintenance activities and in case of ordering a new part for replacement. Additionally O&M records are beneficial for monthly and annual reports as they are used as supporting documents for effective operation and maintenance.

O&M plans are also used as training manuals to provide employees with important reference while learning the facility operation. The plans can also be used by experienced operators to monitor normal system procedures and to note if there is any emergency condition. The plan contains a collection of plans and programs stored in notebooks. The importance is not how it appears but the accessibility of information to the workers and the workers ability to update it (Georgia Environmental Protection Division, 2000). In order to develop effective operation and maintenance plans it is therefore important to have a;

- Proper knowledge on asset failure types, effects of failure and criticality of the assets
- Appropriate maintenance plans specifying materials, usage schedule and location
- updated operation and maintenance registers and manuals
- Operation and maintenance manuals available to responsible staffs (Esmaili, 2012).

Likewise the organisation should ensure all staff who are under the direct control of the asset related functions have suitable competence in terms of education, appropriate training and work experience (PAS, 2008).

2.6 Operation and Maintenance, and Power Outages

The guideline for the best practice in operation and maintenance outlines are important in having effective operation and maintenance, in reducing outages and improving power reliability. It is true that a well-functioning operation and maintenance process does not continually respond to complaints but corrects the situations before they become problems (Sullivan, Pugh, et al., 2010).

On the other hand, Rouse and Kelly (2011) argued that, most utilities do not continuously track the impacts of outages which is important in justifying targeted investment and tracking recovery, repair and maintenance costs separately from the operation costs. Without proper tracking of this information it becomes a challenge to justify network improvement that will eliminate power outages (Rouse and Kelly, 2011).

Moreover, various attempts have been made to assess the cost of unreliable electricity. It is estimated that economic losses resulting from unreliable electricity is approximately $150 billion every year excluding power quality events. The economic losses include the costs of momentary interruptions which impacts today's digital economy. However, most industries do not track economic losses resulting from power outages and interruptions that make the costs of power outages to remain hidden and hence difficult to justify investment into improved reliability (Rouse and Kelly, 2011).

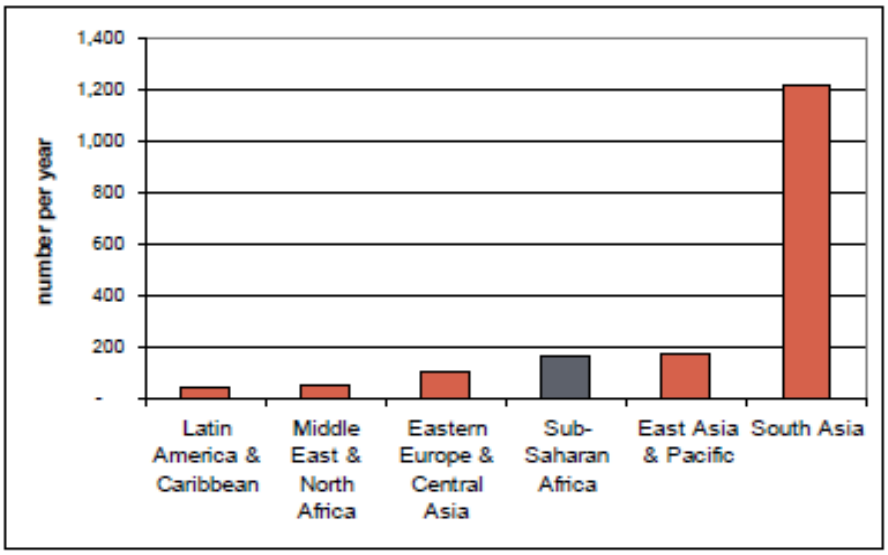
2.6.1 Power Outages

Power outages can be defined as short-term or elongated absence of electricity to a particular area. The effects of power outages go beyond the annoyance experience from outage itself, as power outages can be responsible for death and injuries when they interfere with the daily life activities. Despite posing a public safety hazard, economic costs of power outages go beyond loss of productivity by the citizens. It also reduces productions by the local businesses due to interrupted manufacturing processes, damaged equipment's and spoilt products due to non-functioning cold storage facilities. (Rouse and Kelly, 2011)

The numbers of power outages in African countries are reported to be high when compared to other developed countries in the world. An average number of power outages experienced within a month can go beyond 100 times (Abotsi, 2016). In different countries power outages have different negative effects not only on households but also on commercial activities since electricity is an engine for the economic growth. Moreover, power outages affect utilities income through reduction in units sold which consequently affects the company revenue, and increases the cost to the consumers by forcing them to use standby generators in case of blackouts.

Although African countries have a large number of outages, Tallapragada, Shkaratan, et al., (2009) argued that Sub Saharan Africa (SSA) is reported to have lower outages per year when compared to South Asia region. As stated in the report the annual average number of outages in Sub Sahara Africa stands at 164 while in South Asia the average stands at 1,219 as indicated in Figure (2-3) below. In SSA region, the most magnificent performance is noted in the southern areas have a yearly average of 42 outages per year. This is followed by Eastern Africa, which has 104 outages per year, while central and western parts have an average of 170 and 171 outages respectively.

Figure 2-3: Annual average outage by region



***Source**:* (Tallapragada, Shkaratan, et al., 2009)

According to Tallapragada, Shkaratan, et al., (2009), South Africa has a less number of outages per year in Africa, while Guinea is the leading country with 407 outages per year. Tanzania is among the ten leading countries with a large number of outages. An average number of outages in Tanzania is 148 outages per year which is large when compared to other African countries. Having a large number of outages not only tarnishes the image of the company but also influences customer perspective over the quality of service delivered. Moreover, Tallapragada, Samaritan, et al., (2009) proposed that the number of outages per year should be accepted as a crucial indicator in determining the quality of service to customers.

2.6.2 Number of Outages per Year

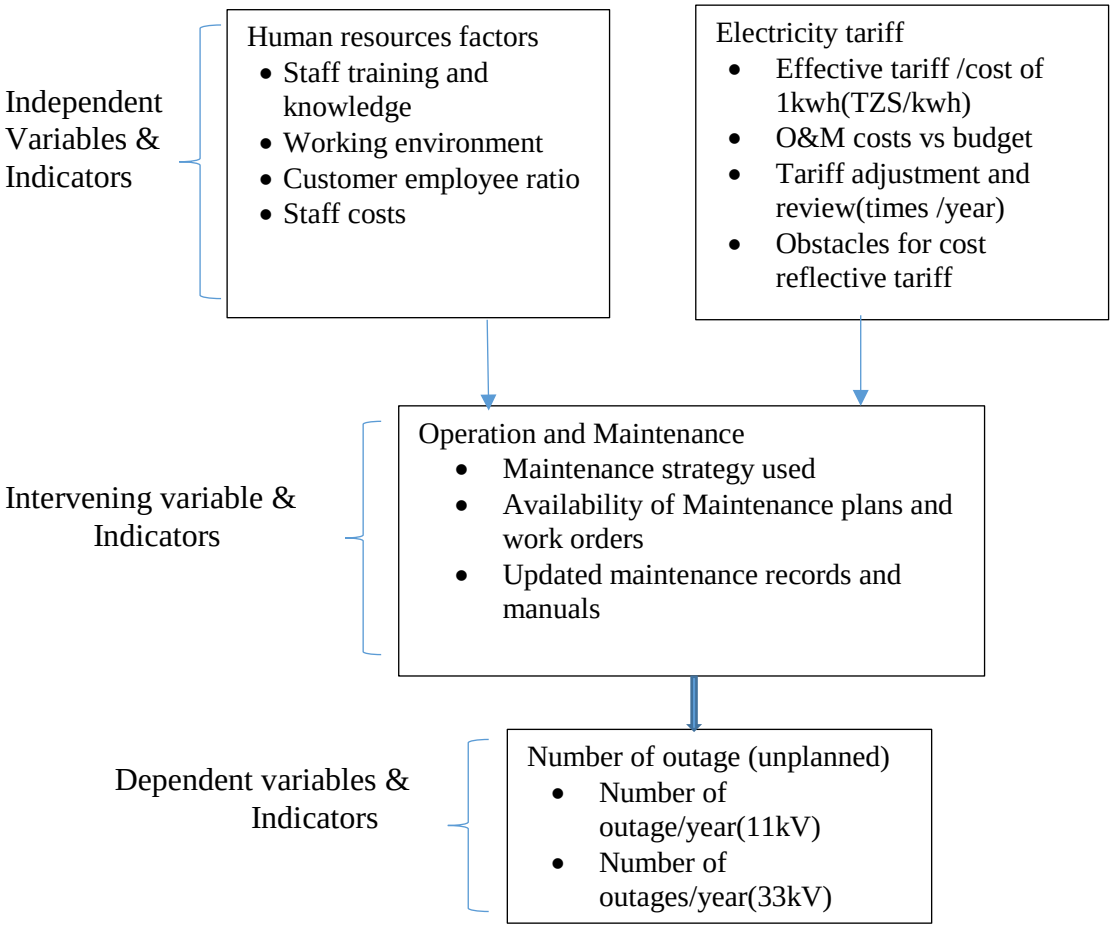
The number of outages per year (number/year) is an indicator that measures the quality of electricity supplied. Customer dissatisfaction with the service is regularly related to the large number of outages. Likewise, customer perspective on service delivered by the utility company is of great importance in determining utility performance. Through customer feedback, different utilities get to know how they perform and can also be used as an essential tool in shaping service providers performance. Although generation failure or distribution network failures can cause power outages, this thesis defines the number of outages/year as the measure of the quality of power supply related to outages resulting from unplanned distribution network failure in both 11Kv and 33Kv voltage levels.

2.7 Conceptual Framework

This research uses modern management theory and concept of strategic management to form the theoretical background. The following section presents the conceptual framework that summarizes the main variables and indicators used in the study as presented in figure. As previously discussed in problem statement and research question, human resource and electricity tariff are identified as independent variables. Moroever, company operation and maintenance is considered as an intervening variable, which affects power outages. (Dependent variable).

Figure (2-4) presents the conceptual framework of the study inicating main variables and the indicators per each variable.

Figure 2-4: Conceptual Framework



Source: Author construct

Chapter 3 : Research Design and Methods

3.1 Introduction

This chapter reviews the main research question and the corresponding sub-questions. The chapter also defines the main theories and concepts used in the study. Moreover, it focuses on the operationalization of the variables and indicators as explained in the conceptual framework. The chapter further describes the research strategy, methods, and techniques. Subsequently, it covers a brief description of the study area, unit of study, the sample size, data collection procedures and analysis, and finally, the study limitations regarding reliability and validity are highlighted.

3.2 Revised Research question

Revised main research question

To what extent does human resource and electricity tariffs influence TANESCO's operation and maintenance activities in reducing power outages?

Revised sub-questions

- How does human resources influence O&M activities?
- To what extent do tariff limit the implementation of TANESCO O&M activities?
- How does operation and maintenance influence power outages?

3.3 Operationalization

3.3.1 Definition of Theory, Variables, and Indicators

3.3.1.1 Morden Management Theory

The modern management theory puts emphases on the organizational effectiveness with an emphasis on strategic issues. It emphasizes more on effectiveness and not only efficiency. Cole, (2004) defined effectiveness as doing right things while efficiency is about doing things right. Either the concern of modern approach to management has been lied in developing a strategic mission, establishing organizational values and promoting quality management to achieve organizational excellence through advocates for attaining organizational effectiveness. The primary focus is accomplishing organizational excellence, enabling personal empowerment and raising stakeholder relationships (Cole and Kelly, 2011).

3.3.1.2 Strategic Management

Strategic management is concerned with the organization as a whole. It deals with the fundamental decisions with what organization is now, and also what is to be in the future. Furthermore, it provides a framework for making decisions about people, governance, clients, risks, funding, incomes, products, systems and technologies. Likewise, it is the determinant of the company's achievements and the decision on what the company will or will not do.

The process of strategic management establishes company mission, objectives, and strategies of the enterprise. The organization's mission statements usually stipulate what the organization is about and what are the organization's values while the organization's objectives are the statements which explain the main goals that an organization aims to achieve. (Morden, 2016a) This research therefore adopts the definitions of the Modern approach to management and strategic management as a foundation to this study.

3.3.1.3 Human Resources

Human resource refers to the company's intangible assets that are very significant for the continuous success of the company (Harel and Tzafrir, 1999). Human resource contributes to the maximization and increase of the company performance and abilities. Moreover, through productive human resource company employees becomes a valuable asset that cannot easily be copied or replaced. In addition, this eventually leads to increased competitive advantage within a company**.** In this study, human resource will consider the factors related to a human asset in achieving company performance. Literature review identified employee training, working environment, number of employees and related costs as the human resources indicators. The study therefore uses the mentioned indicators in the operationalization of the variable.

