FACTORS INFLUENCING THE IMPLEMENTATION OF ENERGY CONSERVATION PROGRAMS IN SELECTED MANUFACTURING FIRMS IN NAIROBI COUNTY, KENYA

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DECLARATION

This research paper report is my original work and has not been submitted before any other academic institution for any award.

Signature:…… Date:…….

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L50/78166/2015

This research project report has been submitted for examination with my approval as the research project supervisor.

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DEDICATION

I owe a special debt to all my family members especially my wife Janet, daughter Ashley and son Bryan for their love, support and inspiration.

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ABBREVIATIONS AND ACRONYMS

CEEC	Centre for Energy Efficiency and Conservation
EEM	Energy Efficiency Measures
EMS	Environmental Management System
ERC	Energy Regulatory Commission
GEF	Global Environmental Facility
GoK	Government of Kenya
IEA	International Energy Agency
KAM	Kenya Association of Manufacturers
KIPPRA	Kenya Institute for Public Policy and Analysis
SEEI	Specific Electrical Energy Intensity
UNDP	United Nations Development Program
UNIDO	United Nations Industrial Development Organization
KW	Kilowatt
KWh	Kilowatt hour

ABSTRACT

The very first input in the development of any nation economically, politically and socially is energy. For the environment to remain safe and protected, energy should highly be guarded and be used carefully.

Energy helps to promote very essential economic activities like transport sector, commercial sector, agriculture among others. Energy is a fundamental factor that any country must adhere to coming up with an economic blueprint. The sector of energy is made up of renewable energy, geothermal power, biogas, solar among others.

The main goal of the project is to determine the full implementation of methods of conserving energy in the county of Nairobi that is located in Kenya. The major goals included: establishment of human as a factor of production to help in the implementation of the programs concerning energy implementation in the firms that specialises in the manufacturing of products in the county of Nairobi, to determine the factors within the technological outfit that affects the implementation of programs of energy conservation in the Nairobi's manufacturing industry. Fifty-five manufacturing companies were selected for the research work within the county of Nairobi. The company under study are registered with Kenya Association of Manufacturers. The size of the sample was placed at twenty-eight which represent approximately fifty percent of all manufacturing companies in the research work. This is made up of the human resource managers, the operations managers and technicians from all over the companies. Therefore, a total of sixty-six respondents emanating from twenty-two companies which filled the questionnaires. Research paper adopted the design of sampling that is purposive.to sample manufacturing company from the total population. The first piloting by issuing the administration of the questionnaires of approximately ten percent of the total size of sample. The collection of data was done using questionnaires by making use of both closed and open-ended questions. The descriptive type of statistics was applied with the use of SPSS version 22. The model of regression was applied to determine the existing relationship between the variables of research. The presentation was done using tabled frequencies. The research work revealed that organisational factors, human factors, technological factors as well as the environmental factors have a great impact on the conservation of the energy. The scholarly made a recommendation on the continued implementation of the efficiency measures by the manufacturing companies to enable it gain the cost of saving.

CHAPTER ONE
INTRODUCTION

1.1 Background of the study

In any large-scale production, energy must be consumed. The extent to which energy is consumed determines the rating of a country in matters of economic development. In the whole world there is growing pressure on energy requirements due to rising population growth, creation of new industries and better standards of living. Consequently, there is ongoing debate in the political circles on how to come up with renewable energy sources, conserving the available sources and being more efficient. (Altenburg & Pegels, 2012).

Electric energy is the most popular source in the energy pyramid. This is due to its use in home, industry, agriculture and in transport. It derives its popularity from its ease of transport, does not pollute the environment and is easy to work with. This is unlike most of the other energy sources. The per capita consumption of energy acts as an indicator of the way of life of the citizenry of a particular country (Adam & Collier, 2010).

Developing nations are confronted by two difficulties; that of creating better economies through activities, for example, extended energy supply, expanded rural production in agriculture and better transportation networks, while likewise assuming an important part globally in reducing carbon dioxide and other poisonous gases. In Rio Conference 2011, the AU expressed that it perceived the advantages and openings in the idea of better economy that is green for the fulfillment of the goals of the development that is sustainable, for example, reducing the level of poverty, coming up with opportunities to employ people, growing the economy and providing equal opportunities for all. However, data to this end has not been forthcoming especially in Africa and there is need for further research. This was an experimental study intended to source data from organizations that have adopted energy conservation practices in Kenya. Manufacturing was the preferred industry of study due to its intense consumption of energy and is also a critical economic activity, industries in this sector also invest huge amounts of their finances in energy tariffs. Since climate change is a reality, developing nations have continued to adopt technologies that reduce energy consumption (Kanie *et al*., 2010).

Energy conservation measures may comprise of distinct measures aimed at bringing down energy consumption by utilizing modern production equipment. In instances where the energy conservation produces obvious benefits, adoption is not always automatic. It is still influenced by conditions like the sector policy, national institutions charged with policy implementation and how those policies relate with the long term objectives (Chaudhary, Sagar and Mathur, 2012; Sagar, 2013; Lema *et al*., 2014). The areas which have received most attention are transfer of technologies from other countries and joint exchange of knowledge through collaborative learning and innovation (Altenburg and Pegels 2012; Lema *et al*., 2014). Energy efficiency improves the economy through saving money resulting from the measures for saving of energy, creation of jobs through energy efficient projects e.g. building improvement and infrastructure repairs; it also spurs innovation where industry leaders come up with energy efficient innovations and policies that lead to breakthroughs among manufacturer e.g. creation of energy efficient standards. (Abrahamse & Talib, 1998).

Kenya currently generates about 1,762MW of electricity with over sixty percent of the energy being generated posted to the national grid system being used by manufacturing enterprise. Energy has been a critical issue to the manufacturers for longest time period driving up the costs of production and driving down Kenya's competitiveness. The cost of energy is comparatively high in relation to other regional countries. For instance in Ethiopia, Egypt and Uganda electricity costs are US cents 3/KWh, 5/KWh and 18.6/KWh respectively. Tanzania had their tariff reviewed recently to US cents 4/KWh from 9/ KWh compared to Kenya's current cost of US cents 18.7/KWh. (KAM, 2014).

The government has shown its commitment to increase the power generation in the country and has promised a total generation of 5000MW by year 2017. The 2014-2015 budget provided for KShs. 10 billion for Geothermal power generation development. Energy efficient usage will be a key instrument in the social-economic development of Kenya through improving competition in the economy, reducing the import bill of the country, improving the trade balance, creation of job, improving security of energy supply among others (Bertani, 2012).

1.1.1 The Manufacturing Sector in Kenya

The sector of manufacturing in Kenya is the largest contributor to GDP constituting 70% while the rest of the sectors i.e. building, construction and quarrying contribute the remainder 30%. If Kenya is to realize a GDP growth rate of 10% every year as envisioned in the Vision 2030 blueprint, then the manufacturing sector must be strengthened. However, the sector's contribution to GDP has been on the decline worsening from approximately 9.6 per cent in 2011 to around 9.2 percent in 2012. This drop-in rate of growth has been occasioned by among other things huge production costs (KIPPRA, 2013). This sector has great potential to provide employment opportunities and thereby reduce poverty. One of the reasons is because the sector is not affected by the size of the land unlike Agriculture (McKane *et al*, 2007).

CSIRO and Griffith University (2007) embarked on a study on energy efficiency. They discovered that firms are investing more in products with energy efficient designs. This has helped them remain competitive through a larger share of the market and make the brands more visible and enhancing customer retention. They pointed out Japan as the champion of helping its companies increased access to a larger global market share by investing in better energy efficiency standards. Japan enacted these Energy Conservation Laws in 1979.

This study identified among others the following energy saving opportunities that can be used by the Kenyan manufacturing industries: Improving efficiency of industrial processes, using recycled plastics as energy source, recycling of waste in paper and pulp manufacturing, recovering waste heat and using it to generate electricity and through re-manufacturing and recycling products. Re-manufacturing products is an important avenue that should be embraced by the manufacturing sector in an effort to bring down its carbon emission. The argument is that less energy is consumed when operating with recycled materials than when dealing with not-used before raw materials (CSIRO & Griffith University, 2007)

In Kenya, bodies e.g. Kenya Association of Manufacturers (KAM) have come up with a raft of measures aimed at encouraging the use of energy efficient practices among its members in order to bring the costs down. Energy Audit is one such measure adopted by the body. This involves computing the company's current energy consumption, with

the aim of identifying areas where conservation may be applied and energy saving measures introduced (KAM, 2014). The Energy Regulatory Commission is dedicated to tackling the challenge of the high energy costs incurred by industries. They aim to do this by encouraging the players to adopt the measures instituted by the regulation of energy, 2012. This type of measures demands that the companies do audit of the energy after every three years with full implementation of the minimum of fifty percent of the recommendation made in the audit report (ERC, 2014)

Energy is thus being a major factor of production in manufacturing. An increase in industrial production (output) will generally lead to an enhanced in energy consumption; one way the manufacturers can reduce this cost is by embracing energy efficiency measures that will not only enhance their cost saving in terms of energy but also through reduced material wastage, reduce carbon emissions, enhanced productivity due to use efficient machinery and improved overall performance of a firm.

