THE EFFECT OF ISO 9001:2008 CERTIFICATION ON PROCESS QUALITY: A CASE STUDY OF KENYA POWER AND LIGHTING COMPANY

BY

MULELA JOHN KYALO

A RESEARCH PROJECT REPORT SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF THE DEGREE OF MASTER OF BUSINESS ADMINISTRATION, SCHOOL OF BUSINESS, UNIVERSITY OF NAIROBI

OCTOBER 2013

DECLARATION

This research project is my original work and has not been submitted for a degree in this or any other university for examination.

Signed ………………………………………………….. Date…………………………..

Mulela John Kyalo

Reg. No. D61/73961/2009

This research project has been submitted for examination with my approval as the University Supervisor.

Signed …………………………………….. Date……………………………

Mr. Stephen Odock,

Lecturer, Department of Management Science,

School of Business,

University of Nairobi.

ACKNOWLEDGEMENT

I wish to extend my heartfelt gratitude to my supervisor Mr Odock for his invaluable advice and contribution that enabled the success of this study. His patience and support are incredible. Special thanks to Mrs and Miss Kyalo for their encouragement and understanding. Special thanks to all lecturers and students of the School of Business (Bandari Campus), for their support during the entire course of the MBA programme.

DEDICATION

My special dedication to my family, Christine and Purity.

ABSTRACT

Many organizations in Kenya and across the world are adopting ISO 9008:2001 in an endeavor to improve their processes and hence process quality. Process quality plays a key role in the performance and survival of organizations in the current competitive world. This is what informed the study. The study endeavored to establish whether KPLC achieved process quality improvements after ISO 9001:2008 certification. It also sought to establish the impact of the certification on process interactions. In order to study whether KPLC had achieved process quality improvements after ISO 9001: 2008 certification, one internal process, the new connections process, was selected and broken down into its sub-processes. These were design, quotation, wayleaves acquisition, construction, metering and process interactions. Six hypotheses were then tested with the use of one-tailed *z-test* at 0.05 significance level for a sample of 150 jobs done before and after ISO 9001:2008 certification. A paired *t-test* was performed on the mean differences of the sub-processes' quality in order to make a final conclusion on overall process quality. The findings of the study revealed that there were significant improvements in process quality in the sub-processes apart from the quotation sub-process which recorded a reduction in quality. The study revealed significant improvement on overall process quality at 0.05 significance level. Process interactions improved significantly after ISO 9001:2008 certification at 0.05 significance level.

TABLE OF CONTENTS

ABBREVIATIONS AND ACRONYMS

BPR	-	Business Process Re-engineering
DCS	-	Design and Construction
EAP&L	-	East African Power and Lighting
ERC	-	Energy Regulatory Commission
GDC	-	Geothermal Development Company
GDP	-	Gross Domestic Product
GOK	-	Government of Kenya
ICS	-	Integrated Customer Service
ISO	-	International Organization for Standardization
KETRACO	-	Kenya Transmission Company
KPLC	-	Kenya Power and Lighting Company
KRA	-	Kenya Revenue Authority
NICU	-	Neonatal Intensive Care Unit
PPP	-	Public Private Partnerships
QMS	-	Quality Management System
RBM	-	Resource Based Management
RBV	-	Resource Based View
REA	-	Rural Electrification Authority
TANESCO	-	Tanganyika Electricity Supply Company
TQM	-	Total Quality Management
UEB	-	Uganda Electricity Board
UN	-	United Nations

LIST OF TABLES

CHAPTER ONE: INTRODUCTION

1.1 Background of the study

All levels of government and public organizations around the world are feeling the effects of unprecedented change, challenge and complexity (KPMG, 2011). This change is affecting their ability to function. The public sector is facing the challenge of how to provide quality products and services to its customers in an efficient and effective way. This has called for the adoption of quality management systems. Redman, Mathews, Wilkinson and Snape (1995) summarize the recent pressures on the public sector that make quality management systems necessary as: legislation that now gives more choice to consumers; compulsory competitive tendering; increasing pressures on cost restraint; the demands of value for money reforms; and more demanding customer requirements.

These challenges are forcing public sector service providers to improve their operations thus pushing product and process quality in the sector to high levels. The public demands that governments operate more like a business, in that they become more cost-effective, competitive, and entrepreneurial and dedicated to pleasing the customer (Box, 1999). Process-centered quality improvement techniques such as TQM, BPR, Lean management, and ISO 9001:2008 that were popular in the manufacturing sector are being applied in the public sector (Pollitt, 2005).

In Kenya several methods have been employed to help improve process and service quality in the public sector. Under Results Based Management (RBM), performance contracts, service delivery charters and Rapid Results Initiatives were introduced to the public service to enhance focus on results (Muthaura, 2010). ISO 9001:2008 which helps to see organization's operations as a network of value-creating processes is also employed by the public sector to enhance service delivery (Amwayi, 2012).

1.1.1 Business Process Quality

Due to increased customer expectations and customization of services in many markets, service quality has become an essential part of an organization's success (Frei, Kalakota and Leone & Marx, 1999). "The definition of service quality is also changing" (Frei et al., 1999:4) to include the quality of the processes that produce the service. Process quality is one of the most important dimensions of service quality (Brady & Cronin 2001; Marley, Collier & Goldstein 2004) and it is important in evaluating the service delivery process in terms of service encounters. This is mainly so because a component of the production process, in terms of the customer expectations and preferences, is different for each instance of service delivery (Frei et al., 1999).

Business process quality defines the process's ability to fulfill functional and non-functional requirements in terms of meeting customer requirements. Heidari, Loucopoulos and Kedad (2011) defines functional requirements as the ability of the business process to deliver quality products and services while non-functional requirements refer to the process aspects such as lead-time, throughput, reliability, availability and maintainability of the process. Nagasaku and Oda (1965) also defines process quality as the quality of the process that causes the product or service to be either acceptable or not.

Since a business process delivers some outputs (products or services), its quality will naturally affect the business to which it belongs (Heidari et al., 2011). Lohrmann and Reichert (2013) define a quality business process as one that is efficacious as well as efficient. However, they also note that a "process can be efficacious, but not efficient; whereas efficiency is only possible if a measure of efficacy is achieved as well" (p.23). International Organization for Standardization (ISO) defines quality as the degree to which a set of inherent characteristics fulfills requirements (ISO, 2005). In their work, Heinrich and Paech (2010) defined business process quality as the components of a business process, the process as a whole as well as the context of the process. The context refers to the organizational environment and conditions of use of the business process while the functions of the business process, the human resources, non-human resources, information objects, input and output objects constitute the components of the business process quality.

Quality is no longer an aspect of the final product or service, but the whole business process. Environmental concerns have called for processes that are environment friendly. Societies in which organization operate expect ethical operations and processes (Elkington, 2004). This calls for quality processes that advocate efficient use of resources, reduction in waste by-products, emission controls and recycling. Organizations therefore have to design processes that assure quality at all stages of the process from design, execution, control and analysis (Lohrmann et al., 2013).

With heightened competition and the need to be conscious of the organizations bottom line, many organizations have resorted to process-oriented quality instead of product-oriented quality. This has lead to the great emphasis of business process quality. Product-oriented quality emphasized on inspections for quality problems which are very expensive (Jay & Barry, 2008) while business process quality emphasizes on prevention of quality problems in the process which is quite cheap, improves customer satisfaction, increases efficiency while at the same time engaging and empowering all staff (Omachonu, Suthummanon & Einspruch, 2004).

Although cheap in the long run, business process quality faces some challenges both in the private and public sector organizations. Business process-oriented quality focuses on horizontal structures and cross functional teams in the organization (Stracke, 2006). This means getting rid of silos in the organizational structure. To attain this, the company culture has to be right. This has always been a challenge to many organizations which were traditionally organized on functions especially public organizations in developing countries.

The foremost requirement for a business process is to realize a business objective in an economic context (Hammer & Champy, 1993). In order to achieve this, the business process components and context stated earlier must meet the perceived or set quality thresholds. For instance, the quality of human resource recruitment process should meet the competence, experience and qualification thresholds. This calls for the adoption of a quality management systems like ISO 9001:2008 that ensures quality is assured at all stages of the organization.

1.1.2 ISO 9001:2008 as a Quality Management System

ISO 9001:2008 is a quality standard. It provides guidelines that are generic and can be applied to any type of organization, from small family business to the world's largest co operations and government institutions (Morris, 2006). It provides a structured yet flexible framework for a customer-focused Quality Management System (QMS) that drives performance improvement. The standard covers all aspects of the organization's activities, including identifying its key processes, defining roles and responsibilities, policies, objectives and documentation requirements (Chow-Chua, Goh, & Wan, 2003). As Stamatis (1995) points out, ISO 9001:2008 relies heavily on documentation and a firm must document all its processes and follow that documentation in order to become certified.

Proponents of ISO 9001:2008 argue that this process of documentation leads to better processes due to greater communication throughout the organization (Joubert, 1998). This increased communication and documented processes highlights inefficiencies and brings them to the attention of management (Morris, 2006) resulting in reduction in costs and an increase in quality (Deming, 1982).

ISO 9001:2008 QMS is meant to certify the processes and the systems of the organization and not the products or service (Mung'ara, 2010). It ensures that the design process of the product or service and the processes for its production and delivery will result in outputs of consistent quality to meet the needs of the customer (United Nations, 2001). It also provides mechanisms to ensure that there is continuous improvement in these processes. It promotes a process-based approach and is designed to ensure that an organization's quality management system has procedures, policies and requirements which ensure that customer satisfaction is consistently achieved (Bhuiyan & Alam, 2005; Vouzas & Gotzmani, 2005).

Although many organizations have adopted the standard, it has not been without criticism. Presumed rigidity and inability to allow for adaptation (Barnes, 1998; Dick, 2000) has been leveled against the 1994 version of ISO 9001. Following this criticism, the new versions, 2000 and 2008 (which, according to ISO (2008), introduces no new requirements, but does clarify the existing requirements of ISO 9001:2000) of ISO 9001 has emphasized on process management instead of conformance to procedures (Owino, 2010). Some researchers have also pointed out a lot of paper work which increases the work and cost of implementing it as some shortcomings of the standard (Casadesus & Karapetrovic, 2005).

1.1.3 ISO 9001: 2008 as a Process Management Tool

Lee, Hareton and Keith (1999) describe ISO 9001 as a list of norms on how to manage a process. Implementing ISO 9001 helps organizations standardize their processes and improve quality on a continual basis (Williams, 2004). Good application of ISO 9001:2008 could lead to more controlled processes (Martínez-Costa et al., 2008). Controlled processes means less process variability and thus high process quality. To achieve this, the standard requires that all the processes needed for the QMS should be identified and their sequence and interactions determined (Carmignani, 2008). The criteria, methods, resources and information necessary to run the processes should also be determined. The standard also requires that criteria and methods for measuring, monitoring and control of these processes be determined.

The standard encourages a process approach to quality management and highlights the importance of the systematic identification and management of the processes employed within an organization. Identification of the processes is necessary to ensure that all the key operational and management processes are captured (Davenport, 1993). The points of process interactions are vital to avoid process disconnects which would affect process quality in terms of delays, invisibility and lack of ownership (Stefano & Giovanni, 2003).