3.3.1.4 Electricity Tariff

Brazilian National Electric Agent defined electricity tariff as the "composition of evaluated costs which represents each part of the investments and technical operations performed by the chain of production agents and the structure necessary for the energy to be consumed by the customers" (ANEEL, 2008, P.1). Moreover, SADC defined cost reflective tariff as the" tariffs that reflect the true costs of supplying electricity, removing reliance on external subsidies to cover the variance between current tariffs and the true cost of electricity" (RERA, 2016 , P.11). This research seeks to understand the extent to which current tariffs limit proper implementation of O&M activities in reducing power outages.(Abotsi, 2016)

3.3.1.5 Operation and Maintenance

Operation and maintenance refer to all activities in controlling and up keeping of network/equipment. It includes the setup of procedures, schedules and work orders. It also involves performing planned and unplanned activities either preventive or predictive, which aim at, preventing equipment failure or deterioration. Furthermore, operation and maintenance aim at raising equipment output, reliability and safety (Sullivan, Pugh, et al., 2010).

3.3.1.6 Power Outages

Esmaili, (2012) defined the level of service as a perceived measure of ordinary output of a particular infrastructure network. Quality of service can be viewed differently from a customer perspective. In this study, quality of service is defined as reduced number of power outages in distribution networks. Likewise, this research defines power outages as short-term or elongated absence of electricity to a particular area. This study uses number of outages per year as an indicator to access the quality of electricity as proposed by Tallapragada, Shkaratan, et al., (2009). Furthermore, this study focuses on outages related to medium voltage only (i.e. 33Kv and 11Kv).

3.3.2 Operationalization of Variables

Table (3-1) below summarizes the operationalization of the theories, concepts, main variables and their corresponding indicators.

Table 3-1: Operationalization of Variables and Indicators

Theory/Concept	Variable	Indicators
Modern management theory The theory defines organizational effectiveness with an emphasis on strategic issues. It emphasizes more on organization effectiveness (doing	Human Resource	• Number of staff attending O&M training in a year • Availability of adequate working and safety tools • Customer/employee ratio • Staff costs/Total cost
	Electricity Tariff	• Effective tariff/cost of 1kwh of electricity (TZS/Kwh)

right things) and not only efficiency(doing things right) **Strategic Management** It provides a framework for decisions about people, leadership, customers, risks, finance, resources, products, systems and technologies.		• O&M cost vs. budgeted cost • Tariff setting adjustment (times/year) • Effective tariff constraints
	Operation and Maintenance	• Type of maintenance strategy used • Availability of O&M plans • Availability of updated O&M, work orders, records, and manuals
	Power outages	• Number of outages/year(11kV) • Number of outages/year(33kV)

3.4 Research Type and Strategy

Van Thiel, (2014) defined research strategy as the overall design or logical procedures that a researcher follows in conducting a particular research. The researcher should consider the subject of the study (problem statement), research objective, the existing body of knowledge and the number of units of study to select appropriate research strategy. (Van Thiel, 2014)
Based on above explanations case study is the proper strategy in this research. Case study aim at explaining increased number of power outages in TANESCO. Specifically this research, aims at getting a deeper understanding on the influence of human resource and tariff on operation and maintenance activities and its consequent effects on power outages. As explained by Van Thiel, (2014) a typical case study takes a holistic approach whereby a researcher collects a large body of data, mainly qualitative concerning a particular case.

The nature of the research question is explanatory. It is, therefore, a single case study, co-variation approach that requires qualitative and quantitative data from both primary and secondary sources. Semi-structured interview was used to collect qualitative primary data and questionnaires were used to collect primary quantitative data to get an in-depth insight of the relationship between the independent variables (tariff and human resource) under the presence of intervening variable (O&M) and its effect on power outages.

3.5 Data Collection Methods and Instruments

Being a case study intending to get deep informations on the study, interview was used as the main data collection instrument although in order to get a wider overview and to allow wide interaction with the participants the researcher also used questionnaires in data collection. As argued by Jansen, (2010), the survey in this research does not count variable but tends to establish any meaningful variation within the population. Thus, the research involved analysis of multiple viewpoints from management in both HQ, regional office and external respondents in their various disciplines through interviews that allowed participation of important informants. The questionnaires also allowed a broader viewpoint of the subject under study.

Moreover, this study used secondary data from various sources including various acaemic literatures regarding electricity sector, different official internet sources and various international reports. Additionally the company performance reports, policies, strategic plans and tariff structures were reviewed.

The interview guidelines and questionnaires were prepared in advance following the conceptual framework and using the main concepts, variables, and indicators. To ensure the collection of accurate information from respondents the researcher assured the confidentiality of the collected

information. The researcher also informed the respondents on the importance of giving accurate information as the study findings will help the utility management in decision making.

3.5.1 Interviews

In this study, the interview was used as a primary qualitative data collection instrument. As defined by Van Thiel, (2014) interview is a conversation where a researcher collects information by questioning the respondents. In this research, qualitative data was gathered using semi-structured interviews. Consequently, key stakeholders in three organizations TANESCO, EWURA and MEM were interviewed in order to get a deep and qualitative understanding of the study. As addressed by Van Thiel (2014), the use of semi-structured interview guide allowed the researcher to ask supplementary questions in case of unclarity. Semi structured interviews also enabled the researcher to ask the respondent to expand the subject of study to get clarity on the data collected. Thus more flexibility to both researcher and respondents during the interview. A copy of interview guideline was prepared prior to the interview and it is in annex 1of this report.

3.5.2 Questionnaires

The research used closed-ended questions. Closed-ended questions used Likert scale rated from (1) strongly disagree to (5) strongly agree for both independent and dependent variables**.**
The questionnaires were administered to the operation and maintenance staffs (management and supervisory level at Ilala region) to gain their insight and perceptions on the effect of human resource and tariff on operation and maintenance activities and its impact on power outages. The use of questionnaires in this research also serves as an essential tool for data triangulation. As explained by Van Thiel (2014), triangulation aims to double or triple check the data collection and research results to enhance study reliability and validity. A copy of the questionnaires is found in annex 2 of this report.

3.5.3 Secondary Data

Secondary data from different sources associated with the subject of study were collected and used. This study used secondary data from various reliable documents such as company monthly reports, company strategic plans, yearly budget, tariff adjustments reports, audit reports from utility, regulator and other official website and related sources. Moreover, the use of semi-structured interviews, questionnaires and secondary data sources serves as data triangulation which ensures study reliability and validity.

3.6 Area of Study

The study area for this research is Dar es Salaam city, Tanzania. Dar es Salaam is the central business city in Tanzania with a population of approximately 4.3 million people. Dar es Salaam is the region that consumes the largest percent of electricity generated in the country. Adminstratively Dar es salaam region has five districts namely Ilala, Kinondoni, Temeke, Ubungo and Kigamboni (United Republic of Tanzania, 2015). Ilala district was used as an area of study in this research.

3.6.1 Unit of Study

The unit of study in this research is TANESCO, which is a single electricity service provider in the country. Due to time and financial limitations, this research focused on one operational region (TANESCO –ILALA). The region has four main operational departments, distribution (technical), finance, human resources and customer relations. In addition, the region serves four main districts; City center, Industrial, Tabata and Gongo la mboto. The region has a total of 267 staffs.

3.7 Sample Size and Selection

- **Semi structured interview.**

This study used non-probability sampling (purposive sampling) to select the respondents for the interviews. Purposive sampling ensured that people with enough knowledge of the research were interviewed. Interviews involved experts from both TANESCO head office and TANESCO Ilala region. However, for triangulation, the study also involved respondents from electricity regulator (EWURA) and Ministry of energy and minerals (MEM). Morover respondents were carefully selected to enable collection of valid and even composed data from all departments.Table (3-2) below illustrate the summary of the preminary list of the interviewees

Table 3-2: Preliminary list of respondents for interviews

Organization	Department	Position	Data collection method	No of respondents
TANESCO HQ	Human resources	Senior Manager HR	Interview	1
	Human resources	Manager HR	Interview	1
	Human resources	Manager training	Interview	1
	Finance	DMD finance	Interview	1
	Finance	Senior manager budget	Interview	1
	D&CS(technical)	DMD(D&CS)	Interview	1
	D&CS	Manager Maintenance	Interview	1
	D&CS	Manager Maintenance	Interview	1
TANESCO-Ilala	Ilala	Regional Manager	Interview	1
	Ilala	Principal Engineer	Interview	1
	Ilala	O&M Engineer	Interview	1
EWURA	Electricity	Senior Manager	Interview	1
MEM	Energy	Energy engineer	Interview	1
Total				13

- **Questionnaires**

The region has 267 employees responsible for operation and maintenance activities. There are only 60 employees at a management and supervisory level. Therefore, the sample size for questionnaires was based on a population of 60 employees involved in the management and supervisory. From a population of 60 using a confidence level of 95% and an interval level of 5, the researcher came up with 53 respondents (monkey survey, 2018), from four departments, technical, human resources, and finance and customer service.

From a given list of 60 employees (management and supervisory staffs),Stratified random sampling was applied to enable researcher control the size of respondents from each department and hence guarantee representativeness of each department (Neuman and Robson, 2007).From four strata based on four departments then simple random sampling was applied to come up with questionnaire respondents. Researcher administered only 30 questionnaires due to time

limitations. Final representation of the questionnaire respondents will be presentment in the following chapter.

3.8 Validity and Reliability

3.8.1 Validity

- **Internal validity**

Internal validity refers to the cogency of the study. It tends to establish whether the researcher measured the effect of what he/ she intend to measure. Internal reliability focus on determining whether the researcher has ensured adequate operationalization of the variables. Internal validity also establish the causal relationship between independent and dependent variables (Van Thiel, 2014). This research ensured that internal validity goes through proper operationalization of the variables and indicators which aim at establishing causal- effect relationship between independent and dependent variables. Moreover, triangulation of data in the research was done through the use of data from three sources questionnaire, semi-structured interviews, and review of published and unpublished secondary data. Also, semi-structured interviews were conducted with electricity experts outside TANESCO to increase internal validity.

- **External Validity**

According to Van Thiel (2014) . External validity tends to establish if the research results can be valid to other persons, organizations or moments in time or location. External validity is most important to statistical research. For this research, the use of single case study makes generalization of the findings difficult because the population used is not large enough to generalize the results. Although Van Thiel (2014), argued that, it is possible to relate a single case study with other cases which makes it possible for the case findings to be a representative of similar situations within the same research domain. Therefore, the theoretical knowledge obtained from the research finding can be generalized to other TANESCO regions as well as other service providers with the same characteristics as TANESCO.

3.8.2 Reliability

Reliability of the study includes accuracy and consistency in measuring the variables. In explanatory studies higher level of reliability means that the explanations given are more likely to be right. According to Van Thiel (2014), the idea of consistency revolves around the concept of repeatability under similar circumstances or similar measurements that lead to the same results. In other words, repeatability enhances the reliability of the study. In this study, although it was difficult to attain reliability due to the nature of an open design, the reliability was improved through the use of questionnaires to supplement the interviews. Moreover, in order to ensure reliability with the questionnaires Cronbach alpha was calculated for all variables to ensure consistency in measuring the variables. The researcher also, documented each step of the study in logbooks to track all the changes to initial proposition.

3.9 Data Analysis Methods

- **Interviews**

Data from the semi-structured interviews were transcribed and analyzed by using Atlas TI version 8. First, codes were developed which helped the researcher to categorize and subdivide data for easy data comparison. Codes were created considering the operationalization of both independent (human resources and tariff), intermediate variable (operation &maintenance) and dependent variable (power outages). For easy analysis of the data, the generated codes were grouped into code groups according to the conceptual framework (Van Thiel, 2014). Furthermore, co-occurrence tables were generated depending on different themes of the study. To discover the actual link between different codes groups the researcher applied query tool. The query tool codes were analyzed by using “AND “and “OR” indicators and then quotation

were retrieved to identify and cluster developed patterns of independent and dependent variables. Established patterns between independent and dependent variables helped the researcher to establish the relationship between code groups. Finally, the researcher generated outputs from each code group and compared the results. The results generated were further used for the final analysis to answer the sub research questions and the main research question.

- **Questionnaires**

Data collected was analyzed by using the SPSS computer program. First, the data was inspected to identify any errors using frequencies. Descriptive statistics technique was carried to demonstrate survey sample characteristics and triangulate the responses from interviews. Since the questionnaires used Likert scale for measurement, Cronbach alpha coefficient was then calculated for all the four variables to ensure consistency of the measured variables Van Thiel, (2014). For this study Cronbach alpha coefficient of the value higher than 0.6 is considered acceptable. As addressed by Gliem and Gliem, (2003) for the research purposes Cronbach alpha value higher than 0.6 is considered reliable.

For the inferential results, correlation was carried out between human resaorces , tariff , O&M and outages to measure how variables interrelate. Similarly, correlation was carried out to establish interrelationship between intermediate variable (O&M) and dependent variable (power outages). For this study p value of equal or less than 0.05 was considered acceptable while a negative value of r (pearson) indicates a negative relationship between variables. Multiple regression analysis was finally conducted between human resource, tariff, O&M and power outages to study the influence of independent variables on power outages. This enabled the researcher to establish how independent variables (human resource, tariff and O&M) simultaneously influence power outages (Neuman and Robson, 2007). Similarly, multiple regression analysis was also undertaken to give an indication of the level of strength of O&M over power outages (Van Thiel, 2014).

- **Secondary Data**

Secondary data was collected, summarized and analyzed by using Microsoft Excel and the findings presented in the forms of graphs, charts, and tables.