1.2 Statement of the problem

Energy demand is rising at a fast rate due to increased industrialization worldwide. This has led to energy crisis as well as the rapid depletion of energy resources in many countries. Numerous Empirical studies have been conducted on productive and efficient energy usage especially in developing countries. Nicola (2011) conducted a research work concerning the efficiency level in 24 third world countries where she studied the firm-level data to find out among others the link between energy efficiency and profitability in developing countries. (Nicola, 2011) Recent research contributions have concentrated on the advantages of being energy efficient, especially from a macroeconomic viewpoint. Research contribution by Taylor *et al* (2008), Semboya (2004), United Nations Development Program (UNDP, 2006), (McKane *et al*, 2007) and International Energy Agency,(IEA), 2009) recognizes that energy efficiency would lead to among other things : More economic output without requiring additional energy supply at both firm and national level, economic competitiveness (through lower prices) at national and firm-level, creation of jobs, improved living standards, energy supply and environmental sustainability and reduced import bill nationally (Nicola, 2011)

The U.S. agency that aids in the protection of the environment observes that the rising energy costs and the pressure of global competitiveness not only pose continuing challenges for the industrial manufacturing sector but also creates an increasing role in enhancing entrepreneurial competitiveness. Kimuyu (2005) observes that power problems are a major impediment to efficiency and productivity. Clearly, a quest for economic growth correspondingly fans the demand for energy. Interestingly, energy has been singled out as a major cause of inflation as almost every consumed product and service has some energy input (IEA, 2013)

In Kenya, both electricity in the commercial manufacturing sector (Kimuyu, 2005; KIPPRA, 2010; Ministry of Energy, GoK, 2011 & IEA, 2013). The major sources of electricity include hydroelectricity, thermal oil among others(Kimuyu, 2005 & Ministry of Energy, GoK, 2011). The low level of contribution, according to Kimuyu (2005) and the Ministry of Energy, GoK (2011) is attributable to the deteriorating energy infrastructure and the perennial droughts that plague the country. Informed by this empirical literature, this study hypothesizes that renewable sources of energy excluding hydroelectricity offer manufacturers in Kenya better promise for growth since they are less susceptible to weather fluctuation like hydro, or global energy market changes, like is the case with oil (GoK, 2011).

KAM has also conducted a study on lowering energy cost in Kenya where Energy Efficiency technologies such as high, co-generation, high efficient boilers and use of recycled materials were identified as available to manufacturers. Studies have been conducted relating to alternative sources of energy in Kenya e.g. Biomass Energy use in Kenya 2010 (Practical Action) Low carbon competitiveness in Kenya 2013 (Karen *et al*), Lowering Energy costs 2006 (GEFKAM Energy efficiency project) and Energy Consumption patterns in Kenya (KIPPRA, 2010) .

Increase in electricity tariffs poses a great challenge/ risk to Kenya's competitiveness. In the year 2008 for instance, Kenya's electricity tariff was US cents 9.4 per KWh; much higher than South Africa's U.S. cent 6.6 per KWh and Egypt's 3.0 U.S. cents per KWh (KIPPRA, 2010). These two are Kenya's major competitors in trade and service in East and South Africa. India, which is currently experiencing a growth rate of 10%, had very low and competitive tariffs at 5.38 cents per KWh, which is good for industries. It is noteworthy that one of Michael Porter's three generic strategies of

competition is low cost production and a country or industry whose cost of production is high will find achieving competitiveness an uphill task. To enhance competition of Kenyan goods in the global market, manufacturers in Kenya must adopt energy efficient methods.

1.3 Purpose of the study

The main goal of this research work was to make a determination of the major factors that are affecting full implementation of energy conservation in the manufacturing firms in Nairobi County, Kenya.

1.4 Objectives of the study.

i. To determine the human factors influencing the implementation of energy conservation programs in the manufacturing firms in Nairobi County.

ii. To access the environmental factors influencing the programs of conserving energy and its implementation sttrategy in the manufacturing firms in Nairobi County.

iii. To determine the technology factors influencing the implementation of energy conservation programs in the manufacturing firms in Nairobi County.

iv. To ascertain the influence of organization factors on the implementation of energy conservation programs in the manufacturing firms in Nairobi County.

1.5 Research Questions.

i. What are the human factors influencing the programs of energy conservation and implementation in the manufacturing firms in Nairobi County?

ii. How do environmental factors influence the energy conservation programs and implementation strategies in the manufacturing firms in Nairobi County?

iii. What technology factors influence the implementation of energy conservation programs in the manufacturing firms in Nairobi County?

iv. What are the factors in the firm that affect implementation of energy conservation programs in the manufacturing firms in Nairobi County?

1.6 Significance of the study

The outcomes would inform the formulation of policy framework for use by the government on Energy conservation or energy efficient measures for use by the manufacturing industry. The study findings may also help to inform the private sector in adopting energy efficient measures and thereby reduce costs on power thus lowering the cost of production of goods and increasing their competitiveness in the market.
The results will be of importance to the researchers as it will provide a basis for further studies in energy conservation.

1.7 Delimitation of the study

This research work was delimited to the determinants of the implementation of energy conservation in the manufacturing firms in Nairobi County. It was also delimited to the sample size of respondents who were 84 employees comprising of the operations manager, human resource manager and utilities/facilities technician from every firm. The firms under study are 28 out of 55 who have undertaken energy audits in Nairobi County.

1.8 Limitations of the study

Lack of commitment among the respondents to offer required information due to knowledge gaps in energy conservation. The respondents also took a lot of time to fill the questionnaires due to inadequate and unavailability of data records in their firms. The researcher made advance appointments with the respondents to assist and verify data based on their current consumption, where records were missing and also offered technical support to bridge the gaps. To address the concern of time and distance, the researcher sent some of the questionnaires using e-mails especially to the human resources managers who had tight schedules of preferred e-mail as opposed hardcopies.

1.9 Assumptions of the study

The scholar made an assumption that the research and their correspondents will be energy conversant hence they have information of the methodologies being used to

conserve energy in the companies. They also made assumption that all the interviewee will be very honest when giving their answers.

1.10 Definition of Significant Terms

Human factors:

These are the human behavior and habits in relation to energy conservation.

Environmental Factors:

Basically environmental factors are the various ways of protecting the air and preventing climate change. Perhaps the most notable way is by decreasing industrial plant emissions by using energy efficient technologies and embracing environmental management systems.

Technology Factors:

The adoption of energy efficient equipment in the manufacturing processes that help in energy conservation.

Organization Factors:

The efforts made by the management to foster the culture of energy conservation within the organization.

These also include the approaches taken by the management to reward the employees who come up with energy conservation initiatives.

Energy efficiency:

The efficiency of energy is the ratio existing between the services provided by energy to the input of the energy. This basically means optimally out of the produced or even consumed energy.

1.11 Organization of the Study

The research work was organised mainly in five sections. The First section consists of historical study, problem statement, the main goal of the study, objectives, significance and proper definition of the crucial terms. The second chapter consists of a review of pertinent literature in relation to the topic of the research. The chapter also entails theoretical foundations and their subsequent interactions, a conceptual framework and summary of knowledge gaps. Chapter Three constitutes design of research, targeted population, procedure of sampling, description of instruments of research work, reliance and the validity of the data obtained, methods of data analysis and ethical

considerations. Chapter Four consists of the analysis of data, presentation, interpretation and discussions while the last chapter is made up of summarised finding, the conclusion as well as proper recommendation.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This section presents the previous research work that has been conducted on energy efficiency/conservation. The chapter is hence broken down into the concept of energy efficiency, environmental factors, human factors, technological factors and the conceptual framework.

2.2 Implementation of energy conservation programs

At the policy level, conservation of energy is prioritized in Kenya and in many other countries. It is seen as the cheapest and best route to addressing energy security and the attendant social and economic repercussions of high energy prices and concerns about climate change. For instance in Ethiopia, Egypt and Uganda electricity costs are US cents 3/KWh, 5/KWh and 18.6/KWh respectively. Tanzania had their tariff reviewed recently to US cents 4/KWh from 9/ KWh compared to Kenya's current cost of US cents 18.7/KWh. (KAM, 2014). Development projects recommended under vision 2030 will increase demand for power. The government has shown its commitment to increase the power generation in the country and has promised a total generation of 5000MW by year 2017. The 2014-2015 budget has provided for Ksh. 10 billion for geothermal power generation development (International Energy Agency, (IEA).

Energy efficient usage will be a key instrument in the social-economic development of Kenya through improving competition in the economy, reducing the import bill of the country, improving the trade of balance, creation of job, improving security of energy supply among others.

2.3 Human Factors influencing implementation of energy conservation programs.

Human conduct is in not necessarily the main part of energy efficiency; however, it is essential. It requires an attention on innovation as well as the practices which surround the choice of innovation, operation and execution. It needs the equipment adjustments and practices of its human administrators. One may buy the best performing, most recent, costly apparatus, however this venture comes to nothing if administrators don't

give careful consideration, are informed, as well as have the knowhow to run it appropriately. Given the common habits of apparatus administrators, it is important to endeavor to ensure change of conduct (Sagar, 2013). Du Plessis (2014) calls attention to the fact that, 'Conduct is the key stage on which you have energy building and saving. The minute you fail to consider the controls, the system will return to its earlier wasteful methods of working.

Social standards and administration involvement are often quoted as a fundamental contribution to acknowledging behavior adjustment. These elements and the related impact may show the existence of social standards, that has been exhibited to spur and provide guidance' (Schultz *et al.* 2007). Social standards were seen before the particular management of the energy mediation and added to implementation level. All that notwithstanding some number of employees beforehand turning light off when one is leaving the house, standards for the work environment were triggered to initiate energy efficiency. Social standards in this sense may be fundamental in ownership levels, which can be cultivated through decentralized administration structures (e.g. those utilized as a part of the usage of energy conservation). Ownership relates to physical issues, as well as to the objectives of an association (Pierce *et al*. 2001).

There are indicators to demonstrate that when the 'green' choice is settled on the default decision, it is chosen all the more regularly (Pichert, 2007). There are, in any case, two sides of the default coin: one that induces efficiency, and one that presents routine hindrances to energy efficiency take-up. Defaults and the present state of affairs should hence be challenged before they can end up with positive establishments whereupon to build practices. New opportunities for the improvement of social standards should be recognized, conveyed, supported, and compensated through positive feedback (e.g. open praise, money related reward). This ought to be sought after in a progressive design to abstain from tolerating existing increases as adequate, or worse, to show lack of concern and add to rebound effects. This has tested default decisions to recognize vitality squandering rehearses. A hindrance to energy efficiency in this and numerous different settings is the norm predisposition, or the reluctance to roll out improvements to the present circumstance (Samuelson/Zeckhauser 2008). This intervention included 'challenging and questioning everything'. AMSW operationalized this by evaluating 'presumptions and changing operational standards and procedures.' This required

looking at generation forms at a small-scale level to recognize open doors for vitality sparing. For instance, it was found that a 250-kW pump could be turned off given that the staying four were upgraded as far as stream and weight. This change brought about yearly funds of ZAR 1.1 million (Ottermann 2014). Behavior change requires steady observing to ceaselessly challenge status quo bias (Frost 2014).

