CHALLENGES FACING THE USE OF TECHNOLOGY ON LEGAL METROLOGY: THE CASE OF MERU MUNICIPALITY, KENYA.

BY

NJIHIA FLORENCE WANJIRU

WChalir Or
yiKUYU, LIBRARY

A RESEARCH REPORT PRESENTED IN PARTIAL FULFILLMENT FOR AWARD OF THE DEGREE OF MASTERS OF ARTS IN PROJECT PLANNING AND MANAGEMENT OF THE UNIVERSITY OF NAIROBI

2012

DECLARATION

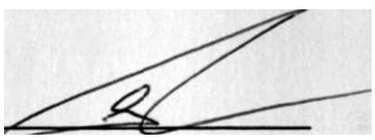
This research project report is my original work and has not been submitted to any other university for a degree or any other award.

Signed:. Date: ?4\(J-2PLL

Njihia Florence Wanjiru

L50/66237/2010

The research project report has been presented for examination with my approval as the university supervisor.

Signed:  Date: [c* (2^3 1

DR.CHRISTOPHER GAKUO

Senior Lecturer

Department of extra mural studies

University of Nairobi

DEDICATION

This work is dedicated to my parents Mr. and Mrs. Njihia, my brothers Benson and Geoffrey, my sister Tabitha and my daughter faith for their support and encouragement.

ACKNOWLEDGEMENT

I would like to thank the Almighty for giving me the chance to take this course.

I would also like to thank my Supervisor Dr Gakuo for the guidance and assistance during the research.

I would like to thank my colleagues at weights and measures Meru for their support and encouragement during the study

Lastly I would like to thank my fellow students for the support and the entire staff of Meru extra-mural centre Nairobi University for their coordination and cooperation that made my time in the university a time to enjoy and not regret.

TABLE OF CONTENTS

PAGES

«««VtH6IIV OF NAKW.
TSKUYU libq*»"

LIST OF TABLES

JNIV£P6ITY OF NAIHW*

LIST OF FIGURES

ABBREVIATIONS AND ACRONYMS

AFM	-	Arab Federation for Metrology
BAT	-	British America Tobacco
CC	-	Common Criteria
ICT	-	Information and Communication Technology
IT	-	Information and Technology
CIPM		International Committee of Weights and Measures
BIPM	-	International Bureau of Weights and Measures
KIBT	-	Kenya institute of Business Training
KIPI	-	Kenya Industrial Property Institute
KTDA	-	Kenya Tea Development Agency
NIS -OIA	-	NIS Office of international affairs
NMI's	-	National Measurement Institutes
O.I.M.L	-	International Organization for Legal metrology
R & D	-	Research and Development
VIML	-	International Vocabulary of Legal Metrology

ABSTRACT

The study will be investigating the challenges facing the use of technology in legal metrology, the case of Meru municipality, Kenya. The study will be guided by the following objectives: To establish the influence of cost of digital/electronic weighing and measuring instruments on legal metrology; to assess the influence of operation of electronic weighing and measuring instruments on legal metrology; to establish the extent to which technical know-how and training on electronic weighing and measuring instruments influence legal metrology; to establish how standardization of electronic weighing and measuring instruments influence legal metrology. The study will target traders, weights and measures officers, licensed weights and measures repairers in Meru region from Meru Municipality. The researcher will use stratified random sampling procedure and then adopt descriptive research design. The data will be gathered from the traders in Meru, weights and measures Officers in Meru region and of Meru Municipality, through questionnaires structured on the basis of the objectives of this study. Data required for analysis will be collected from the respondents and analyzed using Statistical Packages for Social Service. The findings of the study will be significant to the Government of Kenya, various stakeholders, weights and measures department staff of Meru Municipality.

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

Trade and industrial activities in the county are today increasingly being influenced by external factors of globalization consequently, there is mountain pressure on governments in developing countries to embrace outward oriented development polices. The core objective of the Government is to put in place policies that would restore economic growth and reduce poverty through employment and wealth creation articulated in the Economic Recovery strategy for wealth and Employment creation (ERS, 2003-2007).

Dunhill, BIML Assistant Director: Confidence is a major issue for domestic and international trade. Suppliers and buyers conclude a transaction based on a common agreement on the goods, products or services that are sold and these calls for an agreement on the quantity and quality of these goods, products or services. All this is based on measurements which are necessarily conducted by one party to the transaction - legal metrology aims to ensure that the other party may have confidence in them.

The measurement facilities are very often automated so that performing the measurements may be done by operators who are not specialists. Therefore, confidence in the measurement results derives principally from the ability of the equipment to deliver correct measurements under variable measurement and environmental conditions, and from the ability of this equipment to be insensitive to operator errors and to tampering.

This is why many of these measurements fall under the expanding scope of legal metrology, which aims to set up appropriate requirements and controls on the equipment to ensure that the equipment shows the ability mentioned above and that it will therefore provide appropriate confidence in the measurement results.

Without such confidence, trade would be subject to multiple measurements carried out at the initiative of each party to the transaction, creating disputes due to differences in measurements. The additional cost of such multiple measurements and of solving these disputes would considerably affect the efficiency of trade and jeopardize the economy. Legal metrology is therefore an essential tool in ensuring fair trade and for the efficiency of an economy.

Today, we are living in a chaotic transition period to a new age defined by global competition, rampant change, faster flow of information and communication, increasing business complexity, and pervasive globalization. The pace of change has become so rapid that it took a different type of firms to be dominant and marked entirely new era of business. This new environment is also characterized by "more far-reaching technological advances, and a consumer who has adjusted to this quicker pace and whose fickle preferences are revised with the speed of a television commercial." (*The Center less Corporation*, by Bruce A. Pasternak and Albert. J. Viscio)

Today's growth era produces huge discontinuities, creates new industries and destroys old ones, and accelerates global economic growth in the process. "Expectations are rising everywhere; human creativity is flowering in every field. Emerging economies are industrializing, and everyone is joining the digital revolution of boundless information and seamless electronic commerce. The ideas, technologies and capital to satisfy new needs flow freely." (Every Business is a Growth Business", Ram Charan and Noel. M. Tichy)

1.2 Problem statement

Metrology is the name given to the science of measurements. Legal Metrology may be briefly defined as the process of making measurements under conditions dictated by statutes. In this age of rapid technological change, growing competition and expanding trade, measurement standards and techniques have been recognized as fundamental elements. Indeed a sound legal metrology system is an essential cog in the economic well-being of any country. According to Kiarie, (2006), the importance of science of measurement (metrology) cannot be gainsaid. There is no life without measurement. Though metrology includes different aspects such as scientific, industrial and legal, I will concentrate on legal metrology which is otherwise known as trade metrology. The study will focus on challenges that are being faced by different stakeholders in the field of trade due to introduction and use of electronic/digital instruments to weigh and measure goods.

We may rarely think about metrology the science of measurement, but it is indeed fundamental to both our personal lives and to our economic prosperity of our country. Accurate measurement is absolutely essential in industry: components produced and assembled in different sites need to fit exactly; technical regulations and most written standards depend on measurement; and good measurement significantly increases the value, acceptance and quality of a product or service.

According to Kamau, (2006), metrology is classified in three main fields: scientific metrology, industrial metrology and legal metrology. Legal metrology is part of metrology which is subject to legal or regulatory control. Legal metrology concern itself with measurement, units of measurement, measuring instrument and methods of measurement which are performed by any competent government body or organization.

Beard. NRCS, South Africa (2011) explained the main function of a legal metrology system being to provide reliable conformity assessment of regulated products so that regulations can be enforced. Legal metrology brings credible measurements to health, safety, protection of the environment and law enforcement; provides a level playing field for commercial and economic growth; promotes international trade by bringing confidence to measurements; enables the accurate collection of government taxes; brings the full national benefit from commodity exports; and reduces fraud and disputation costs.

In Kenya legal metrology is the responsibility of the weights and measures department under the ministry of trade. Though metrology includes different aspects such as scientific, industrial and legal, the researcher will concentrate on legal metrology otherwise known as trade metrology or metrology of transactions. Wambua 2010 on his paper on effect of technology of weighing scales on small and medium enterprises recommended a research on the challenges of electronic scales on small and medium enterprises.

Many factories and even individuals have turned to digital/electronic weighing and measuring instruments, but they are facing various challenges. It is against this background that the researcher seeks to assess the challenges of use of technology on legal metrology.

1.3 Purpose of the study

The purpose of this study is to identify the challenges that have come with the use and introduction of weighing and measuring instruments and how this affects legal metrology.

1.4 Objectives of the study

The following are the objectives of the study:

i) To establish the influence of cost of digital/electronic weighing and measuring instruments on legal metrology.

ii) To assess the influence of operation of electronic weighing and measuring instruments on legal metrology.

iii) To establish the extent to which technical know-how and training on electronic weighing and measuring instruments influence legal metrology.

iv) To establish how standardization of electronic weighing and measuring instruments influence legal metrology.

1.5 Research questions

i) How does the cost of electronic weighing and measuring instruments affect legal metrology?

ii) To what extent does the operation of electronic weighing and measuring instrument on legal metrology?

iii) How does technical know-how and training on electronic/digital weighing instrument affect legal metrology?

iv) To what extent does standardization of electronic weighing and measuring instruments affect legal metrology?

1.6 Significance of the study

The study will provide useful information and knowledge to the Government, various stakeholders in the use and maintenance of electronic scales. It will help the existing technicians of weighing machines of searching for new knowledge on how the machines work as well as go hand in hand with the technology. The study will also help the weights and measures department staff on how to solve the challenge of coping with global and technology changes.

The study will make contribution to existing body of knowledge of bringing to the country spare parts for the electronic weighing scales which are overtaking the manual ones as well as the measuring instruments especially the electronic/digital dispensing pumps.

1.7 Delimitation of the study

The study will focus on traders who engage in selling goods and services by way of weighing or measuring within Meru municipality, this will include kiosk owners, petrol stations and various

factories and societies. The study will also focus on the weights and measures officers in the area as well as the authorized weights and measures technicians within the Meru municipality. The study seeks to investigate the challenges of technology changes on legal metrology, trade and economy within Meru municipality.

