



**Sudan University of Science and Technology**

**College of Graduate Studies**



**The Impact of Internal Audit on Improvement of Quality  
System Regarding ISO 17025 in National Leather Technology  
Center and Sudanese Standards and Metrology Organization,  
Khartoum State- Sudan**

**أثر المراجعة الداخلية على تحسين نظام الجودة فيما يتعلق بالآيزو 17025  
في المركز القومي لتكنولوجيا الجلود و الهيئة السودانية للمواصفات و المقاييس،  
ولاية الخرطوم - السودان**

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degree in Total Quality Management and Excellence

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# الآية

قال تعالى:

بسم الله الرحمن الرحيم

(وَتَرَى الْجِبَالَ تَحْسَبُهَا جَامِدَةً وَهِيَ تَمُرُّ مَرَّ السَّحَابِ ج

صُنِعَ اللَّهُ الَّذِي أَنْقَنَ كُلَّ شَيْءٍ ج إِنَّهُ خَيْرٌ بِمَا تَفْعَلُونَ)

صدق الله العظيم

سورة النمل - الآية 88

# Dedication

To the soul of my father who carried me to this level.

To my beloved mother.

To my beloved husband who supported me without limits until this work was  
completed.

To my beloved brothers, sisters and friends.

I dedicate this work.

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## **Abstract**

This a descriptive case study aimed to assess the impact of the internal audit on improvement of the quality system regarding ISO 17025. The study was conducted at National Leather Technology Center and Sudanese Standards and Metrology Organization in Khartoum State- Sudan, during the period from August 2018 to August 2019. A questionnaire was used as data collection tool. Thirty questionnaires were distributed to all laboratories in the study area, 26 of the laboratories technicians were respond with percentage of (87%) and 4 were not respond. The data were analyzed using the statistical package for the social sciences (SPSS); the methodology used was the descriptive correlation analysis. The study showed that (65.9%) respondents were strongly agreed that there was a relationship between implementation of internal audit methodology and implementation of the quality system according to requirements for performance competence of calibration and testing laboratories ISO/IEC 17025:2005. Also, the study reflected that (56%) respondents were strongly agreed that there was a relationship between implementation of internal audit methodology and number of cases of non-conformity of the quality system according to requirements for performance competence of calibration and testing laboratories ISO/IEC 17025:2005. In addition to, (54.6%) of them strongly agreed that there was a relationship between implementation of the internal audit methodology and the continuous improvement of the quality system and increased customer satisfaction. The study indicated that implementation of the internal audit methodology

have impact on the improvement of the quality system according to the requirements of ISO/IEC 17025:2005 in the study area.

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## المستخلص

هدفت هذه دراسة الحالة الوصفية لتقييم أثر المراجعة الداخلية على تحسين نظام الجودة فيما يتعلق بالآيزو 17025. أجريت الدراسة في المركز القومي لتكنولوجيا الجلود و الهيئة السودانية للمواصفات و المقاييس في ولاية الخرطوم- السودان، خلال الفترة من أغسطس 2018 إلى أغسطس 2019م. استخدمت الاستبانة كأداة لجمع البيانات. ثلاثون استبانة وُزعت على جميع تقنيي المعامل في منطقة الدراسة، استجاب منهم 26 بنسبة (87%) ولم يستجب 4 منهم. حُللت البيانات باستخدام الحزم الإحصائية للعلوم الاجتماعية (SPSS)، المنهجية التي استخدمت كانت التحليل الوصفي الارتباطي. اظهرت الدراسة أن (65.9%) من المستجيبين وافقوا بشدة على وجود علاقة بين تطبيق منهجية المراجعة الداخلية و تطبيق نظام الجودة وفقاً للمواصفة القياسية لكفاءة أداء معامل المعايرة و الإختبار آيزو 17025: 2005. أيضاً، عكست الدراسة أن (56%) من المستجيبين وافقوا بشدة على وجود علاقة بين تطبيق منهجية المراجعة الداخلية و عدد حالات عدم مطابقة نظام الجودة وفقاً للمواصفة القياسية لكفاءة أداء معامل المعايرة و الإختبار آيزو 17025: 2005. بالإضافة إلى، (54.6%) منهم وافقوا بشدة على وجود علاقة بين تطبيق منهجية المراجعة الداخلية و التحسين المستمر لنظام الجودة و زيادة رضا العملاء. خلصت الدراسة إلى أن تطبيق منهجية المراجعة الداخلية له أثر في تحسين نظام الجودة وفقاً للمواصفة القياسية لكفاءة أداء معامل المعايرة و الإختبار آيزو 17025: 2005 في منطقة الدراسة.