2.4 Environmental Factors influencing implementation of energy conservation programs

Lately, organizations have been confronted with pressure that is great from their partners to help in the actualisation of the management. The firms in the manufacturing sector have influenced especially emphatically on the grounds that by using exercises of production they are essentially polluters. In these conditions, nevertheless, there is a trade-off system in an organization's economic as well as environmental practices, since private ecological costs and immediate hiking of prices and thereby reducing competitiveness (Backlund *et al*, 2012).

Noteworthy a lot of efforts has been undertaken to make test of the connection between ecological administration practices and business practically. For instance, the subject of various inquiries about were whether the connection between the usage of the technologies for energy reduction and improved performance of the companies are either negative or positive. However, no agreement has been achieved (Blomberg *et al*. 2012).

The primary challenge in making clear inferences lies not just in the mixed outcomes from various research yet in addition the way that researchers utilize distinctive definitions/measures of business and environmental. Various studies tested the connection between natural practices and the performance of the business was divided into two: studies that connect environmental factors to enhanced economic performance and studies that connect environmental factors to negative financial performance or give no proof of improvement (Croucher, 2012).

Numerous researchers contend that there is no particular single, direct connection between proactive management of the environment and performance of the organization. The firm assets most straightforwardly connected with proactive ecological administration and the impact that environmental management and financial performance have an upper hand on business performance. Firms that diminish emissions can expand their economic performance through an expanded demand in improved efficiency. For instance, the adoption of environmental guidelines, for example, ISO 14001 enhances producers' productivity in the design and textiles

enterprises over a three-year time span as measured by return-on-resources (ROA) (Bunse *et. al*, 2011).

Low cost cleaner production exercises, for example, enhancing employee environmental awareness, enhancing working conditions to diminish waste, strict compliance with standards for cleaner production, or expanding the recyclability of items, make a greater commitment to economic performance than the high-cost exercises, for example, utilizing energy efficient and clean innovations or utilizing inexhaustible assets as raw materials. The latter require noteworthy monetary investment however it may not bring about quick financial returns. The low cost production exercises don't require noteworthy financial investment yet may bring quick financial advantages (Kew *et al*, 2008) On the other hand, the utilization of energy and material saving technologies does not have a direct association with financial performance.

2.5 Technology Factors influencing implementation of energy conservation programs.

Alleviating environmental change and attaining the desired level of the concentration of the greenhouse gases - the target of the (UNFCCC), will require profound decreases in worldwide Carbon Dioxide releases that are associated with Energy. G-8 pioneers required a half decrease in such releases by 2050 to keep away from the most hazardous outcomes of change in climate. Achieving this objective requires changing the methods of energy production, conveyance and use over all parts of the economy and locations in the entire world. Such efficiency in energy production offers guarantees in savings for purchasers and utilizers, returns for investors, higher volumes of goods produced by industries worldwide and diminished undesirable environmental effects. As worldwide energy demand keeps on going up, activities to raise efficiency in energy will be fundamental. The open doors are many and potential cost reduction real, however shoppers and utilities have so far been laid back in putting resources into the most cost effective, energy efficient innovations accessible (UNFCCC, 2015).

The energy efficiency of structures, electric appliances, and equipment being used misses the point with regard to what is in fact feasible. Energy analysts have credited this proficiency gap to an assortment of market, institutional and technical constraints. Energy efficiency procedures can possibly narrow this gap and accomplish noteworthy savings. Electric motors used all through all industrial branches, however the fundamental applications vary. With just a few special cases, electric motors are the primary providers of mechanical energy in industry. Lately, a lot of research has distinguished expansive energy saving possibilities in electric motors and systems with a variety of opportunities of making savings with a very short time of recovering the investment and cost-effectiveness. Moreover, all power in India is created by rotating electrical generators, and roughly 50% of that produced is spent on driving electrical motors (UNFCCC, 2015). Subsequently, efficiency changes with machines that use electricity can have a huge effect on energy utilization. The key difficulties to expanded efficiency in frameworks that are driven by electrical machines lie in three regions: to begin with, to broaden the use of the variable-speed drives through reducing of energy electronic and control costs also, to incorporate the driven load to augment framework proficiency lastly, to improve the effectiveness of the machine. Lighting is a vast and quickly developing area that is consuming a lot of power. Meanwhile, the saved funds from such investment is sizeable even before better innovation is available, and also new lighting innovations that save energy. At present, more than 33 billion bulbs work around the world, devouring more than 2650 KWh of energy every year, which is roughly 19% of the worldwide power use. The onset of more energy efficient lighting items and strategies can in the meantime give better living and workplaces and furthermore contribute in a low cost way to the worldwide reduction in power use and reduce emissions (UNFCCC, 2015).

2.6 Organizational factors influencing implementation of energy conservation programs

There are two key elements by which efficient energy activities start in organizations: top-down and bottom up. Both approaches share the perception that new activities dependably begin with the activities of people. The best activities however exhibit components of both approaches. In top-down approaches, administration, usually the CEO or another senior official, chooses to make a key shift in the way the organization

gets value from energy that would otherwise be wasted. This regularly prompts interests in investment in the mutual resources or the creation of new organization policies. Top-down activities can possibly make huge leaps for change through the activities of one or just a couple of key decision makers. The organizational change scholars have however argued that without successfully captivating the worker base to take responsibility for activities rapidly, they can lose that underlying impetus and fail to come up with enduring improvements (Kotter, 2006; Senge *et al*. 2009).

In bottom up approaches, the first activity is driven by workers themselves, for instance office administrators, office laborers, or another gathering of energy users who compose keeping in mind the end goal to impact change specifically. Such endeavors have the benefit of early eagerness and engagement, however will in the long run fail on the chance that they are not taken up for consideration by leaders with the ability to finance them specialist to give assets expected to scale and maintain those activities. How at that point do successful associations guarantee that EE activities whether they are driven from the top or bottom keep on operating effectively and accomplish performance changes? The key is to guarantee that the activities of people inside the organization serve to support each other over time. In particular, the inspirations of the highest level leaders need to be converted into providing resources that help and reward the workers to recognize and execute the project. The projects need to convert into quantifiable successes that obviously enhance the performance of the organization and approve the choices made by the leaders.

The virtuous cycle is a generative instrument for high energy performance. Official engagement empowers investment in resources (i.e., cash and time) for EE endeavors. Those assets empowers individuals and tools all throughout the association to recognize and enumerate prospects for EE, and to actualize projects whose outcome is financial and environmental wins. At the point when the outcomes and stories are evaluated, spun into a convincing story of progress, and promoted, official engagement goes higher further. Strengthening feedback loops (denoted by the "R") can produce exponential development or rot. For this situation, the virtuous cycle, left unobstructed, can produce exponential development in energy performance.

Since it is a circle, it can begin anywhere, yet we think that it is most valuable to consider official engagement or individuals and instruments as the beginning stages since activities begin with the actions of individuals. The test of organizational Energy proficiency endeavors is that development in performance is compelled by an arrangement of limited "stocks" of accessible opportunities, data transmission, consideration, spending plan, and ability. As these run out, development is hindered. The outcome is an arrangement of negative feedback loops that hinder the development of proficiency activities. For instance, an association that starts the virtuous cycle may recognize and execute different quick win projects in the initial couple of years.

After some time the supply of accessible quick win openings will lessen, diminishing the quantity of projects the organization can actualize. Less implementation implies less outcomes and stories and the virtuous cycle slows. As an analogy, the strengthening loop can be viewed as a sort of flywheel, turning up and conveying the force of the association, while the balancing loop resembles brakes connected to the flywheel. Senge *et al*, (1999), whose study discovered a comparable cluster of restricting flow for endeavors at organizational learning and change. While there are numerous limitations that may restrict organizations' energy management achievement, our perceptions have discovered these five constrained opportunities: chances, transmission capacity, consideration, spending plan, and ability—to be the most inescapable hindrances to this prudent cycle. The way to setting in motion the virtuous cycle is to defeat these imperatives by creating practices, approaches, and instruments that serve to extend or recharge the restricted stocks being released.

2.7 Theoretical framework

This theory makes an introduction and description of the theories that explain the reason behind the problem of research under the investigation. The research work was guided by the following theoretical frameworks.

The Rebound Effect

The best methodology that many analyses has been able to exam the impact about a changes made to bring about energy efficiency and afterward analyse the accomplished

decreases in energy use to those planned with no user and market reactions to the improvement.

Such market wide and the consumer reactions are probably going to happen in light of the fact that the improvement itself brings about changes in related costs (and, in this case, the income). The consequential impact is communicated as the fraction of the forecasted decrease in energy utilization that is 'lost' because of the totality of the customer and market reactions. For example, consider an air cooling system with yearly power utilization of 100 kWh/year. Assume a more efficient system helped save 10 kWh/year off this aggregate before taking into account the consumer and market responses. If such market reactions raised energy use by 1kWh/year, at that point the rebound effect would be equivalent to 10 percent that is 1 of the 10 kWh every year in expected energy investment funds would be "reclaimed" because of the purchaser and market reactions.

The 'direct rebound effect' is for the most part characterized as the adjustment in energy utilization coming about because of the joined income effect for the energy efficient items (Blomberg, Henriksson & Lundmark, 2012). This definition is helpful on the grounds that economists normally appraise elasticity of demand, which can be effectively changed into a direct rebound effect.