The requirements of the ISO 9001 standard aim at ensuring that all the requirements of a process are met which eventually affect the organization's process quality. The standard advocates on documentation of agreed upon processes (Quazi, Hong & Meng, 2002) and process ownership by assigning responsibilities. This leads to openness of the organizations processes and gives everyone an opportunity to suggest improvements on the processes to improve their quality.

1.1.4 Public Sector in Kenya

The public sector in Kenya plays a very critical role in service delivery. It is central to the country's socio-economic development (Muthaura, 2010). In the 2011/2012 financial year, there were 681,100 employees in the public sector which accounted for 32% of the total employees in the country (Kenya National Bureau of Statistics, 2012). In the same financial year, total wage expenditure for the sector was KShs 863.6B accounting for 74.1% of the total government expenditure. This wage bill translated to 28.5% of the country's GDP. These figures show how vital the public sector is to the country's economy and well being.

Increased demand for quality and affordable services due to high population under constrained budgets from the citizens (KPMG, 2011) has posed serious challenges and called for reforms in Kenya's public sector. Public Private Partnerships (PPP), Business Process Re-engineering, Performance Contracting and ISO 9001:2008 are some of the strategies adopted in the public sector to help overcome these challenges (Koimett, 2012; Kariuki & Kasomi, 2011). Under the operation of ISO 9001:2008 QMS, the government can consolidate authority with relevant responsibility through document control and standardization of operation processes (Chu & Wang, 2001). Transparency, efficiency, accountability and responsiveness to citizens' needs (Muthaura, 2010) -which characterize qualities of a good public sector, -can only be achieved when management of public sector institutions is viewed as systems which comprise of individual processes.

In Kenya, many public institutions are ISO 9001:2008 certified, including ministries, public universities, parastatals and regulatory bodies. As per Kenya Bureau of Standards website accessed on April 20, 2013, one hundred and five public institutions in Kenya have been ISO 9001:2008 certified and the number is increasing. The main aim of the high rate of acquisition of the ISO certification in the public sector in Kenya is to improve public sector performance (Macharia, 2010).

The Energy Sector is one of the key areas in which the public sector plays a key role in service provision and economic development. It is one of the key ingredients of the achievement of Kenya's economic blue print, Vision 2030 (Vision 2030, 2007). Kenya Power and Lighting Company is one of the main players in this subsector among others (Ministry of Energy, 2011).

1.1.5 Kenya Power and Lighting Company

Kenya Power and Lighting Company is one of the public sector organizations charged with the task of transmitting and distributing electric power in the country. Its history dates back 1922 when the Mombasa Electric Power and lighting Company merged with the Nairobi Power and Lighting Syndicate to form the East African Power and Lighting Company (EAP&L). EAP&L's geographical reach covered the three east African countries; Kenya, Uganda and Tanzania. In 1983, EAP&L was renamed Kenya Power and Lighting Company after the formation of Uganda Electricity Board and Tanganyika Electricity Supply Company. With the government owning 50.1 per cent shareholding, Kenya Power and Lighting Company is considered a parastatal (KPLC, 2011)

Initially, the company used to handle generation, transmission and distribution. A policy paper on economic reforms (Government of Kenya, 1996) set out the government's intention to separate the regulatory and commercial functions of the electricity sector, facilitate restructuring and promote private-sector investment (Pauly et al., 2009). This led to unbundling of Kenya Power and Lighting Company and liberalization of the electricity sector which gave birth to Kengen (generation) in 1997, KETRACO (transmission) in 2008, REA (rural distribution projects) in 2007 and the Geothermal Development Company (geothermal exploration) in 2008 (KPLC, 2011).

A regulation body –Energy Regulatory Commission (ERC) was also established to oversee the operations in the subsector, ensure competition in the sub-sector's generation and set and review tariffs in the electricity sector (Onyango, Njeru & Boaz, 2011). The government was left with the role of policy and guidance under the Ministry of Energy (Mbogho, Zhu & Sharma, 2003). All Kenya Power and Lighting Company processes and operations were left under the monitoring and regulation of ERC (Kinyua, 2010). Like any other public sector organization, Kenya Power and Lighting Company operates in a highly regulated environment (Onyango et al., 2011). It is subjected to the requirements of the ERC regulations, Energy Act (2006), the grid code, Environment Management and Co-ordination Act, Public Procurement and Disposal Act, Capital Markets Authority Act and the State Co-operations Act (Nyoike, 2004).

Appendix 2 shows the performance indicators of Kenya Power and Lighting Company for the last eleven years. It is clear from the appendix that prior to 2005, the operational performance indicators were not very impressive. This in turn affected financial performance indicators. The year 2006 is when performance contracting was introduced in public institutions (Lillian, Mathooko & Sitati, 2011). From then on, performance improved yearly.

Achievement of these performance indicators in such a competitive and highly regulated environment highly depends on the quality of the organization's processes that produce them. For instance, the number of connected customers will depend on how efficient the connection process is. In its endeavor to achieve these performance indicators and meet the ever changing customer and stakeholder requirements, the company attained ISO

9001:2000 certification in 2006 to control and document its various processes, improve the quality of its services, enhance efficiency, customer satisfaction, performance and profitability (KPLC, 2007).

1.2 Research Problem

Researchers have established a relationship between customer satisfaction and process quality (Frei et al., 1999). Process quality is determined by process variation and variation of process performance statistics which in turn affects service quality. In order to produce high quality services and products, organizations must build an effective quality management system (Gotzamani, Tsiotras, Nicolaou, Nicolaides & Hadjiadamou, 2007) by adopting ISO 9001:2008. Many public organizations have acquired ISO 9001:2008 certification mainly because the standard has a good international reputation and adoption and offers a process based approach to quality management. However, things will not change because of procedures, work instructions and documentation, they will change because people believe they can and want them to (Anthony, 2000). Therefore, one cannot say that the products or services of an ISO 9001 certified company are of better quality than those of an uncertified firm (Morris, 2006). Simmons (1999) also noted that since the standard does not stipulate how to design quality processes, products and services, a certified organization can still have poor quality processes, products and services.

The energy and public sectors are becoming increasingly important in many economies in the world. In Kenya, they comprise two of the main foundations of Vision 2030 (Vision 2030, 2007). Kenya Power and Lighting Company belong to both the energy and public sectors. As can be seen from appendix 2, as at the end of 2012, only 33.7% of the country's population had access to electricity and the company was experiencing many challenges including high system losses (21.3%) and low customer base (0.6Million) which contributed to poor financial performance (Nyoike, 2004). In 2003, the government expressed dissatisfaction with the performance of the power sector (GOK, 2003) mainly in terms of unreliability and cost of power supply. The energy sector reforms of 2004 (GOK, 2004) called for reforms within the power sector. The public sector was also undergoing reforms to enhance service delivery (Muthaura, 2010). In order to cope with the dynamic power sector environment and reforms in the public sector, Kenya Power and Lighting Company became ISO 9001: 2000 certified in 2006 in its endeavor to improve service delivery.

Kenya Power and Lighting Company is of particular interest for study since it deals in a very crucial commodity, electric energy, which is a fundamental ingredient to socio-economic development in Kenya. It is subject to policies laid down by relevant regulatory bodies. As stated by Lee, To, and Yu (2009:2), "most policies and ISO 9001:2000/2008 implementations are administered top-down, how to execute such a quality system and make better public management decisions is crucial for everyone". This necessitated the need for this study.

Several studies have been done on the effect of ISO 9001:2008 certifications. Majority established a positive relationship with organizational performance improvement (Owino, 2010, Singh & Nahra, 2006; Luz & Maria, 2011; Daniel, Bhaofeng & Zhaojun, 2012; Zaramdini, 2007; Anyango & Wanjau, 2011). However, another group of researchers found no positive relationship between ISO 9001 certification and organizational performance (Terziovski, Samson & Dow, 1997; Quazi, Wing & Tuck, 2002; Vouzas & Gotzmani (2005); Conca, Llopis & Tari, 2004) while others have got mixed results on the effect of ISO 9001:2008 certification (Martinez-Costa, Martinez-Lorente, & Choi 2008). Much of the research has focused on business and operational performance which are more of functional performance than process based performance. None of these studies has explored the effect of ISO 9001:2008 certification on process quality which focuses on cross-functional performance, particularly in KPLC. This study intends to fill this gap by evaluating the effect of ISO 9001:2008 certification in KPLC on process quality by evaluating pre and post certification process performance and interaction statistics. Thus, this leads the researcher to pose the following question: how does ISO 9001:2008 certification affect process quality in Kenya Power and Lighting Company?

1.3 Research Objectives

The objectives of the study are:

i. To determine the effect of ISO 9001:2008 certification on process quality in KPLC.

ii. To determine the effect of ISO 9001:2008 certification on process interactions in KPLC

1.4 Value of the Study

The results of this study will benefit the management of KPLC, other public sector, private organizations and researchers. For management in private and public institutions, the study will shed light on the importance of process-oriented quality, change management in terms of improving business process quality and process re-engineering. Once well established and operational, ISO 9001:2008 QMS will provide a basic framework for the incorporation of innovations leading to fewer nonconformities within and outside the organization. It will be useful as a first step tool towards Total Quality Management (TQM).

To the researchers, this study will add to the growing body of knowledge on the impact of ISO 9001:2008 certification. Business Process Quality is a key ingredient to the success of any organization. Therefore, the impact of any QMS tools like ISO 9001:2008 on the quality of the organization’s processes is paramount and worthy studying. It will also provide openings for further research on the effects of ISO 9001:2008 certification on the performance of organizations.

The study will also go a long way in assisting the regulation and policy makers of public institutions. Based on the results of the study, they would decide to make it a policy for all the public institutions to adopt ISO 9001:2008 as a QMS tool or not. This could also be extended to other organizations in the private sector who would wish to do business with the public sector.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

The research objectives are based on a proposition that there is a relationship between ISO 9001:2008 QMS certification and process quality. The literature review lays emphasis on ISO 9001:2008 adoption theories, motivations for ISO 9001:2008 certification, challenges of implementing the standard and finally, ISO 9001:2008 implementation and related studies.

2.2 ISO 9001:2008 QMS Adoption Theories

Several theories explain the adoption of ISO 9001:2008 QMS by organizations. One of these theories is the institutional theory. It suggests that external factors could influence an organization's decision to adopt a practice (Meyer & Rowan, 1977). As such, external factors can be grouped in three different isomorphism processes: coercive, mimetic, and normative (DiMaggio & Powell, 1983). When applied to ISO certification, normative isomorphism arises when firms consider that certification is necessary for enhancing their reputation in the market (Lowrey, 2005). Mimetic isomorphism arises when firms seek certification in order to match their competitors who seem to be successful (Chua & Petty, 1999). Coercive pressures result when a firm pursues certification in response to the demands posed by customers, suppliers, trade unions or government to whom its businesses is largely dependent.

The above mentioned external pressures may make organizations not consider the benefits from ISO 9001:2008 certification but their legitimacy of being certified (Daniel, 2011). The theory thus, suggests that early adopters of a practice are motivated by opportunities for efficiency gains from implementing it (Aravind & Christmann, 2008) before it becomes a norm. Martínez-Costa et al. (2008) notes that having been implemented all over the world, ISO 9000:2008 has been institutionalized.