1.8 Limitation of the study

Financial and time constraints are the anticipated challenges during the study. Another challenge that might affect the study is the language barrier as the researcher does not come from the community. This will be solved by use of an interpreter.

1.9 Assumptions of the study

Respondents will answer questions accurately and correctly. All business owners, weights and measures technicians and officers will be available.

1.10 Definition of significant terms

Weighing instrument - includes all instruments constructed to calculate and indicate prices, compute wages, count or grade articles by use of weighing principles, together with all weights and counterpoises belonging thereto.

Measuring instrument - includes every instrument for the measurement of length, width, height, area, size, volume, capacity, weight and number.

Use **for trade** - the transaction is by reference to quantity or is a transaction for purposes of which there is made or implied statement of the quantity of goods to which the transaction relates and the use is for purpose of determination or statement of that quantity.

Repairer - means a person licensed to engage in repair or overhauling of weights, measure or instruments.

To **repair** - includes making any adjustment to any weight, measure or instrument other than adjustment of the balance arrangement which is required under the weights and measures rule in respect of specified types of weighing instruments.

(Laws of Kenya, weights and measures act chapter 513, Revised Edition 1993)

Metrology - is the name given to the science of measurements.

Legal **Metrology** - may be briefly defined as the process of making measurements under conditions dictated by statutes.

1.11 Organization of the study

The study is organized into five chapters. Chapter one is the introduction of the study, chapter two is the literature review, chapter three deals with the research methodology that were used in the study, chapter four shows data presentation, analysis and interpretation of the data collected during the study and chapter five gives the summary of findings, discussions of results, conclusions and recommendations made by the res

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter focuses on literature conducted by various persons on different topics; this includes weighing and measuring, economy, trade as well as the technological changes. It also shows studies done on challenges of technology changes to organizations.

2.2 Historical background for Metrology

Legal metrology developed over 5000 years ago with the development of civilizations that required consistency of a wide range of measurements used in everyday life. These included; Time and the calendar, Distance and area, Weights and measures. The relationship between the State and metrology was symbiotic. The State needed measurements to provide the information necessary to organize, plan, defend and tax with efficiency. Such accounting depended on uniform measurements across wide geographical areas and across a broad spectrum of farming and manufacturing practices and work organization. Metrology on the other hand required the mandate of the State to ensure conformity to measurement requirements (Kenneth, 1974)

As well as being a user of metrology the State was also required to provide the necessary trust and confidence in measurement by mandatory standards and requirements. This ensured the integrity of commerce and was realized by the State decreeing and enforcing measurement standards and requirements and controlling fraud to underpin market transactions.

In metrology confidence is generally used to indicate the extent to which the technical requirements for consistency have been met, trust relates to the normative relationship between parties to a transaction. Kenneth Arrow the Nobel laureate in Economics has written extensively about the importance of trust in economic transactions and the two following quotations from his publications highlight aspects of this concept. "Virtually every commercial transaction has within itself an element of trust, certainly any transaction conducted over a period of time. It can be plausibly argued that much of the economic backwardness in the world can be explained by the lack of mutual confidence;" (Kenneth, 1974) "Now trust has a very important pragmatic value, if nothing else. Trust is an important lubricant of a social system. It is extremely efficient; it saves a lot of trouble to have a fair degree of reliance on other people's word. Unfortunately

according to Wayne Stiegel, (1973) this is not a commodity that can be bought very easily. If you have to buy it, you already have some doubts about what you have bought. Trust and similar values, loyalty or truth-telling, are examples of what the economists would call "externalities." They are goods, they are commodities; they have real, practical, economic value; they increase the efficiency of the system, enable you to produce more goods or more of whatever values you hold in high esteem. But they are not commodities for which trade on the open market is technically possible or even meaningful." (Kenneth, 1972).

China well illustrates this traditional relationship between the State and metrology. During the Shang Dynasty some 3500 years ago a system of standard measuring instruments for length, mass and capacity was established. A State organization with special officials was assigned responsibility for checking the accuracy of these instruments twice a year. As well as trade in commodities these standards were also mandatory for the production of weapons, vehicles, and a wide range of handicrafts and the construction of buildings. With the development of the modern State royal decrees and moral precepts were replaced by Weights and Measures legislation which gave legislative force to the rules of the measurement system and established enforcement mechanisms to ensure compliance. This provided the trust in the system, ensured consistency of measurement and established the foundation for what we now describe as legal metrology. What is clear from the history of metrology is that its development was driven by a need of the State for information. Where the State was strong the need, particularly by the bureaucracy, was greatest and there was a strong commitment to the metrology system. As the State declined metrology declined with it and over the centuries the national metrology systems have ebbed and flowed with the power of the State.

France at the time of the Revolution, where non-uniformity of measures was upheld as a feudal right, illustrates this problem of metrological fragmentation. Over 800 differently named measures and untold units of the same name ensured inconsistency of measures, fraud and constant disputation. Hence the overwhelming demands at the meeting of the Estates General in Paris in 1789 for the establishment of a uniform system of weights and measures, out of which grew the metric system.

2.3 Metrology in the 20th Century

23.1 Scientific Metrology

The late 19th century saw a marked increase in international trade and metrology responded to this with initiatives to enhance the global consistency of measurements. The 1875 Treaty of the Meter with its aim of "international uniformity and precision in standards of weights and measures" was the most significant of these metrological initiatives and it resulted in the establishment of the International Committee of Weights and Measures (CIPM) and the establishment of National Measurement Institutes (NMI's) in the developed nations to maintain national standards of measurement and provide traceability to these standards. This was to provide one of the necessary infrastructures for the development of science and technology throughout the century. In this regard the National Academy of Sciences (US) commented; (National Academy of Sciences, 1979) "precise measurement is the hallmark of the remarkable advancement in understanding the physical universe in modern times"

Whilst the Treaty of the Meter was originally focused on measurement of length and mass, the physical quantities of the weights and measures system, it's scope was extended in the 20th century to measurement of electricity (1927), photometry and radiometry (1937), ionizing radiation (1960) and to time scales (1988) and a degree of coherence in the measurement system was established by the adoption in 1960 by the 11TH CGPM of the International System of Units **(SI).**

2.3.2 Legal Metrology

One institutional aspect of the development of metrology in the 20th century was the separation of metrology in many countries into scientific metrology, led by the NMI's, and practical or legal metrology, administered by weights and measures authorities, which continued to provided a legislative basis for measurements and measuring instruments when used for legal purposes, and supported the development of domestic and international trade and a wide range of government regulations. This division was eventually formalized in the two International metrology treaties.

Technological change also facilitated the development of a wide range of new measuring instruments and processes and a massive expansion in the scope of metrology. Metrology responded to these changes with the development of a range of new control mechanism that complemented traceability and were designed to maintain confidence in the integrity of the

measurement system. These included: Introduction from the late nineteenth century of national pattern approval requirements and certification of trade measurement instruments to ensure fitness for purpose; Introduction from 1947 of accreditation of calibration and testing facilities to ensure confidence in measurement capability; Development of national and international documentary standards for measuring instruments and processes which ensured greater consistency of measurement (Barry, 1977); Development of the SI system of units of measurement, which replaced a multiplicity of national, craft and industry units.

The need to ensure international consistency of trade and regulatory measurements, and to "resolve internationally the technical and administrative problems raised by the use of measuring instruments", led to the establishment in 1955 of a second metrology .Treaty organization, the International Organization of Legal Metrology (OIML). Originally focused on trade metrology, the rapid expansion in the use by governments of regulatory measurements has seen OIML become increasingly involved in establishing international requirements for a wide range of environmental, occupational health and safety and medical measurements.

Legal metrology comprises both regulated measurements conducted by private individuals and controlled by a State authority e.g. trade metrology and regulated measurements conducted by State authorities e.g. environmental & traffic control etc. As each of these types of legal metrology has distinctive costs and benefits .report (Raymond, 1972-75).

2.4 Weighing and measuring

Ngatia (2001), Director of weights and measures department, said that assessment by weighing and measuring is a prime necessity of life in a human society. It is essential to the making and exchange of goods, to erection of building and to the devices of transport. There is no trade or industry of human beings which does not tend to depend on it, no dealing in property which is not defined by it. Without it there is no civilization, no society but the primordial. It is the first essential tool of materials creation and the private and public economy depends on it. The accuracy of weights and measures therefore becomes a first duty of any government, for the right people *by* john A. O'Keefe.

According to Kamau (2006), acting director of weights and measures department, the use of inaccurate weighing and measuring instruments is expressly prohibited by the law. This is due to the fact that inaccuracies in weighing and measuring instruments may cause serious economic

loss to the consumer. Without the metrology control of weighing and measuring instruments afforded by the law, economic loss to the consumers due to inaccuracies in the weighing and measuring instruments would be colossal. The economic wellbeing of the consumer or purchaser is likely to be exploited in respect of quality and quantity thereby denying him the maximum economic benefits from his or her hard earned money.

Ministry of trade has the mandate of empowering people through growth in agriculture and trade. The ministry is sub-divided into various departments which ensure facilitation of trade in our country. The departments includes; internal trade, external trade, weights and measures, KIBT, and KIPI. It also works hand in hand with the ministry of industry which encourages MSE'S growth in the country.

The department of weights and measures ensures accuracy in trade measurement through enforcement of the weights and measures act, cap513 Of the laws of Kenya. The department ensures that all weights, weighing and measuring instruments in use for trade in Kenya must be of a pattern approved by the director. This is undertaken to ensure that all equipment upon which trade transaction are carried out are accurate and can be relied upon by the transacting parties. The department, being the legal metrology standardization body for this country is a member of the international organization of legal metrology (O.I.M.L). tfHcuYu'iMAft^""*'

Richard, BIPM, 2011 accurate measuring of mass and volume in Africa affects almost any product traded in the continent, whether domestically or internationally. Oil, minerals, pharmaceuticals, fresh fruits and vegetables require accurate measurements to determine their purity, specific content and bulk weight. The calibration and control of pumps, balances and meters ensure that customers get what they pay for and protect their purchasing power.