2.8 Conceptual framework.

The independent variables are human factors, environmental conservation factors, technology factors and organizational factors, while implementation of energy conservation is the dependent variable.

Independent Variables **Dependent Variable**

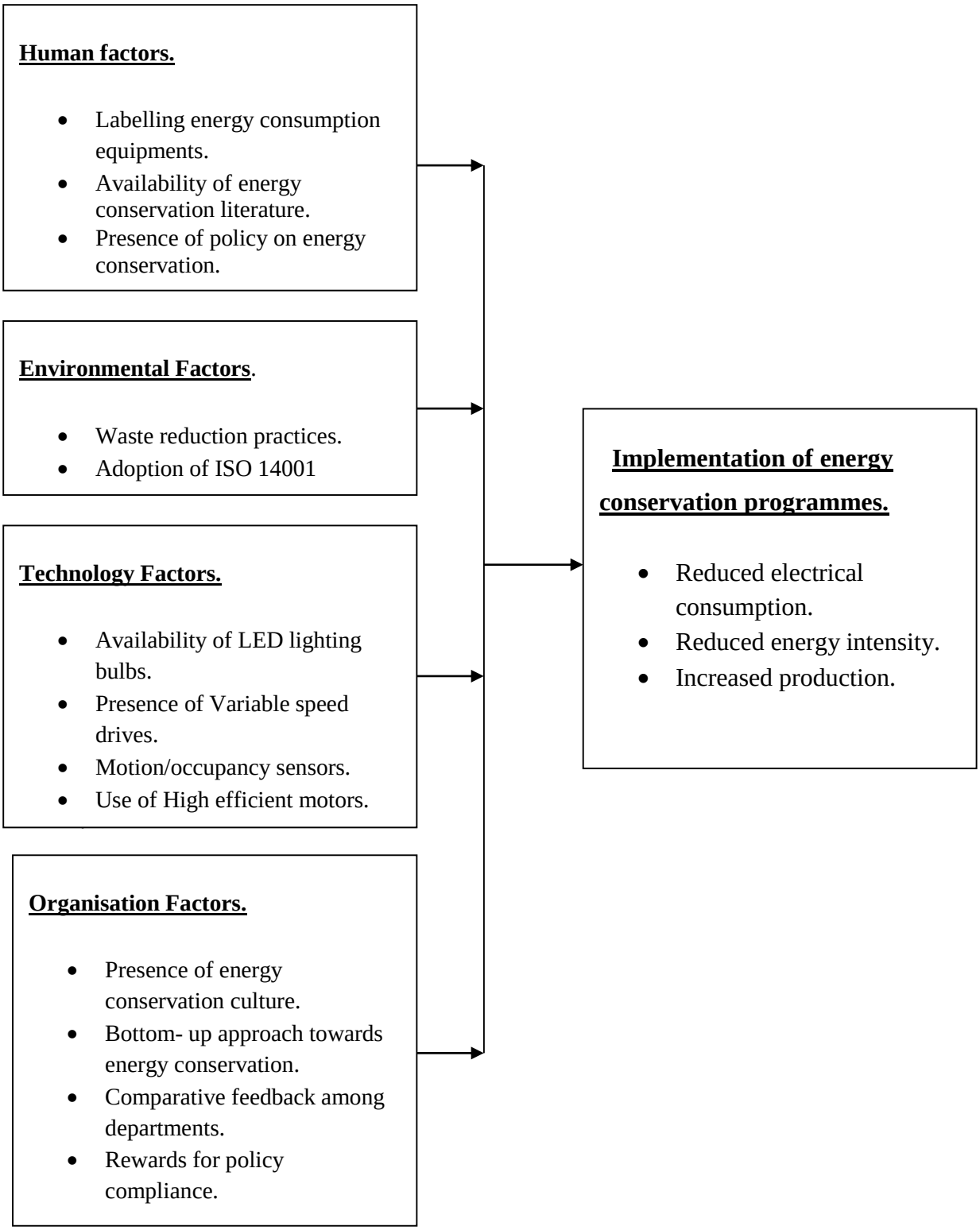

Figure 2.1 Conceptual Framework

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction

The section makes a coverage of the methods applied in the research work. It contains the design of the research, the population targeted, the technique of the sampling and its size, the research piloting, instrumental validity, the level of reliance of the instruments, methods of collecting data, analysis and consideration in the ethical considerations.

3.2 Research Design

The scholarly work employed a descriptive design of research which expresses the situation as it is. This kind of study tries to explain things such as characteristics, values, possible behaviour and attitudes (Kothari, 2004).

3.3 Target Population

The research population targeted was the 55 manufacturing firms in Nairobi County which have conducted energy audits as listed by Kenya Association of Manufacturers (KAM). The population comprised 3 respondents from each firm that is the human resources manager, operations manager and facilities/utilities technicians giving a total of 165.

3.4 Sample size and sampling procedure

The research work used a purposive sampling design since the sample consisted of a predefined group of firms that had conducted energy audits. Data was collected from 28 firms out of the 55 which is 50% of the firms with a total of 84 respondents. The size of the sample was determined according to Kothari (2004) which states that 10% is a good representation of the whole research. Questionnaires were issued to the operations manager, human resource manager and utilities/facilities technicians in each firm, giving a total of 84 questionnaires.

3.5 Data Collection

The research work relied on secondary data sources that had been documented by KAM and from financial reports of the firms under studied. Secondary sources are more cost effective as they provide more detailed data suitable for this study. Data on energy efficiency conservation measures, energy consumption pattern and energy savings by the different firms was collected from different reports by KAM including their Energy Management Awards Assessment tools. The collection of the primary data used structured questionnaires. They were directed to the factory managers or operation managers or their representatives for each target entity. Many questionnaires were given using the email address as well as drop and pick later methodologies.

3.5.1 Pilot testing of the instrument

This enable validating of the questionnaire (Alan & Emma, 2011). The questionnaires were administered to 3 manufacturing firms, which was 10% of the total sample size. The respondents were; operations managers, human resource managers and technicians of the firms. The selected individuals for piloting responded to the items in the questionnaires. Piloting establishes whether the instrument will measure the construct adequately; establish if respondents will find the items easy to respond to. The respondents in the piloting exercise were not included the main research.

3.5.2 Validity of the instruments

Instruments validity involves establishing whether the data collection instruments measure what they are intended to. The instruments of the research were availed to peers to make sure that all items were adequately representative of the study subject.

3.5.3 Reliability of the instruments

The level of the reliability refers to the tools of research that gives a consistent result when used a number of times (Mugenda, 2008). The researcher used the the method of the split half. The test was first divided into halves and administered to the total respondents in the pilot study and scored separately. The scores of one half of test were then compared to the scores of the remaining half (Kaplan & Saccuzzo, 2001).

Cronbach Alpha α of at least 0.7 the full items under the investigation. The questionnaire had a reliability of 0.717 therefore it was reliable for data collection.

3.6 Data collection procedure

Drop and pick later method was adopted with a time lapse of one week (Schindler, 2003).

3.7 Data Analysis

Data analysis was done after clean up, reduction, differentiation and explanation. All data was keyed using SPSS version 22.0. The resultant information was analysed by employing the quantitative approach entailing both descriptive and inferential statistical procedures whose results were presented in percentages, frequencies and cross tabulations.

The following multiple regression model was used

$$\mathbf{Y = \alpha + \beta 0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon}$$

Where; Y = Implementation of energy conservation programs

X_1 = Human factors

X_2 = Technology factors

X_3 = Environmental factors

X_4 = Organizational factors

ε= Error term

β=Coefficient

α= Constant

the analysis of regression was useful to test the association existing between the factors and implementation of energy conservation programs. The factors (human factors, technology, environmental and organizational factors) were the independent variables while implementation of energy conservation programs was the dependent variable.

3.8 Ethical considerations

In this study, ethical considerations were made on the basis of the basic aspects of considerations in social science research. (Oliver, 2008). First and foremost, the researcher obtained research authority from the University of Nairobi to do a study. Approval was also required from the management of companies where data collection was conducted.

Secondly, the researcher wrote an introductory letter to inform respondents in the research process that the research was purely for academic purposes. The respondents were further assured that the information they gave would be treated with utmost confidentiality. Respondents were further requested not to indicate their names.

3.9 Operationalization of variables

This section deals with how the variables were measured in the study. This study had four autonomous variables and one dependent variable which were measured as shown on Table 3.1

Table 3.1: Operationalization of variables

Objective	Variable	Indicators	Measurement Scale	Measurement Tool
To make a determination of the impact of factors related to human on energy conservation.	Independent Human factors	• Labelling of equipment • Availability literature	• **Interval** • **Nominal** • **Ordinal**	-Descriptive statistics -Inferential statistics
To establish the influence of environmental factors on the implementation of energy conservation	Independent Environmental factors	• Waste reduction practices • Adoption of ISO 14001	• **Interval** • **Nominal** • **Ordinal**	Descriptive statistics; Mean and standard deviation
To establish the influence of technology factors on the implementation of energy conservation	Independent Technology factors	• Availability of energy efficient technologies e.g. LED lighting bulbs, variable speed drives	• **Interval** • **Nominal** • **Ordinal**	Measures of Central tendencies; Mean Inferential statistics
To establish the influence of organizational factors on implementation of energy conservation	Independent Organizational factors	• Culture e.g. bottom-up approach • Feedback mechanisms • Rewards	• **Interval** • **Nominal** • **Ordinal**	Descriptive statistics; Mean and standard deviation
Implementation of energy conservation programs	Dependent Implementation of energy conservation programs	• Reduced electrical consumption • Reduced energy intensity • Increased production	• **Interval** • **Nominal** • **Ordinal**	Mean Inferential statistics

CHAPTER FOUR
DATA ANALYSIS, PRESENTATION AND INTERPRETATION

4.1 Introduction

This particular section presents the scrutiny of data and its verdicts, presentation and the research discussion. The results on the factors that impacts the implementation of energy conservation in the manufacturing firms in Nairobi County were presented.