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# **CHAPTER ONE**

## **Introduction, Research Problem, Rationale, Objectives and Hypotheses**

# Chapter 1

## Introduction, research problem, rationale, objectives and hypotheses

### 1.1 Introduction

International organization for standardization/international electro technical commission (ISO/IEC) 17025 is the global quality standard for testing and calibration laboratories, it is the basis for accreditation from an accreditation body. Laboratories that are accredited to this international standard have demonstrated that they are technically competent and able to produce precise and accurate test and\ or calibration data, located anywhere in the world. Accreditation is an objective way to assure customers that technical competence has been fully implemented to provide reliable and accurate test or calibration results (Borsting *et al.*, 2009). ISO/IEC 17025 is an ideal management system model for laboratories because it aims to control quality costs, improve measurement accuracy and guarantee consistency of results. It is also customer-driven when implemented correctly. Furthermore, when your company achieves ISO/IEC 17025 accreditation, you will be presented with a certificate of accreditation. This certificate can be used in advertising, promotional literature and stationary to show current and potential customers that your laboratory is committed to quality and has demonstrated technical competency to perform calibration or testing services (Metha, 2013). There are two main clauses in ISO/ IEC 17025:2005: management requirements and technical requirements. Management requirements are specializes in the operations, activities and the effectiveness of the quality system in the laboratory. And it has requirements similar to the standard requirements of ISO 9001. Technical requirements address the competence of staff, testing, methodology, equipments and reporting of test and calibration results. In the 10<sup>th</sup> items of the standard of ISO/IEC 17025:2005 improvement was



achieved as a basic requirement by improving the effectiveness of the quality system continuously by focusing on quality policy, quality objectives, internal audit results, data analysis, corrective actions, preventive actions and management review (Huber, 2007). Auditing is defined as the on-site verification activity, such as inspection or examination, of a process or quality system, to ensure compliance to requirements. An audit can apply to an entire organization or might be specific to a function, process, or production step. Some audits have special administrative purposes, such as auditing documents, risk, or performance, or following up on completed corrective actions. Some audits are named according to their purpose or scope. The scope of a department or function audit is a particular department or function. The purpose of a management audit relates to management interests, such as assessment of area performance or efficiency. An audit may also be classified as internal or external, depending on the interrelationships among participants. Internal audits are performed by employees of your organization. External audits are performed by an outside agent. Internal audits are often referred to as first-party audits, while external audits can be either second-party or third-party (ASQ, 2019). Internal audit is one of the most important requirements of the system of organizations that adopt ISO/IEC 17025:2005 which is one of the most important which is mediated by examines and evaluates the activities within the organization which have been established in the form of producers and work instructions to ascertain their compliance with requirements of standard 17025. Implement the producers established by them and ensure their effectiveness and seek to improve all their activities to increase their effectiveness (ASQ, 2019).

## **1.2 Research problem:**

The lack of full implementation of internal audit within the laboratories is the most important reasons that lead to inaccurate and retesting results. So, this study tried to answer the following questions:

What is the impact of implementation of internal audit on implementation of the quality system according to requirements of ISO/IEC17025:2005 in the study area?

What is the impact of implementation of internal audit on the number of cases of non-conformity of the quality system according to requirements of ISO/IEC17025:2005 in the study area?

What is the impact of implementation of internal audit on continuous improvement of the quality system and increased customer satisfaction according to requirements of ISO/IEC17025:2005 in the study area?

### **1.3 Rationale:**

Nowadays, quality is important in business and industries world. Many of the customers require high quality product and service. In order to fulfill the requirements of the customers, the company must have a quality system to ensure that their product or service that provided has high quality to fulfill the customer requirement. For a laboratory that only provide testing and calibration to the customer, it should have a quality system that to ensure the testing and calibration result has high quality that fulfill the requirement of the customers. If the laboratory has been accredited with this standard, the testing and calibration results are being recognize internationally. So, this study will be beneficial to the laboratory community and it enhances the importance of implementation of the internal audit on improvement of quality system according to ISO/IEC 17025 for the economic and social development of the country. In addition to helpful to assess the views of employees involved in the management system based on ISO/IEC 17025. Therefore, findings are expected to contribute towards improving staff motivation and the management system.