The Metrological Supervision [VIML 2.3] " control exercised in respect of the manufacture, import, installation, use, maintenance and repair of measuring instruments, performed in order to check that they are used correctly as regards the observance of metrological laws and regulations". It includes checking the correctness of the quantities indicated on and contained in prepackages. The government understands that this is a sensitive area upon which the economy of this county is hinged and has thus put in place rules and regulations governing the repair and overhaul of weighting equipment for trade use.

The department is also responsible of monitoring and issuing of licenses to repairers of the

weighing and measuring instruments after certifying that they are able to perform the work. The licenses are renewed every year to ensure accountability as well as good performance in the field; this ensures that only those who are qualified for the repair works serve the wananchi.

EL Sayed, head of the NIS Office of international affairs (NIS-OIA) and Assistant Secretary General of Arab Federation for Metrology (AFM) said the four pillars of a quality structure are metrology, standardization, conformity assessment and accreditation. The quality infrastructure facilitates participation in global trade by supporting competitiveness, the avoidance of technical barriers to trade, and achievement of environmental, health and consumer policy goals.

2.5 Operation of electronic weighing and measuring instrument on legal metrology

Technology is the making, usage, and knowledge of tools, machines, techniques, crafts, systems or methods of organization in order to solve a problem or perform a specific function. It can also refer to the collection of such tools, machinery, and procedures. Technology is a vital component of industrialization and any country which envisions industrialization pay much attention to securing technology appropriate to peculiar needs (Republic of Kenya, trade and industry quarterly publication, vol. 1, 2006). Use of electronic weighing and measuring instrument on legal metrology is one of changes that are catching up with Kenya technologically.

Electronic weighing and measuring is of high quality and reliability. Traders when using these measuring instruments need to be knowledgeable. They should ensure that their weighing or measuring instruments are: Accurate and in correct working order at all times, easy for consumers to read the scales or measuring instruments, e.g. by using dual-faced indicator type instrument, instruments that come with a level indicator must be adjusted by setting the height adjustments of the instrument to ensure that the bubble is at the centre of the level indicator, Zeroed before goods are weighed or measured clean and free from foreign particles on the weighing pan. The WMO seal must be affixed onto the instrument at all times, sent for annual re-verification to prevent short weights or measures.

Technology also plays a direct role in the current structural disinflation because technological innovation has reduced the real cost of certain crucial goods, especially information systems, telecommunications, and transportation. Strong productivity gains—driven in part by technology— also keep inflation low, even when labor markets are very tight. (Shapiro)

2.5.1 Technology and measuring instruments

With the advent of programmable hardware components and their integration into measuring instruments, the influence and hence the importance of software, especially in legal metrology, has remarkably increased. Software validation is an indispensable part of the type examination process in legal metrology. The validation of software with respect to the developed requirements basically remains a demanding task due to the absence of straightforwardly defined procedures. (D. Richter)

OIML D 31 gives examples of configurations with PCs by focusing on a variant with a computer fully embedded into the measuring instrument. The secure configuration of a computer as part of a measuring instrument differs from that of a part of a desktop in some aspects. Due to the requirements of legal metrology, measurement data, parameters, and measuring instrument in use shall not be changeable, at least not without leaving a trace. Wambua 2010, argued that innovation and technology forced introduction of digital scales which have gradually faced off traditional mechanical weighing scales.

Clarke 2009, electronic merged with weighing instruments, taking accuracy and precision to one step further. Since then there have been remarkable advances with gradual release of sophisticated precision instruments such as digital floor scales, moisture analyzers and many more. With all advances in weighing instruments, mankind has only improved its ability to weigh and measure with great accuracy than ever. Herbner, 2008, noted that rapid changes in technology and globalization of commerce have put tradition measurement system under pressure to change.

Manfred (2002), vice-president of PTB and OIML, argued that globalization of markets and technological developments have had profound effects on products. There has been explosion in the number and complexity of products available. Science and technology have permitted the development and mass dissemination of new products that were simply unavailable to all but very few in the past, ranging from foodstuffs to consumer durables. Innovation has also introduced even more complcx production processes and inputs, the long-term effects of which cannot be foreseen with certainty.

New technologies such as worldwide use of internet for all kinds of network, software control, remotely controlled measuring systems. If government control and legal metrology are still

necessary in the year 2020; it will be quite a challenge to maintain an effective surveillance system in a global market. New technologies are very demanding as regards both the drawing up of sufficiently flexible harmonized regulations and the competence by well educated, well trained and highly motivated civil servants.

2.5.2 Industrial automation - electronic weighing

Industrial automation - electronic weighing in modem factories electronic weighing systems fully integrated in the total production control system, assure high and long term quality of the plant products. Use of electronic/digital weighing and measuring instruments in big organizations to weigh and measure products is a technological breakthrough that is expanding businesses. Examples of such organizations are: KTDA, BAT, COFFEE FACTORIES, KENYA AIRWAYS, and WHEAT PROCESSING FACTORIES among others. Butcheries have not been left out also. This has led to competitive advantage to those already using the digital scales as they are not only being used for weighing but also printing and storage of data thus making work easier and reducing fraud as well as cheating. Though the introduction of these weighing and measuring instruments has led to laying-off of some factory workers, the benefits weigh more than the loss. The recent use of ICT in most businesses has come hand in hand with the digital weighing instruments.

2.53 IT and legal metrology

In the last decade, an international standard for it security, the so called Common criteria for information Technology security Evaluation (cc) has been developed. To date a successful application of cc-base methods in the legal metrology area is not known.

According to Ngaari 2000, an inspector of weights and measures, the use of electronics and especially computer technology in measuring instruments has accurately disrupted the state of

He further shows difficulties which have with this development: the extreme rapidity with which electronic components have developed, and which have raised the problem of conformity of the instruments to the approved pattern. This problem was not completely new, since even with mechanical measuring instruments, the quality of steel used, the quality of the processing of the surface of certain metallic parts, the composition of plastics, or even the packaging of plastic granules before injection were all essential criteria, though of course difficult to check on finished product. Conformity assurance of electronic instruments was therefore dealt with in the

same way as that of mechanical instruments, which has in fact given satisfactory results.

2.6 Knowledge as the Source of Business Value

Electronics has considerably developed instruments' performance, though at the expense of an increased sensitivity to their external environment (temperature, humidity, electrical and electromagnetic disturbances).the reliability and durability of these electronic measuring instruments have become critical subjects.

Knowledge and continuous learning are now critical elements of success. In the new economy, the knowledge component of products and services has increased dramatically in importance and has become the dominant component of customer value. The shift to knowledge as the primary source of value makes the new economy led by those who manage knowledge effectively - who create, find, and combine knowledge into new products and services faster than their competitors.

There are three forces driving the new economy: these are knowledge, change and globalization; Knowledge - intellectual capital as a strategic factor; a set of understandings used by people to make decisions or take actions that are important to the company; Change - continuous, rapid and complex; generates uncertainty and reduces predictability; Globalization - in R&D, technology, production, trade, finance, communication and information, which has resulted in opening of economies, global hyper competition and interdependency of business

The World Metrology Day 2011 message *Chemical measurements for our life, our future* built upon the IYC 2011 theme. Chemistry and chemicals pose particularly interesting challenges to the measurement community: thousands of compounds must be measured, and the range of concentrations at which some compounds must be reliably detected, quantified, and in some cases regulated can nowadays extend down to parts per billion (or even trillion). Yet the ability to make appropriately accurate and reliable chemical measurements is crucial to our economy, our environment and our personal well being **(www.oiml.org** *"Press Release WORLD METROLOGY DAY 2011")*

2.7 Trade/business in relation to weights and measuring instrument

2.7.1 New Dimensions in Business Space

New dimensions in Business Space get constantly created. Forces like technological breakthroughs, economic growth, market evolution, and shifts in customer tastes, social changes, and political events can expand or shrink Business Space. Vast amounts of new Business Space created today change perspectives. This unoccupied territory represents a land of opportunity for the technological and strategic innovators who can see or create it faster than their competitors do. The opportunities are great, but so are the competition and the chance of failure. (Bruce and Albert, 2002)

Wamwana 2007, an inspector of weights and measures, the country's vision 2030 is for the realization of a vibrant economy growing at a rate of 10% with a people enjoying a high standard of living. The road towards this is the attainment of a state where trade in goods is transacted upon approved and accurate weighing and measuring instruments.

2.8 Standardization of weights and measuring instruments

According to Louis and Greenleaf (2009), weights and measures standards are necessary, reasonable and proper for protection of consumers and businesses from use of false or malfunctioning weighing and measuring instruments in all commercial transactions.

Onyango (2003^, an inspector of weights and measures observed that the ideal situation for a manufacturer of weighing and measuring instruments would be to achieve worldwide acceptance of a certificate by one-stop testing of his product in just one laboratory of his choice. But this is not the case as on the global scale, different trends of a politico-economical nature are observed in legal metrology. Another current trend in standardization that will shape metrology in the near future is the establishment of formal international and regional agreements among nations to recognize each other's capabilities in calibration, testing and certification.

Republic of Kenya, trade and industry quarterly publication (2007), added that one of the ISO certification requirements for any industry or organization is that where weighing and measuring is involved, the equipment in use for that purpose must carry a valid certificate of verification as proof of accuracy of the said equipment. For example Kenyan tea from KTDA cannot be accepted on the world international market in the absence of proof that their weighing

instruments have been verified. Likewise, cargo planes cannot take off from our airports to any destination in the world unless there is proof that they were loaded using weighing equipment bearing a valid mark of verification and a certificate to that effect from the weights and measures department.

2.9 Training and legal metrology

According to Onyango (2003), an inspector of weights and measures, the department of weights and measures is a member of OIML and liaises with other regional bodies. Kenya is a member of OIML; much has not been done to adopt OIML recommendations to bring us to into line with international requirements. Much of the technical regulations in use today were borrowed from the British Weights and Measures act way back in 1963. These regulations have largely remained the same. This is largely attributed to lack of technical committees to review and recommend OIML recommendation wherever possible.