Another theory that explains the causality of ISO 9001:2008 certification and performance is the resource based view theory. This theory holds that a company's success is based on the resources and capabilities it holds in control which may become a source of competitive advantage (Martinez-Costa et al., 2008). Barney (1991) argued that for a resource to yield competitive advantage, it must be valuable, rare among competitors, imperfectly imitable, and should not be substitutable by competitors. When these resources are socially complex, it takes time to acquire them.

When adoption of ISO 9001:2008 is based on internal factors to enhance efficiency and improve processes, the knowledge and expertise gained (Somsuk, 2010) over time is a socially complex valuable resource that is not easily imitable nor substitutable (Barney, 1991). This eventually creates opportunities for real competitive advantage (Alcina & Inaki, 2013). Martinez-Costa et al., (2008) noted that such organizations would have improved performance as compared to before certification. However, if the motivation for adoption of the standard is solely external, the organization would implement the standard to meet the external pressures and might not improve performance (Anderson, Daly & Johnson, 1999).

2.3 Motivations for ISO 9001:2008 Adoption

Organizations seek ISO 9001:2008 certification for different reasons. Continuous improvement, reduction of waste, reaction to environmental factors, reaction from customers and competitors and business performance improvement are some motivations for seeking certification (Terziovski & Power, 2007). Some adopt it as a marketing tool (Withers & Ebrahimpour, 2000). Achievement of customer satisfaction, pressure from foreign partners, increase of market share, government demands and quality system efficiency improvement are the leading motivations for seeking ISO 9001:2008 certification as suggested by Lundmark and Westelius (2006).

Zaramdini (2007) identified as motivators for certification, improvement of processes and procedures, enhancement of product and service quality, improvement of productivity and efficiency, reduction of incidents, rejections and complaints, enhancement of public image and competitive advantage as motivators for certification. Other researchers showed that other organizations adopted ISO 9001:2008 as a first step towards TQM (Gotzamani & Tsiotras, 2002; Claver, Tari & Molina, 2002; and Kanji, 1998).

2.4 Empirical Literature Review

Singh et al., (2006), in their study to analyze the benefits of adoption of ISO 9001:2008 in Australia’s public sector using a case study methodology, established that there was improvement in processes and operations in the sector after adoption of the standard. Recently, another study was carried out in the same country by Daniel et al., (2012) to establish the relationship of ISO 9001:2008 certification with three key supply chain management practices; internal processes, supplier relationships and customer relationships. Data collected and analyzed showed that, implementation of the standard was positively related to all the three aspects of supply chain management.

In his study on the effectiveness of ISO 9001:2008 in the public sector of Nova Scotia, Canada, Beaudin (2009) noted most improvement in the implementation of processes, continual improvement and involvement of people. The study established improvements in all the eight categories of the quality management system at a statistically significant confidence level of 95%, with five of the eight areas witnessing a level of statistical significance at the 99% confidence level. Similarly process standardization, improved efficiencies, clarification of duties and responsibilities, establishment of process measurement and evaluation, improved documentation and control were noted as benefits of the standard in Portuguese vocational schools in a study carried out by Gamboa and Melao (2012).

In their study on a small-scale service oriented economy in the public sector in China on the impact of ISO 9001:2008, Lee et al (2009), noted that adoption of the standard can improve the quality of public service delivery to both internal and external customers. In Greece a study by Psomas, Pantouvakis and Kafetzopoulos (2013) on the impact of ISO 9001:2008 effectiveness on the performance of service companies, established direct improvement of service quality and operational performance. Vitner, Nadir, Feldman and Yurman (2011) noted that process yield and service satisfaction improved after the adoption of the standard in Neonatal Intensive Care Unit (NICU) in Israel. Luz and Maria (2011) in their study on ISO 9001:2008 certification and business results in Spain established a positive relationship between ISO 9001:2008 certification and quality results.

In Kenya, Owino (2010) concluded that the standard can help optimize operational performance when applied appropriately in government agencies. Mung'ara (2010) established improved efficiency, streamlined operations, customer satisfaction, reduced waste and improved business performance as some benefits of the standard in the insurance industry in Kenya. Olouch (2010) cited enhanced quality as a benefit of adopting the standard by Kenya Medical Training College (KMTC). A study by Anyango and Wanjau(2011) of certified Manufacturing Firms in Nairobi established increased performance after ISO 9001:2008 certification as shown by greater positive impact on higher perceived quality (100% of the responses), improved corporate image (100%), competitive advantage (100%) and increased market share (72.7%). They also established that ISO 9001:2008 certification impacted positively on financial resource management (p=0.001), customer satisfaction (p=0.03), human resource management (p=0.074) and control measures (p=0.061).

A study in Australia of certified firms by Terziovski and Power (2007) pointed out that organizations can use ISO 9001:2008 certification as a means of promoting and facilitating a quality culture. In their survey of Australian and New-Zealand based manufacturing and service companies, Feng, Terziovski and Samson (2008) found out that ISO 9001:2008 certification resulted into a positive and significant improvement on operational performance. In a study on the impact of ISO 9001:2008 certification on training and development activities of organizations operating in Singapore, Quazi and

Jacobs (2004) cited improved quality records' management as a benefit of the certification.

However, other researchers did not establish any quality benefits after adopting the standard. Quazi et al., (2002) established no link between adoption of the standard and Total Quality Management(TQM) practices and quality results in firms in Singapore. Vouzas et al., (2005) pointed increased bureaucracy, lack of flexibility in the design and implementation of the model, low utilization of employee's skills and knowledge, and utilization of the award as a marketing tool and as a means of penetrating new markets as some of the problematic areas of the standard. Daniel et al., (2012) pointed out that basic implementation of the standard has no influence on supply chain management practices. Martinez-Costa et al., (2008) in their study of Spanish companies on simultaneous consideration of TQM and ISO 9000 on performance and motivation established mixed results. They concluded that internal motivation for certification is associated with high performance while external motivation is not.

From the foregoing literature review, it can be observed that, although there are several studies on the effect of ISO 9001:2008 certification on the performance of organizations from Kenya and around the world, there is no study that has focused on the effect of the standard on process quality especially in the public sector. The main aim of this study is therefore to fill this research gap by evaluating the effect of ISO 9001:2008 certification on process quality in the public sector.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

This chapter gives details of the methodology that was used in the study. This was guided by the objectives of the study outlined in chapter one. The chapter gives details on research design, data collection and data analysis.

3.2 Research Design

A case study approach was adopted for this research. The case study was Kenya Power and Lighting Company. This approach helped in obtaining detailed information on the subject of the study. Omondi (2008) argued that case studies excel in bringing out an understanding of complex issues or objects. As pointed out by Leedy and Ormond (2005), case studies are useful for investigating how individuals or programs change as a result of circumstances or interventions overtime. Therefore, the case study design approach was the most appropriate for the study on the effect of ISO 9001:2008 certification on the quality of Kenya Power and Lighting Company processes.

3.3 Data Collection

Secondary data was used for this study. The data was obtained from KPLC's information systems namely: Integrated Customer Service (ICS) System, Design and Construction System (DCS). The two information systems logs information for every customer's application at all stages of the application. For this study, three processes were selected for analysis. These were: the design process for new customers' applications, the construction process for new customers and the metering process for the same customers. This was necessitated by the availability of data for the three processes for the periods under consideration as compared to other processes. The same information systems was used to collect data on the time it took for a customer application to be processed from design and construction function to finance function for budget allocation and back (process interactions).

The data was collected for three years prior to the ISO 9001:2008 certification and three years after the certification (from 2003 to 2009) since this data is readily available and satisfied the condition of *z-test* that the data for the two samples should have a normal distribution, with the same variance in each sample. Jobs which required construction of a line and a meter only were selected for analysis. This was necessitated by the fact that the customer's readiness does not play a major role in the progress of the job as compared to when a transformer is required where the customer actually determines the process lead time. Fifty jobs were randomly selected with the help of a random number generator for each year in question resulting into 300 jobs for the analysis. Although *z-test* requires that the sample of data should be greater than 30 (n>30), a sample of 300 jobs was chosen as it is a good representative of the high number of applications done during the period in question (266,831 applications). The data obtained from the information systems was recorded in the data collection form shown in appendix 2.

3.4 Data Analysis

The secondary data was analyzed using *z-test* for comparison of process performance statistics (design time, quotation time, construction time, metering time and process interactions) before and after ISO 9001:2008 certification. When the sample size of the data being analyzed is greater than 30 (n>30), the *z-test* is the most appropriate of comparing the means of two samples (Kothari, 2008). The following hypotheses were tested:

a) **H_0:** $\boldsymbol{\mu \leq \mu_1}$, (There is no improvement in design sub-process quality after ISO 9001:2008 certification)

H_{1a}: $\boldsymbol{\mu > \mu_1}$, (There is a statistically significant improvement in design sub-process quality after ISO 9001:2008 certification),

Where μ is the average overall design time before ISO 9001:2008 certification and μ_1 is the average overall design time after ISO 9001:2008.

b) **H_0**: $\boldsymbol{\mu \leq \mu_2}$, (There is no improvement in quotation sub-process quality after ISO 9001:2008 certification)

H_{2a}: $\boldsymbol{\mu > \mu_2}$, (There is a statistically significant improvement in quotation sub-process quality after ISO 9001:2008 certification),

Where **μ** is the average quotation time before ISO 9001:2008 certification and $\boldsymbol{\mu_2}$ is the average quotation time after ISO 9001:2008.

c) **H_0**: $\boldsymbol{\mu \leq \mu_3}$, (There is no improvement in process interactions sub-process quality after ISO 9001:2008 certification)

H_{3a}: $\boldsymbol{\mu > \mu_3}$, (There is a statistically significant improvement in process interactions sub-process quality after ISO 9001:2008 certification),

Where **μ** is the average process interaction time before ISO 9001:2008 certification and $\boldsymbol{\mu_3}$ is the average process interaction time after ISO 9001:2008.

d) **H$_0$:** $\boldsymbol{\mu} \leq \boldsymbol{\mu_4}$, (There is no improvement in wayleaves acquistions sub-process quality after ISO 9001:2008 certification)

H$_{4a}$: $\boldsymbol{\mu} > \boldsymbol{\mu_4}$, (There is a statistically significant improvement in wayleaves acquisition sub-process quality after ISO 9001:2008 certification)

Where **μ** is the average wayleaves acquisition time before ISO 9001:2008 certification and $\boldsymbol{\mu_4}$ is the average wayleaves acquisition time after ISO 9001:2008

e) **H$_0$**: $\boldsymbol{\mu} \leq \boldsymbol{\mu_5}$, (There is no improvement in construction sub-process quality after ISO 9001:2008 certification)

H$_{5a}$: $\boldsymbol{\mu} > \boldsymbol{\mu_5}$, (There is a statistically significant improvement in construction sub-process quality after ISO 9001:2008 certification),

Where **μ** is the average construction time before ISO 9001:2008 certification and $\boldsymbol{\mu_5}$ is the average construction time after ISO 9001:2008.

f) **H$_0$:** $\boldsymbol{\mu} \leq \boldsymbol{\mu_6}$, (There is no improvement in metering sub-process quality after ISO 9001:2008 certification)

H$_{6a}$: $\boldsymbol{\mu} > \boldsymbol{\mu_6}$, (There is a statistically significant improvement in metering sub-process quality after ISO 9001:2008 certification),

Where **μ** is the average metering time before ISO 9001:2008 certification and $\boldsymbol{\mu_6}$ is the average metering time after ISO 9001:2008.