3.10 Field Visit and Data Collection

During the field works conducted between 25th June and 22nd July the schedule was carried out as planned although there were some few amendments made to the initial sample of interview respondents. These amendments were due to failure to meet some of the initially planned respondents. During the time of data collection, most of the Executive Management Members were attending ministry budget presentations, which affected the schedules of appointment. The absence of some respondents resulted in a reduction in an initial interview sample although it did not affect the results as the researcher was able to get representantives from targeted departments. A new table of interview respondent is given below (see table 3-3 below).

Table 3-3: Final list of the respondents for the interview

Organization	Department	Level/Hierarchy	Data collection method	No of respondents
	Human resources	Senior management	Interview	1
	Finance	Senior Management	Interview	1
	Finance	Middle Management	Interview	1
	D&CS	Supervisory	Interview	1
TANESCO-Ilala	Ilala	Middle Management	Interview	1
	Ilala	Supervisory	Interview	1
EWURA	Electricity	Senior Management	Interview	1
MEM	Energy	Middle Management	Interview	1
Total				8

Source: Author

Chapter 4 : Research Findings

The following chapter presents the research findings from the field works. The chapter first describes the overview of the case and the unit of analysis. Furthermore, the results of the data collected from the fieldwork are organised according to the variables and indicators. The data collected is organized based on the responses from interviews and questionnaires. Findings are summarized using frequency tables, and discussion is done based on literature review and secondary data. Finally, statistical results presented for consistency.

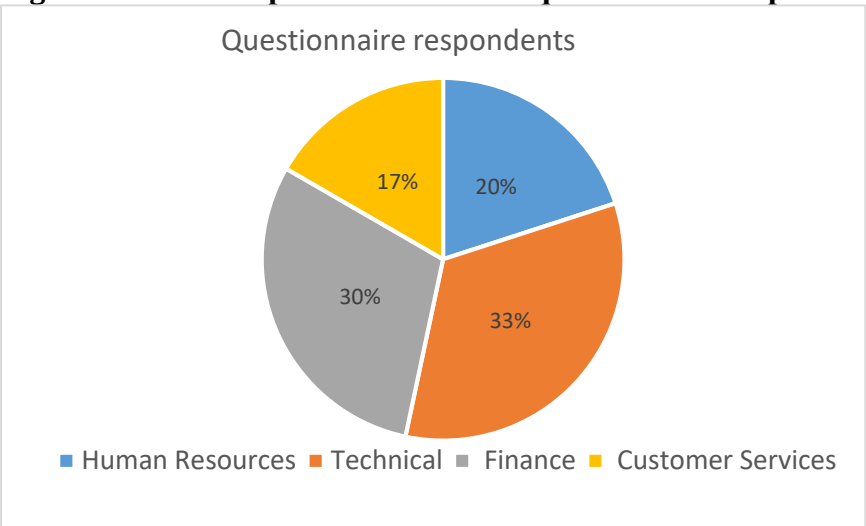
4.1 Description of the Case

This study used TANESCO as a single unit of study. TANESCO is the only electricity service provider in Tanzania. It is a vertically integrated electricity utility company responsible for generation, transmission and distribution of electricity. For a number of years the utility has been encountered the problem of frequent power outages. Continuous power outages are attributed to various factors which including human resources and low tariff which lead to poor operation and maintenance. This study, therefore, aims at *explaining to what extent does human resources and tariff influences utility operation and maintenance activities in reducing power outages.* This study used TANESCO's ILALA region as the case of analysis.

To answer the main research question the study applied both interviews and questionnaires. For the interviews, purposive sampling was used to select respondent from both inside and outside TANESCO. Respondents included senior, middle and lower management from both head office and Ilala regional offices; one respondent was from the regulator and one from the ministry of energy and minerals. Selection of the respondents was carefully made to enable the researcher to obtain an in-depth information and views of the subject under study.

Furthermore, this study administered thirty questionnaires to management and supervisory staffs from four departments (human resources, finance, and technical and customer service) of TANESCO Ilala region obtained through stratified random sampling. Figure (4-1) below summarizes the final presentation of questionnaire respondents

Figure 4-1: Final representation of the questionnaire respondents



Source: Field data

4.2 Presentation and Analysis of the Research Question

The following section presents data according to sub-research questions. The analysis of the data starts with a summary of the interview responses from an interview conducted with eight respondents. A summary of the quotations mentioned in the analysis can be seen in annex 5 in the appendix. The results of the questionnaire are then compared and contrasted with the interview responses.

Additionally, the secondary data collected was used for triangulation of the data obtained through interviews and surveys. Lastly, the findings are presented in consistency with the literature review in chapter 2, and a summary of the significance results is outlined under each sub research question. Finally, the statistical results (correlations and multiple regression) are presented to elaborate the relationship between human resource, electricity tariff, O&M and power outages.

4.2.1 How does human resources influence O&M activities in reducing power outages?

To answer the above sub question, respondents were interviewed following the selected indicators. These indicators include staff training, working environment, customer-employee ratio and staff costs. Table (4-1) below summarizes the answers from interviewed respondents. Also, the results of the questionnaires (summarized in Likert scale) applied to the 30 respondents are presented in figure (4-2) below.

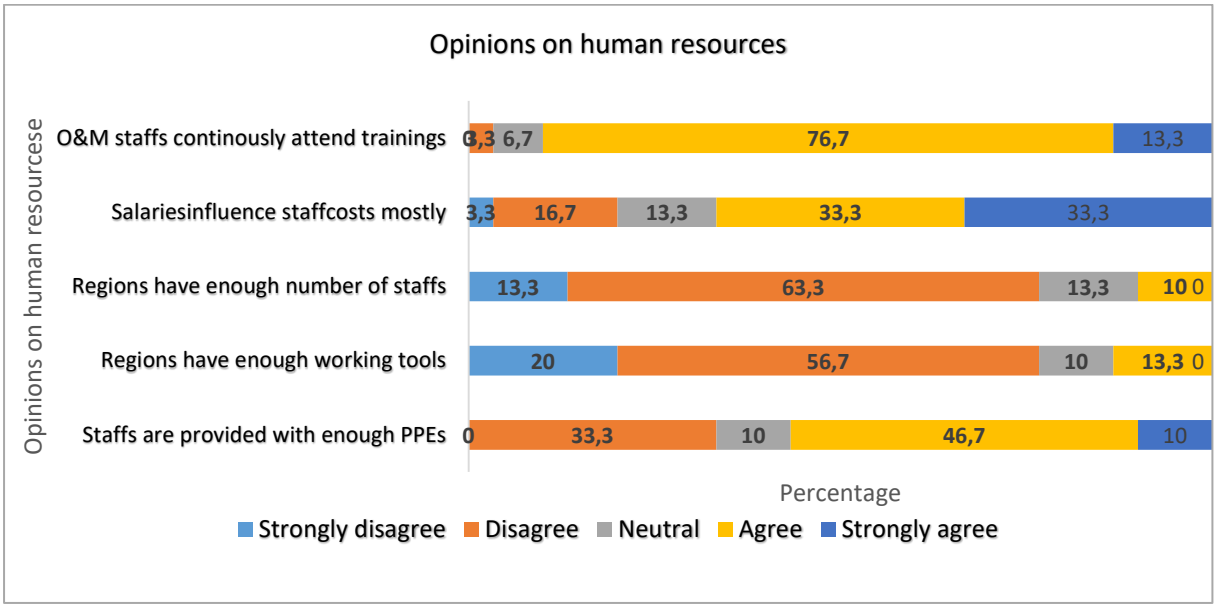
Table 4-1: Summary of the interview responses on factors of human resources influencing O&M

Indicator	Summary of the responses	Frequency
Staff training and knowledge)	The company has continuous training programmes for O&M staffs. The company has a training school for technical teams (engineers, technicians, and linesman) at Masaki Dar es Salaam that is essential in providing continuous training to employees. For example in the year 2017, a total of 23 technical staffs attended training, and in the year 2018 a total of 67 of the technical staff participated in the training at Masaki Training school.	6
	Although the company offer continuous training to the staff, there is no training needs assessment (TNA) done which is vital in the training provision of the staffs.	5
Working environment	The working environment especially working tools is pointed out as the main problem. The region has less and old working tools which hinder O&M performance. Transport is also a major challenge in regional O&M activities which affect regional performance	8
	Staffs are provided with Personal Protective Equipment (PPE), but sometimes the equipment	4

	are of low quality which triggers accidents in daily operational activities.	
Customer-employee ratio	There is staff inadequacy mostly in the technical department as compared to total customers served within the region.	5
TANESCO staff cost drivers	Due to inadequacy of the number of staff presence of Temporary and Specific task employees affect the provided budget for O&M as salaries are directly deducted from the project budget.	4
	Salaries and overtime(working extra hours) is high due to the nature of the activities	3
	The technology used is still outdated which also triggers staff costs	2

Total number of respondents (N) = 8

Figure 4-2: Survey results – Opinions on human resources factors influencing O&M



Source: Field data

Company training and development policy

From the interview conducted 6 out of 8 respondents explained that the company has a strong training policy and development of O&M staff particularly for the technical staff (Engineers, technicians, and Artisans). The company has a training school, TANESCO Training School (TTS) that provides continuous training to employees. Respondents explained their satisfaction with the short courses and long courses given to employees. For instance respondent 4 explained that *"for the year 2017 only, a total of 23 technical staff attended training at TTS while in the year 2018 a total of 67 staff attended continuous training in the region at TTS"(Annex 5).*

The respondents further explained that the training given to the employees is of greater importance not only in providing knowledge to employees but also in increasing staff morality for work which eventually contributes to the improved performance in the organization of the O&M activities. However, 5 out of the 7 respondents pointed out that despite the training offered

to staff, some training does not give positive results due to the reason that the company does not continuously conduct Training Needs Analysis (TNA) to identify which training is relevant/ irrelevant to a particular staff at a given time. Similarly survey results confirmed the above findings. The survey results revealed that 90% of the respondents (combined agree and strongly agree) agree that O&M staff continuously attend training, (see figure 4-2 above).

Adequacy of working environment (Working tools and Personal Protective Equipment (PPE))

From the interview conducted all the eight respondents pointed out the problem of working tools in the region. The respondents argued that the working tools used by the region are still outdated and most regions have few working tools. Consequently, 5 out of 8 respondents mentioned transport as a critical problem in Ilala region. The respondents explained that region does not have enough vehicles for carrying out O&M activities. The respondents further pointed that the few available cars are old. As result, most of the times the vehicles are not working which results in delays in regional O&M activities.

Furthermore, the respondents argued that TANESO is still using the outdated tools, which affects O&M activities. Respondents pointed out that the lack of modern working tools has been a central challenge in improving performance in the region. Respondent 5 was quoted claiming that *"It is a high time for the company to invest in modern working tools as the world is moving into science and technology era."(Annex 5).* Moreover, the respondents argued that working tools is the primary challenge for both technical and non-technical staff.

On the other hand, 4 out of 8 of the respondents explained that the employees are provided with enough PPE although of poor quality. The respondents further pointed out that many PPE provided especially gloves, reflectors, and helmets are easily damaged, hence, increased exposure to risks and accidents.

Similarly, the questionnaires revealed same results as the interviews. From the survey conducted 76.7 % (combined disagree and strongly disagree) of the respondents disagree with the opinion that the region has enough working tools as summarized in figure (4-2) above.

Adequacy of number of staffs in the region

From the interview conducted 5 out of the 8 respondents explained that the number of employees in the region is less (inadequate) when compared to the total number of customers served in the region. The respondents pointed out that there is more deficit in the technical department (technicians and artisan) in comparison to other departments. This pushes the region to hire temporary and specific task employees to cover the gap. The gap analysis report revealed a shortage of 16 technicians and 135 artisan, which is quite a high number when compared to other departments as shown in table (4.2) below.

Similarly,the survey results confirmed the findings from the interviews whereby 76.6% of the respondent (combined disagree and strongly disagree) disagreed with the opinion that the region has enough number of staff to carry out O&M activities as summarized in figure(4-2) above.

Factors influencing staff costs

From the interview conducted 4 out of the 8 respondents mentioned salaries as a high driver of staff costs. The respondents pointed out that the high costs of salaries are due to payments of temporary and specific task employees. In explaining the costs contributed by salaries respondent six further suggested that "*instead of spending a lot on causal labors TANESCO could use that fund to procure high technology vehicles which can be operated by only one person and hence reduce unnecessary costs*. On the other hand, 3 out of the 8 respondents

mentioned overtime (extra hours) as a factor contributing to high staff costs. The respondents argued that overtime in higher in this region due to the nature of the work and geographical location. The region at the city center serves all essential offices and institutions in the country, which requires a continuous supply of electricity. Therefore, it becomes difficult for the region to conduct planned maintenance during working days and hence many maintenance works are conducted during weekends, which increase overtime costs. Also, the results obtained from the survey confirm the findings as 66.6% of the respondents (agree and strongly agree) agreed with the opinion that salaries influences staff cost the most as summarized in figure (4-2) above.

Summarizing the results, from both the interview and the conducted survey, the importance of TNA is identified as an essential aspect to consider before doing any training in the organization. TNA will help the organization to provide required training and hence increase performance as addressed by Itika (2011), training need is a gap between knowledge, skills, and altitude of the employees versus what is required by the job. Training Needs Analysis (TNA) as a logical process by which training needs are examined and consolidated to provide a base for the training programme.