Kenya has no institutions offering course in legal metrology, as a result the training function is currently done in-house. The equipment in use today by the inspectors of weights and measures are basically 40 years ago. This coupled with lack of continued technical training is largely responsible for inefficiencies that we witness today.

Afrimets 2011 realized that measurements that meet international expectations cannot be applied without appropriate institutions that are able to both satisfactorily demonstrate their ability on international stage and that capability to the national user community. The lack of measurement infrastructures in African countries has put them a major disadvantage in international trade. Many are unable to manufacture to international sections, to ensure the integrity of their export commodities, to apply quality control to their fresh produce exports, and to monitor public health and environmental conditions. And where they do have basic metrology infrastructures, there is often lack of competence and skills, in many instances they operate in silos without international recognition.

2.10 Conceptual Framework

The conceptual framework shows the relationship between the independent and the dependent variables. Further, it shows any other factor that may have any effect on the two variables as summarised in figure I.

The conceptual framework in this particular study shows the challenges facing the use of technology in legal metrology, with independent variable being; cost of instruments, operation of instrument, Know-how and training, standardization of instruments and training and legal metrology. Moderating variable includes the government and environment policy, and intervening variable being international trade and market. It is then through this conceptual frame that the researcher will be able to find out challenges facing use of technology in legal metrology in Meru municipality in Kenya. The challenges facing use of technology in legal metrology has not been given a lot of attention in terms of research and documentation. It is because of this that this study is going to be carried out by the researcher.

CONCEPTUAL FRAMEWORK

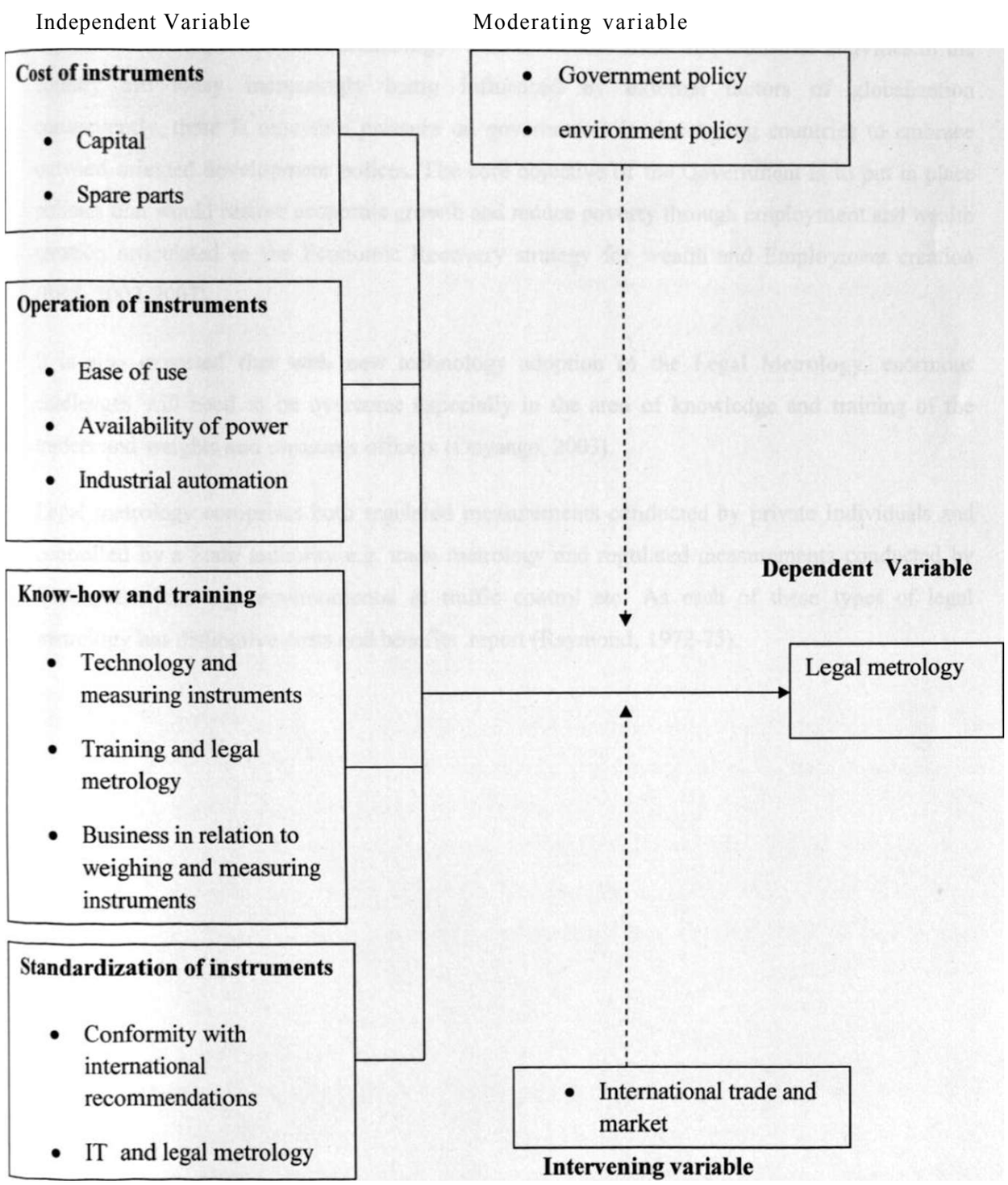


Figure I: conceptual framework

2.11 Summary

Literature review in this study shows that it is important for the weights and measures department to adopt electronic technology. This is because trade and industrial activities in the country are today increasingly being influenced by external factors of globalization consequently, there is mountain pressure on governments in developing countries to embrace outward oriented development polices. The core objective of the Government is to put in place policies that would restore economic growth and reduce poverty through employment and wealth creation articulated in the Economic Recovery strategy for wealth and Employment creation (ERS, 2003-2007).

It is also expected that with new technology adoption in the Legal Metrology, enormous challenges will need to be overcome especially in the area of knowledge and training of the traders and weights and measures officers (Onyango, 2003).

Legal metrology comprises both regulated measurements conducted by private individuals and controlled by a State authority e.g. trade metrology and regulated measurements conducted by State authorities e.g. environmental & traffic control etc. As each of these types of legal metrology has distinctive costs and benefits .report (Raymond, 1972-75).

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter introduces the methodology that was used in carrying out the study. It includes research design, target population, sampling design, methods and instruments of data collection and procedures that were used in the study, it also gives the operational definition of variables as used in the research study, methods of analyzing data is also given in this chapter.

3.2 Research design

Mugenda and Mugenda (2003), say that to research is to carry out a diligent inquiry or a critical examination of a given phenomenon. It involves critical analysis of existing theories or conclusions with regard to new discovered facts. This study used descriptive research. Gay (1983) defines descriptive research as a process of collecting data in order to test hypotheses or to answer questions concerning the current status of the subjects in the study. Descriptive research aided in determining and reporting the way things are.

3.3 Target population

According to Mutai (2000), a target population refers to a group of individuals, objectives or items from which a sample is drawn. The population of the study was from wholesale shops, retail shops, kiosks, cereal stores and butcheries within the Meru municipality which covers from Gitimbine, Kemu, showground and thimangiri. The researcher used a population of 1600 which included 1586 businesses, six 6) weights and measures officers in Meru and eight (8) licensed weights and measures repairers in Meru region.

3.4 Sampling and sample size

According to Kombo and Tromp (2006) sampling refers to how cases are to be selected for observation. Stratified random sampling will be used in this study in order to achieve desired representation from various subgroups in the study population. According to Mugenda and Mugenda (2003) Sample size depends on factors such as the number of variables in the study, type of research design, method of data analysis and size of accessible population. According to

Sekarah (2007) a researcher can take samples of 10% of bigger population and at least 20% for a smaller population and a sample of above 30 to 60 is a good representation of the population.

The study used a formula by Yamane Tora (1967) for sample size selection.

Where $n=N/(1+Ne^2)$

Where n = sample size

N = target population = 1600

e = precision

= 5%

Therefore

n= $1600/(1+1600(0.05)^2)$

=320

The study adopted a purposive sampling procedure whereby all six (6) weights and measures officers and eight (8) repairers were selected since they constituted a small sample compared to the businesses, the remaining 306 were businesses.

Table 3.1: sampling frame showing distribution of target respondents

Item	Population	Sample
Weights and measures officers	6	6
Repairers	8	8
Businesses	1586	306
Total	1600	320

3.5 Data Collection Instruments.

In designing research instruments the researcher considered the objectives of the study and the research questions. Data was collected using questionnaire, interview schedules and observation. The Questionnaire was used as primary data collection. Interviews and observation methods were also be used. These are informal and conversational methods of data collection.

3.5.1 Questionnaires

A questionnaire is "a set of related questions designed to collect information from a respondent". The questionnaire is the most appropriate instrument due to its ability to collect a large amount of information in a reasonably quick span of time. It also ensures confidentiality of the source of information through anonymity while ensuring standardization. Three sets of questionnaire were used in this study. They were administered to the weights measuring Officers, traders and weights and measures repairers within Meru Municipality. These questionnaires' were both unstructured and structured. Most of the questions were unstructured. The questionnaire contained sections covering all the independent variables.

3.5.2 Interviews Schedule

The researcher also adopted both structured and unstructured interviews. These methods aided in getting complete information because the interviewer was able to express herself freely and get all possible answers from the interviewee. The items in the interview schedule were collected from traders and repairers in Meru municipality. The schedule entailed: gender, the type weighing and measuring instrument being used, the advantages and challenges the trader experiences for adapting electronic weighing and measuring instrument, also get information from repairers especially on the challenges they get in repairing.

3.5.3 Observation

Observation was used by the researcher; it involved going to the scene of action/behavior and getting involved with what was going on. The researcher used structured observation schedule. This enabled the researcher to use an assistant in the observation process. The observation schedule had the following items: checking the type of weighing and measuring instrument being used, how customers react to both traditional and electronic instruments and seeing whether the traders have knowhow in operating the instrument

3.6 **Data Collection Procedure**

In collecting data, the researcher visited the sampled traders in Meru municipality to administer the questionnaire and carry out the interviews. Where necessary, clarification was made on the items of the questionnaire. The researcher administered the questionnaires to the respondents, waited for them to fill and then collected for analysis.