For two samples, sample1 and sample2,

$$Z = \frac{observed\ \ difference\ -expected\ \ difference}{SE\ for\ \ difference}$$

$$= \frac{(\bar{X}_1 - \bar{X}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$$ (Kothari, 2008*)*

Where n_1 and n_2 are the sample sizes, $\bar{X}_1$ and $\bar{X}_2$ are the sample means, and σ_1 and σ_2 are the population variances. When σ_1 and σ_2 are not known, the researcher can use the sample variances $s_1$and s_2 provided the sample size is greater than 30**.**

$$Z = \frac{(\bar{X}_1 - \bar{X}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

For ease of calculation and use of readily available tables and software, a significance level of $\propto = 0.05$ was chosen for the study. This significance level is commonly used in many business studies. For instance, Kowour (2012) used the same significant level in his study of the experience of Kenya Power and Lighting Company in outsourcing line construction in coast region.

In order to draw final conclusion on the overall process quality, a paired t-test was conducted on the obtained sub-processes' quality data using the formula:

$$t = \frac{\bar{d}}{s_d/\sqrt{n}}$$

Where $\bar{d}$ is average of the differences between the times taken to execute the sub-processes before and after ISO 9001:2008 certification. s_d is the standard deviation of the differences while n is the number of pairs (differences).

3.5 Operationalization of Study Variables

In order to measure the overall process quality performance, the following variables were defined.

3.5.1 Design Time

This variable measures the time a customer application takes to be processed from the date the application is lodged to the time it is ready for quotation in ICS. It is measured in days. It includes the following three items: insertion of the application in ICS, design and approval

3.5.2 Quotation Time

This variable measures the duration it takes for a customer quotation to be prepared after the design is completed. It is measured in days and includes the approval of the quotation and printing.

3.5.3 Wayleaves Acquisition Time

The wayleaves acquisition variable is the time it takes to acquire permits from individual property owners and authorities. It is measured in days and includes the acquisition of the permits, the relevant documentation, physical approvals of permits and approvals in DCS.

3.5.4 Construction Time

This variable measures the time it takes for a customer's application to be executed after wayleaves approval. It is measured in days and includes acquisition of materials, equipment and human resources

3.5.5 Metering Time

The metering time variable measures the duration it takes from the time a customer's application is executed on the ground to when an energy meter is installed. It includes inspection of the premise's internal wiring, acquisition of metering materials, testing and fixing of the meter. It is measured in days.

3.5.6 Process Interactions

This variable measures the time it takes for two unrelated processes to exchange information. For this study, it is the exchange of information between the ICS and DCS systems concerned with new customer connections and finance which deals with finance processes. It includes the request of information from finance by ICS/DCS and the relay of the information back to ICS/DCS by finance.

CHAPTER FOUR: DATA ANALYSIS, RESULTS AND DISCUSSION

4.1 Introduction

The chapter outlines the analysis of the secondary data collected. This secondary data sought to establish whether process quality in Kenya Power and Lighting Company (KPLC) improved after ISO 9001:2008 certifications. *Z-test* was used to explore the relationship between ISO 9001:2008 certification and process quality. This was done by comparing new connection process performance parameters before and after the certification. The parameters in focus for this analysis were design time, quotation time, wayleaves acquisition time, construction time, metering time and process interactions. All these were measured in days.

4.2 Comparison of Process Quality before and after ISO 9001:2008 Certification

A total of 150 jobs done before ISO 9001:2008 certification (between 2003 and 2005) and 150 jobs done after ISO 9001:2008 certification (between 2007 and 2009) were analyzed for comparison of process quality. Only jobs that did not require a transformer were considered for the analysis. Appendix 3 gives the descriptive results obtained from secondary data. The means of each sub-process quality parameter before and after certification were compared using *z-test*.

4.2.1 Design Time

Table 4.1 outlines the results obtained from secondary data on design time before and after ISO 9001:2008 certification. This process quality parameter was measured in days.

Design time was obtained by getting the difference in days between the date a job was applied and the date when it was sent to ICS for quotation.

Hypothesis testing

H_0: $\boldsymbol{\mu \leq \mu_1}$, (There is no improvement in design sub-process quality after ISO 9001:2008 certification)

H_{1a}: $\boldsymbol{\mu > \mu_1}$, (There is a statistically significant improvement in design sub-process quality after ISO 9001:2008 certification),

Where **μ** is the average overall design time before ISO 9001:2008 certification and $\boldsymbol{\mu_1}$ is the average overall design time after ISO 9001:2008. **H_0** is rejected if $z > 1.645$.

With the use of results in appendix 3, the *z* value of the design time parameter was calculated as shown in Table 4.1. The calculated *z=1.7018* value was greater than the critical *z* value(*z=1.645*) therefore the null hypothesis **H_0: $\mu \leq \mu_1$,** is rejected implying that there was a significant reduction in average design time from 65.53 days before certification to 55.51 days after certification.

Table 4.1: Comparison of design time z-test results

	n	**AVERAGE DESIGN TIME BEFORE ISO CERTIFICATION($\bar{X}_1$)**	**AVERAGE DESIGN TIME AFTER ISO CERTIFICATION($\bar{X}_2$)**	$\bar{X}_1$-$\bar{X}_2$	S_1	S_2	CRITICAL Z- VALUE	Calculated Z	CONCLUSION
DESIGN TIME(DAYS)	**150**	65.53	55.51	10.02	108.8	71.35	+1.645	1.70	Reject H_0

Source: Research Data

4.2.2 Quotation Time

Table 4.2 outlines the results obtained from secondary data on quotation time before and after ISO 9001:2008 certification. The unit of measure is days. Quotation time was obtained by getting the difference in days between the date a job was send to ICS for quotation and the date when it was quoted.

Hypothesis testing

H_0: $\boldsymbol{\mu \leq \mu_2}$, (There is no improvement in quotation sub-process quality after ISO 9001:2008 certification)

H_{2a}: $\boldsymbol{\mu > \mu_2}$, (There is a statistically significant improvement in quotation sub-process quality after ISO 9001:2008 certification),

Where **μ** is the average quotation time before ISO 9001:2008 certification and $\boldsymbol{\mu_2}$ is the average quotation time after ISO 9001:2008. $\mathbf{H_0}$ is rejected if $z > 1.645$.

With the use of results in appendix 3, the *z* value of the quotation time process parameter was calculated as shown in Table 4.2. The calculated z=0.3059 value was less than the critical z value (z=1.645) thus we fail to reject the null hypothesis $\mathbf{H_0}$: ⍰ ≤ ⍰$_{\mathbf{2}}$ implying that average quotation time increased from 4.91days before certification to 5.69 days after certification.

Table 4.2: Comparison of Quotation Time *z-test* results

	n	AVERAGE QUOTATION TIME BEFORE ISO CERTIFICATION($\bar{X}_1$)	AVERAGE QUOTATION TIME AFTER ISO CERTIFICATION ($\bar{X}_2$)	$\bar{X}_1$-$\bar{X}_2$	S_1	S_2	CRITICAL Z- VALUE	CALCULATED Z	CONCLUSION
QUOTATION TIME(DAYS)	**150**	4.91	5.69	-0.78	12.45	31.03	+1.645	-0.3059	Fail to Reject H_0

Source: Research Data

4.2.3 Wayleaves Acquisition Time

Table 4.3 outlines the results obtained from secondary data on wayleaves acquisition time before and after ISO 9001:2008 certification measured in days. Wayleaves acquistion time was obtained by getting the difference in days between the date a job was sent to wayleaves in ICS and the date when it was wayleaves approved.

Hypothesis testing

H_0: $\boldsymbol{\mu \leq \mu_4}$, (There is no improvement in wayleaves acquisitions sub-process quality after ISO 9001:2008 certification)

H_{4a}: $\boldsymbol{\mu > \mu_4}$, (There is a statistically significant improvement in wayleaves acquisition sub-process quality after ISO 9001:2008 certification),

Where $\boldsymbol{\mu}$ is the average wayleaves acquisition time before ISO 9001:2008 certification and $\boldsymbol{\mu_4}$ is the average wayleaves acquisition time after ISO 9001:2008. $\mathbf{H_0}$ is rejected if $z > 1.645$.

With the use of results in appendix 3, the *z* value of the wayleaves acquistion time parameter was calculated as shown in Table 4.3. The calculated z=7.4523 value was greater than the critical z value (z=1.645) thus we reject the null hypothesis $\mathbf{H_0}$: $\boldsymbol{\mu \leq \mu_4}$, implying that average wayleaves acquisition time reduced from 32.76days before certification to 18.01 days after certification.

Table 4.3: Comparison of Wayleaves Acquisition Time *z-test* results

	n	AVERAGE WAYLEAVES ACQUISTION TIME BEFORE ISO CERTIFICATION($\bar{X}_1$)	AVERAGE WAYLEAVES ACQUISTION TIME AFTER ISO CERTIFICATION ($\bar{X}_2$)	$\bar{X}_1$-$\bar{X}_2$	S_1	S_2	CRITICAL Z- VALUE	CALCULATED Z	CONCLUSION
WAYLEAVES ACQUISTION TIME(DAYS)	150	32.76	18.01	14.75	44.72	23.3	+1.645	7.4523	Reject H0

Source: Research Data

4.2.4 Construction Time

Table 4.4 outlines the results obtained from secondary data on construction time before and after ISO 9001:2008 certification. Construction time was measured in days and was obtained by getting the difference in days between the date a job was approved in wayleaves section and the date when it was send to ‘supply ready’ status in DCS.

Hypothesis testing

$\mathbf{H_0}$: $\boldsymbol{\mu \leq \mu_5}$, (There is no improvement in construction sub-process quality after ISO 9001:2008 certification)

H_{5a}: $\mu > \mu_5$, (There is a statistically significant improvement in construction sub-process quality after ISO 9001:2008 certification),

Where **μ** is the average construction time before ISO 9001:2008 certification and μ_5 is the average construction time after ISO 9001:2008. **H_0** is rejected if $z > 1.645$.

With the use of results in appendix 3, the *z* value of the construction time parameter was calculated as shown in Table 4.4. The calculated z=9.2494 value was greater than the critical z value (z=1.645) thus we reject the null hypothesis **H_0: $\mu \leq \mu_5$**, implying that there was a reduction in average construction time from 440.07 days before certification to 255.38 days after certification.

Table 4.4: Comparison of construction time z-test results

	n	AVERAGE CONSTRUCTION TIME BEFORE ISO CERTIFICATION($\bar{X}_1$)	AVERAGE CONSTRUCTION TIME AFTER ISO CERTIFICATION($\bar{X}_2$)	$\bar{X}_1$-$\bar{X}_2$	S_1	S_2	CRITICAL Z-VALUE	CALCULATED Z	CONCLUSION
CONSTRUCTION TIME(DAYS)	150	440.07	255.38	184.69	334.43	243.87	+1.645	9.2494	REJECT H_0

Source: Research Data

4.2.5 Metering Time

Table 4.5 outlines the results obtained from secondary data on metering time before and after ISO 9001:2008 certification measured in days. Metering time was obtained by getting the difference in days between the date a job's meter was installed and the date when it was received for execution.