Secondly, the working environment is revealed as a problem especially the working tools. Armstrong and Taylor (2014), noted that it is essential for an organisation to encourage a good working environment to promote not only positive attitudes toward workers but also increase workers performance. It is necessary for the utility to consider the quality of safety gears offered to employees. These findings are consistent with literature review in chapter 2, which addresses the importance of prioritising health and safety, in an organisation to encourage performance (Itika, 2011).

Thirdly, the number of working employees in the region is revealed to be inadequate when compared to the number of customers served. Literature review in chapter two shows that TANESCO is overstaffed. According to Trimble, Kojima, et al., (2016), TANESCO is overstaffed by 2694 workers. The standard benchmark staff number is 3634 while the current number of staff in the generation, transmission and distribution department is 6328.

Literature addresses overstaffment at the national level, but this is different from the findings at the regional level which reveal understaffing especially in the technical department. This is supported by secondary data collected from the regional office which point out a gap of 155 technical staff (total of technicians and artisans) as presented in employee gap analysis report below (See table 4-2).

Table 4-2: Ilala region employee gaps analysis

s/no	Position	Number
1	Procurement officer	1
2	Assistant CRO	3
3	Technicians	16
4	District BAO	3
5	Record Assistant	4
6	Drivers	29
7	Artisan	139

Source: Staff gap analysis report 2018

4.2.2 To what extent does electricity tariff limit the implementation of company O&M activities?

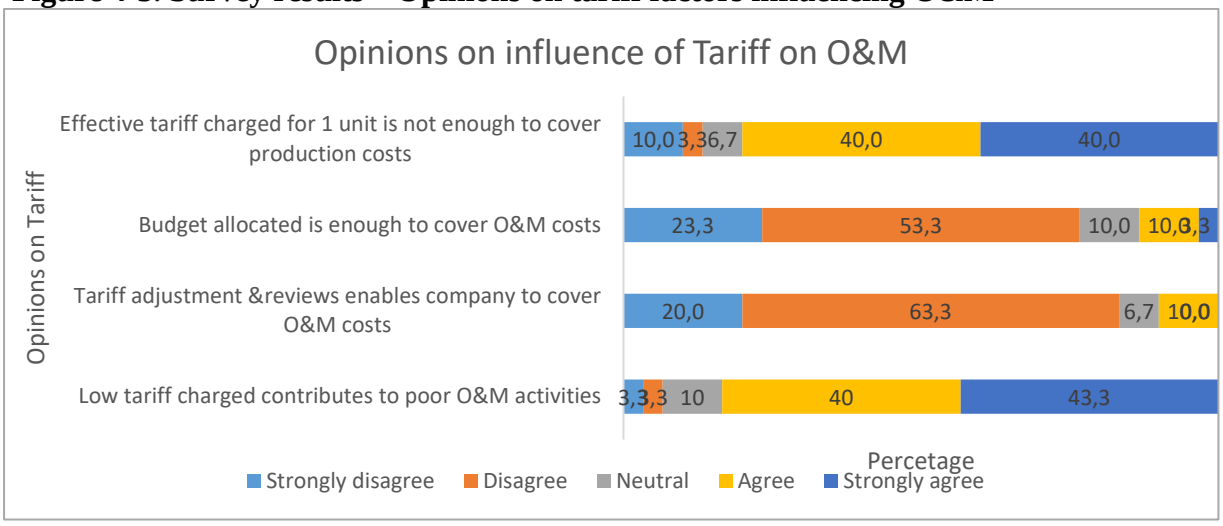
In answering the above sub question, four indicators were used. These indicators include effective tariff/kWh, adequacy of O&M budget allocated, tariff adjustments and review schemes and constraints on cost reflective tariff. Table (4-3) below summarises the answers from interviewed respondents and figure (4-3) shows the results of Likert scale questionnaires applied to the 30 survey respondents.

Table 4-: Summary of the interview responses on tariff factors influencing O&M

Indicator	Summary of the responses	Frequency
Effective tariff/kWh	Tariffs are low and not enough to cover the production costs	6
Adequacy of the budget to meet company O&M costs	Allocated budget is not enough to cover O&M activities	6
	Delays in procurement processes	4
Tariff adjustment and review procedures/schemes	Review and procedures are set to cover inflation, currency rate, and oil price, but they are not implemented accordingly. When there is upward change in price, it is difficult to apply the adjustment or reviews due to political interference	5
Constraints on cost reflective tariffs	Political influence from government officials	7
	Customer ability to pay	4
	Company Internal operation inefficiency	2

Total number of respondents (N) =8

Figure 4-3: Survey results – Opinions on tariff factors influencing O&M



Source: Field data

Adequacy of effective electricity tariffs

From the interview conducted 6 out of 8 explained that the effective tariff charged is less when compared to production costs. He current electricity tariff charged by the service provider is 242.21TZS/kWh, which is low compared to production costs. Respondents clearly explained that for the service provider to cover the operation and maintenance costs, he has two alternatives. First is to increase the existing tariffs to cover its cost upon approval by the regulator. The second alternative is for the operator to minimise his O&M costs and production which is still a challenge for the service provider. Respondents argued that the company is still operating at low tariffs. In the 2017-multiyear tariff review done by the regulator, was not approved by the ministry of energy hence the company continues to run with the low tariffs.

Similarly, the results obtained from the survey conducted confirm the interview findings discussed above. The results revealed that 80% of the respondent (combined agree and strongly agree) agreed with the opinion that effective tariff charged for 1 unit of electricity is not enough to cover the production cost (see figure 4-3 above).

Adequacy of the allocated budget to cover O&M costs

From the interview conducted 6 out of the 8 respondents explained that the budget allocated for O&M activities is not enough to cover the region's O&M activities. The respondents revealed that in previous years the company was allocating 15% of the revenue for O&M activities. However, delays in the procurement process led to the underutilization of the budget. This led to the reduction in O&M budget to 6% of the company revenue. As business is expanding 6% has now become insufficient to cover O&M costs. Additionally, the respondents argued that the budget allocated is not only less, but it is also difficult to get materials and spares on time due to delays in the procurement process.

The survey results conducted confirm the interview results whereby 76.6% (combined disagree and strongly disagreed) disagreed with the fact that the allocated budget is enough to cover utility O&M activities and only 13.3% (combined agree and strongly agree) agreed that the budget allocated is enough for O&M activities. Figure (4-3) above summarise the survey results.

Sufficiency of tariff adjustment and reviews schemes in covering O&M costs

From the interview conducted 5 out of the 8 respondents argued that tariff adjustment and review schemes are by-laws and they should be used to cover inflation, currency change, and oil price. These adjustments are supposed to be done quarterly in a year, but that is not the practice. Respondents further explained that this adjustment and review are not implemented as required by laws due to political pressures especially when there is upward increment. On the other hand, respondents from the regulator side pointed out that often the service provider does not submit the review applications on time which prevent the regulator from processing and approving them on time.

Similarly, the survey conducted confirms the interview findings as summarised in figure (4-3) above. From the survey results, 83.3%(combined disagree and strongly disagree) of the respondents disagreed that tariff adjustments and review schemes enable the company to cover its operation and maintenance costs while only 17.3%(combined agree and strongly agree) agreed that the schemes are enough to cover utility O&M activities.

Constraints in Attaining cost reflective tariffs

From the interview conducted, respondents pointed out three main factors which restrict utility from attaining cost reflective tariff as explained below.

Government influence - 7out of the 8 respondents pointed out that the utility is still a monopoly, and therefore a lot of decisions made by the company management should get an approval from

the central government. For instance, when it comes to the tariff increase the government considers first the ability and affordability of the service to the citizens before considering the expenses incurred by the utility in providing the particular service.

Company Internal inefficiencies - 4 out of the 8 respondents, explained that TANESCO fails to attain cost reflective tariffs due to its internal company inefficiencies. The respondents pointed out that TANESCO is not doing well in reducing transmission and distribution losses which influence the company in getting low revenue. A respondent from outside utility argued that "*losses are money, but TANESCO does not consider that."(Annex 5)* Moreover, respondents argued that if the bills and all the existing debts of the utility were managed effectively it would be in a position to convince the government for tariff increase and hence attain a cost reflective tariff.

Customer Ability to pay - 4 out of 8 respondents mentioned the problem of customers' ability to pay prevent the utility from attaining cost reflective tariffs. The respondents explained that most of the customers in the country could not afford to pay electricity charges. The respondent also pointed out the problem currently encountered by rural customers. Rural customers have meters having first 50 units which they are supposed to pay on their first purchase. The situation is worse since many of the customers cannot afford to pay for the first unit and in the end, the customers do not use electricity.

Summing up the findings on how the electricity tariff limits the implementation of O&M in reducing power outages results from both interviews and questionnaires revealed that effective tariff charged for one unit of electricity is low to cover the production cost and are not cost reflective. Secondly, due to low tariff charged, the revenue collected by the company is not enough to cover all the activities which results in allocation of less budget for O&M activities

These tariff barriers negatively impact the utility in its operation and maintenance activities which results in the poor level of services. Moreover, tariff adjustment and reviews are not implemented accordingly. Furthermore, the secondary data reviewed is consistent with the interviews and survey results as addressed in the service provider's report of the year 2016. In this report, the service provider claimed under-recovery of 23.26TZS/kWh. The report further claimed that the under recovery is restricting the company from providing services to the customers and hence being unable to provide the best services to both the lenders and its customers (Tanzania Electric Supply Company Limited, 2016b).

These findings were found to be inconsistent with the literature review in chapter 2. Literature pointed out the importance of having enough financial resources for effectively carrying out of O&M maintenance. As addressed by Ortega, Pérez-Arriaga, et al., (2008), productivity in electricity sector will not only be attained by introducing competition in generation and commercial activities but also by the proper design of transmission and distribution tariffs which are economically viable. These findings are as expected as the utility is charging low tariff as discussed early.

These results suggest that the low tariff charged and low budget allocated for O&M, the utility is limited in its activities hence the utility cannot adequately maintain its distribution networks which results into poor service to customers including increased power outages. As suggested by (ANEEL, 2008) the budget allocated should be sufficient to cover utility O&M to enable the utility to guarantee desirable services to customers. Furthermore, literature addresses that for the utility to be operationally effective it should be capable of financing maintenance activities. Attaining this goal requires electricity tariffs that are high enough to cover the operation and maintenance costs (Foster and Briceño-Garmendia, 2010).

4.2.3 How Does Operation and Maintenance Influence Power Outages

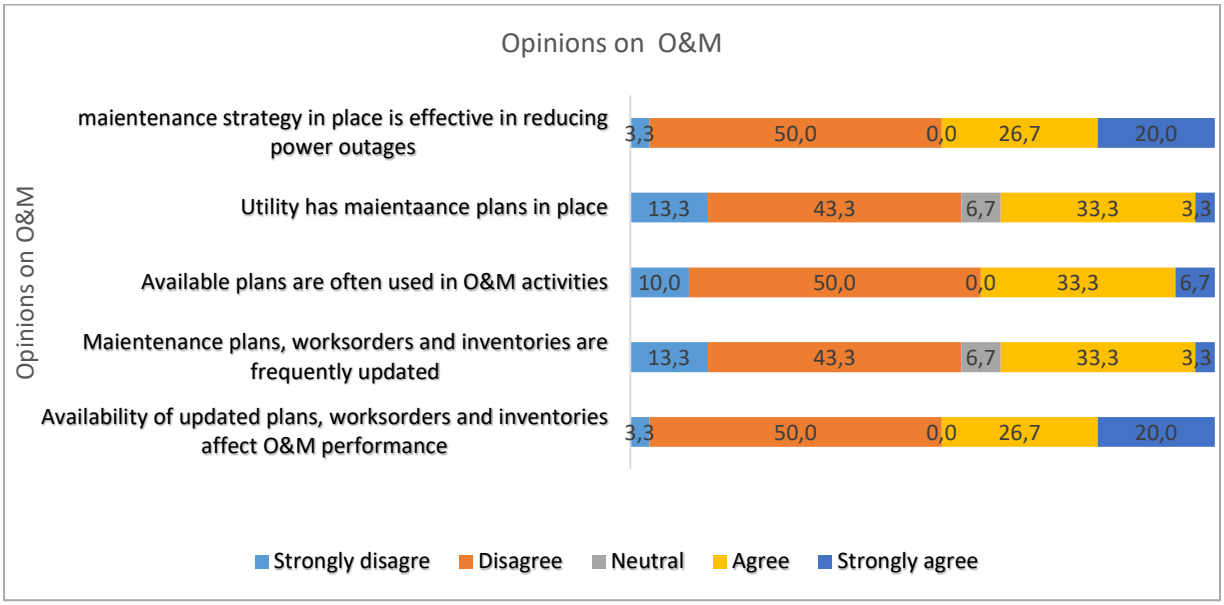
Operation and maintenance are essential aspects not only in utility management but also in service delivery. Three indicators are used to answer the above question. Type of maintenance strategy used, availability of maintenance plans and work orders and continuous updating of maintenance records and inventories. Table (4-4) below summarizes answers from the interviewed respondents and figure (4-4) shows the results of Likert scale questionnaires applied to the 30 survey respondents on opinions in company operational and maintenance activities.