The researcher used both unstructured and structured observation. In unstructured observation the researcher went to the field and looked at the state of weighing and measuring instruments.

3.7 **Instruments Reliability**

Mugenda and Mugenda (2003) reliability refers to a degree to which a research instrument yields consistent results. In this study, I ensured reliability by pre-testing questionnaires using a selected sample from data collected. To increase reliability test - retest technique in which instruments was administered twice but to different groups of subjects. The pretesting data was conducted in Tigania east district by administering questionnaires to ten (10) traders

3.8 **Instruments Validity**

According to Mugenda and Mugenda (2003) validity is the accuracy and meaningfulness of inferences, which are based on the research results. Validity of the data was done using content validity. A pilot study was carried out by administering the data collection twice but to different groups of subjects. The pretesting data was conducted in Tigania east district by administering questionnaires to ten (10) traders and this aided to ensure desired data or results were obtained when real study was conducted in Meru municipality.

3.9 **Data analysis**

Data analysis involved checking the research instruments to ensure completeness and error free. The data was categorized according to research questions. Qualitative data was organized into themes. The data was then coded and entered into Statistical Package for Social Sciences (SPSS) software. Quantitative data was analyzed using descriptive statistical analysis From SPSS, frequencies and percentages were calculated to give meaning to the data.

3.10 Operationalization of variables

Table 3.2 Operationalization of variables

Objectives	Variables	Indicators	Measurement	Scale	Data analysis
To establish the influence of cost of digital/electronic weighing and measuring instruments on legal metrology.	Independent variables a)cost of the instrument	Amount in kshs of the electronic weighing instruments	Number of traders able to afford an electronic weighing /measuring instruments	Interval	qualitative
	b) cost of maintenance	Number of times instrument is maintained in an year	Number of times repair is done in a year	Nominal	Quantitative
	c)avai lability of spare parts	Number of shops for instruments spare-parts.		Nominal	Quantitative
	Dependent variable Legal metrology		Many people using the electronic instrument		Quantitative
To assess the influence of operation of electronic weighing and Measuring instruments on	Independent variables Ease of use	Number of people who can be able to operate the electronic weighing and measuring instruments	Number of people using the electronic instruments in their weighing	Nominal	Quantitative

Objectives	Variables	Indicators	Measurement	Scale	Data analysis
legal metrology.		without problems.			
	Availability of power	Hours the weighing or measuring instruments can be in use without electricity.	Hours/days the instrument stays before charging	Interval	Quantitative /Qualitative
	Dependent variable Legal metrology		Number of people know how to operate electronic weighing and measuring instruments	ordinal	Quantitative
Establish the extent to which technical know-how and fining on electronic weighing and measuring	**a**)availability of technicians	Number of licensed weights and measures repairers within the Mcru municipality	Level of training	ordinal	Quantitative

Objectives	Variables	Indicators	Measurement	Scale	Data analysis
instruments influence legal metrology	**b**)training opportunities	Number of training sessions attended in a given period	Number of training available in a year	Nominal	Quantitative
	C)availability of training experts in legal metrology	Number of training personnel available and hours they are available to train	Number of training experts available Hours training experts is available	No mi nal	Quantitative
	Dependent variable Legal metrology		Many people are trained		Quantitative
Establish influence of standardization of electronic weighing and measuring instruments on legal metrology.	Independent variables a)Conformity with international recommendatio ns.				Quantitative
	b)Approval experts	Knowledge background of the approving persons.	Level of knowledge	ordinal	qualitative

Objectives	Variables	Indicators	Measurement	Scale	Data analysis
	Dependent variable Legal metrology			Nominal	Quantitative

t

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND INTERPRETATION

4.1 Introduction

This chapter involves the presentation and analysis of the collected data as well as interpretation of findings. Data is represented by use of frequency tables, tables, and charts.

4.2 Weights and measures officer's responses

4.2.1 Gender of respondents

Table 4.1 Gender analysis of the weights and measures officers

Below table shows the gender of weights and measures officer respondents.

Gender	frequency	percentage (%)
Male	5	83.3
Female	1	16.7%
Total	6	100%

The weights and measures office in Meru have 83.3% of male and 16.7% of female. This on the other hand leaves many with question of why there are so many men in the office and only one lady doing the legal metrology work, the researcher went deeper to find the reason for this and the results she got was that for you to qualify for the legal metrology work, you ought to have passed well in mathematics and physics. This from the tradition has been taken as the men's subjects with the ladies pursuing art subjects. Even with the gender balance being practiced now days in the government offices it seems that the government together with women still has a lot to achieve on this.

4.2.2 Level of education of weights and measures officers

Table 4.2 Education level of weights and measures officers

Below table shows the distribution of education levels of the weights and measures officers in meru region.

Level of education	Frequency	Percentage
Secondary	1	16.7
College	4	66.7
University	1	16.7
Total	6	100

From the calculations, 16.7% of respondent had reached secondary level, 66.7% in college level and 16.7% in the university level. This implies that all the respondents are competent for the jobs they do. The respondents also confirmed that they had undergone an in-job training ranging from 6 months to four years before actual starting of the work.

4.2.3Number of years in service

Table 4.3 Number of years in service

Below table shows the number of year's respondent has worked in the weights and measures

Yrs in service	Frequency	Percentage
0-5 yrs	i	16.7
6-10 yrs	1	16.7
Over 15 yrs	4	66.7
Total	6	100

4.2.4 Training opportunities for weights and measures officers

Most of the officers have confirmed that they have had training opportunities. The only problem they are encountering is that, there is no institute not only in Meru but in the country that is specifically set to train on weighing and measuring instruments. The training is done in-house at the weights and measures department headquarters.

Table 4.4 shows the relationship between performance of legal metrology duties and conversancy of the legal metrology requirements

Duty	performance Indicator (%)	conversancy with legal requirements (%)
Verification	60	50
Inspection	50	40
Sensitization	30	55
Stamping	100	100
Total	240	245

Table 4.4 shows that the weights and measures officer have an average mean of 60% of performance and mean conservancy with legal requirement in performance of duties of 61.25%. This is an indication that the officers are well skilled to do their work.

Table 4.5 shows the relationship between number of years in service and training opportunity on weights and measures requirements.

Number of years in service	Training opportunity
0-5 years	16.7%
6-10 years	16.7%
Over 15 years	66.7%
Total	100%

Table 4.5 shows that the more one had stayed in the service the more he had had training opportunity. For those who had worked for less than five years having 16.7%, between six and 10 years a 16.7% training opportunity and those with over 15 years having 66.67% training opportunity.

4.2.5 Challenges faced due to introduction of electronic equipments

From the data collected it is clear that there are several challenges that have come with the introduction of electronic/digital weighing and measuring equipment. These includes; lack of training for officers on their application and the equipment testing; overreliance on the manufacturers/ technicians even while doing the verification work; rapid change in technology thus not able to cope with the pace.

Table 4.6 shows cross tabulation between challenges and standardization problem impacting on legal metrology negatively.

Challenge	effect on standardization
Lack of training on application and the	
Equipment testing	100%
Overreliance on the manufacturers	100%
Rapid change in technology	100%

Table 4.6 shows there is a 100% negative impact on standardization brought about by lack of training of officers' on application and equipment testing, this leads to a situation where they rely on the manufacturer while doing their control work, the rapid change in technology has also rendered it impossible for the officers to move with the same pace.

4.3 weighing and measures repairer's responses

4.3.1 Gender of weighing and measures repairer's responses

Table 4.7 **Gender of weights and measures repairer's**

Below table shows the gender of weights and measures repairer's

Gender	frequency	percentage (%)
Male	8	100
Total	8	100%

All the weights and measures repairers in Meru region (100%) are male.

4J.2 Education level of weights and measures repairer's

Table 4.8 Education level of repairer's

Below table shows the education levels of the weights and measures repairers.

Level of education	Frequency	Percentage
Secondary	7	87.5
University	1	12.5
Total		100

87.5% of the repairers have reached secondary level as their highest level of education, while 12.5% has reached the university level. The repairers also confirmed that they have been gaining skills and knowledge from their fellow repairers especially those in Nairobi. Others have been learning through trial and error method.

4.3 J Period of service

Table 4.9 years working as a repairer

Table 4.9 shows the years that each weights and measures repairer has worked as repairers

Yrs in service	Frequency	Percentage
0-5 yrs	1	12.5
6-10 yrs	1	12.5
11-15 yrs	2	25.0
Over 15 yrs	4	50.0
Total	8	100

12.5% have worked between o and 5 years, 12.5% between 6 and 10 years, 25% between 11 and 15 years, while 50% have worked for over 15 years. Those who have stayed long in the repair field have been able to help others who are up-coming on the repair work.

43.4 License of repairer's

Table 4.10 license types of the repairers

Table 4.10 shows the license type the repairer has which also indicate the type and capacity of weighing and measuring instrument he is legally authorized to repair.

License type	Frequency	Percentage
Type 1	7	8Z5
Type 2	1	12.5
Total		**100**

87.5% of the repairers have type I, while 12.5% have type II license. There are six (6) different types of licenses that are given to qualified mechanics and technicians in order to repair different types of weighing and measuring instruments. The licenses are issued by the director of weights and measures department in the ministry of trade after the repairer has proved to have required skills and integrity to do so. The licenses are: Type 1- for repair of weights, spring balances, platform machines of capacity not exceeding 250kgs and non-self indicating instruments, Type 2 for repair of platform machines of capacity not exceeding 1,000 kgs, self- indicating and semi-self- indicating weighing machines, excluding weighbridges, Type 3 for repair of platforms exceeding 1,oookgs, weighbridges and automatic weighing machines, Type 4 for repair of balances of precision and weighing instruments incorporating electronic devices, Type 5 for repair of pumps, measure of capacity and bulk measures, Type 6 for repair of bulk meters and proving tanks and type 7 for repair of liquid measuring instruments incorporating electronic devices. It is therefore very clear from the data collected that there is no repairer in Meru who is qualified for the repair of the digital/electronic weighing/measuring equipment.

f

4.3.5 Training opportunities

Table 4.11 training opportunities for weights and measures repairers

Training opportunity	Frequency	percentage
Yes	6	75.0
No	2	25.0
Total	8	100

75% of respondent have had opportunities to enrich their knowledge, while 25% of the respondents did not have an opportunity. Even though most of the repairers have had opportunity for training, they were clear that they never had a chance to train and acquire skills and knowledge of repairing the electronic weighing/measuring equipment.