4.2 Questionnaire Response Rate

The researcher singled out 3 personnel from 28 firms, who included the operations manager, human resource manager and utilities/facilities technicians in each firm. However, only personnel from 22 firms responded and provided complete data, thereby giving a total of 66 questionnaires. This gave the study a response rate of 78.5%. This was adequate for reporting and concurs with Kothari (2004) says that the fifty percent response was very sufficient, the 70% response was deemed to be very good.

4.3 Demographic Information

The research work was meant to ascertain the age, gender, highest educational capacity and age the respondents worked in the firm. This was done to find out whether respondents were suitable for responding concerning factors affecting energy conservation implementation programs in selected manufacturing firms in the county of Nairobi.

4.3.1 Gender Distribution of Respondents

The research work endeavoured the response gender as well as its reslts were as shown on Table 4.1.

Table 4.1 Gender Distribution of Respondents

Gender	Frequency	Percentage (%)
Male	43	66

Female	23	34
Total	**66**	**100**

From Table 4.1, majority (66%) of the respondents were male while 34% were female. This showed that there was gender disparity among the staff working in the various manufacturing firms.

4.3.2 Age of the Respondents

The research work endeavoured to make an establishment of the research findings. The findings were as shown on Table 4.2.

Table 4.2 : Age of the Respondents

Gender	Frequency	Percentage (%)
Under 35 years	6	9
36-40 years	12	18
41-44 years	24	36
45-50 years	15	23
Over 51 years	9	14
Total	**66**	**100**

From Table 4.2, 36% of the respondents age was between 41-44 years, 23% were aged between 45-50 years, 18% were aged above 35-40 years, 14% were aged above 51 while 9% of the age of the respondents were under 35 years. This predicted that all respondents were adults and as such were suited to respond on the factors affecting the energy conservation implementation in the manufacturing firms in Nairobi County.

4.3.3 Highest Level of Education

The research work was meant to make an establishment of the education level of the respondents. The findings were as shown on Table 4.3.

Table 4.3 Highest Level of Education

Gender	Frequency	Percentage (%)
Bachelor's Degree	38	57
Master's Degree	14	21

Higher National Diploma	11	16
Ph.D	4	6
Total	**66**	**100**

From Table 4.3, 57% of the respondents had a Bachelor's degree, 21% had a Master's degree, 16% had a Higher National Diploma while 6% had Ph.Ds. This depicted that all the respondents had the requisite knowledge on energy conservation matters and as such were knowledgeable enough to fully appreciate the factors affecting implementation of energy conservation in the manufacturing firms in Nairobi County.

4.3.4 Number of Years worked in the Firm

The research work was meant to establish the Respondents' number of years worked in their firms. The results were as illustrated on Table 4.4.

Table 4.4 Number of Years worked in the Firm

Gender	**Frequency**	**Percentage (%)**
Less than 2 years	4	6
2-5 years	9	14
6-10 years	15	22
11 years and above	38	58
Total	**66**	**100**

The study found that majority (58%) had worked for more than 11years, 22% had worked for 6-10 years, 14% had worked for 2-5 years while 6% had less than two years of working experience. This implied that majority of the workers had worked long enough and had gathered the necessary experience thus they were suitable respondents for the study.

4.4 Human Factors Influencing Energy Conservation

The research work meant to determine the impact of human factors on energy conservation. The findings were as discussed in the following sub-headings.

4.4.1 Extent of influence of human factors on energy conservation

The study meant to research the level to which factors of human influenced energy conservation. The research results discovered that majority (57.7%) of the respondents indicated that human factors influenced energy conservation to a moderate extent, 23.1% to a great extent, 9.3% to a very great extent, 7.4 % to less extent while 2.5% indicated that human factors did not influence energy conservation at all. This implied that human factors, which are usually human behavior and habits, contributed a great deal towards energy conservation and therefore any effort to improve on them would greatly conserve energy.

4.4.2 Agreement with statements on the influence of Human Factors on Energy Conservation

To identify the impact of Human Factors on Energy Conservation, the respondents were required to show their agreement with certain statements. The SPSS was applied to generate both mean and the standard deviation and were as shown in Table 4.5.

Table 4.5 Agreement with statements relating to Human Factors and Energy Conservation

Statement	Mean	Std. Dev
There is well labelled energy efficient equipment in the firm	4.472	.1347
I switch off the lights when I leave a room.	3.416	.8260
There is enough literature on importance of energy conservation in our firm	3.979	.1818
There are frequent seminars on the importance of energy conservation in our firm	3.023	.9132
Sense of ownership enhances energy efficiency	3.963	.2458

The study findings indicated that there was well labelled energy efficient equipment in the firm (Mean 4.472), there was enough literature on importance of energy conservation in our firm (Mean 3.979), sense of ownership enhances energy efficiency (Mean 3.963), I switch off the lights when I leave a room (Mean 3.416), there are

frequent seminars on the importance of energy conservation in our firm (Mean 3.023) respectively.

These findings indicated that the staff in the various manufacturing firms agreed that human factors as a key to energy conservation in the following ways; well labelled energy efficient equipment in the firm, enough literature on importance of energy conservation, sense of ownership enhances energy efficiency, switching off the lights when leaving a room and frequent seminars on importance of energy conservation.

The findings agree with Schultz *et al*. (2007) who posit that social standards and administration involvement are often quoted as a fundamental contribution to acknowledging behavior adjustment. These elements and related effects may show the existence of social standards. Social standards in this sense may be fundamental in ownership levels, which can be cultivated through decentralized administration structures (e.g. those utilized as a part of the usage of energy conservation). Ownership relates to physical issues, as well as to the objectives of an association (Pierce *et al*. 2001).

4.5 Environmental Factors influencing Energy Conservation

The study endeavoured to establish the influence of environmental factors on energy conservation. The findings were as discussed in the following sub-headings.

4.5.1 Extent of influence of Environmental factors on energy conservation

The research meant to identify the influencing factors of environmental factors on energy conservation. The outcome of the research discovered that majority 61% of the respondents indicated that the environmental factors influenced energy conservation to a moderate extent, 13% to a less extent, 12% to a great extent, 11% to a very great extent and 3% to no extent. This implied that majority agreed on the extent to which environmental factors influenced energy conservation. This concurs with Backlund *et al*, (2012) who posits that lately, organizations have been confronted with a lot of pressure emanating from the management of the environment. The firms in the manufacturing industry have received a big influence concerning their exercise of

production especially the polluters. In many condition there is existence of the trade-off that promote economic activities and its performance hence increase I the economic conditions in the country. (Backlund *et al*, 2012).

4.5.2 Agreement with statements on influence of Environmental factors on energy conservation

To identify the impact of Human Factors and Energy Conservation, the respondents were required to show their agreement with certain statements. The both standard deviation and the mean were generated by using the and were as shown in Table 4.6.

Table 4.6: Environmental Factors and Energy Conservation

Statement	Mean	Std. Dev
There is an environmental management system (EMS) in our firm	4.079	.1818
Waste water is recycled in our firm	3.523	.9132
Our firm has acquired ISO 14001 certification	4.963	.2458
We use natural lighting during the day in our firm	4.460	.5024
There is a clear waste disposal mechanism in place in our firm	4.381	.7710
ISO 14001 certification has enhanced energy conservation in our firm	3.454	.7613

The study findings indicated that firms had acquired ISO 14001 certification (Mean 4.963), they used natural lighting during the day in their firms (Mean 4.460), there is an environmental management system (EMS) in our firm (Mean 4.079), there was a clear waste disposal mechanism in place in the firms (Mean 4.381), waste water is recycled in our firm (Mean 3.523) and ISO 14001 certification has enhanced energy conservation in our firm (Mean 3.454) respectively. This implied that environmental factors affected energy conservation in the following ways: firms had acquired ISO 14001 certification, firms used natural lighting during the day, there was an environmental management system (EMS) in the firms, there was a clear waste disposal mechanism, waste water was recycled and there was ISO 14001 certification which had enhanced energy conservation.

These findings concur with (Bunse *et. al*, 2011) who argue that energy conservation to a great extent is related to the environmental policy.

4.6 Technology Factors influencing Energy Conservation

The study sought to establish the influence of technology factors on energy conservation. The findings were as discussed in the following sub-headings.

4.6.1 Extent of influence of Technology factors on energy conservation

The study sought to find out the extent of influence of technology factors on energy conservation. The results of the study discovered that majority (52%) of the respondents indicated that technology factors influenced energy conservation to a moderate extent, 17% to a less extent, 13% to a great extent, 12% to a very great extent and 6% to no extent. This implied that majority of the respondents agreed that environmental factors influenced energy conservation.

This is supported by the UNFCCC (2014) which argues that the world will require profound decreases in worldwide Carbon Dioxide releases that are associated with Energy. G-8 pioneers required a half decrease in such releases by 2050 to keep away from the most hazardous outcomes of change in climate. Achieving this objective requires changing the methods of energy production, conveyance and use over all parts of the economy and locations in the entire world. Such efficiency in energy production offers guarantees in savings for purchasers and utilizers, returns for investors, higher volumes of goods produced by industries worldwide and diminished undesirable environmental effects.

4.6.2 Presence/Absence of observable energy efficient technologies

The research work was meant to establish whether the companies had embraced energy saving technologies. The following were the findings as shown on Table 4.7.

Table 4.7: Presence/Absence of observable energy efficient technologies

Extent	Frequency	Percentage (%)
Yes	60	91
No	6	9
Total	**66**	**100**

From Table 4.10, majority of the respondents (91%) indicated that there were observable energy efficient technologies in their firms while 9% indicated that there were no such technologies in their firms. This implied that the various manufacturing firms had deployed technologies that were aimed at conservation of energy. This is supported by UNFCCC (2015) who posit that investment in green energy offers apparently sparkling guarantees to all-savings for purchasers and utilities, returns for investors, improvements in industrial productivity worldwide competitiveness and diminished environmental effects.