Hypothesis testing

H_0: $\mu \leq \mu_6$, (There is no improvement in metering sub-process quality after ISO 9001:2008 certification)

H_{5a}: $\mu > \mu_6$, (There is a statistically significant improvement in metering sub-process quality after ISO 9001:2008 certification),

Where **μ** is the average metering time before ISO 9001:2008 certification and μ_6 is the average metering time after ISO 9001:2008. **H_0** is rejected if $z > 1.645$.

With the use of results in appendix 2, the *z* value of the metering time parameter was calculated as shown in Table 4.5. The calculated z=9.6393 value was greater than the critical z value (z=1.645) thus we reject the null hypothesis **H_0: $\mu \leq \mu_6$**, implying that there was a reduction in average metering time from 153.03 days before certification to 56.47 days after certification.

Table 4.5: Comparison of Metering Time *z-test* results

	n	AVERAGE METERING TIME BEFORE ISO CERTIFICATION($\bar{X}_1$)	AVERAGE METERING TIME AFTER ISO CERTIFICATION($\bar{X}_2$)	$\bar{X}_1$-$\bar{X}_2$	S_1	S_2	CRITICAL Z-VALUE	CALCULATED Z	CONCLUSION
METERING TIME(DAYS)	**150**	153.03	56.47	96.56	249.58	117.82	+1.645	9.6393	REJECT H_0

Source: Research Data

4.3 Comparison of Process Interactions Before and After ISO 9001:2008 Certification

Table 4.6 outlines the results obtained from secondary data on process interactions in days before and after ISO 9001:2008 certification. Process interaction was obtained by getting the difference in days between the date a job was sent to finance for allocation of budget and the date when it was sent to wayleaves section for wayleave acquisition.

Hypothesis testing

$\mathbf{H_0}$: $\boldsymbol{\mu} \leq \boldsymbol{\mu_3}$, (There is no improvement in process interactions sub-process quality after ISO 9001:2008 certification)

$\mathbf{H_{3a}}$: $\boldsymbol{\mu} > \boldsymbol{\mu_3}$, (There is a statistically significant improvement in process interactions sub-process after ISO 9001:2008 certification),

Where $\boldsymbol{\mu}$ is the average process interaction time before ISO 9001:2008 certification and $\boldsymbol{\mu_3}$ is the average process interaction time after ISO 9001:2008. $\mathbf{H_0}$ is rejected if $z > 1.645$.

With the use of results in appendix 3, the z value of the process interactions time parameter was calculated as shown in Table 4.6. The calculated z=8.0853 value was greater than the critical z value (z=1.645) thus we reject the null hypothesis $\mathbf{H_0}$: $\boldsymbol{\mu} \leq \boldsymbol{\mu_3}$, implying that there was a reduction in process interaction time from 6.64 days before certification to 2.29 days after certification.

Table 4.6: Comparison of Process Interaction Time *z-test* results

	n	AVERAGE PROCESS INTERACTIONS TIME BEFORE ISO CERTIFICATION($\bar{X}_1$)	AVERAGE PROCESS INTERACTIONS TIME BEFORE ISO CERTIFICATION($\bar{X}_2$)	$\bar{X}_1$-$\bar{X}_2$	S_1	S_2	CRITICAL Z-VALUE	CALCULATED Z	CONCLUSION
PROCESS INTERACTIONS TIME(DAYS)	**150**	6.64	2.29	4.35	9.43	5.83	+1.645	8.0853	REJECT H_0

Source: Research Data

Therefore the null hypothesis **H_0**: $\boldsymbol{\mu \leq \mu_3}$, is rejected implying that average process interaction time decreased after ISO 9001:2008 certification.

4.4 Comparison of Overall Process Quality Before and After ISO 9001:2008 Certification

In order to make conclusions on the overall process quality, a *t-test* hypothesis was conducted on the mean differences of the five sub-processes' quality parameters and process interactions at α=0.05 significance level and 5 degrees of freedom.

H_0:$\mu_d \leq 0$ (There is no significant improvement in overall process quality in KPLC after ISO 9001:2008 certification)

H_a: μ_d>0 at n=6

Reject **H_0:$\mu_d \leq 0$** if the *t* value is greater than t_c=1.943.

Table 4.7a: Comparison of differences in means

	Before ISO 9001:2008 (X_1)	After ISO 9001:2008 (X_2)	$d=(X_1-X_2)$
DESIGN TIME(DAYS)	65.53	55.51	10.02
QUOTATION TIME(DAYS)	4.91	5.69	-0.78
WAYLEAVES ACQUISTION TIME(DAYS)	32.76	18.01	
CONSTRUCTION TIME(DAYS)	440.1	255.38	184.69
METERING TIME(DAYS)	150	56.47	93.56
PROCESS INTERACTION(DAYS)	6.64	2.29	4.35

Table 4.7b: *t-test* on difference in means

	n	MEAN DIFFERENCE, $\bar{d}$	STANDARD DEVIATION OF DIFFERENCES, S_d	STANDARD ERROR OF THE MEAN DIFFERENCE, $SE(\bar{d})$	CALCULATED t-statistic	CRITICAL ***t***	CONCLUSION
DIFFERENCE IN MEANS	6	7.185	65.56	1.6378	4.3897	1.943	REJECT H_0

Source: Research Data

A final conclusion was made that the calculated t=4.3897 was greater than the critical value t_c=1.943 and therefore, the null hypothesis was rejected implying that the average execution time for the new connection process in KPLC decreased after ISO 9001:2008 certification.

CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

The chapter presents a summary, draws conclusion and presents the recommendations on the findings of the study. The chapter also highlights the limitation of the study and suggestions for further study.

5.2 Summary

The main objective of the study was to establish whether KPLC had achieved process quality improvement in its new connection process after ISO 9001:2008 certification. It also sought to investigate the impact of the certification on process interactions. The study established that average design time decreased significantly from 65.53 days to 55.51 days after the certification. It is evident from the study results that wayleaves acquisition time and construction time both decreased from an average of 32.76 and 440.1 days to 18.01 and 255.38 days respectively after the certification. The study also established that metering time decreased from an average of 150 days to 56.47 days after certification. Quotation time however, increased from an average of 4.91 days to 5.69 days after the certification.

On process interactions, the study established that, process interaction average time significantly decreased from 6.64 days to 2.29 days after certification. As a whole, the study established an overall decrease in new connection process execution time in KPLC after ISO 9001:2008 certification.

5.3 Conclusion

The findings of the study indicate a significant increase in process quality of design, wayleaves acquisition, construction and metering sub-processes of the new connection process. However, the quotation sub-process registered a decrease in process quality after ISO 9001:2008 certification. On the other hand, process interactions indicated a tremendous improvement with a reduction factor of three in the average process interaction time after the certification. This is in conformance with Owino (2010) and Mung'ara (2010) who established improved efficiency, optimized operational performance and streamlined operations after ISO 9001: 2008 certification. According to the study, ISO 9001:2008 certification led to a significance improvement on overall process quality at 0.05 significance. These findings are consistent with Singh et al., (2006), Daniel et al., (2012) and Beaudin (2009) who found out that adoption of ISO 9001:2008 QMS led to improvements of internal processes and operations when adopted by organizations.

From the sub-process point of view, the results offer mixed results. Design, wayleaves acquisition, process interaction, construction and metering sub-processes recorded improvements after the certification while quotation sub-process recorded decreased performance after certification. This is due to the fact that after the introduction of the flat payment rate of Kshs 35,000 in 2003, many Kenyans applied to be connected with electricity therefore a surge in applications during the period of the study. Failure to match the high demand with required resources like design engineers during the period of the study led to the reduction in average quotation time. It can therefore be argued that ISO 9001:2008 certification does not necessarily lead to improvement of process quality in all the processes (or sub-processes) in an organization especially if dynamic external environment factors are ignored.

5.4 Recommendations

On the performance of the internal processes, the study recommends regular monitoring and evaluation of the processes' performance of KPLC in an endeavor to improve their quality. It also recommends that the company makes the golden move towards Total Quality Management (TQM) which assures quality in all the organization's processes, both internal and external. This will improve its service offerings, image and trust by its customers. The study would also recommend that KPLC continuously scans the external environment to identify opportunities to improve its processes. Finally, it is recommended that the motivation for ISO 9001:2008 should be purely internal since it leads to improvement of process performance as compared to when the motivation is purely external.

To the regulators, the study recommends that all the organizations in the energy sector should be compelled to adopt ISO 9001:2008 as a Quality Management System (QMS). Adoption of the standard should be accompanied with clear process definitions and measurements though. This will aid in process monitoring and eventual continual improvement.

To the researchers, the study recommends continued research on the benefits of ISO 9001:2008 as a Quality Managent Tool. With process management being the direction being adopted in modern management practices, the study recommends more research on the standard as a basis for process management.

5.5 Limitation of the Study

A control group could not be established to investigate the process quality performance without ISO 9001:2008 certification for the whole period under investigation. This led to the challenge of establishing whether the change in process quality was purely due to ISO 9001:2008 certification and not other factors. Another limitation was the unavailability of secondary data for other processes such as customer service which hindered the study of their process quality performance for the period in question.

5.6 Suggestions for Further Study

A further study is recommended on the real motivations by KPLC for the adoption of ISO 9001:2008 certification and whether they were achieved. It is also recommended that a study is carried out on other dimensions of process quality apart from service delivery time. This will go a long way in helping understand process quality better and help managers make the right decisions on process management.

REFERENCES

Alcina, D., & Inaki, H. (2013). Efficiency of ISO 9001 in portugal: a qualitative study from a holistic theoretical perspective. *International Journal for Quality Research*, *7*(1), 31–62. ISSN 1800-6450

Amwayi, O. W. (2012). The role of ISO standards in Kenya's economy. Kenya Bureau of Standards. Retrieved from http://www.iso.org/iso/iso_essay_contest-2012.pdf

Anderson, S. W., Daly, J. D., & Johnson, M. F. (1999). Why firms seek ISO 9000 certification: regulatory compliance or competitive advantage? *Production and Operations Management*, *8*(1), 28-43.

Anthony, S. (2000). Benefits of an ISO 9001 certification: the case of a Swiss regional hospital. *International Journal of Health Care Quality Assurance*, *13*(1), 27-33

Anyango, D. M. O., & Wanjau, K. (2011). *Assessment of the Relationship between ISO 9001 Certification and Performance of Manufacturing Firms in Nairobi* (Unpublished master's thesis). JKUAT, Kenya

Aravind, D., & Christmann, P. (2008, August). Institutional and resource-based determinants of substantive implementation of iso 14001. In *Academy of Management Proceedings* , *1*, 1-6. Academy of Management.

Barnes, F.C. (1998). ISO 9000 *Myth* and *Reality*, a reasonable approach to ISO 9000, *SAM. Advanced Management Journal*, *63*(2), 23- 30.

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management 17*(1), 99-120.

Beaudin, E. L. (2009). The effectiveness of ISO 9001: 2000 in the public sector: a case study of the Nova Scotia Regional Development Authorities

Bhuiyan, N., & Alam, N. (2005). An investigation into issues related to the latest version of ISO 9000. *Total Quality Management*, *16*(2), 199-213.