Table 4.12 shows the cross tabulation between training opportunities and number of years in service

Number of years in service	training opportunity
0-5 years	5%
6-10 years	15%
11-15 years	30%
Over 15 years	50%
Total	100%

Table 4.12 shows that the more the years that one had served a repairer, the more the training opportunity he had had. Those who had worked for up to 5 years had 5%, for 6 to 10 years 15%, 11 to 15 years had a 30% of opportunities while those who had worked over 15 years had a 50% of training opportunities.

43.6 Training institution

Table 4.13 training institutions on electronic weighing/measuring instruments in meru municipality

Training institution	Frequency	Percentage
Yes	0	0
No	8	100
Total	8	100

From the data collected, it is clear that there exists no institution in the Meru region which deals with weighing and measuring knowledge

4.3.7 Challenges encountered

Challenges encountered by the repairers includes: lack of transport, lack of cooperation from traders where traders feel that they are exorbitant on repair prices, lack of spare parts of some of the weighing and measuring equipments, means of submission for re-verification of the equipment and lack of capital.

Table 4.14 General challenges encountered by repairers

Table 4.14 shows general challenges encountered by repairers while performing their repair work.

Challenge	Percentage
Lack of transport	50
Lack of cooperation from traders	80
Lack of spare parts	90
Means of submission for re-verification	60
Lack of capital	85

43.8 Challenges due to use of electronic weighing and measuring equipments

Challenges encountered by the repairers due to introduction of electronic/digital weighing and measuring equipment includes: lack of experience to repair the equipments, rapid flow of the equipments into the market, lack of spare parts, different modes of calibrations for different weighing and measuring equipments and the cost of repairing the equipments is too high.

Table 4.15 shows cross tabulation between challenges faced by repairers due to use of electronic weighing equipment and lack of training opportunity

Challenge	lack of Training opportunity		Total
	Yes	No	
Lack of repair experience	85%	15%	100
Difference in modes of calibration	90%	10%	100

Table 4.15 shows that 85% of the repairers attributed their lack of experience to repair the electronic weighing equipment to lack of training, while 15% did not attribute their lack of experience to lack of the training opportunity, 90% also attributed different modes of calibrations of the electronic weighing equipment.

4.4 Traders responses

4.4.1 Gender

Table 4.16 Gender of traders who responded to the questionnaires

Gender	Frequency	Percentage
Male	143	46.7
Female	163	53.3
Total	306	100

From the calculations, 46.7% were male while 53.3% are female; this shows that there are more women who are trading. This was contributed by the fact that most of the businesses visited were

cereal stores; most men operated the butcheries and hardware shops. The store owners also confirmed that their husbands were out looking for more cereals as they did the selling.

4.4.2 Education level

Table 4.17 Education level of traders

Education level	Frequency	Percentage
Primary	14	4.6
Secondary	237	77.4
College	34	11.1
University	21	6.9
Total	306	100

4.6% of trader respondents reached primary level as their highest level of education, 77.5% reached secondary level, and 11.1% reached the college level while 6.8% have reached the university.

4.4.3 Business location

All businesses are within the Meru Municipality.

4.4.4 Type of business

Table 4.18 Type of business of traders

Business type	Frequency	Percentage
Butchery	45	14.7
Cereal store	104	34.0
Retail/wholesale shops	53	17.3
Others	104	34.0
Total	306	100

From the calculations, 14.7% businesses are butcheries, 34% are cereal stores, 17.3% are retail and others wholesale shops while 34,0% are other types of businesses including hardware shops, fashion exhibitions and furniture shops.

4.4.5 Use of weighing/measuring equipment

Table 4.19 Table showing the whether the respondent uses weighing/measuring instrument

Use of weighing/measuring instrument	Frequency	Percentage
Yes	285	93.1
No	21	6.9
Total	306	100

Most of the traders (93.1% of the respondents) confirmed that they used weighing/measuring instrument while 6.9% did not use any weighing/measuring instrument.

4.4.6 Type of equipment

Table 4.20 Type of weighing /measuring instrument that the respondent uses

Type of instrument used	Frequency	Percentage
Mechanical	124	43.5
Electronic/digital	161	56.5
Total	285	100

Out of the 285 traders who used weighing instruments, 43.5% used mechanical instrument, 56.5% used electronic/digital weighing /measuring instrument.

Table 4.21 shows the relationship between the profit earned per day and the type of weighing equipment used

Mean percentage	Type of weighing instrument	
Profits in '000'	mechanical	electronic
1.0 -2.0	40	5
2.1 -3.0	38	10
3.1 -4.0	30	15
4.1 -5.0	10	35
5.1 -6.0	5	44
6.1 -7.0	1	52
Total	124	161

Table 4.21 shows that there exists a relationship between profit earned and type of weighing instrument being used. Most of those who use mechanical instruments earned a mean profit of between kshs 1,000 and 4,000 in a day, while most of those who used the electronic instruments earned between kshs 4,100 and 7,000 in a day.

4.4.7 Knowledge on use of equipment

With minimum guidance from the sellers of instruments and the instrument manuals, the traders are able to operate the weighing and measuring instruments with little or no difficulties at all. This is contributed by the fact that most of the traders are well educated and many have also confirmed that they have been attending seminars and part time classes on how to better their businesses. For those who are not able to go further studies, they confessed that they always go for competent staff who are academically well equipped with business skills. Others also said that they have been taking their staff for further training

4.4.8 Number of repairs per year

Table 4.22 Repair for weighing/measuring instrument in a year by the users.

Number of repairs per year	Frequency	Percentage
Once	101	35.4
Twice	114	40.1
Five times	46	16.1
Others	24	8.4
Total	285	10cT

Most traders with electronic instruments repaired once or even did not repair their instruments apart from the annual verification and stamping by the weights and measures officers. On the other hand, those with mechanical instruments repaired them more than once per year.

4.4.9 Training and seminar

Table 4.23 training and seminar attained and attended by the respondents

Training /seminar attended	Frequency	Percentage
Yes	71	23.2
No	235	76.8
Total	306	100

23.5% of the respondents had seminars and training session's concerning use of weighing instruments and rules relating to the same. Most of the traders had not attended any training; this

was contributed by their tight schedules in their businesses leaving them with no extra time to attend such functions.

4.4.10 Challenges due to use of electronic/digital weighing and measuring equipment

Table 4.24 Challenges experienced by the respondent due to introduction and use of electronic weighing/measuring instruments.

Challenges	Frequency	Percentage
Lack of capital	48	15.7
Lack of power	61	19.9
Lack of spare parts	23	7.5
Cost too high	96	31.4
3 and 4	78	25.5
Total	306	100

Challenges due to introduction and use of electronic/digital weighing/ measuring instruments includes lack of capital to buy them, lack of power in some areas, lack of spare parts during repair, and the cost of maintaining being too high. Another challenge that most traders complained of is loss of customers for those who were still using the mechanical weighing and measuring instruments. Most customers especially those who were buying meat preferred to buy their meat from those using the electronic weighing machines. Those who were able to acquire electronic weighing/measuring instruments said that they had had a great change in their profits which were raising daily as more customers preferred to be weighed for using the electronic instruments. This have left them with more confidence of even abandoning there manual weighing instruments. Those with electronic instruments also confirmed that they were not repairing the instruments as many times as they did with the mechanical instruments.

The researcher during the survey observed how various challenges that were being faced by

traders impacted on legal metrology.

Table 4.25 shows cross tabulation of various challenges and there impact on legal metrology

Challenge	impact on legal metrology	
	Positive	negative
Cost of electronic weighing instrument	40%	60%
Cost of maintaining the electronic instrument	30%	70%
Lack of spare parts for the instruments	0%	100%
Fees for verification of instrument	10%	90%
Lack of qualified repair personnel	0%	100%

Table 4.25 shows that the cost of the electronic weighing instrument had a positive effect of 40% and a negative effect of 60%. With was brought by the argument that at this age of technological advancement, the high cost of electronic weighing instrument was hindering legal metrology in advancing technologically, it is also clear that lack of spare parts as well as qualified repair personnel had a 100% negative impact on the legal metrology aspect. The traders also complained that the fees charged for the verification was too high compared to those of mechanical ones, the traders were therefore reluctant to produce their instruments for verification.

CHAPTER FIVE

SUMMARY OF FINDINGS, DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the summary of the findings, discussions and study conclusions and gives recommendations. The main objective of this study was to establish the challenges being faced by various stakeholders due to the introduction and use of electronic weighing and measuring instruments in trade. The specific objectives of the study were: to establish the influence of cost of digital/electronic weighing and measuring instruments on legal metrology, to assess the influence of operation of electronic weighing and measuring instruments on legal metrology, establish the extent to which technical know-how and training on electronic weighing and measuring instruments influence legal metrology and establish how standardization of electronic weighing and measuring instruments influence legal metrology.

5.2 Summary of the findings

This section gives the summary of findings from the data analysis.

5.2.1 General information

Majority of the weights and measures officers, traders and repairers respondents are male (83.3%, 46.6%, and 100% respectively), the rest 16.7%, 53.4% and 0% respectively are female, Who has worked in their offices and businesses for more than 5 years. According to collected data, 16.7% of weights and measures officers have worked between 0 to 5 years, 16.7% has worked between 6 and 10 years and 66.7% have worked for over 15 years. 12.5% have worked between o and 5 years, for repairers, 12.5% had worked between 6 and 10 years, 25% between 11 and 15 years, while 50% have worked for over 15 years.

In addition most of the weights and measures officers (66.7%) had reached college level of education, 16.7% had reached secondary level, and 16.7% in the university level, (87.5%) of the repairers reached secondary level and 12.5% has reached the university level, while (77.5%) of

traders respondent had reached secondary level of education.