4.6.3 Agreement with statements on influence of Technology Factors on Energy Conservation

To establish the effect of the technical and conservation of energy factors on the economy information was generated using statistical software known as illustrated on Table 4.8.

Table 4.8: Agreement with statements on Technology Factors and Energy Conservation

Statement	Mean	Std. Dev
There are variable speed drives in our firm	4.321	.8630
There are air-con savers in use in our firm	4.714	.7868
There is LED lighting in our firm	4.357	.3393
There are energy efficient motors in our firm	3.957	.3393
Use of modern technologies has enhanced energy conservation	4.464	.6373
The use of electric lighting is optimised in our firm	3.963	.2458
All stakeholders in this firm understand the importance of using efficient lighting	4.460	.5024
Use of energy efficiency technologies has reduced energy consumption in the firm.	4.521	.6373

The study findings indicated that there were air-con savers in use in our firm (Mean 4.714), Use of energy efficiency technologies has reduced energy consumption in the firm (4.521) use of modern Technology had enhanced energy conservation (Mean 4.464), all stakeholders in this firm understand the importance of using efficient lighting (Mean 4.460), there is LED lighting in our firm (4.357), there are variable speed drives in our firm (4.321), the use of electric lighting is optimised in our firm (3.963) and there are energy efficient motors in our firm (3.957).

4.7 Organization Factors Influencing Energy Conservation

The study sought to establish the influence of organization factors on energy conservation. The findings were as discussed in the following sub-headings.

4.7.1 Extent of influence of Organizational factors on energy conservation

The study sought to find out the extent of influence of organizational factors on energy conservation. The results of the study discovered that majority (71%) of the respondents indicated that the organizational factors influenced energy conservation to a moderate extent, 14% to a less extent, 9% to a great extent, 5% to no extent and 3% to a very great extent. This implied that organizational factors influenced energy

conservation. This is supported by Kotter, (2006) who avers that the most effective initiatives demonstrate elements of top-bottom and bottom-up approaches in organizations. In top-down approaches, administration, usually the CEO or another senior official, chooses to make a key shift in the way the organization gets value from energy that would otherwise be wasted. This regularly prompts interests in investment in the mutual resources or the creation of new organization policies

4.7.2 Agreement with statements on influence of Organizational factors on energy conservation

To identify the impact of Organization Factors on Energy Conservation, the respondents were required to show their level of agreement with certain statements. The responses were rated on a 5-point Likert scale where: 5 - Strongly Agree, 4 - Agree, 3 - Neutral, 2 – Disagree and 1 - Strongly Disagree. The mean and standard deviations were generated from SPSS and were as shown on Table 4.9.

Table 4.9: Organization Factors and Energy Conservation

Statement	Mean	Std. Dev
We have an energy conservation culture in our firm	4.634	.4853
There is a bottom–up approach towards energy conservation in our firm	4.254	.7177
Only the management can initiate conservation measures in the firm	1.685	.0116
There is comparative feedback on energy conservation among departments in our firm	4.912	.4853
There are rewards for policy compliance in our firm	4.736	.7177

The study findings indicated that there was comparative feedback on energy conservation among departments in our firm (4.912), there are rewards for policy compliance in our firm (4.736), we have an energy conservation culture in our firm (4.634), there is a bottom–up approach towards energy conservation in our firm (4.254) and only the management can initiate conservation measures in the firm (1.685) respectively.

4.8 Inferential statistics

The research paper made use of multiple regression analysis to establish the importance of each and every variable in respect to the conservation of energy in manufacturing firms. Findings are as presented in the following tables;

Table 4.10: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	. 918[a]	.843	.805	.51038

a. Predictors: (Constant), Human factors, Technology factors, Environmental factors, and Organizational factors
b. Dependent Variable: Energy Conservation

The four independent variables that were studied, explain 84.3% of variance in energy conservation as represented by the R^2. This therefore means that other factors not studied in this research contributed 15.7% of variance in the dependent variable.

Table 4.11: ANOVA (Analysis of Variance)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.214	4	.114	11.833	.000[a]
	Residual	5.045	62	.200		
	Total	6.259	66			

a. Predictors: (Constant), Human factors, Technology factors, Environmental factors, and Organizational factors
b. Dependent Variable: Energy Conservation

The significance value is .000 which is less that 0.05 thus the model is statistically significant in predicting how Human, Technology, Environmental and Organizational factors affect Energy Conservation. The F critical at 5% level of significance was 3.23. Since F calculated is greater than the F critical (value = 11.833), the overall model was significant.

Table 4.12: Multiple Regression Analysis

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta	B	
(Constant)	3.374	.842		4.009	.000
Technology factors	0.842	.046	0.330	1.830	.001
Environmental factors	0.656	.13	0.032	5.046	.0041
Organizational Factors	0.752	.88	0.167	8.545	.0015
Human factors	0.705	.65	0.154	4.5779	.0022

From the regression findings, the substitution of the equation

$(Y = \alpha + \beta 0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon)$ becomes:

$Y = 3.374 + 0.330X_1 + 0.032X_2 + 0.167X_3 + 0.154X_4 + \varepsilon$

Where Y is the dependent variable (Energy Conservation), X_1 is the Technology factors, X_2 is the Environmental factors, X_3 is Organizational Factors and X_4 is the Human factors.

Taking all factors (human factors, technology factors, environmental factors, and organizational factors) constant at zero, energy conservation will be 3.374. Further, a unit increase in technology factors will lead to a 0.330 increase in energy conservation in the manufacturing firms; a unit increase in organizational factors lead to a 0.167 increase in energy conservation, a unit increase in human factors lead to a 0.154 increase in energy conservation and a unit increase in environmental factors lead to a 0.032 increase in energy conservation. This means that the most significant factor is technology factors, followed by organization factors, human factors and then environmental factors.

At 5% level of significance and 95% level of confidence, technology factors had a 0.001; environmental factors had a 0.0041, organizational factors had a 0.0015 while

human factors had 0.0022 level of significance. This meant that the most significant factor is technology factors followed by organizational factors, human factors and lastly environmental factors.

4.9 Implementation of Energy Conservation programs

The study sought to find out whether the various efforts employed by the manufacturing firms had led to energy conservation. The findings were as shown under the following sub headings.

4.10.1 Electrical Consumption

The study sought to establish whether electrical consumption had reduced after the implementation of the energy saving technologies. The results were as shown on Table 4.13.

Table 4.13: Electrical Consumption

Before Energy Conservation Implementation		After Energy Conservation Implementation	
Year	**Electrical Consumption in KW/h**	**Year**	**Electrical Consumption in KW/h**
2011	140,236	2014	139,986
2012	141,502	2015	138,335
2013	143,130	2016	136,302

From Table 4.13, there was reduced electrical consumption in the years 2014-2016 i.e. after the implementation of the energy conservation measures compared to before implementation.

4.10.2 Level of Production

The study sought to establish whether the level of production had gone up after the implementation of the energy conservation technologies. The results were as shown on Table 4.14.

Table 4.14: Level of Production

Before Energy Conservation Implementation Level of Production		After Energy Conservation Implementation Level of Production	
Year	**in 000 tons**	**Year**	**in 000 tons**
2011	2.41	2014	2.49
2012	2.43	2015	2.69
2013	2.42	2016	2.91

From Table 4.14, there was increased production in the years 2014-2016 i.e. after the implementation of the energy conservation measures compared to before implementation.

4.10.3 Kilowatts Used per Unit of Production

The study sought to establish whether electrical consumption (KWh/per unit of production) had reduced after the implementation of the energy saving technologies. The results were as shown on Table 4.15.

Table 4.15: Kilowatts Used per Unit of Production

Before Energy Conservation Implementation Kilowatts used per unit		After Energy Conservation Implementation Kilowatts used per unit	
Year	**of production**	**Year**	**of production**
2011	18.1	2014	17.2
2012	18.0	2015	15.8
2013	18.4	2016	14.8

From Table 4.15, there was reduced electrical consumption (KWh/per unit of production) in the years 2014-2016 i.e. after the implementation of the energy conservation measures compared to before implementation.

CHAPTER FIVE
SUMMARY OF THE FINDINGS, DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This particular section summarizes the findings, its discussion conclusion as well as the recommendation of the scholarly work. The goals of this study were to investigate the influence of human factors, environmental factors, technology factors and organization factors on energy conservation in the Kenyan manufacturing industry..

5.2 Summary of the Findings

From the findings human factors were key to energy conservation in the following ways; well labelled energy efficient equipment in the firm, enough literature on importance of energy conservation, sense of ownership enhances energy efficiency, switching off the lights when leaving a room and frequent seminars on importance of energy conservation.

The environmental factors influenced energy conservation in the following ways; firms had acquired ISO 14001 certification, firms used natural lighting during the day, there was an environmental management system (EMS) in the firms, there was a clear waste disposal mechanism, waste water was recycled and there was ISO 14001 certification which had enhanced energy conservation.

The findings showed that technology factors influenced energy conservation in the following ways: there were air-con savers in use in the firms, use of energy efficiency technologies had reduced energy consumption, use of modern technologies had enhanced energy conservation, all stakeholders understood the importance of using efficient lighting, there was LED lighting, there were variable speed drives, there was use of optimised electric lighting and there were energy efficient motors in the firms in order to conserve energy.

Organizational factors influenced energy conservation in the following ways: comparative feedback on energy conservation among departments, presence of rewards for policy compliance, energy conservation culture, bottom–up approach towards energy conservation and only the management can initiate conservation.