Box, R.C. (1999). Running government like a business: Implications for public administration theory and practice. *The American Review of Public Administration, 29,* 19-43.

Brady, M. K., & Cronin, J. J. Jr. (2001). Some New Thoughts on Conceptualizing Perceived Service Quality: A Hierarchical Approach. *Journal of Marketing 65*(3), 34–49.

Carmignani, G. (2008). Process-based management: A structured approach to provide the best answers to the ISO 9001 requirements. *Business Process Management Journal*, *14*(6), 803-812

Casadesus, M., & Karapetrovic, S. (2005). Has ISO 9000 lost some of its lustre? A longitudinal impact study. *International Journal of Operations & Production Management*, *25*(6), 580-96.

Chow-Chua, C., Goh, M. and Wan, T.B. (2003), “Does ISO 9000 certification improve business performance?”, International Journal of Quality & Reliability Management, *20*(8), 936-53.

Chua, W., & Petty, R. (1999). Mimicry, director interlocks and the inter organizational diffusion of a quality strategy: a note. *Journal of Management Accounting Research*, *11*, 93-104.

Chu, P. Y., & Wang, H. J. (2001). Benefits, critical process factors, and optimum strategies of successful ISO 9000 implementation in the public sector: an empirical examination of public sector services in Taiwan. *Public performance & management review*, 105-121.

Claver, E., Tarí, J. J., & Molina, J.F. (2002). Areas of improvement in certified firms advancing towards TQM. *International Journal of Quality and Reliability Management*, *19*(8&9), 1014-1036.

Conca, F. J., Llopis, J., & Tari, J. J. (2004). Development of a measure to assess quality management in certified firms. *European Journal of Operational Research*, *156*(3), 683-97.

Daniel, I. P. (2011). The roles of firms’ motives in affecting the outcomes of ISO 9000 adoption. *International Journal of Operations & Production Management*, 31(1), 78-100

Daniel, P., Baofeng, H., & Zhaojun, H. (2012). The effect of different aspects of ISO 9000 implementation on key supply chain management practices and operational performance. *Supply Chain Management: An International Journal 17*(3), 306–322

Davenport, T. H. (1993). *Process innovation: reengineering work through information technology*. Boston, Mass.: Harvard Business School Press.

Deming, W. E. (1982). *Quality, productivity and competitive position*; Cambridge, MA: MIT

Deming, W.E. (1986). *Out of the Crisis*. MIT Press, Cambridge, MA.

Dick, G.P.M. (2000). ISO 9000 certification benefits: reality or myths? *The TQM Magazine*, *12*(6), 365-71.

DiMaggio, P. J., & Powell, W. W. (1983). The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. *American Sociological Review*, *48*, 147-160.

Elkington, J. (2004). Enter the triple bottom line. *The triple bottom line: Does it all add up*, 1-16.

Feng, M., Terziovski, M., & Samson, D. (2008). A survey in Australia and New Zealand-based manufacturing and service companies. *Journal of Manufacturing Technology Management, 19*(1), 22-37

Frei, F. X., Kalakota, R., Leone, A. J., & Marx, L.M. (1999). Process Variation as a Determinant of Service Quality and Bank Performance: Evidence from Retail Banking Study. *Management Science*, *45*(9), 1210-1220

Gamboa, A. J., & Mela˜o, N. F. (2012). The impacts and success factors of ISO 9001 in education:Experiences from Portuguese vocational schools. *International Journal of Quality & Reliability Management*, *29*(4), 384-401

Gotzamani, K.D., & Tsiotras, G.D. (2002). The true motives behind ISO 9000 certification. Their effect on the overall certification benefits and their long term contribution towards TQM. *International Journal of Quality and Reliability Management*, *19*(2), 151-169.

Gotzamani, K.D., Tsiotras, G.D., Nicolaou, M., Nicolaides, A., & Hadjiadamou, V. (2007). The contribution to excellence of ISO 9001: the case of certified organisations in Cyprus. *The TQM Magazine*, *19*(5), 388-402.

Government of Kenya. (1996). *Annual Budget Statement by the Minister for Finance*. GoK, Nairobi

Government of Kenya. (2003). *Energy Sector Development Strategy*. Rural Energy Task Force Final Report. Ministry of Energy, Nairobi.

Hammer, M., & Champy, J. (1993). Reengineering theCorporation: A Manifesto for Business Revolution. Harper Business, New York, NY.

Heidari, F., Loucopoulos, P., & Kedad, Z. (2011). A Quality-oriented Business Process Meta-Model in J. Barjis, T. Eldabi, and A. Gupta (eds): EOMAS 2011 LNBIP, *88*, 85-99

Heinrich, R., & Paech, B. (2010). Defining the quality of business processes. In: Proc. Modellierung 2010, *LNI*, P-161, 133–148.

International Organization for Standardization (ISO). (2008). Introduction and support package: implementation guidance for ISO 9001:2008. ISO/TC 176/SC 2/N836 document.

Jay, H., & Barry, R. (2008).. Principles of operations management. Sixth edition, (p. 198).

Joubert, B. (1998). ISO 9000: International quality standards. *Production and Inventory Management Journa*l, *39*(2), 60-65.

Kanji, G. K. (1998). An innovative approach to make ISO 9000 standards more effective. *Total Quality Management*, *9* (1), 67-78.

Kariuki, M. M., & Kasomi, F. M. (2011). The perception of Kenyan citizens on improvement of public service delivery since the implementation of performance contracts in Kenya. *DBA Africa Management Review*, *1*(1).

Kenya National Bureau of Statistics. (2012). *Kenya facts and figures*. Retrieved from http://knbs.or.ke/downloads/pdf/Kenyafacts2012.pdf

Kowour, E. (2012). *The experience of Kenya Power and Lighting in outsourcing line construction in Coast Region* (Unpublished master's thesis). University of Nairobi, Kenya

KPLC. (2007). *Annual Report and Financial Statements, 2006/2007*. KPLC, Nairobi. Retrieved from http://www.kenyapower.co.ke

KPLC. (2011). *Annual Report and Financial Statements 2010/2011*. KPLC, Nairobi. Retrieved from http://www.kenyapower.co.ke/AR/Annual%2520Report%25202010%2520-%25202011.pdf

KPLC. (2012). *Annual Report and Financial Statements, 2011/2012*. KP, Nairobi. Retrieved from http://www.kenyapower.co.ke

Kinyua, J. K. (2010). *Challenges of Pusiness Process Outsourcing at KPLC* (Unpublished master's thesis). University of Nairobi, Kenya

Koimett, E. (2012). Public Private Partnerships in Kenya. Retrieved from http://www.cbcglobal.org/library/details/kis2012-public-private-partnerships-in-kenya-esther-koimett

Kothari, C. R. (2008). *Quantitative techniques* (3rd Revised Ed.). Vikas Publishing House Pvt Ltd

KPMG. (2011). Government and Public Sector Services, Cutting through complexity for the Public Sector and Government

Lee, P. K.C., To, W.M., & Yu, B. T.W. (2009). The implementation and performance outcomes of ISO 9000 in service organizations, An empirical taxonomy. *International Journal of Quality & Reliability Management, 26*(7), 646-662

Lee, P. K.C., To, W.M., & Yu, B. T.W. (2011). ISO 9001:2000 implementation in the public sector A survey in Macao SAR, the People's Republic of China. *The TQM Journal, 23*(1), 59-72

Lee, T. Y., Leung, H. K., & Chan, K. C. (1999). Improving quality management on the basis of ISO 9000. *The TQM Magazine, 11*(2), 88-94.

Leedy, P.D., & Ormond, E. J. (2005). *Practical Research Planning and Design (*8th Ed.). Parson International Edition.

Lillian, G. O., Mathooko, P., & Sitati, N. (2011). *The effects of performance appraisal system on civil servants job perfomance and motivation in Kenya: A case study of ministry of state for public service* (Unpublished master's thesis). Jomo Kenyatta University of Agriculture and Technology, Kenya

Lohrmann, M., & Reichert, M. (2013). Understanding business process quality. In *Business Process Management* (pp. 41-73). Springer Berlin Heidelb

Lowrey, W. (2005). Commitment to newspaper – TV partnering: a text of the impact of institutional isomorphism. *Journalism and Mass Communication Quarterly, 82*(3), 495-515.

Lundmark, E. & Westelius, A. (2006). Effects of quality management according to ISO 9000: a Swedish study of the transit to ISO 9000:2000. *Total Quality Management & Business Excellence. 17*(8), 1021-42.

Luz, M. M., & Maria, C. R. M. (2011). ISO 9000 9000:2000 certification and business results. *International Journal of Quality & Reliability Management*, 28(6), 649-61.

Magd, H.A.E. (2006). An investigation of ISO 9000 adoption in Saudi Arabia. *Managerial Auditing Journal, 21*(2), 132-147

Macharia, K. (2010, May 10). Kibaki's ISO Plan turns the heat on Co-operations. *Business Daily*. Retrieved from http://www.businessdailyafrica.com/Corporate-News/Kibakis-ISO-plan-turns-the-heat-on-corporations/-/539550/915116/-/xwnoo/-/index.html

Magd, H.A.E. (2007). ISO 9001:2000 in the Egyptian manufacturing sector: perceptions and perspectives. *International Journal of Quality & Reliability Management, 25*(2), 173-200

Marley, K. A., Collier D. A., & Goldstein S. M. (2004). The Role of Clinical and Process Quality in Achieving Patient Satisfaction in Hospitals. *Decision Sciences*, 35(3), 349–369.

Martinez-Costa, M., Martinez-Lorente, A.R., & Choi, T.Y. (2008). Simultaneous consideration of TQM and ISO 9000 on performance and motivation: an empirical study of Spanish companies. *International Journal of Production Economics, 113*(1), 23-39.

Mbogho, S. M., Zhu J. G., & Sharma, D. (2003). *Meeting energy needs: the Kenyan scenario* (Unpublished master's thesis). University of Technology, Sydney, Australia.

Meyer, J.W., & B. Rowan. (1977). Institutional organizations: formal structure as myth and ceremony. *American Journal of Sociology, 83*, 340-363.

Ministry of Energy. (2011). Retrieved from http://www.MOE.go.ke.

Morris, P.W. (2006). ISO 9000 and financial performance in the electronics industry. *The Journal of American Academy of Business*, *8*(2), 227-34.

Mung'ara, M. W. (2010). *Management perception on implementation and maintenance of ISO 9001 certification among insurance companies in Kenya* (Unpublished master's thesis) University of Nairobi, Kenya.

Muthaura, F. K. (2010, December). *The role of Kenya public service in a changing global environment: opportunities and challenges – what is working and what is not?* Paper presented at the KAPAM annual dinner, Holton Hotel, Nairobi.

Nagasaku, C., & Oda, M. (1965). *Planning and execution of quality control*. Juse Press, Tokyo

Nyoike, P. M. (2004). AFRICAN ENERGY POLICY RESEARCH NETWORK (AFREPREN).

Omachonu, V.K., Suthummanon, S., & Einspruch, N.G. (2004). The relationship between quality and quality cost for a manufacturing company. *International Journal of Quality & Reliability Management, 21*(3), 277-90.

Omondi, D. O. (2008). *Application of lean thinking to business process management: the case of Kenya Revenue Authority* (Unpublished master's thesis). University of Nairobi, Kenya.