5.2.2 Cost of digital/electronic weighing and measuring instruments versus legal metrology

According to the data analysis, 15.6% of the traders lacked the capital to buy the digital/electronic weighing and measuring instruments in order to boost their businesses.31.6% of the traders complained of the high cost of maintaining the instruments due to consumption of power and cost of repairing in case of a breakdown. Some parts do not have electric power and those using the electronic instruments are forced to carry them to areas where there is power in order to charge them.

5.2.3 Operation of electronic weighing and measuring instruments versus legal metrology

Many traders do not have problem of using the electronic /digital weighing and measuring instruments as both the sellers of the instruments and the manuals are handy enough to guide them on the operation of the instrument. The problem comes in identifying whether the instrument is working correctly or not. Most or all the traders using this electronic /digital weighing and measuring instruments confessed that they cannot tell whether the instrument is cheating either them or the customer as it is the case with the manual weighing and measuring instruments. The weights and measures officers as well as the repairers also complained of the mode of operation of the electronic weighing and measuring instrument, saying that almost each instrument has a different method of operation thus they are forced to rely on the manufacturer in case of a problem.

5.2.4 Training on electronic weighing and measuring instruments versus legal metrology

From the analysis, 75% of both the weights and measures officers and repairers have not had adequate training to equip them well with knowledge to deal with electronic /digital weighing and measuring instruments. In addition 76.5% of the traders have not been in any training sessions on use of the electronic weighing and measuring instruments.

5.2.5 Standardization of electronic weighing and measuring instruments versus legal metrology.

Challenges encountered by the repairers due to introduction of electronic/digital weighing and measuring equipment includes: lack of experience to repair the equipments, rapid flow of the

equipments into the market, lack of spare parts, different modes of calibrations for different weighing and measuring equipments and the cost of repairing the equipments is too high. Challenges faced by weights and measures officers due to the introduction of electronic/digital weighing and measuring equipment. This includes lack of training for officers on their application and the equipment testing; overreliance on the manufacturers/ technicians even while doing the verification work; rapid change in technology thus not able to cope with the pace. From this it is clear that there lacks standardization of the electronic weighing and measuring instruments.

S.l Discussions

Technological advancement has taken the shape of all organizations. To remain in business and competitively, organizations are incorporating ICT in their daily routines as it is making them more competitive and are also able to update themselves with any new developments that are beneficial in good time. The weighing and measuring industries have not been left out either, organizations such as KTDA have acquired electronic weighing scales that have been programmed in such a way that, when a farmer weighs his or her tea in the buying centres the data is transmitted immediately up to the head quarters, this on the other hand has helped KTDA boost their trust with the farmers, reduce redundancy and also speed up the processes apart from reducing the overall head over costs. This is also helping the organization in meeting the ISO standards that helps them in the marketing of their products. Export firms are using ICT knowledge in their weighing in order to boost their sales in the world market.

The introduction and use of electronic/digital weighing and measuring instruments have come with various challenges to various stakeholders in the developing countries and especially in our country Kenya.

5.3.1 Cost of digital/electronic weighing and measuring instruments versus legal metrology

According to the data collected, more than 31.6% of traders who responded confirmed that the cost of both acquiring and maintaining the electronic weighing instruments is too high for them, this was coupled up with lack of electric power in some areas and those with electronic instruments were forced to take their instruments for charging now and then. Apart from the cost of the instruments there also lacks spare parts in case of a breakdown which adds to the cost of repair as the spares have to be gotten from Nairobi. Another problem that is adding to

the cost is the fact that there are no qualified repairers for the electronic instruments in Meru and organizations are forced to get repairers from Nairobi.

53.2 Operation of electronic weighing and measuring instruments versus legal metrology

According to Birzerba, the importance of industrial scales, as well as special weighing units has become greater for following industries: steel works and foundries, chemicals, food, animal feed, meat and dairy plants and other branches of industry. Besides weighing, these industrial scales must fulfill numerous other operations such as filling, mixing, batching, checking, control, counting, printing of weights, or transmission of data into process computers, and at least control entire manufacturing cycles. In doing so, electricity and electronics play an ever increasing part today.

According to Ngaari (2010), an inspector of weights and measures, majority of people are not familiar with use of electronic equipments and the traders with some technicians were taking advantage of the situation to cheat them. According to observations made during the survey, this is true, most customers and even traders were not conversant with the use of the electronic instruments and did not know whether they were getting their money's worth. The traders rely on the manual and at times affect the operation of the instruments. Though at the beginning there are difficulties, the traders are coping with the technological changes and have started appreciating it.

5.3.3 Training on electronic weighing and measuring instruments versus legal metrology

According to Onyango (2003), an inspector of weights and measures, much of the technical regulations in use today were borrowed from the British Weights and Measures act way back in 1963. These regulations have largely remained the same. This is largely attributed to lack of technical committees to review and recommend OIML recommendation wherever possible. Kenya has no institutions offering course in legal metrology, as a result the training function is currently done in-house. From data collected things are still the same and weights and measures officers are not well equipped to approve the electronic weighing machines. Most of the times they are forced to rely on the manufacturer on any available information while doing the approval, this is making them to lose control over the same. On the other hand the repairers have not had an easy sail through either; this is because those who have the knowledge of the electronic weighing and measuring instruments are not ready to share so that they can remain the

kings in the business. The traders are also suffering as they are not able to detect in good time when their instruments is not working properly as is the case with manual instruments. According to Afrimets 2011 there is often lack of competence and skills for both weights and measures officers and repairers in Africa which leads to competitive disadvantage in the international market.

53.4 Standardization of electronic weighing and measuring instruments versus legal metrology

Onyango (2003,), an inspector of weights and measures observed that the ideal situation for a manufacturer of weighing and measuring instruments would be to achieve worldwide acceptance of a certificate by one-stop testing of his product in just one laboratory of his choice. But this is not the case as on the global scale, different trends of a politico-economical nature are observed in legal metrology. EL Sayed, head of the NIS Office of international affairs (NIS-OIA) and Assistant Secretary General of Arab Federation for Metrology (AFM) said the four pillars of a quality structure are metrology, standardization, conformity assessment and accreditation. From data collected, the officers emphasized of the need to standardize the electronic weighing and measuring instruments to ease their work in the field as at now each instrument has a different method of calibration. The repairers complained of the rapid flow with which the instruments are flowing into the market, they also said that the electronic instruments had different modes of calibration.

5.4 Conclusions

The study findings reveal that with the introduction and use of electronic/digital weighing and measuring instruments in the market, various challenges are being faced by various stakeholders. These includes: lack of capital, lack of spare parts, lack of sufficient skills and knowledge , competitive disadvantage of those not using the electronic instruments and overreliance on the manufacturers for approval and maintenance. According to the collected data, all the weights and measures officers admitted that they required training on the application and testing of the electronic weighing and measuring instruments, they also admitted that they were relying on manufacturers even while doing their verification work which is supposed to be the other way round. The officers emphasized of the need to standardize the electronic weighing and measuring instruments to ease their work in the field as at now each instrument has a different method of

calibration.

The repairers complained of the rapid flow with which the instruments are flowing into the market, they also said that the electronic instruments had different modes of calibration which is making it difficult for them to learn the new technology. On the other hand they admitted that they did not have the required skills and knowledge to repair the electronic weighing and measuring instruments and they were being forced to send them back to Nairobi for repairs, the repairs also complained of the lack of spare parts in Meru to repair the same. Some 75% of the repairers felt that they were being competitively disadvantaged by the use and introduction of the weighing and measuring instruments both legally as they do not legal licenses to repair them and academically as they did not a chance to go for further training even if they wanted, this is because there are few institute that dealt with the same. According to collected data, 100% showed there were no institutes in Meru that trained on electronic weighing instruments.

The traders encountered various challenges due to use and introduction of electronic weighing and measuring instruments in the market: 15.6% admitted that they lacked capital to buy the instruments, 19.9% complained of lack of power in the area they work, 7.5% complained of lack of spares for the instruments when they required repair.31.6% said that the cost of maintaining the instruments was too high compared to that of mechanical or manual weighing and measuring instruments. 25.4% of the traders said that the cost was too high which was contributed by lack of spares and also qualified technicians to do the repair work when need aroused. Though not all the traders possessed the electronic weighing instruments, according to collected data 53.7% had electronic instruments while 40.7% had mechanical instruments, they admitted that technology was changing the face of businesses. Those with electronic instruments confirmed of raised earnings while those with mechanical ones admitted that they were losing more and more customers as well as their profits and they were contemplating of acquiring the electronic weighing and measuring instruments if they were to remain in business. The traders also admitted that the electronic instruments required less repairs compared to the mechanical ones.

5.5 Recommendations

The researcher recommends the following:

1. The weights and measures departments needs to regain its control by training their staff further on the application and testing of the electronic weighing and measuring instruments.
2. The repairers need to seek further knowledge in order to cope with the pace of the technological development.
3. The government should establish regulation and control of the manufacture of the electronic weighing and measuring instruments as well as establish standardization of the same.
4. The weights and measures officers should also raise more sensitization and awareness to the public on rules relating to weighing and measuring.
5. The traders should be empowered through subsidized loans for them to be able to go hand in hand with the rest of the world and remain competitive both in the local and international market.

5.6 Areas for further researches

The researcher suggests that;

I. Assess the economic impact of electronic weighing on international market.
II. Influence of academic performance of girl child on performance of legal metrology duties.
III. Assess challenges due to introduction and use of electronic weighing and measuring instruments in other areas.

REFERENCES

Bruce A. Pasternak and Albert. J. Viscio (2002)"*The Centerless Corporation"*

Barry W. Paulson, Economic Analysis of the National Measurement System September 1977, A report from the 1972-75 Study of the National Measurement System by the NBS Institute for Basic Standards pi-37

Birch, J A (2001), The Role of Legal Metrology in Economic and Social Development in Papua New Guinea. Seminar at the Department of Trade and Industry, Port Moresby, PNG, 2 September

Chairpersons Summary Report, Expert Meeting on Diversification of Production and Exports in Commodity Dependent Countries, Including Single Commodity Exporters for Industrialization and Development, taking into account the Special Needs of LDCs, Geneva 26-28 June 2002

Cesar Luiz L. M. da Silva " Legal Metrology and Consumer Protection

Common criteria for Information Technology, (2009) version 3.1, revision 3

D. Richter, Validation of software in metrology, computer standards and interfaces (2006) vol. **28**

Economic Recovery strategy for wealth and Employment creation (ERS, 2003-2007).