Table 4-3: Summary of the interview responses on Operation and Maintenance

Indicator)	Summary of responses	Frequency
The main type of the maintenance strategy used by the utility	The utility mainly use corrective maintenance strategy. Most of the maintenance activities are undertaken when the equipment shows signs of damage, for example a learning pole or broken conductors.	5
Availability of maintenance plans	The region does not have maintenance plans in place.	5
Availability of updated maintenance work orders, records, and inventories	Updation of works orders, records and inventories are rarely done, and manually. The absence of computerised maintenance systems/software makes it difficult to keep proper records.	6
	The procurement process is taking too long, and sometimes maintenance cannot be done due to a shortage of working materials	3
	Poor quality of materials and tool supplied affect company operation and maintenance activities	4

Total number of respondents (N) =8

Figure 4-4: Survey results – Opinions on utility operation and maintenance activities



Source:Field data

Type of the maintenance strategy used by the utility

From the survey conducted 5 out of the 8 respondents pointed out that the region uses corrective maintenance as the primary maintenance strategy. Respondents argued that it is common for the region to arrange for maintenance activities when the network has started showing signs of damage. For instance, when the poles have started to learn or wires have started to tear out. On the other hand, 3 out of the 8 respondents pointed out the use of Holistic Maintenance (HOMA) project in Dar es Salaam and coastal zone regions.

The HOMA project aims at achieving complete maintenance of the distribution network from the Medium voltage (MV), distribution transformers, Low Voltage (LV) up to the customers. The main idea with HOMA is to do maintenance for all the feeders and hence reduce power outages in the system. One respondent from the head office (Respondent 3) pointed out "*so far most regions practice corrective maintenance activities, but it is promising that Dar es Salaam and coastal zone is now implementing the HOMA project "(Annnex 5).*

Availability of maintenance plans and work orders.

From the interview conducted 5 out of the 8 respondent stated that the utility did not have maintenance plans in place. Respondents explained that regions are busy repairing and fixing the emergency breakdowns and fixing up the old networks. There are no long term or short term maintenance plans in the regions. For instance respondent 5 emotionally asked "*if you are always doing repair and corrective maintenance on how you can have a plan."(Annex 5)*
Moreover, respondents explained that unavailability of maintenance plans results into deteriorated utility network day after day. The respondent further added that it is true that the existing network is very aged and there are no proper maintenance plans is and therefore difficult to reduce the number of outages.

Similarly the survey conducted confirms the findings from the interviews whereby 56.6% (combined disagree and strongly disagree) disagree with the opinion that the region has maintenance plans in place as summarised in figure (4-4) above.

Availability of updated maintenance works orders, records, and inventories.

From the interview conducted 6/8 respondents argued that updating of work orders, and records is done manually, and it is rare, which makes it difficult to keep proper records. The absence of an automated system for recording maintenance works contributes much to the lack of updated plans and inventories. Currently, the utility is having Service Delivery Management (SDM), which helps, in service delivery activities but not for maintenance activities.

Simlarly survey results presented in figure (4-4) above comfirm the iterview findings. The results revealed that 56.6 %(combined disagree and strongly disagree) disagreed with the fact that maintenance records, work orders and inventories are frequently updated.

To summarise the findings, the results revealed that the utility mainly uses corrective maintenance in its daily activities. From the interviews Dar es Salaam zone has shown the sign of making one step towards Preventive maintenance through Holistic Maintenance project (HOMA) project. From the results, it is true that utility is not doing well in maintenance activities as mostly the maintenance is on emergency basis. Literature review in chapter 2 addressed shortcomings with a corrective maintenance strategy.

Corrective maintenance may result in more cost compared to preventive maintenance; also, this strategy might lead to increased power unreliability by increasing power outages due to the continued deterioration of the network which might impact the utility (Schneider, Gaul, et al.,

2006), Abu-Elanien and Salama, (2010). Moreover, results revealed that the utility is against the recommended practices. As explained in literature review authors insist on the importance of utility to have proper and updated maintenance plans for reference and guidance in operation and maintenance activities (Esmaili, 2012). Either these findings reveal that the utility system is endangered by not having proper maintenance plans taking into account that the network is aged as observed in the literature review that the probability of losing equipment/ asset to a distribution system is increasing mostly with aging assets (Abu-Elanien and Salama, 2010).

4.3 Opinions on Power Outages

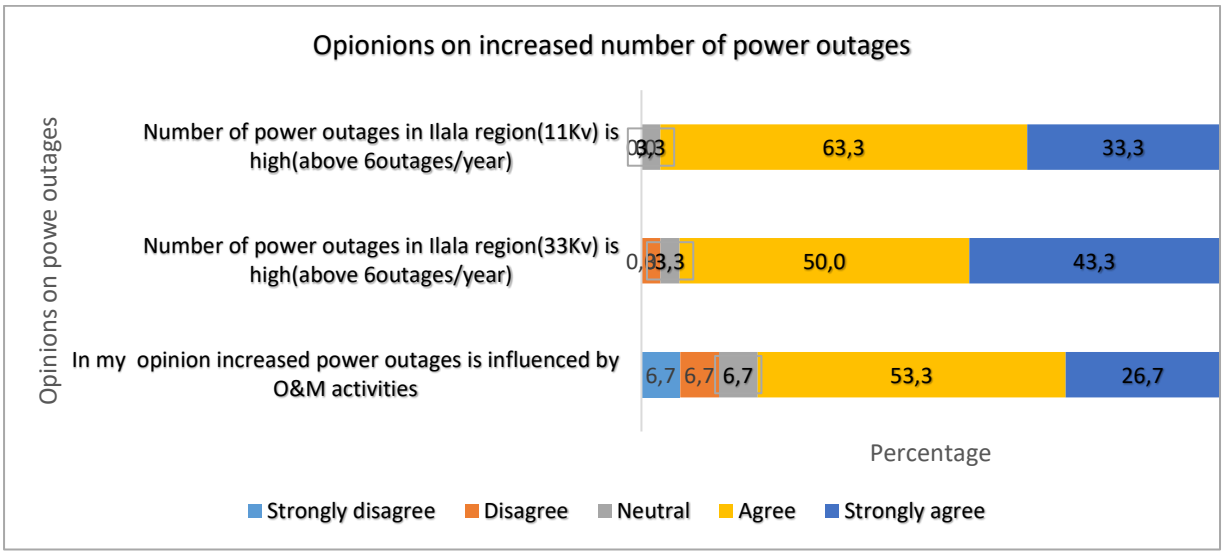
The following section discusses power outages in relation to the utility operation and maintenance activities. A large number of power outages not only tarnish the image of the company but also influences customer perspectives over the quality of service delivered. Table (4-5) summarises answers from the interviewed respondents and figure(4-5) shows the results of Likert scale questionnaires applied to the 30 survey respondents on opinions over power outages.

Table 4-4: Summary of the interview responses on power outages

Indicator	Response	Frequency
Number of outages/year(11Kv)	Poor maintenance on distribution networks contributes an increased number of power outages.	7
	Aged network also contributes to increased power outages	3
Number of outages/year/33kV	An average number of outages is 2 times/month per feeder as per 2017/2018 feeder report which is still high compared to other regions.	4
	Following the introduction of HOMA project the region expect improvements in the number of outages.	3

Total number of respondents (N) =8

Figure 4-5: Opinions on number of power outages



Source: Field data

Frequent power outages in the region

From the interview conducted 7 out of 8 respondents pointed out that poor maintenance on distribution networks contribute to the increased power outages in Ilala region. Respondents pointed out different factors contributing to the increased power outages. These factors include; lack of materials and poor quality of works done by the utility staffs . Moreover, respondent 8, from outside the utility pointed out that aged distribution networks influence the increase of outages in the region. He particularly said that "*Existing network is aged and there are no proper maintenance plans it is therefore difficult to reduce the number of power outages*" *(Annex 5).*

Additionally, the respondents argued that lack of proper planning in distribution networks is leading to the random expansion of networks leading to an increased number of outages. Respondents also pointed out that the unplanned extension of distribution network has been growing day after day which leads to the overloading of the existing system resulting in low voltages to the customers as well as frequent power outages.

The survey results also confirm that increased number of power outages is influenced by to the utility's O&M activities as revealed by 80%(combined agree and strongly agree) of the respondents who agreed that increased power outages are influenced by company O&M activities as summarised in figure (4-5) above.

Average number of power outages and performance

4 out of the 8 respondents revealed that an average number of outages is 2 times/month per feeder for both 11Kv and 33kv. This means that there is an outage twice a month for each particular feeder. Respondents pointed out that Ilala region has an average of 30 feeders, and if there is a monthly average of 2 times outages therefore in a month, there is an average of 60 outages per month which is not acceptable. A survey conducted on the opinions of the increased number of power outages confirms the interview results described earlier. The findings discovered that 93.3 %(combined agree and strongly agree) of the respondents admitted that the region has a large number of power outages (Above 6 per year) in 33kv feeders. Similarly, 96.6% of the respondents also agreed that the Ilala region has a large number of power outages in its 11Kv feeders as summarised in figure (4-5) above.

Findings from the interviews and questionnnaires are also supported by secondary data collected from the regional office. The report summarized in table (4-6) below shows the supply and reliability status of the region. Report point out that the number of unplanned outages for both 33kv and 11kv is increasing considerably. From the report for the year 2017, there was a total of 596 outages for 33kv and 1564 outages in 11kv. On the other hand, up to April 2018 outages in 33kv had already reached 488 in 33kv and 684in 11kv.

Table 4-5: Ilala region power outages report

Supply and reliability report	2017	As at April 2018
Outage time - 33 kV in hrs.	1,049.70	967.93
Planned Outage - 33kV in hrs.	539.31	580.06
Un Planned Outage - 33kV in hrs.	509.22	387.87
Total Nos of Outage - 33kV	596	488.00
Total number of customers affected by 33kV outages	691,862	447.41
Outage time - 11 kV in hrs.	2,702.93	1,090.78
Planned Outage - 11kV in hrs.	1,060.45	329.88
Un Planned Outage - 11kV in hrs.	1,667.14	385.52
Total Nos of Outage - 11kV	1,564	684.00
Total number of customers affected by 11kV outages	1,610,925	454,265.40

Source: (Tanzania Electric Supply Company Limited, 2018)

In summary power outages can generally be pointed out to increase as observed from the findings discussed earlier and from Ilala region power outage report (table 4-6 above) above. From January to April 2018, the outages for both 33kVand 11Kv are already more than half. As discussed earlier the main factors influencing increased power outages include inadequacy in human resources, poor working environment especially working tools, and insufficient financial funds. All these factors have claimed to bring challenges in operation and maintenance activities in ensuring continuous power supply to the customers.

The findings are consistent with literature review. In chapter 2 (Tallapragada, Shkaratan, et al., 2009) revealed that Tanzania is among the countries in Africa with a large number of outages/ year. Moreover, the authors argued that an average number of power outages experienced in a typical month could go to over 100 times (Abotsi, 2016).

4.4 Statistical Results

4.4.1 Influence of Human Resource and Tariff on O&M

To develop relationships between variables, statistical tests were conducted between human resource and tariff with operation and maintenance and then between operation and maintenance with power outages. Before executing the statistical tests between variables, Cronbach alpha was carried out to examine consistency in measuring variables and the results are summarised in the table (4-7) below.

Table 4-6: Summary of Cronbach alpha results

Variable	Human resource	Tariff	O&M	Power outages
Cronbach alpha	0.715	0.643	0.704	0.654

As it can be seen from the table (4-7) above all variables have Cronbach alpha value higher than 0.6 which is acceptable for this thesis research implying that there was consistency in measuring the variables as pointed out by (Gliem and Gliem, 2003)

Pearson correlation test was then conducted to examine the nature of the relationship between variables. First, Pearson correlation was performed between human resources and tariff individually with O&M and the results presented in table (4-8)

Table 4-7: Pearson correlation between human resource and tariff individually with O&M

	Operation& Maintenance
Human resource	r = 0.399 p =0.029
Tariff	r = 0.212 p = 0.262

As it can be seen from the results, human resources is significant correlated with operation and maintenance(r = 0.399 and p =0.029). The results are further supported by Liu, Combs, et al., (2007) in his study based on 19000 organisations it concludes that human resource management adds significant value to the organisation. These results confirms the interviews and secondary data, which explain that improvement in human resource has a positive effect (improvement) on utility operation and maintenance activities. Similarly, interview results suggested increase in number of staff, improvement in working environment and appropriate training to the employee has significant effects into utility O&M activities.

On the other hand, the results show that tariff do not have significant correlation with Operation and Maintenance (r =0.212 and p = 0.262) within the confidence interval of 95% adopted for this study. Literatures addresses that generally, financially viable utilities are more effective operationally because they can finance maintenance activities timely and hence have healthy networks leading to power reliability. To attain this goal requires electricity tariffs that are high enough to cover operation and maintenance costs (Foster and Briceño-Garmendia, 2010). Even though statistical results reveal inconsistent results, the inconsistency may possibly be due to the reason that sample adopted for this study are not involved directly in tariff setting and hence respondents involved might not be up to date with the current tariff information since tariffs are approved by the regulator and not the utility.