Onyango, C. H., Njeru, G. N., & Boaz M. O. (2011). Regulatory and competition-related reforms in Kenya's power and petroleum sectors. ICBE-RF Research Report No. 19/11. Retrieved from, http://www.cuts-international.org/ARC/Nairobi/Competition_in_Energy_Sector/pdf/ICBE.pdf

Oluoch, K. J. (2010). *Benefits and Challenges of implementation of ISO 9001:2008 certification at Kenya Medical Training College* (Unpublished master's thesis), University of Nairobi, Kenya

Owino, A. O. (2010). Dissertation PhD: The relationship between ISO 9001 certification status and operational performance of government agencies in Kenya, University of Nairobi.

Pauly, B., Abebe, G., Azer, T., Bounah, B., Diu, J., Bangui, L., Mumbuna, N., Prisokotto, I., & Sithole, M. (2009). Power sector reform in Africa. UPDEA,

Pollitt, C. (2005). Quality journeys in the european public sector: from there, to here, to where? (Doctoral dissertation, Katholieke Universiteit Leuven).

Psomas, E. L., Fotopoulos, C. V., & Kafetzopoulos, D. P. (2010). Critical factors for effective implementation of ISO 9001 in SME service companies. *Managing Service Quality*, 20(5), 440-457

Psomas, E. L., Fotopoulos, C. V., & Kafetzopoulos, D. P. (2013). The impact of ISO 9001 effectiveness on the performance of service companies. *Managing Service Quality*, *23*(2), 149-164

Quazi, H. A., Hong, C. W., & Meng, C. T. (2002). Impact of ISO 9000 certification on quality management practices: a comparative study. *Total Quality Management*, *13*(1), 53-67.

Quazi, H. A., & Jacobs, R. L. (2004). Impact of ISO 9000 certification on training and development activities , An exploratory study. *International Journal of Quality & Reliability Management*, 21(5), 497-517

Quazi, H.A., Wing H. C., & Tuck Meng, C. (2002). Impact of ISO 9000 certification on quality management practices: a comparative study. *Total Quality Management*, *13*(1), 53-67.

Redman, T., Mathews, B., Wilkinson, A., & Snape, E. (1995). Quality management in services: Is the public sector keeping pace?. *International Journal of Public Sector Management, 8*, 21-34.

Simmons, B.L. (1999). The relationship between ISO 9000 and business performance: does registration really matter? *Journal of Managerial Issues*, 11(3), 330-43.

Singh, P.J., Feng, M., & Smith, A. (2006). ISO 9000 series of standards: comparison of manufacturing and service organizations. *International Journal of Quality & Reliability Management*, *23*(2), 122-42.

Somsuk, N. (2010). Theoretical perspectives in quality management implementation: A literature review. *Industrial Engineering and Engineering Management (IEEM)*, 916- 920.

Stamatis, D. H. (1995) *Understanding ISO 9000 and Implementing the Basics to Quality.* New York: Marcel Dekker

Stefano, B., & Giovanni, B. (2003). Process management practices and quality system standards: risks and opportunities of the new ISO 9001 certification. *Business process management Journal*, *9*(2), 149-169

Stracke, C. M. (2006). Process-oriented Quality Management, in: Ehlers, Ulf-Daniel/ Pawlowski, Jan Martin (Eds.): *Handbook on Quality and Standardisation in E-Learning*. Berlin: Springer. 79-96.

Terziovski, M., & Power, D. (2007). Increasing ISO 9000 certification benefits: a continuous improvement approach. *International Journal of Quality&Reliability Management*, *24*(2), 141-63.

Terziovski, M., Samson, D., & Dow, D. (1997). The business value of quality management systems certification. Evidence from Australia and New Zealand. *Journal of Operations Management* atis, D. H. (1995). *Understanding ISO 9000 and Implementing the Basics to Quality*. New York: Marcel Dekker

United Nations. (2001). Application of ISO 9000 standards in local governments and other public sector organizations. Retrieved from http://logotri.hypermart.net/download/iso9000.pdf

Vision, Kenya. 2030. (2007). *Ministry of Planning and National Development*. Retrieved from https:// www.opendata.go.ke.

Vitner, G., Nadir, E., Feldman, M., & Yurman, S. (2011). ISO 9001 in a neonatal intensive care unit (NICU). *International Journal of Health Care Quality Assurance*, *24*(8), 644-653

Vouzas, F. K., & Gotzamani, K. D. (2005). Best practices of Greek companies on their road to business excellence: the contribution of the new ISO 9000:2000 series of standards. *The TQM Magazine*, *17*(3), 259-266.

Williams, J.A. (2004). The impact of motivating factors on implementation of ISO 9001: 2000 registration process. *Management Research News*, *27*(1), 74-84.

Withers, B., & Ebrahimpour, M. (2000). Does ISO 9000 affect the dimensions of quality used for competitive advantage? *European Management Journal*, *18* (4), 431-443.

Zaramdini, W. (2007). An empirical study of the motives and benefits of ISO 9000 certification: the UAE experience. *International Journal of Quality & Reliability Management*, *24*(5), 472-491

APPENDICES

Appendix 1: Introduction Letter

UNIVERSITY OF NAIROBI
COLLEGE OF HUMANITIES AND SOCIAL SCIENCES
SCHOOL OF BUSINESS
DEPARTMENT OF MANAGEMENT SCIENCE

Telephone: 4184160/1-5 Ext. 220
Email: commerce@uonbi.ca.ke

P.O. Box 30197
Nairobi, Kenya

Introduction Letter

12th June 2013

Regional Manager, Coast Region,
Kenya Power and Lighting Company Limited,
P.O. Box 90104 -80100,
Mombasa, Kenya

RE: REQUEST FOR DATA ACCESS

The bearer of this letter, **Mulela, John Kyalo** of Registration Number **D61/73961/2009** is a Master of Business Administration (MBA) student of the University of Nairobi, Mombasa Campus.

He is required to submit as part of his coursework assessment a research project report. His project is titled: ***The Effect of ISO 9001:2008 certification on Process Quality: A Case Study of Kenya Power and Lighting Company Limited***. We would, therefore, appreciate if you assist him by allowing him to collect data in your organization for the research.

The data will be used solely for academic purposes and a copy of the final report will be availed to you on request.

Thank you very much in advance.

Yours Sincerely,

UNIVERSITY OF NAIROBI
EXAMINATIONS OFFICER
12 JUN 2013
SCHOOL OF BUSINESS
MOMBASA CAMPUS

Odock Stephen Ochieng,
Lecturer, Department of Management Science

Appendix 2: KPLC's performance for the last eleven years

Performance indicator	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Number of customers	593,621	643,274	**686,195**	**735,144**	**802,249**	**924,329**	**1,060,383**	**1,267,198**	**1,463,639**	**1,753,348**	**2,038,625**
Revenue	27,353,043	25,236,574	23,323,083	28,341,356	33,966,730	**39,665**	**42,865**	**69,545**	**77,444**	**74,053**	**102,642**
System Losses	21.3%	20.5%	20.0%	18.8%	18.1%	19.6%	17.9%	16.6%	16.0%	16.1%	17.3%
Profit before tax	(1,879)m	(2,897)m	876m	1,981m	2,500M	2,384m	3,524m	63.0	5,633m	6,255m	8,807m
Customer Satisfaction index									65%	69%	70%
Population Access to electricity									25%	29%	33.7%

Source 2010/11 and 2011/2012 Kenya Power and Lighting Company financial reports(For the colored cells, data was not available at the time of the study).

Appendix 3:Data CollectiOn Table

BEFORE ISO 9000:2008 CERTIFICATION

COUNT	DESIGN TIME	QUOTATION TIME	WAYLEAVES ACQUISTION TIME	CONSTRUCTION TIME	METERING TIME	PROCESS INTERACTIONS
1	14	0	12	151	43	1
2	0	0	0	668	48	3
3	28	4	4	54	38	3
4	32	4	5	449	29	2
5	17	3	0	542	59	4
6	36	0	4	71	118	7
7	74	2	5	119	22	2
8	84	6	1	382	32	3
9	16	4	53	375	92	11
10	15	1	1	522	11	1
11	6	2	1	483	110	28
12	1	0	5	244	9	1
13	5	2	4	648	9	1
14	38	1	1	509	58	1
15	12	1	12	590	184	3
16	622	0	2	261	309	2
17	1	0	0	453	63	1
18	21	7	32	235	183	7
19	29	0	0	443	54	1
20	1	1	2	471	34	5
21	76	0	0	375	23	6

COUNT	DESIGN TIME	QUOTATION TIME	WAYLEAVES ACQUISTION TIME	CONSTRUCTION TIME	METERING TIME	PROCESS INTERACTIONS
22	43	3	7	416	28	1
23	2	0	4	431	11	1
24	0	30	17	514	117	1
25	6	0	18	472	96	1
26	7	25	23	476	99	1
27	32	0	51	182	28	6
28	32	8	11	185	43	1
29	18	2	26	227	28	1
30	30	5	23	284	57	3
31	170	6	14	254	7	1
32	20	12	32	422	45	4
33	35	29	17	379	584	1
34	64	4	18	567	25	15
35	21	7	142	1000	93	11
36	19	4	20	627	14	8
37	42	3	27	193	9	35
38	12	5	88	1110	96	2
39	21	4	0	162	22	2
40	28	2	39	77	25	1
41	11	1	35	503	19	3
42	28	0	16	448	103	2
43	22	0	12	78	81	2
44	39	2	6	408	29	1

COUNT	DESIGN TIME	QUOTATION TIME	WAYLEAVES ACQUISTION TIME	CONSTRUCTION TIME	METERING TIME	PROCESS INTERACTIONS
45	40	1	22	199	10	4
46	7	2	7	267	8	14
47	12	2	12	359	28	1
48	154	1	41	165	26	2
49	16	1	140	418	368	7
50	33	2	3	329	559	2
51	1	0	15	430	68	2
52	26	9	35	313	160	12
53	10	3	30	204	195	5
54	6	0	5	271	298	2
55	92	0	233	563	329	8
56	31	5	1	202	62	1
57	19	1	10	349	247	28
58	7	0	14	316	36	1
59	54	0	2	229	78	6
60	6	1	54	127	78	8
61	20	0	4	100	97	2
62	22	0	13	320	337	5
63	70	2	15	541	288	7
64	14	1	14	199	37	4
65	2	4	0	360	40	1
66	1	3	44	338	197	8
67	35	0	13	549	1681	1

COUNT	DESIGN TIME	QUOTATION TIME	WAYLEAVES ACQUISTION TIME	CONSTRUCTION TIME	METERING TIME	PROCESS INTERACTIONS
68	2	3	17	100	34	4
69	1	0	5	210	144	1
70	24	0	32	175	21	1
71	11	2	39	250	23	2
72	22	0	9	10	12	1
73	6	0	168	576	573	28
74	7	0	33	939	156	1
75	22	1	7	225	65	3
76	46	5	82	85	4	12
77	56	7	6	430	47	7
78	21	12	70	221	183	5
79	15	8	18	158	151	1
80	35	25	74	142	122	3
81	33	7	0	301	200	0
82	32	26	9	1362	146	5
83	330	0	51	187	32	0
84	54	6	9	312	17	10
85	29	9	40	219	912	8
86	8	0	22	1433	159	18
87	19	1	8	170	124	1
88	17	2	4	194	147	6
89	77	1	228	848	253	14
90	182	1	47	430	409	23