5.3 Discussion of Findings

The findings established that human factors were key to energy conservation in the following ways; there was well labelled energy efficient equipment in the firm, enough literature on importance of energy conservation, sense of ownership enhances energy efficiency, switching off the lights when leaving a room and frequent seminars on importance of energy conservation. The findings agree with Schultz *et al*. (2007) who posit that who posit that social standards and administration involvement are often quoted as a fundamental contribution to acknowledging behavior adjustment. These elements and related effects may show the existence of social standards. Social standards in this sense may be fundamental in ownership levels, which can be cultivated through decentralized administration structures (e.g. those utilized as a part of the usage of energy conservation). Ownership relates to physical issues, as well as to the objectives of an association (Pierce *et al*. 2001).

The study found that environmental factors affected energy conservation in the following ways: firms had acquired ISO 14001 certification, firms used natural lighting during the day, there was an environmental management system (EMS) in the firms, there was a clear waste disposal mechanism, waste water was recycled and there was ISO 14001 certification which had enhanced energy conservation. These findings concur with (Bunse *et. al*, 2011) who argue that who argue that energy conservation to a great extent is related to the environmental policy. Firms that diminish emissions can expand their economic performance through an expanded demand in improved efficiency. For instance, the adoption of environmental guidelines, for example, ISO 14001 enhances producers' productivity in the design and textiles enterprises over a three-year time span as measured by return-on-resources (ROA) (Bunse *et. al*, 2011).

The study also discovered that technology factors influenced energy conservation in the following ways: there were air-con savers in use in the firms, use of energy efficiency technologies had reduced energy consumption, use of modern technologies had enhanced energy conservation, all stakeholders understood the importance of using efficient lighting, there was LED lighting, there were variable speed drives, there was use of optimized electric lighting and there were energy efficient motors in the firms. This is in agreement with UNFCCC (2015) argument that that the world will require

profound decreases in worldwide Carbon Dioxide releases that are associated with Energy. G-8 pioneers required a half decrease in such releases by 2050 to keep away from the most hazardous outcomes of change in climate. Achieving this objective requires changing the methods of energy production, conveyance and use over all parts of the economy and locations in the entire world. Such efficiency in energy production offers guarantees in savings for purchasers and utilizers, returns for investors, higher volumes of goods produced by industries worldwide and diminished undesirable environmental effects.

The energy efficiency of structures, electric appliances, and equipment being used misses the point with regard to what is in fact feasible. Energy specialists have credited this proficiency gap to an assortment of market, structural and technical challenges. Energy proficiency procedures can possibly narrow this gap and accomplish noteworthy savings. The heavy work in industries is handled by electric motors, for example presses or roll mills, compressed air generation, ventilation or pumping water. They are commonly used in all the branches of the various industries, however the fundamental uses are not the same. With just a few special cases, electric motors are the primary providers of mechanical energy in industry. Lately, a lot of research has distinguished expansive energy saving possibilities through use of electric motors and systems while providing a number of ways to make savings with a very short time of recovering the investment (UNFCCC, 2015).

The study further discovered that organizational factors affected energy conservation in the following ways: comparative feedback on energy conservation among departments, presence of rewards for policy compliance, energy conservation culture, bottom–up approach towards energy conservation and only the management can initiate conservation measures. This agrees with the assertion by Kotter (2006) and Senge *et al*. (2009) who posit that the organizational change scholars have however argued that without successfully captivating the worker base to take responsibility for activities rapidly, they can lose that underlying impetus and fail to come up with enduring improvements. Such endeavors have the benefit of early eagerness and engagement, however will in the long run fail on the chance that they are not taken up for consideration by leaders with the ability to finance them specialist to give assets expected to scale and maintain those activities. How at that point do successful

associations guarantee that EE activities whether they are driven from the top or bottom keep on operating effectively and accomplish performance changes? The key is to guarantee that the activities of people inside the organization serve to support each other over time.

In particular, the inspirations of the highest level leaders need to be converted into providing resources that help and reward the workers to recognize and execute the project. The projects need to convert into quantifiable successes that obviously enhance the performance of the organization and approve the choices made by the leaders. The virtuous cycle is a generative instrument for high energy performance. Official engagement empowers investment in resources (i.e., cash and time) for EE endeavors. Those assets empowers individuals and tools all throughout the association to recognize and enumerate prospects for EE, and to actualize projects whose outcome is financial and environmental wins. At the point when the outcomes and stories are evaluated, spun into a convincing story of progress, and promoted, official engagement goes higher further. Strengthening feedback loops (denoted by the "R") can produce exponential development or rot. For this situation, the virtuous cycle, left unobstructed, can produce exponential development in energy performance (Borenstein, 2015)

5.4 Conclusions

The research work concluded that human factors affect energy conservation in the following ways; there were well labelled energy efficient equipment in the firms, enough literature on importance of energy conservation, sense of ownership which enhances energy efficiency, a culture of switching off the lights when leaving a room and frequent seminars on importance of energy conservation.

The environmental factors influenced energy conservation in the following ways; firms had acquired ISO 14001 certification, firms used natural lighting during the day, there was an environmental management system (EMS) in the firms, there was a clear waste disposal mechanism, waste water was recycled and there was ISO 14001 certification which had enhanced energy conservation.

Technology factors influenced energy conservation in the following ways; there was presence of air-con savers in use in the firms, use of energy efficiency technologies which had reduced energy consumption, use of modern technologies which had enhanced energy conservation, all stakeholders understood the importance of using efficient lighting, there was LED lighting, there were variable speed drives, there was use of optimised electric lighting and there were energy efficient motors in the firms in order to conserve energy.

The study further concluded that organizational factors influenced energy conservation in the following ways; presence of comparative feedback on energy conservation among departments, presence of rewards for policy compliance, energy conservation culture, bottom–up approach towards energy conservation and only the management can initiate conservation measures.

5.5 Recommendations

The study recommends continued adoption measures of energy efficiency by the manufacturing firms so as to continue gaining from cost savings.

The study also recommends more awareness by the government and other stakeholders on the use of Energy Efficiency among manufacturing firms. Capacity building should be done by the government and other stakeholders to the executives of the

manufacturing firms especially on the determination of the energy savings as it was established that many firms could not give data on the amount of savings.

5.6 Suggestions for further study

The research work makes a suggestion for another research to be done to follow up this study, probably after 3 years so as to assess whether there is improvement in the energy and cost savings. The research work recommends that similar research be done in other types of energy e.g. thermal, solar, wind and Biogas usage

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APPENDICES

APPENDIX I: LETTER OF TRANSMITTAL OF DATA COLLECTION

University of Nairobi,
PO BOX 30197-00100
Nairobi

Dear sir/Madam,

RE: REQUEST FOR YOUR PARTICIPATION IN DATA COLLECTION

I am a Masters Degree student in Project Planning and Management at the University of Nairobi and in my final year of study. As part of the requirements for the award of the degree of Master of project planning and management, I am undertaking a research on *"Factors influencing the Implementation of Energy Conservation in Selected Manufacturing Firms in Nairobi County".*

In this regard, I request for your time and by responding to the attached questionnaire. Your accuracy and candid response will be critical in ensuring objective research. This is an academic research and confidentiality is emphasized, your name will not appear anywhere in the report. Kindly spare some time to complete the questionnaire attached.

Thank you in advance

Yours faithfully,

Anthony M. Kilonzo

Registration no. L50/78166/2015

APPENDIX II: QUESTIONNAIRE

Please read the instructions given and answer the questions as appropriately as possible). It is advisable that you answer or fill in each section as provided. Make an attempt to answer every question fully and honestly.

I am Antony Kilonzo, a student at the University of Nairobi taking a Masters in Project Planning and Management. As a requirement for the fulfilment of the Master's degree, I intend to carry out research on **"**Factors Influencing the Implementation of Energy Conservation in Selected Manufacturing Firms in Nairobi County, Kenya." Do I have your consent to proceed?

SECTION A: GENERAL INFORMATION

1. Gender Male [ ] Female [ ]

2. What is your age bracket?

Under 35 years [ ] 35 – 40 years [ ]

41 – 44 years [ ] 45 – 50 years [ ]

Over 51 years [ ]

3. What is your highest level of education?

Master's Degree [ ] Bachelor's Degree [ ]
Diploma Degree [ ] Higher national diploma [ ]
PhD Degree [ ]
Others (specify)……

4. How many years have you worked in this firm?

Less than 2 years [ ] 2-5 years [ ] 6-10 years [ ]
11 years and above [ ]

SECTION B: HUMAN FACTORS AFFECTING THE IMPLEMENTATION OF ENERGY CONSERVATION

7. To what extent do human factors influence the success of energy conservation?

Very great extent [ ] Great extent [ ] Moderate extent [ ] Less extent [ ]

Not at all [ ]

8. What is your level of agreement with the following statements that relate to the human factors which influence energy conservation? Use a scale of 1-5, where; 1 - Strongly Disagree 2 - Disagree 3 - Neutral 4- Agree and 5- Strongly Agree.

Human factors that influence energy conservation	**1**	**2**	**3**	**4**	**5**
There is well labelled energy efficient equipment in the firm					
I switch off the lights when I leave a room.					
There is enough literature on importance of energy conservation in our firm					
There are frequent seminars on the importance of energy conservation in our firm					
Sense of ownership enhances energy efficiency					

SECTION C: ENVIRONMENTAL FACTORS THAT AFFECT ENERGY CONSERVATION

12. To what extent do environmental factors affect energy implementation in your company?

Very great extent [ ] Great extent [ ] Moderate extent [ ] Less extent [ ]

Not at all [ ]

13. To what extent do you agree with the following statements? Use a scale where 1 - Strongly Disagree 2 - Disagree 3 - Neutral 4- Agree and 5- Strongly Agree.