Nevertheless interviews and secondary data collected reveal that tariffs charged on electricity significantly limit utility O&M activities through low tariff charged and less budget allocated to effectively implement O&M activities. The results are supported by Ortega, Pérez-Arriaga, et al., (2008), whom advocates that productivity in electricity sector can be attained through proper design of transmission and distribution tariffs, which are economically viable.

However when human resource and tariff are combined and correlated with Operation and Maintenance the results revealed significant relationship as summarized in table (4-9) below.

Table 4-8:Pearson correlation between combined human resource and tariff with O&M

	Operation& Maintenance
Human resource and Electricity tariff	r = 0.405 p =0.027

As can be seen from the table above human resources and tariff together were significantly correlated with operation and maintenance. These results suggest that improvement in both human resources and tariff have a positive effect (improvement) in utility operation and maintenance activities.

These results are supported by literature that is essential for the utility to have enough and qualified staffs to execute O&M activities to improve performance (Sullivan, Pugh, et al., 2010, Esmaili, 2012). Similarly, Armstrong and Taylor (2014), in literature addressed the importance of suitable working environment such as working tools and information to enable the employees

to perform effectively. Consequently Pérez-Arriaga et al., (2008), noted that productivity in electricity sector can be attained through proper design of transmission and distribution tariffs which are economically viable. The results further support by the interview results and secondary data that both human resources and tariff influences O&M activities. Additionally interview results suggest that there are also other factors which affect utility O&M activities such as aged distribution networks, availability and quality of materials supplied for O&M activities.

4.4.2 Influence of Operation and Maintenance on Power Outage

To examine the relationship between O&M and power outages the researcher carried out correlation between O&M and power outages. Summary of the Pearson correlation presented in the Table (4-10) below

Table 4-9: Pearson correlation between O&M and power outages

	Power outages
Operation & Maintenance	r = -0.517 p =0.003

As it can be seen from the table, the results reveal *a strong and negative correlation* between operation and maintenance and the power outages. The results suggest that improvement in operation and maintenance will ultimately reduce power outages. The results are also supported by different authors who argue that, O&M does not only contributes to the power reliability, and the quality service, but it is also a cost effective method of ensuring power reliability (Sullivan, Pugh, et al., 2010, Fernández and Márquez, 2009).

Furthermore these results confirms the interview and secondary data which revealed that corrective maintenances strategy used by the utility, lack of maintenances plans as well as the absence of updated maintenance records results into an increased number of power outages. With corrective maintenance strategy, the utility is having an unhealthy system, which contributes to increased power outages, also the absence of maintenance plans leads to the lack of network reinforcement and rehabilitation plans which forces the region into the problem of system overloading (overloaded lines and transformers) hence an increased number of power outages. Moreover, the interviews pointed out that other factors such as aged network also influence utility power outages.

4.4.3 Multiple Regression

Multiple regression in this study was applied to identify which independent variables have more effect on the power outages. Multiple regression aims at explaining technically the gradual variation of independent variable on the basis of dependent variables (Jansen, 2010). Summary of the results is presented in table (4-11) and table (4-12) below.

Table 4-10 : Coefficients table showing statistical significance of variables.

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	5.327	.833		6.397	.000
HR	.076	.195	.066	.391	.699
O & Maintenance	-.409	.133	-.532	-3.082	.005
Tariff	.109	.135	.137	.809	.426
Dependent Variable: Outages					

From the table (4-11) above significance test for the operation and maintenance indicates that the variable was statistically significance with p value less than 0.05 which is acceptable for this study. However, electricity tariff and human resources were significantly insignificant with p value higher than 0.05. Princeton University (2007), addressed that when independent variables correlate, coefficients of the individual variables may become insignificant while regression as whole is significant. Automatically this is due to the fact that highly correlated independent variable explain the portion of variation in dependent variable hence their explanatory power and significance is shared up between them. In this research because of the high correlation between O&M and power outages the explanatory power in coefficients and significance divided among them thus shows insignificant correlation on human resource and tariff, however the whole regression was significant.

Furthermore, from the values of the standardised coefficients, the results in the table illustrate that O&M had the highest standardized coefficient (- 532) signifying that O&M had a higher influence on power outages while negative value implies that poor O&M lead to increased power outages, followed by Electricity tariff at beta 0.137 and human resources at (0.066). The results are supported by Rosnes and Shkaratan (2011), who calls for critical interventions in improving utility operations, bringing tariffs to the level of long-run marginal costs and proper management of human resources for the better performance of the sector.

Table 4 12: Model Summary - Multiple regression results

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
	.538a	.289	.207	.56063
a. Predictors: (Constant), Tariff, HR, O_Maientenance				

Furthermore, from the multiple regression results table (4-12) above, predictors human resource, tariff and operation, and maintenance influenced power outages (dependent variable) by an adjusted R Square of 0.207. Statistically, this means that the effect of O&M, tariff and human resources are explaining the 20.7% of the variance of a power outage. This implies that all the three variables (human resources, tariff and O&M) have a significant influence on power outages.The results further indicate that there are also other factors, which influence power outages which are explained by the remaining 79.3%. The results are also supported by the literature as discussed in chapter 2 that it is crucial to have effective operation and maintenance in networks to reduce outages and improve power reliability (Sullivan, Pugh, et al., 2010). The literatures also notes that, in power sector successful management of physical assets depends on various factors such as human assets, financial assets, and information (PAS, 2008).

Furthermore, these results confirms the interview results which pointed out that power outages is not only contributed by O&M but also other factors. The interview pointed out other factors such as quality of materials supplied as well as the absence of line materials as among the factors influences on utility O&M and hence increased power outages. From the findings it is evidently found that human resources, tariff and O&M significantly influence power outages. However both interviews and statistical results indicate that it is important for more research to be conducted on other factors influencing power outages.

Chapter 5 : Conclusions and Recommendations

5.1 Conclusion

The following chapter presents the conclusion and recommendations as revealed by the study findings. The section presents the challenges of O&M contributing to the increased power outages at TANESCO Ilala. Power outages are a persisting problem not only in the region but also Africa at large (Rosnes and Shkaratan, 2011, Abotsi, 2016). Moreover, increased power outages not only contribute to the increased customer complaints but also contribute to the utility revenue losses as well as revenue loss in the industrial sector. (Kapika and Eberhard, 2013).

The aim of this study is, therefore, to explain how human resources and electricity tariff has been influencing utility operation and maintenance in reducing power outages. A single case study approach was used to review in depth factors of human resource affecting O&M activities and how financially tariff limit utility O&M activities in reducing power outages. The previous chapter analysed qualitative and quantitative data obtained from the field with the support of secondary data collected from different sources. The results revealed that the utility is facing various challenges in its operation and maintenance activities, which are reflected by an increased number of power outages.

To address the main research question "*to what extent human resources and electricity tariffs influences TANESCO's operation and maintenance activities in reducing power outages"?* This study first addresses the three sub-questions separately before answering the main question and arrives at a conclusion.

How do human resources influence operation and maintenance?
From the findings collected from interviews, questionnaires and secondary data it is evident that human resource ***moderately influences operation*** and maintenance activities. These results are further confirmed by statistical results which reveal a moderate positive significant relationship with O&M ($p = 0.029$, $r = 0.399$). Human resource factors identified to influence company O&M activities are found to be less in number of working tools. Lack of enough working tools was identified as the main problem in implementing O&M activities. The majority of the respondents in both qualitative and quantitative data mentioned working tools including vehicles.

The results are supported by literature as addressed by (Armstrong and Taylor, 2014) discussing the importance of the utility to encourage good working environment to promote positive work altitude among workers and improve performance. Less staff in technical teams in the region has been argued to result in delayed maintenance as well as poor quality of work and hence increased power outages. Trimble also emphasises appropriate staffing, Kojima et al., (2016), who mention staffs numbers as an essential aspect to determine utility performance. Lastly, training needs assessment (TNA) analysis is also identified as another human resource influencing O&M factor by creating less productive staff who limit proper implementation of O&M activities as staffs will have irrelevant training for a particular task. As addressed in the literature review by Itika, (2011) it is crucial for the employees involved in an organisation to have the general and specific knowledge and skills of the tasks for the acceptable performance of the team, department, and company in general.

To what extent do tariff limit the implementation of TANESCO O&M activities

From the results gathered from interviews, questionnaires and secondary data it is found that electricity tariff is not adequate to meet utility O&M activities hence ***significantly limit the***

implementation of O&M activities. As discussed earlier, this is due to low charges on electricity compared to the production cost. The utility company's report, indicates under-recovery of 23.26TZS/kWh from the current tariff charged of TZS 242.21TZS/kWh. Under-recovery is urged to limit utility to provide required services to the customers. Low tariff charged on electricity further results into the inadequate budget for operation and maintenance activities as argued by Foster and Briceño-Garmendia (2010) that with less budget the region is not enabled to implement network maintenance activities accordingly, instead it is forced to do maintenance based on the available fund while sacrificing other parts of the distribution network.

Subsequently, lack of proper maintenance in the distribution network is revealed by the poor power reliability as in demonstrated by an increased number of power outages. According to Ortega, Pérez-Arriaga, et al., (2008), productivity in electricity sector can be attained through proper design of transmission and distribution tariffs, which are economically viable. The author further states that financially viable utilities are more effective operationally because they can finance maintenance activities timely and, hence, healthy networks leading to power reliability.

How do human resource and tariff influence O&M?

Moreover, the results from the interviews, questionnaire and secondary data explained that both human resources and tariff collectively *moderately influenced utility O&M*. These results are further confirmed by the statistical analysis computed which revealed a moderate and positive correlation between (human resource and tariff) on O&M with ($p = 0.027$ $r = 0.405$). The results imply that improvement in both tariff and human resources bring positive change (improvement) in operation and maintenance activities.

As pointed out in the literature that failure to have sufficient tariff to cover for the operation and maintenance cost results into poor levels of service to the customers as well as continued deterioration of the assets. (Farvacque-Vitkovic and Kopanyi, 2014). Also Liu, Combs, et al., (2007) in his studies on human resources he established a strong relationship between organisational performance and human resources. He advised on the importance of human resources management as a significant factor in attaining organisation operations performance.

How do operation and maintenance influence power outages?

From the results gathered from interviews, questionnaires and secondary data it is revealed that utility O&M activities ***have a strongly influence on power outage***s. These results are also confirmed by the statistical results as described in chapter 4 above. Analytical results reveal that operation and maintenance has a strongly influence with a negative correlation with power outages ($p = 0.03$) and ($r = -0.507$). These results implied that poor operation and maintenance has contributed to the increased number of power outages.

These results, therefore, explain that improvement in utility O&M activities will lead to the reduction in power outages. From the findings, main factors identified to influence O&M activities negatively includes corrective maintenance strategy used by the utility. With this strategy no maintenance done on the distribution network unless there is a sign of failure or complete failure on the network. With corrective maintenance strategy, the utility has unhealthy system which contributes to increased power outages. As argued in literature corrective maintenance strategy is likely to results in more cost as compared to preventive maintenance and also this strategy interferes with the supply reliability of the utility (Schneider, Gaul, et al., 2006, Abu-Elanien and Salama, 2010). Likewise, Esmaili, (2012), warned that with the corrective maintenance, equipment/network service is threated and its life is endangered.

Similarly, lack of updated maintenance plans, work orders and inventories negatively influence power outages. Lack of maintenance plans lead to the absence of network reinforcement and

rehabilitation plans. Absence of these plans forces the region into the problem of system overloading (overloaded lines and transformers) which results into an increased number of power outages. Literature pointed out the importance of having proper and updated maintenance plans as they are essential in understanding failure types (Esmaili, 2012). Furthermore having updated maintenance plans, work orders, and records help future planning of the network to avoid system constraints and overload hence reducing the number of power outages.

To finally answer the main question ***to what extent have human resources and electricity tariff influences TANESCO operation and maintenance activities in reducing power outages in Ilala region*.**

From the results of the interviews, descriptive statistics and secondary data, and inferential statistics it is concluded that human resources and electricity tariff *moderately influences O&M*. Consequently *O&M strongly influence power outages.* Statistical results also confirm these findings that the correlation test revealed a significant negative relationship between operation and maintenance and power outages($r = -0.517$ and $p = 0.003$). The results are further confirmed by multiple regression which revealed that human resource, tariff and operation and maintenance activities are explaining the 20.7% of the variance of a power outage.

These results explain that improvement in operation and maintenance lead to the reduction in power outages. The study further confirms the conceptual framework that O&M activities have a direct and robust effect on power outages indicating that O&M is a higher predictor of power outages. Sullivan, Pugh, et al., (2010) supports these findings by advocating that effective operation and maintenance is an essential aspect in reducing power outages and improving power reliability. Moreover, from the results, it can be suggested that successful O&M activities of a utility depend not only on human resources and tariffs factors but also on different factors. Similarly, this is explained by (PAS, 2008) which pointed out that successful management of physical assets depends on various factors such as human assets, financial assets, and information.

5.2 Recommendation

Increased power outages in developing countries is still a persisting problem and particularly in Ilala region and utility at large. To improve power reliability, this study, therefore, recommends that TANESCO should focus on addressing limiting factors identified in this research as follows.