COUNT	DESIGN TIME	QUOTATION TIME	WAYLEAVES ACQUISTION TIME	CONSTRUCTION TIME	METERING TIME	PROCESS INTERACTIONS
91	95	0	47	167	87	6
92	91	0	173	925	321	10
93	205	0	90	383	260	1
94	247	3	141	785	195	27
95	38	6	66	881	62	13
96	237	0	30	808	443	10
97	106	4	99	338	287	1
98	25	56	14	320	57	1
99	13	18	2	179	33	0
100	26	1	21	46	14	38
101	203	0	19	966	297	5
102	11	0	4	428	50	5
103	6	1	3	982	257	6
104	2	0	23	1348	308	4
105	20	0	31	490	55	2
106	291	0	153	162	39	28
107	47	0	33	277	183	4
108	47	0	15	378	13	2
109	1	0	1	512	182	3
110	52	1	33	406	29	6
111	20	7	98	434	500	5
112	59	127	51	358	41	0
113	2	1	22	604	92	1

COUNT	DESIGN TIME	QUOTATION TIME	WAYLEAVES ACQUISTION TIME	CONSTRUCTION TIME	METERING TIME	PROCESS INTERACTIONS
114	174	0	14	261	26	2
115	24	1	13	1456	36	5
116	0	0	2	165	99	5
117	9	1	17	611	113	2
118	27	1	16	1570	981	3
119	20	3	11	1140	26	0
120	171	12	7	846	77	3
121	21	1	27	1301	10	2
122	13	0	31	1289	1818	3
123	20	0	26	1074	167	1
124	35	1	1	172	28	2
125	18	0	19	153	109	14
126	2	0	80	177	841	1
127	21	3	4	51	20	1
128	103	6	228	1299	22	1
129	2	0	91	164	22	5
130	84	1	51	355	171	4
131	157	6	25	1048	333	21
132	31	2	5	314	40	57
133	88	6	20	215	102	0
134	277	13	67	846	164	0
135	22	1	44	355	237	22
136	29	3	10	1011	114	17

COUNT	DESIGN TIME	QUOTATION TIME	WAYLEAVES ACQUISTION TIME	CONSTRUCTION TIME	METERING TIME	PROCESS INTERACTIONS
137	134	10	15	316	244	12
138	191	12	40	185	31	5
139	114	0	84	471	45	5
140	55	2	49	413	35	52
141	134	6	10	208	282	2
142	768	33	8	196	23	5
143	486	2	36	154	40	7
144	159	4	35	790	318	5
145	185	7	99	504	38	5
146	433	12	2	293	22	38
147	194	8	29	280	19	14
148	81	4	5	169	97	7
149	77	4	25	105	11	4
150	69	3	4	292	41	4
σ	**108.7984**	**12.45390786**	**44.72461299**	**334.432688**	**249.575194**	**9.425283717**
μ	**65.52667**	**4.913333333**	**32.76**	**440.073333**	**153.033333**	**6.64**

AFTER ISO 9001:2008 CERTIFICATION

COUNT	DESIGN TIME	QUOTATION TIME	WAYLEAVES ACQUISTION TIME	CONSTRUCTION TIME	METERING TIME	PROCESS INTERACTIONS
1	1	0	4	1035	98	0
2	10	1	3	857	15	1
3	4	0	0	349	39	0
4	0	0	4	99	14	0
5	72	1	0	1610	40	3
6	11	0	5	695	17	1
7	311	0	23	319	281	1
8	117	0	38	84	70	1
9	0	0	6	357	9	1
10	13	0	27	191	6	1
11	27	5	8	86	10	1
12	44	4	24	178	26	2
13	117	20	35	193	19	4
14	24	368	5	313	12	0
15	19	7	3	161	38	1
16	100	1	31	68	9	0
17	16	1	8	178	6	1
18	8	5	6	455	8	1
19	17	4	3	340	16	0
20	193	1	18	67	27	0
21	32	2	2	529	539	6
22	21	5	68	168	10	0

COUNT	DESIGN TIME	QUOTATION TIME	WAYLEAVES ACQUISTION TIME	CONSTRUCTION TIME	METERING TIME	PROCESS INTERACTIONS
23	396	1	14	68	45	0
24	1	0	1	297	623	0
25	140	1	23	225	17	0
26	111	10	11	108	38	1
27	47	6	9	170	3	1
28	364	5	91	191	27	1
29	60	2	29	310	182	1
30	58	1	10	596	73	6
31	97	3	42	217	11	4
32	114	1	51	284	169	0
33	20	0	12	630	68	0
34	42	0	15	238	36	3
35	26	2	38	161	19	0
36	59	11	27	290	70	15
37	138	1	30	282	22	4
38	113	0	2	112	10	4
39	146	18	51	185	31	4
40	19	1	82	469	116	2
41	103	93	24	391	20	0
42	89	2	2	365	110	7
43	100	27	2	212	82	4
44	99	11	7	401	629	3

COUNT	DESIGN TIME	QUOTATION TIME	WAYLEAVES ACQUISTION TIME	CONSTRUCTION TIME	METERING TIME	PROCESS INTERACTIONS
45	84	12	3	178	50	2
46	4	1	5	373	29	2
47	69	23	0	896	742	0
48	148	5	1	105	6	1
49	23	8	2	261	407	0
50	94	0	2	557	12	1
51	46	1	8	423	15	3
52	6	4	3	65	40	0
53	5	1	10	753	14	1
54	5	0	20	403	4	2
55	1	3	0	16	36	0
56	6	5	3	464	5	3
57	26	0	18	466	26	1
58	165	0	41	326	21	0
59	235	3	10	307	13	0
60	36	0	47	1047	5	0
61	17	3	12	324	22	2
62	6	0	4	48	42	2
63	33	0	38	18	12	1
64	19	4	11	47	32	1
65	14	1	27	106	13	0
66	5	0	2	10	7	0

COUNT	DESIGN TIME	QUOTATION TIME	WAYLEAVES ACQUISTION TIME	CONSTRUCTION TIME	METERING TIME	PROCESS INTERACTIONS
67	24	1	10	68	7	0
68	28	3	16	15	29	1
69	34	2	7	63	5	0
70	188	0	54	119	15	0
71	16	1	30	107	51	1
72	22	0	25	438	31	5
73	32	0	18	81	11	0
74	103	4	6	323	15	1
75	61	0	2	162	30	1
76	423	0	1	46	9	0
77	5	2	2	346	6	0
78	42	1	7	109	31	7
79	10	3	19	366	16	2
80	191	2	11	241	39	0
81	65	1	9	82	23	7
82	4	0	21	143	33	3
83	7	0	13	111	72	1
84	89	3	12	213	58	7
85	152	0	12	134	43	6
86	32	10	21	247	16	4
87	11	1	113	100	13	4
88	164	1	30	187	16	13

COUNT	DESIGN TIME	QUOTATION TIME	WAYLEAVES ACQUISTION TIME	CONSTRUCTION TIME	METERING TIME	PROCESS INTERACTIONS
89	26	0	104	297	290	0
90	34	1	17	143	30	0
91	133	0	22	162	25	1
92	61	8	15	353	69	0
93	20	1	17	315	57	0
94	105	3	26	89	16	2
95	22	19	28	194	40	3
96	43	0	7	150	66	0
97	37	0	108	717	93	0
98	6	0	6	78	57	8
99	26	6	30	98	46	0
100	69	0	15	160	25	5
101	5	0	1	187	16	0
102	36	0	3	182	57	3
103	10	0	8	590	18	0
104	2	1	2	1052	5	3
105	0	0	0	925	564	3
106	14	0	0	202	48	0
107	27	1	1	21	21	5
108	7	0	2	171	2	0
109	16	1	14	373	10	4
110	26	0	16	205	18	0

COUNT	DESIGN TIME	QUOTATION TIME	WAYLEAVES ACQUISTION TIME	CONSTRUCTION TIME	METERING TIME	PROCESS INTERACTIONS
111	19	0	4	88	5	0
112	4	0	2	147	17	3
113	78	4	13	90	24	0
114	27	2	4	149	8	4
115	6	1	5	166	23	0
116	8	0	4	90	138	5
117	8	2	14	201	21	0
118	9	1	6	26	8	2
119	11	0	41	41	59	2
120	68	1	6	7	5	6
121	9	7	15	62	5	1
122	25	3	6	67	12	1
123	124	0	11	270	44	1
124	8	1	0	248	3	0
125	44	1	75	319	81	3
126	32	0	2	40	9	0
127	80	0	20	42	16	2
128	35	0	9	211	25	1
129	69	0	11	319	125	0
130	19	0	19	72	13	0
131	23	5	5	150	48	67
132	22	6	9	319	66	2

COUNT	DESIGN TIME	QUOTATION TIME	WAYLEAVES ACQUISTION TIME	CONSTRUCTION TIME	METERING TIME	PROCESS INTERACTIONS
133	33	1	7	236	16	1
134	18	0	28	90	21	0
135	81	0	8	82	4	4
136	57	2	10	110	11	4
137	37	1	12	9	4	1
138	23	4	6	17	5	1
139	40	2	9	99	42	4
140	15	4	65	62	30	4
141	38	0	28	79	8	0
142	55	0	8	341	17	3
143	36	1	42	260	14	1
144	1	1	19	430	10	2
145	68	2	134	105	18	0
146	31	6	1	661	7	1
147	23	0	0	170	35	4
148	36	3	2	105	12	3
149	22	1	0	138	12	2
150	11	21	0	97	44	1
σ	**71.35428**	**31.02585**	**23.29674**	**243.8699**	**117.8169**	**5.830188**
μ	**55.51333**	**5.693333**	**18.01333**	**255.38**	**56.46667**	**2.286667**

Appendix 4: Analysis Of Data

	n	X1	X2	A=(X1-X2)	S_1	S_2	S_1^2	S_2^2	B=(S_1^2)/n	C=(S_2^2)/n	B+C	SQRT(B+ C)	Z=A/{SQRT(B+ C)}
DESIGN TIME(DAYS)	**150**	65.53	55.51	10.02	108.8	71.35	11837.40	5090.82	0.73	33.94	34.66	5.89	1.7019
QUOTATION TIME(DAYS)	**150**	4.91	5.69	-0.78	12.45	31.03	155.00	962.86	0.08	6.42	6.50	2.55	-0.3059
WAYLEAVES ACQUISTION TIME(DAYS)	**150**	32.76	18.01	14.75	44.72	23.3	1999.88	542.89	0.30	3.62	3.92	1.98	7.4523
CONSTRUCTION TIME(DAYS)	**150**	440.1	255.38	184.69	334.43	243.87	11184	59472.58	2.23	396.48	398.71	19.97	9.2494
METERING TIME(DAYS)	**150**	150	56.47	93.56	249.58	117.82	62290.20	13881.55	1.66	92.54	94.21	9.71	9.6393
PROCESS INTERACTION(DAYS)	**150**	6.64	2.29	4.35	9.43	5.83	88.92	33.99	0.06	0.23	0.29	0.54	8.0853