Environmental factors that affect energy conservation	**1**	**2**	**3**	**4**	**5**
There is an environmental management system (EMS) in our firm					
Waste water is recycled in our firm					
Our firm has acquired ISO 14001 certification					
We use natural lighting during the day in our firm					
There is a clear waste disposal mechanism in place in our firm					
ISO 14001 certification has enhanced energy conservation in our firm					

SECTION D: TECHNOLOGY FACTORS INFLUENCING ENERGY CONSERVATION

14. To what extent does technology affect energy conservation?

To a very great extent [ ] to a great extent [ ] to a moderate extent [ ]

To a little extent [ ] to no extent [ ]

15. Are there observable energy efficient technologies in your firm?

Yes [ ] No [ ]

16. To what extent do you agree with the following statements?

Use a scale where: 5-To a very great extent, 4-To a great extent, 3-To a moderate extent, 2-To a little extent, and 1-To no extent.

Technology factors influencing energy conservation	**1**	**2**	**3**	**4**	**5**
There are variable speed drives in our firm					
There are Air-con savers in use in our firm					
There is LED lighting in our firm					
There are energy efficient motors in our firm					
Use of modern Technology has enhanced energy conservation					
The use of electric lighting is optimised in our firm					
All stakeholders in this firm understand the importance of using efficient lighting					
Use of energy efficiency technologies has saved reduced energy consumption in the firm.					

SECTION E: ORGANIZATIONAL FACTORS

17. To what extent does your organization support energy conservation?

To a very great extent [ ] to a great extent [ ] to a moderate extent [ ]

To a little extent [ ] to no extent [ ]

18. To what extent do you agree with the following statements?

Use a scale where: 5-To a very great extent, 4-To a great extent, 3-To a moderate extent, 2-To a little extent, and 1-To no extent.

Organizational factors influencing energy conservation	1	2	3	4	5
We have an energy conservation culture in our firm					
There is a bottom–up approach towards energy conservation in our firm					
Only the management can initiate conservation measures in the firm					
There is comparative feedback on energy conservation among departments in our firm					
There are rewards for policy compliance in our firm					

SECTION F: IMPLEMENTATION OF ENERGY CONSERVATION PROGRAMS

19. To what extent has the implementation of energy conservation in your firm led to reduced electrical consumption (KWh)?

To a very great extent [ ] to a great extent [ ] to a moderate extent [ ]

To a little extent [ ] to no extent [ ]

Please indicate the values for the last 3 years

MONTH	Before implementation			After implementation		
	2011	2012	2013	2014	2015	2016
January						
February						
March						
April						
May						
June						
July						
August						
September						
October						
November						
December						

20. To what extent has the implementation of energy conservation in your firm led to reduced energy intensity (KWh/unit production?)

To a very great extent [ ] to a great extent [ ] to a moderate extent [ ]

To a little extent [ ] to no extent [ ]

Please indicate the values for the last 3 years

MONTH	**Before implementation**			**After implementation**		
	2011	**2012**	**2013**	**2014**	**2015**	**2016**
January						
February						
March						
April						
May						
June						
July						
August						
September						
October						
November						
December						

21. To what extent has the implementation of energy conservation in your firm led to increased production)?

To a very great extent [ ] to a great extent [ ] to a moderate extent [ ]

To a little extent [ ] to no extent [ ]

Please indicate the values for the last 3 years

MONTH	**Before implementation**			**After implementation**		
	2011	**2012**	**2013**	**2014**	**2015**	**2016**
January						
February						
March						
April						
May						
June						
July						
August						
September						
October						
November						
December						

Thank you for your time and participation

APPENDIX III: MANUFACTURING FIRMS IN KENYA BY SECTOR

	Sector	**Members**	**%**
1	Building, mining & Construction	23	3.12
2	Chemical & Allied Sector	70	9.52
3	Energy, Electrical & Electronics	39	5.53
4	Plastic & Rubber	64	8.7
5	Motor vehicle & Accessories	40	5.44
6	Metal & Allied Sector	71	1.65
7	Leather & Footwear	10	1.36
8	Food & Beverages	172	23.43
9	Timber, Wood & Furniture	17	2.31
10	Pharmaceutical & Medical Equipment	24	3.26
11	Textile & Apparels	60	8.16
12	Paper & Board Sector	64	8.7
13	Service & Consultancy- Support to Manufacturers	75	10.2
14	Fresh produce	2	0.27
	Total		

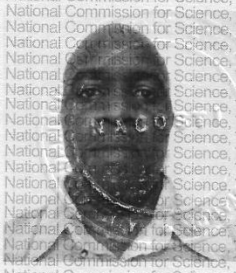
APPENDIX IV: NACOSTI PERMIT

THIS IS TO CERTIFY THAT:
MR. ANTHONY MUTISO KILONZO
of NAIROBI UNIVERSITY, 0-200
Nairobi,has been permitted to conduct
research in *Nairobi County*

on the topic: *FACTORS INFLUENCING THE IMPLEMENTATION OF ENERGY CONSERVATION PROGRAMMES IN SELECTED MANUFACTURING FIRMS IN NAIROBI COUNTY, KENYA.*

for the period ending:
13th June,2018

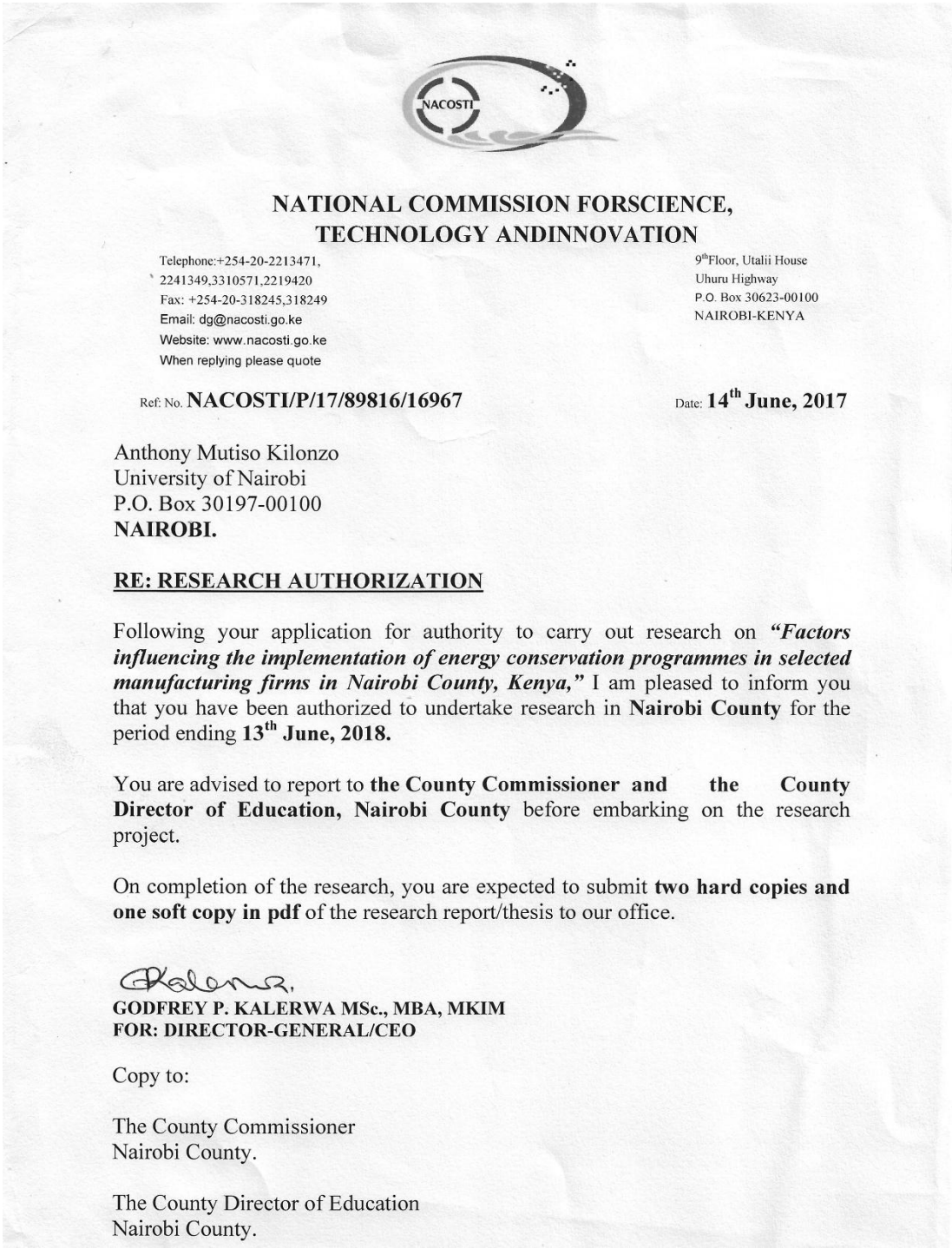
Permit No : NACOSTI/P/17/89816/16967
Date Of Issue : 14th June,2017
Fee Recieved :Ksh 1000



.....
Applicant's Signature

.....
Director General
National Commission for Science, Technology & Innovation

APPENDIX V: RESEARCH AUTHORIZATION



NATIONAL COMMISSION FORSCIENCE, TECHNOLOGY ANDINNOVATION

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9th Floor, Utalii House
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P.O. Box 30623-00100
NAIROBI-KENYA

Ref: No. **NACOSTI/P/17/89816/16967**

Date: **14th June, 2017**

Anthony Mutiso Kilonzo
University of Nairobi
P.O. Box 30197-00100
NAIROBI.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***"Factors influencing the implementation of energy conservation programmes in selected manufacturing firms in Nairobi County, Kenya,"*** I am pleased to inform you that you have been authorized to undertake research in **Nairobi County** for the period ending **13th June, 2018.**

You are advised to report to **the County Commissioner and the County Director of Education, Nairobi County** before embarking on the research project.

On completion of the research, you are expected to submit **two hard copies and one soft copy in pdf** of the research report/thesis to our office.

GODFREY P. KALERWA MSc., MBA, MKIM
FOR: DIRECTOR-GENERAL/CEO

Copy to:

The County Commissioner
Nairobi County.

The County Director of Education
Nairobi County.