George A. Akerlof, The Market for "Lemons": Quality Uncertainty and The Market Mechanism, Quart. J. of Economics, 84, 1970, 488-500.

Geoffrey Heal, (1976) Do Bad Products Drive out Good, Quart. J. of Economics 90, 499-503.

Government Press Revised Edition (1993) Laws of Kenya, weights and measures act chapter 513,

Gregory Tassey, (1992) Technology Infrastructure and Competitive Position (Kluwer Academic **Publishers)**

Hari Prawoko,(1999) Measuring Bulk Materials in Trade by Draft Survey, Problems and implementation, 6th APLMF Forum, Nusa Dua, Indonesia.

Ian Dunmill, BIML Assistant Director, World trade organization 2009, G/TBT/GEN/87

International Organization of legal metrology, (2008) general requirements for software controlled measuring instruments, OIML31:2008

Jens Chr. Lange, (1985). High Capacity Bulk Weighing for Iron Ore, OIML Seminar on Testing of Bulk Weighing Installations, April 1985, 14 Pages

Jeremy Bray, (1986) The impact of systems thinking in government, *Measurement And Control,* 19,175-180, July 1986.

J.M. Juran ed., A History of Managing for Quality, ASQC Quality Press

J.S.Hunter, (1980) The National System of Scientific Measurement, *Science,* 210, 869-873, November 1980

Kenneth J.Arrow, (1972). Gifts and Exchanges, Philosophy and Public Affairs, 1,343-362.

Kenneth J. Arrow, (1974) *The Limits of Organization,* W.W. Norton

Kombo D. K and Tromp E. A (2006) Proposal and thesis writing. An introduction Pauline's publication Africa Nairobi

Manfred Kochsiek,(2002), paper presented at the OIML seminar in France on "what will legal metrology be in the year 2020"

Mr. Brian Beard, (2011) AFRIMETS, legal metrology overview pg 19

Mugenda and Mugenda (2003) Research Methods Quantitative and Qualitative Approaches

Mutai K. B (2000), how to write Quality research proposal, these publications, George squire, Edinburgh (Scotland)

National Academy of Sciences (US) (1979), Science and Technology-a Five Year Outlook (W.H.Freeman and Company)

N. Greif, (2006) Software testing and preventive quality assurance for metrology, computer standards and interfaces, vol. 28

Phillip Nelson, (1970) Information and Consumer Behavior, J. of Political Economy, 78, 311-329.

Proben Howarth (2008). Methodology -in short 3rd Edition

Prof Dr Ahmed El Sayed, (2011) Afrimets, the four pillars of national quality infrastructure, pg 17

R.D.Huntoon, (1967) Concept of a National Measurement System, *Science* 158, 67-71, October

Ram Charan and Noel. M. Tichy (2000) "Every Business is a Growth Business"

Raymond C.Sangster,(1972-75) Final Summary Report Study of the National Measurement System , NBSIR 75-925, December 1976,1-35

Republic of Kenya trade and industry quarterly publication, vol. 1, (2001)

Republic of Kenya trade and industry quarterly publication, vol. 2, (2006)

Republic of Kenya, trade and industry quarterly publication vol.1, 2006 "the scope and dynamics of legal metrology in Kenya pg 10

Republic of Kenya, trade and industry quarterly publication vol.3, 2007 "legal metrology standardizing weights and measures" pg 26

Republic of Kenya, trade quarterly publication vol.1 (2009)

Robert J. Shapiro "The Global Context for Technology and Trade"

Robert's E. Hebner (2008), a paper on research on technological development on standards, measurements and testing in the USA.

Sekarah, Uma (2007) Research Methods for Business, John Wiley and sons, Singapore

The Journal of Language, (1998) Technology & Entrepreneurship in Africa, Vol. 2. No.1. 2010, ISSN -1279 106

S.Wayne Stiefel, (1973) Management Assistance for Weights and Measures Progress, Measuring Inaccuracy's Economic Distortion, presented at the 58th National Conference on Weights and Measures.

The trading standards monitor ITS A publication (2000), technological developments security of computerized instruments. Pg 18

The trading standards monitor ITSA publication (2003), what will legal metrology be in year **2020**

Vision 2030

www.oiml.org(2011) *"Press Release WORLD METROLOGY DAY 2011"*

World Development Report (1997)-The State in a Changing World (The World Bank/ Oxford University Press 1997)

APPENDICES

APPENDIX Is INTRODUCTORY LETTER

Florence W. Njihia

P.O. box 2422

Meru.

15/05/2012

Dear respondent

RE: RESEARCH ON CHALLENGES FACING USE OF TECHNOLOGY IN LEGAL METROLOGY WITHIN MERU MUNICIPALITY

I AM A STUDENT AT THE University of Nairobi carrying out a study on challenges facing use of technology in legal metrology within the Meru Municipality being part of the partial fulfillment for the award of the degree of Master of Arts in Project Planning and Management.

I kindly request your input through filling this questionnaire. Please note that your honest response will be in strict confidence and any additional information you may consider relevant for this research will be greatly appreciated.

Thank you in advance.

Yours truly

Florence W. Njihia.

APPENDIX II: QUESTIONAIRES'

QUESTIONAIRE FOR WEIGHTS AND MEASURES OFFICER

Instructions: Please tick the correct answer

1. Please indicate your gender

   Female [ ]

   Male [ ]

2. What is your designation?

3. For how long have you been in the service?

   0-5 yrs [ ] 6-10 yrs[] 11-15 yrs[] overl5yrs[]

4. State your highest level of education

   Primary level [ ]

   Secondary level [ ]

   College [ ]

   University [ ]

5. Are there adequate training opportunities?

   Yes [ ] No [ ]

6. If yes, have you been able to attend to those relevant to your field of work?

7. Are you conversant with all weighing and measuring instruments in your area of work coverage?

8. Which area do you feel need to be improved upon?

9. Do you hold seminars/training sessions for public especially on use and laws concerning weighing and measuring instruments?

Yes [ ] No [ ]

10. If yes, how often?

11. If no, why?

12. How do you ensure all weighing and measuring instruments in your area of jurisdiction is weighing accurately?

13. What challenges have you encountered with introduction and use of electronic weighing and measuring instruments?

QUESTIONAIRE FOR TRADERS

Instructions: Please tick the correct answer

1. Please indicate your gender

   Female

   Male [ ]

2. State your highest level of education

   Primary level [ ]

   Secondary level i |

   College []

   University []

3. Please indicate Location of business.

   Makutano [ ] Meru town [ ] Kaaga/kemu [ ] Gitimbine [ ] Thimangiri [ ]

   Other[ ]

4. What is type of business?

   Butchery [ ] Cereals store [ ] retail/wholesale shop [ ] others [ ]

5. Do you use any weighing or measuring instrument in your business?

   Yes [ ] No [ ]

6. If yes, what type of instrument do you use?

   Mechanical [ ] Electronic/digital [ ]

7. How do you know whether your instrument is working well?

   iii

8. How often is your instrument repaired in a year?

Once [ ] twice [ ] five times [ ] other specify [ ]

9. Do you take your instrument for verification and stamping?

   Yes [ ] No [ ]

10. What challenges have you encountered while using weighing or measuring instrument?

    I

    Ii

    Iii

    IV

    V

    VI

    Vii

11. Are you aware of laws concerning use of weighing and measuring instruments?

    Yes [ ] No [ ]

12. Have you attended any seminar or training concerning the use and laws governing use of weighing and measuring instrument?

    Yes [ ] No [ ]

PL ESTIONAIRE FOR LICENCED WEGHITS AND MEASURES REPAIRERS

Instructions: Please tick the correct answer

1. Please indicate your gender

   Female [ ]

   Male [ ]

2. State your highest level of education

   Primary level [ ]

   Secondary level [ ]

   College [ ]

   University [ ]

3. For how long have you repaired weighing/ measuring instruments?

   0-5 yrs [ ] 6-10 yrs [ ] 11-15 yrs [ ] over15yrs[ ]

4. Do you repair all types of weighing or measuring instruments? Specify

5. Do you have opportunity to add your knowledge?

6. Are there any institutions within your region offering necessary skills to better your work?

7. What challenges have you encountered while doing your work?

   I

   Ii

   Iii

   IV

   V

8. What challenges are you facing due to introduction and use of electronic weighing and measuring instruments?

   I

   Ii

   Iii

   Iv

   V

Appendix III: OBSERVATION SCHEDULE

1. Type of weighing /measuring instrument being used.
2. Checking the condition of weighing instrument.
3. Check whether the instrument has been verified and has current stamp.
4. Assess knowledge of user of electronic weighing instrument on use of instrument.

Appcadii IV: Sample size determination

Table III. Sample size determination

Table 1. Sample size for ±3%. ±5%. ±7%, ± 10% precision levels Where Confidence Level is 95% and p=.5

Size of	Sample size (n) for precision (e)of:			
Population	±3%	±5%	±7%	±10%
500	a	222	145	83
600	a	240	152	86
700	a	255	158	88
800	a	267	163	89
900	a	277	166	90
1,000	a	286	169	91
2,000	714	333	185	95
3,000	811	353	191	97
4,000	870	364	194	98
5,000	909	370	196	98
6,000	938	375	197	98
7,000	959	378	198	99
8.000	976	381	199	99
9,000	989	383	200	99
10,000	1,000	385	200	99
15,000	1,034	390	201	99
20,000	1,053	392	204	100
25,000	1,064	394	204	100
50,000	1,087	397	204	100
100,000	1,099	398	204	100
>100,000	1,111	400	204	100

a=Assumption of normal population is poor (Yamane, 1967). The entire population should be sampled