Regarding managerial implications, the utility should ensure that the regions have enough and trained staffs to carry out O&M activities effectively. Similarly, the service provider should guarantee an appropriate working environment for employees by providing regions with enough working tools as well as standard Personal Protective Equipment (PPE). Furthermore, the utility should address the existing gap in O&M activities especially by engaging more effort in HOMA project. As discussed earlier HOMA project aim at achieving complete maintenance of the distribution network from the Medium voltage (MV), distribution transformers, Low Voltage (LV) up to the customers. Effectively implementation of HOMA project, will guarantee complete feeder maintenance and hence reduce power outages in the system.

To the energy regulator and the policymakers, the researcher recommends that they should emphasise on addressing constraints encountered by the utility in attaining cost-reflective tariffs. Overcoming these barriers will enable the country to have a financially viable utility which is more effective operationally and hence finance maintenance activities timely leading to healthy distribution networks and consequently improved power reliability.

5.3 Recommendations for Future Research

Regarding future academic studies, researcher perceives that there is a need in developing countries to expand research on other factors influencing increased power outages. As revealed from the interviews and the statistical results, there is therefore a great need for further researches on what are the other factors contributing to increased power outages in developing countries where power outages is still a persisting problem.

Moreover, the study realises contribution of human resources in organisation performance especially Training and development although it is researcher's view that further research is crucial in utilities on an aspect of Training Needs Assessment (TNA) to establish the impact of training given to utility employees.

On the other hand, the results of this study cannot be generalised, either the findings of this study are not meant for transfer to any other region/ organisation. Lastly, it is researcher opinions that, it is important to use large of sample size in data collection to increase the reliability and validity of future the research.

Bibliography

Abotsi, A., 2016. Power Outages and Production Efficiency of Firms in Africa. Available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2729838 .

Abu-Elanien, A. E. B. and Salama, M. M. A., 2010. Asset management techniques for transformers. Available at: http://www.sciencedirect.com/science/article/pii/S0378779609002405 .

ANEEL, 2008. Questions and answers about electricity distribution tariffs. Brasilia: Brazilian Electricity Regulatory Agency. Available at: http://www2.aneel.gov.br/arquivos/PDF/cartilha_RTP_ingles2.pdf [Accessed 5-5-2018].

Armstrong, M. and Stephens, T., 2005. A handbook of management and leadership: A guide to managing for results. Kogan Page Publishers. Available at: https://books.google.nl/books?hl=en&lr=&id=FkccWmbCG9kC&oi=fnd&pg=PR9&dq=Armstrong,+M.+and+Stephens,+T.,+2005.+A+handbook+of+management+and+leadership:+A+guide+to+managing+for+results.+Kogan+Page+Publishers&ots=PKfcICDwXP&sig=K8tU4Mdi8xhxpinak-0Yr5Fe4yg#v=onepage&q=Armstrong%2C%20M.%20and%20Stephens%2C%20T.%2C%202005.%20A%20handbook%20of%20management%20and%20leadership%3A%20A%20guide%20to%20managing%20for%20results.%20Kogan%20Page%20Publishers&f=false [Accessed 4-8-2018].

Armstrong, M. and Taylor, S., 2014. Armstrong's handbook of human resource management practice. Kogan Page Publishers. Available at: https://scholar.google.nl/scholar?hl=en&as_sdt=0%2C5&q=Armstrong%2C+M.+and+Taylor%2C+S.%2C+2014.+Armstrong%27s+handbook+of+human+resource+management+practice.+Kogan+Page+Publishers.+&btnG= [Accessed 2-9-2018].

Cole, G. A., 2004. Management theory and practice. Cengage Learning EMEA. Available at: https://books.google.nl/books?hl=en&lr=&id=HQhvAnb4TgMC&oi=fnd&pg=PR8&dq=Cole,+G.+A.,+2004.+Management+theory+and+practice.+Cengage+Learning+EMEA.+&ots=5HejjQuBiX&sig=knmjXLbs_87a1im9_lskjttcejI#v=onepage&q=Cole%2C%20G.%20A.%2C%202004.%20Management%20theory%20and%20practice.%20Cengage%20Learning%20EMEA.&f=false [Accessed 1-9-2018].

Cole, G. A. and Kelly, P., 2011. Management theory and practice. South-Western Cengage Learning. Available at: https://scholar.google.nl/scholar?hl=en&as_sdt=0%2C5&q=Cole%2C+G.+A.+and+Kelly%2C+P.%2C+2011.+Management+theory+and+practice.+South-Western+Cengage+Learning.&btnG= [Accessed 1-9-2018].

Esmaili, D., 2012. *Assessing Organizational Competency in Infrastructure Asset*. *Assessing Organizational Competency in Infrastructure Asset Management: The Case of Water and Wastewater in Ontario Municipalities,* Available at: https://tspace.library.utoronto.ca/handle/1807/33412 [Accessed 23-8-2018].

Farvacque-Vitkovic, C. D. and Kopanyi, M., 2014. Municipal finances: A handbook for local governments. World Bank Publications. Available at:

https://elibrary.worldbank.org/doi/abs/10.1596/978-0-8213-9830-2 [Accessed 20-8-2018].

Fernández, J. F. G. and Márquez, A. C. 2009. Framework for implementation of maintenance management in distribution network service providers. *Reliability Engineering & System Safety*, 94 (10), pp. 1639-1649. Available at: https://www.sciencedirect.com/science/article/pii/S095183200900091X [Accessed 30-7-2018].

Foster, V. and Briceño-Garmendia, C., 2010. Africa's infrastructure: a time for transformation. World Bank. Available at: https://elibrary.worldbank.org/doi/abs/10.1596/978-0-8213-8041-3 [Accessed 28-7-2018].

Georgia Environmental Protection Division, 2000. Guidance manual for preparing public water supply system: O&M Plans. Atlanta, Georgia: Georgia Environmental Protection Division. Available at: https://epd.georgia.gov/sites/epd.georgia.gov/files/related_files/site_page/o%26m.pdf [Accessed 25-5 2018].

Gliem, J. A. and Gliem, R. R., 2003. Calculating, interpreting, and reporting Cronbach's alpha reliability coefficient for Likert-type scales. Midwest Research-to-Practice Conference in Adult, Continuing, and Community Education. Available at: https://scholarworks.iupui.edu/handle/1805/344 [Accessed 4-9-2018].

Harel, G. H. and Tzafrir, S. S. 1999. The effect of human resource management practices on the perceptions of organizational and market performance of the firm. *Human Resource Management*, 38 (3), pp. 185-199. Available at: https://onlinelibrary.wiley.com/doi/abs/10.1002/(SICI)1099-050X(199923)38:3%3C185::AID-HRM2%3E3.0.CO;2-Y [Accessed 22-8-2018].

Itika, J., 2011. Fundamentals of human resource management: Emerging experiences from Africa. African Studies Centre [etc.], Leiden [etc.]. Available at: https://openaccess.leidenuniv.nl/handle/1887/22381 [Accessed 4-9-2018].

Jansen, H., 2010. The logic of qualitative survey research and its position in the field of social research methods. Available at: http://www.qualitative-research.net/index.php/fqs/article/view/1450 [Accessed 4-9-2018].

Kalra, P. and Shekhar, R. 2006. Chapter 9: Urban energy management. Chapter 9: Urban energy management. 2006. India infrastructure report 2006. New Delhi: Oxford University Press. pp. 180-207. Available at: http://www.idfc.com/pdf/report/iir-2006.pdf. [Accessed 19/2/2018].

Kapika, J. and Eberhard, A., 2013. Power-sector reform and regulation in Africa: lessons from Kenya, Tanzania, Uganda, Zambia, Namibia and Ghana. HSRC Press. Available at: http://repository.hsrc.ac.za/handle/20.500.11910/2926 [Accessed 2-9-2018].

Liu, Y., Combs, J. G., Ketchen Jr, D. J. and Ireland, R. D. 2007. The value of human resource management for organizational performance. *Business Horizons*, 50 (6), pp. 503-511.

Available at: https://www.sciencedirect.com/science/article/pii/S0007681307000833 [Accessed 23-8-2018].

Ministry of Energy and Minerals, 2014. Electricity supply industry reform strategy and roadmap 2014 - 2025. Dar es saalam: Available at: http://www.tanesco.co.tz/index.php/media1/downloads/announcements/12-electricity-supply-industry-reform-strategy-and-roadmap-2014-2025 [Accessed 17-4-2018].

Monkey survey, 2018. Sample size calculator. Available at: https://www.surveymonkey.com/mp/sample-size-calculator/ [Accessed 2018].

Morden, T., 2016a. Principles of strategic management. Routledge. Available at: https://www.taylorfrancis.com/books/9781317075820 [Accessed 24-8-2018].

Morden, T., 2016b. Principles of strategic management. Routledge.

Neuman, W. L. and Robson, K. 2007. Basics of social research: Qualitative and quantitative approaches. *Power,* 48 pp. 48. Available at: https://epdf.tips/basics-of-social-research-qualitative-and-quantitative-approaches-2nd-edition.html [Accessed 5-8-2018].

Ortega, M. P. R., Pérez-Arriaga, J. I., Abbad, J. R. and González, J. P. 2008. Distribution network tariffs: A closed question? *Energy Policy,* 36 (5), pp. 1712-1725. Available at: https://www.sciencedirect.com/science/article/pii/S0301421508000190 [Accessed 3-8-2018].

PAS, B., 2008. 55-1: Asset management. Part 1: Specification for the optimized management of physical assets. *British Standards Institution,* Available at: https://scholar.google.nl/scholar?hl=en&as_sdt=0%2C5&q=PAS%2C+B.%2C+2008.+55-1%3A+Asset+management.+part+1%3A+Specification+for+the+optimized+management+of+physical+assets.+British+Standards+Institution&btnG= [Accessed 2-8-2018].

Peng, D. and Poudineh, R., 2016. Sustainable electricity pricing for Tanzania. London: International Growth Centre. Available at: https://www.theigc.org/wp-content/uploads/2016/08/Peng-Poudineh-2016-Working-Paper.pdf [Accessed 17-5-2018].

Princeton University, 2007. Interpreting regression output. The Trustees of Princeton University. Princeton University. Available at: https://dss.princeton.edu/online_help/analysis/interpreting_regression.htm#coefficients [Accessed 30-08-2018].

RERA, 2016. RERA Publication on Electricity Tariffs & Selected Performance Indicators for the SADC Region 2014. Regional Electricity Regulators Association of Southern Africa (RERA). Available at: http://www.erb.org.zm/press/publications/newsletters/2014RERAPublication.pdf [Accessed 4-5-2018].

Rosnes, O. and Shkaratan, M., 2011. Africa's power infrastructure: investment, integration, efficiency. World Bank Publications. Available at: https://elibrary.worldbank.org/doi/abs/10.1596/978-0-8213-8455-8 [Accessed 5-8-2018].

Rouse, G. and Kelly, J., 2011. Electricity Reliability: Problems, progresss and policy solutions. USA: Galvin Electricity Initiatives. Available at: http://www.galvinpower.org/sites/default/files/Electricity_Reliability_031611.pdf [Accessed 10-5-2018].

Schneider, J., Gaul, A. J., Neumann, C., Hogräfer, J., et al., 2006. Asset management techniques. *International Journal of Electrical Power & Energy Systems,* 28 (9), pp. 643-654. Available at: https://www.sciencedirect.com/science/article/pii/S0142061506000834 [Accessed 30-8-2018].

Sullivan, G., Pugh, R., Melendez, A. P. and Hunt, W. 2010. *Maintenance best practices-A guide to achieving operational efficiency (Release 3). Operations & Maintenance Best Practices-A Guide to Achieving Operational Efficiency (Release 3),* Available at: https://www.osti.gov/biblio/1034595 [Accessed 3-9-2018].

Tallapragada, V., Shkaratan, M., Izaguirre, A. K., Helleranta, J., et al., 2009. Monitoring performance of electric utilities: Indicators and benchmarking in Sub-Saharan Africa. Available at: https://openknowledge.worldbank.org/handle/10986/13030 [Accessed 2-8-2018].

Tanzania Electric Supply Company Limited, 2016a. Corporate Business Plan – 2016/17 June. Dar es saalam: Available at: http://www.ewura.go.tz/wp-content/uploads/2016/11/Corporate%20Business%20Plan%20–%202016-17.pdf [Accessed 17-4-2018].

Tanzania Electric Supply Company Limited, 2016b. TANESCO Tariff Adjustment Application for year 2017. Dar es saalam: Available at: http://www.ewura.go.tz/wp-content/uploads/2016/11/TANESCO%20Tariff%20Adjustment%20Application%20for%20year%202017.pdf .

Tanzania Electric Supply Company Limited, 2018. Monthly report Ilala region. Unplished.

Trimble, C., Kojima, M., Arroyo, I. and Mohammadzadeh, F., 2016. Financial viability of electricity sectors
in Sub-Saharan Africa: Quasi-Fiscal Deficits and Hidden Costs. 7788. Energy and Extractives Global Practice Group. Available at: http://documents.worldbank.org/curated/en/182071470748085038/pdf/WPS7788.pdf [Accessed 21-5-2018].

United Republic of Tanzania, 2015. National energy policy. Dar es Salaam: Ministry of Energy and Minerals. Available at: https://www.nishati.go.tz/# [Accessed 12/2/2018].

Van Thiel, S., 2014. Research methods in public administration and public management: An introduction. Routledge. Available at: https://www.taylorfrancis.com/books/9781136155352 [Accessed 2-6-2018]

Annex 1: Interview questions

My names are Mary Dominick Kabakuzi studying at Institute for Housing and Development Studies of Erasmus University, Rotterdam in the Netherlands. I am researching the influence of human resources and Electricity tariff on Company operation and maintenance activities in reducing power outages. A case of Tanzania Electric Supply Company (TANESCO). I would like to seek your opinions and experiences regarding this study. The interview will take about 30 minutes of your time. I also request your permission to record this discussion. The recording will help me with data analysis. I assure you that all the data collected will be treated confidentially. And the information collected will be used for academic purposes only.

Thank you very much, your contributions and comments are appreciated.

Semi-structured interview guide

	Human resources		
S/no	**Question**	**Indicator**	**verification**
1	Can you tell me about the company training and development policy?? • How many staff working on O&M attend training per year • How do you rate the relevance of the training given to staff with performance	Number of staff attending O&M training in a year	
2	Can you please tell me which factors most influence staff costs? In your opinions how do these costs affect O&M activities?	Staff cost	Budgets and monthly reports
3	Do regions have enough number of O&M staff in comparison to the customers served? • How does this number of available staff affect region O&M activities	Customer/employee ratio	
4	How do you rate the adequacy of working tools and PPE given to O&M staffs	Available working &safety tools	Copy of tool and PPE inventories
5	In your opinion what do you think are the essential Human resources factors which influence company O&M activities in reducing power outages		

6	How does above(number 5) above factors affect O&M activities in regions		
	Electricity Tariff		
	What are your opinions on the tariff charged on the effective implementation of company O&M activities?		
6	What is the ratio of the effective tariff as compared to the cost of producing 1unit of electricity • Is this cost enough to cover the company O&M activities	Effective tariff/kWh	Copy of tariff structure/user category
7	What is your average annual O&M annual budget? • Does approved budget cover actual O&M costs	O&M costs vs. budget	Copy of approved budget
8	In your opinions does tariff adjustment and review procedures sufficient for proper implementation of company O&M activities	Tariff adjustment and review(times /year)	
9	Cost reflective tariff has many benefits to the utilities in your opinions, what prevent TANESCO from attaining cost reflective tariff?	Constraints on cost reflective tariffs	
	Operation and Maintenance		
10	How do you rate company general O&M activities (efficient, average, poor)		
11	Which maintenance strategy is used by the company (CM,TBM,RCM,CBM) • How do you rate it (effective, average, less effective)	Type of the maintenance strategy used	
12	Do the company have maintenance plans in place (Yes/No) if yes • Does maintenance works orders, records and	Available maintenance plans &updated maintenance records	Copy of works order and inventories

	inventories continuously updated		
14	In your opinion What are the other factors of O&M affect the number of outages and how	**Descriptive**	
	Power outages		
16	In your opinion why there is frequent power outages?		
17	In the past five year what is the average number of outages in both 11kv and 33kv distribution line • In your opinions what is the reason for the increase or decrease in the number of outages in relation to company O&M activities? • How do you rate the performance	Number of outages(11 &33kv)	Distribution annual report for past five years.

Thank you for your time, we have now reached the end of our interview. Is there anything you would like me to add or if there is anything you feel I need to know before I left out?

Annex 2: Questionnaires

My names are Mary Dominick Kabakuzi studying at Institute for Housing and Development Studies of Erasmus University, Rotterdam in the Netherlands. Iam researching the influence of human resources and Electricity tariff on Company operation and maintenance activities in reducing power outages. A case of Tanzania Electric Supply Company (TANESCO).

I would like to seek your opinions and experiences regarding this study. I would like to ask your opinions on this topic through answering the following questionnaire. I assure you that all collected data will be confidential and all the information gathered will be anonymous. The data collected will be used for academic purposes only. Thank you for your participation, your contribution and comments are appreciated.

Questionnaires

Thank you for your time, we have now reached the end of the questionnaire. Is there anything you would like me to add or if there is anything you feel I need to know do not hesitate to contact me.

S/no	**Questions**	**Response (**Kindly explain or Tick a suitable response)
	Section A- General Information	
	Department	
1	Gender	☐Male ☐Female
2	Job title	
3	Working experience	☐ Less than 3 years ☐ More than 3 years
	Section B – Human Resources	
4	Operation and maintenance(O&M) staffs continuously attend training concerning their daily activities	☐I strongly disagree ☐I disagree ☐Neutral ☐I agree ☐I strongly agree
5	Training given to staffs is of great importance in their daily O&M activities	☐I strongly disagree ☐I disagree ☐Neutral ☐I agree ☐I strongly agree
6	Salaries influence staff cost mostly	☐I strongly disagree ☐I disagree ☐Neutral ☐I agree ☐I strongly agree
8	Available number of staffs affect organization O&M activities	☐I strongly disagree ☐I disagree ☐Neutral ☐I agree

		☐I strongly agree
9	Region (s) have adequate working tools for their daily O&M activities	☐I strongly disagree ☐I disagree ☐Neutral ☐I agree ☐I strongly agree
10	O&M Staffs are adequately provided with PPEs for their daily activities to ensure their safety and security	☐I strongly disagree ☐I disagree ☐Neutral ☐I agree ☐I strongly agree
11	In your opinion what are the important Human resources factors which influence company O&M activities in reducing power outages(You can choose maximum of 3 factors)	☐Staff trainings ☐Staff costs ☐ Enough working tools ☐ Enough PPE ☐Enough number of staffs
	Section C - Electricity Tariffs	
12	Effective tariff charged for single unit of electricity is not enough to cover operation and production costs	☐I strongly disagree ☐I disagree ☐Neutral ☐I agree ☐I strongly agree
13	O&M budget allocated is enough to cover the company O& M activities	☐I strongly disagree ☐I disagree ☐Neutral ☐I agree ☐I strongly agree
15	Low tariff charged on electricity contributes to poor company O&M activities	☐I strongly disagree ☐I disagree ☐Neutral ☐I agree ☐I strongly agree
16	In your opinion what do are the important Tariff factors which limits the proper implementation of O&M activities.(You can choose maximum of 3 factors)	☐Effective tariff/kwh ☐Less O&M budget approved ☐High O&M costs ☐ Tariff adjustment and review schemes ☐Non-reflective tariff Others (Explain……
17	Cost reflective tariff has many benefits to the utilities in your opinions What constrains to you think prevent TANESCO from attaining cost reflective tariff	Please explain
	Section D – Operation and Maintenance	
19	Which maintenance strategy is mainly used by the company in its day to day activities	☐ Corrective Maintenance (CM) ☐ Time based maintenance (TBM)

		☐ Reliability Centered maintenance(RCM) ☐ Condition Based Maintenance (CBM)
20	maintenance strategy in place is effective in in reducing power outages in region(s)	☐I strongly disagree ☐I disagree ☐Neutral ☐I agree ☐I strongly agree
21	Company has maintenance plans in place	☐ I strongly disagree ☐I disagree ☐Neutral ☐I agree ☐I strongly agree
20	Available Maintenance plans are frequently used in carrying out company O&M activities	☐I strongly disagree ☐I disagree ☐Neutral ☐I agree ☐I strongly agree
22	maintenance works orders, records and inventories are continuously updated	☐I strongly disagree ☐I disagree ☐Neutral ☐I agree ☐I strongly agree
23	Availability of updated maintenance plans, works orders and inventory effects performance of O& M activities	☐I strongly disagree ☐I disagree ☐Neutral ☐I agree ☐I strongly agree
	Section E - Power outages	
25	Number of power outages in Ilala region (11Kv) is high (Above 6 outages/ year)	☐I strongly disagree ☐I disagree ☐Neutral ☐I agree ☐I strongly agree
26	Number of power outages in Ilala region (33Kv) is high (Above 6 outages/ year)	☐ I strongly disagree ☐I disagree ☐Neutral ☐I agree ☐I strongly agree
27	In my opinions increased power outages is influenced by operation and maintenance activities	☐ I strongly disagree ☐I disagree ☐Neutral ☐I agree ☐I strongly agree

Annex 3: Research Schedule

Activity	**Time**				
Planning and preparations	April - June 2018				
Data collection	June - July 2018				
	Week 1	Week 2	Week 3	Week 4	Week 5
Site familiarization					
Identifying key respondents					
Contact with key respondents					
Interview with TANESCO					
Interview with EWURA					
Administering questionnaires					
Data processing					
Data analysis, recommendation, and conclusion	July - September 2018				
Final submission	September 2018				

Annex 4: SPSS Results

Reliability tests

Cronbach Alpha reliability analysis results (Human resources)

Reliability Statistics

Cronbach's Alpha	N of Items
.715	5

Cronbach Alpha reliability analysis results (Tariff)

Reliability Statistics

Cronbach's Alpha	N of Items
.643	3

Cronbach Alpha reliability analysis results (O&M)

Reliability Statistics

Cronbach's Alpha	N of Items
.704	5

Cronbach Alpha reliability analysis results (Power outages)

Reliability Statistics

Cronbach's Alpha	N of Items
.653	3

Correlation tests

Correlations(Human resources with O&M

		O_Maientenance	HR
O_Maientenance	Pearson Correlation	1	.399*
	Sig. (2-tailed)		.029
	N	30	30
HR	Pearson Correlation	.399*	1
	Sig. (2-tailed)	.029	
	N	30	30

*. Correlation is significant at the 0.05 level (2-tailed).

Correlations(Human resource and Tariff) with O&M

		O_Maientenance	HR_Tariff
O_Maientenance	Pearson Correlation	1	.405*
	Sig. (2-tailed)		.027
	N	30	30
HR_Tariff	Pearson Correlation	.405*	1
	Sig. (2-tailed)	.027	
	N	30	30

*. Correlation is significant at the 0.05 level (2-tailed).

Correlations(O&M and outages)

		O_Maientenance	Outages
O_Maientenance	Pearson Correlation	1	-.517**
	Sig. (2-tailed)		.003
	N	30	30
Outages	Pearson Correlation	-.517**	1
	Sig. (2-tailed)	.003	
	N	30	30

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

Correlations

		O_Maientenance	Outages	HR	Tariff
O_Maientenance	Pearson Correlation	1	-.517**	.399*	.212
	Sig. (2-tailed)		.003	.029	.262
	N	30	30	30	30
Outages	Pearson Correlation	-.517**	1	.225	.023
	Sig. (2-tailed)	.003		.231	.904
	N	30	30	30	30
HR	Pearson Correlation	.399*	.225	1	.222
	Sig. (2-tailed)	.029	.231		.239
	N	30	30	30	30
Tariff	Pearson Correlation	.212	.023	.222	1
	Sig. (2-tailed)	.262	.904	.239	
	N	30	30	30	30

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

*. Correlation is significant at the 0.05 level (2-tailed).

Multiple Regression Test

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.538[a]	.289	.207	.56063

a. Predictors: (Constant), Tariff, HR, O_Maientenance

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	5.327	.833		6.397	.000
	HR	.076	.195	.066	.391	.699
	O_Maientenance	-.409	.133	-.532	-3.082	.005
	Tariff	.109	.135	.137	.809	.426

a. Dependent Variable: Outages

Annex 5: Respondent Quotations - Interviews

Respondent	Hierarchy
Respondent 1	Senior management
Respondent 2	Senior management
Respondent 3	Senior management
Respondent 4	Middle management level
Respondent 5	Middle Management
Respondent 6	Middle Management
Respondent 7	Supervisory level
Respondent 8	Supervisory level

1. Can you tell me about the company training and development policy??How many staffs working on regional O&M attend training per year?

Respondent 4

'' in the year 2017, total of 23 technical staffs attended training at TTS while in the year 2018 a total of 67 staffs attended continuous training in the region at TTS''

2. How do you rate the adequacy of working tools and PPE given to O&M staffs?

Respondent 5

"*It is a high time for the company to invest in modern working tools as the world is moving into science and technology era."*

3. Can you please tell me which factors most influence staff costs? In your opinions how do these costs affect O&M activities?

Respondent 6

Respondent further alleged that "*instead of paying a lot of causal labors TANESCO could use that fund to procure high technology vehicles which can be operated by only one person and hence reduce unnecessary costs"*

4. Cost reflective tariff has many benefits to the utilities in your opinions, what prevent TANESCO from attaining cost reflective tariff

Respondent 6

Argued that "*losses are money, but TANESCO do not consider it."*

5. Which maintenance strategy is used by the company?

Respondent 5

"*So far most regions practice corrective maintenance activities, but it is promising that Dar es salaaam and coast zone is now implenting HOMA project "*

6. Do the company have maintenance plans in place?

Respondent 4,

He argued that "*if you are always doing repair and corrective maintenance how you can have a plan.*"

7. In your opinion why there is frequent power outages?

Respondent 5

"*Existing network is very aged and there are no proper maintenance plans it is therefore difficult to reduce the number* of outages"

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