## **1.4 Objectives:**

### **General objective:**

To assess the impact of internal audit on improvement of quality system according to requirements for performance competence of calibration and testing laboratories ISO/IEC 17025:2005 in National Leather Technology Center and Sudanese Standards and Metrology Organization, Khartoum State- Sudan.

### **Specific objectives:**

- To identify the relationship between implementation of internal audit and implementation of the quality system according to requirements of ISO/IEC 17025:2005 in the study area.
- To identify the relationship between implementation of internal audit and the number of cases of non-conformity of the quality system according to requirements of ISO/IEC 17025:2005.
- To identify the relationship between implementation of internal audit and continuous improvement of the quality system and increased customer satisfaction according to requirements of ISO/IEC 17025:2005.

### **1.5 Research hypotheses:**

- There is a statistically significant relationship between implementation of internal audit and implementation of the quality system according to requirements of ISO/IEC17025:2005 in the study area.
- There is a statistically significant relationship between implementation of internal audit and the number of cases of non-conformity of the quality system according to requirements of ISO/IEC17025:2005 in the study area.
- There is a statistically significant relationship between implementation of internal audit and continuous improvement of the quality system and increased customer satisfaction according to requirements of ISO/IEC17025:2005 in the study area.

**CHAPTER TWO**  
**Literature Review**

## **Chapter 2**

### **Literature review**

#### **2.1 The quality:**

It is an undeniable fact that, in our contemporary world, being competitive is the key to success for any company. Competitiveness involves delighting the customer and exceeding his expectations and to achieve these goals, there is a need for quality. The benefit attached to the quality of products is the reputation it brings to company. In addition, the search for quality drives companies towards continual improvement of their management system and development of efficient ways to meet customer satisfaction (Khodabocus, 2011).

##### **2.1.1 Definition of quality:**

Quality is defined as the essential character of something, an inherent or distinguishing character, degree or grade of excellence (Lewis and Veerapillai, 2004). Quality satisfies the (expressed needs) customers, delights them by fulfilling their unstated or implied needs, and as per current trend, quality is to enchant the customers (Naagarazan and Arivalagar, 2006).

##### **2.1.2 Quality concept and perspectives:**

Quality has been a common concept in history, and has been one of the most controversial concepts. It is because of the variation of human perception in the world, as well as the difference in culture, that make the concept of quality and quality assurances vary from place to place. As there are different ways to understand and interpret the concept of quality, there is also neither way to define quality simply with a single perspective. Therefore, quality is not just characteristic of a product used daily, but also applied to a process or system. In modern business context, the concept of

quality expands to processes, organization, responsibilities, work instructions and resources to meet normal ISO standards (Hoyle, 2007). It is an essential approach and a tool for all business looking for sustainable development. This could be simply explained in a way that, when a business implements quality into all the process, improvement of business performance can always be created and renewed. After all, quality has become a necessary factor for a successful business (Bui, 2017).

### **2.1.3 Quality in laboratories:**

From several definitions that quality could be understood, there is one that more notice able and suitable in laboratorial work, known as freedom from defects, imperfections or contamination (Hoyle, 2007). Laboratories generally have a slightly different approach towards quality and customers. It has become crucial to determine the validity and to improve the results delivered. Even if a laboratory is operated as a private business, the accuracy, quality and validity of results are still more important than customers' opinions. Thus, it turns into a questionable matter if assessing quality shall be done on the single point of view of the users or customers. Quality in laboratories can be considered as work to be done in order to conform to requirements and guidelines from standardized and accredited organizations. Under business angle, it is an act to be accepted by the customers (Bui, 2017).

### **2.2 Quality management system (QMS):**

A quality management system (QMS) is formed by a series of coordinated activities that are carried out on a set of elements to achieve the quality of the products or services offered to the customer or user. In the case of laboratory, the accuracy, reliability and timeliness of the analytical results reported defined its quality, and all aspects of analytical. The QMS plans,



controls, shares, and improves the elements that influence the fulfillment of user requirements and satisfaction as well. An alternative definition of a QMS is through the meaning of each word separately, according to the ISO 9000:2015 quality management system fundamentals and vocabulary:

- System: a set of interrelated or interaction elements.
- Management: coordinated activities to direct and control an organization.
- Quality: degree in which a set of inherent characteristics of an object (product, service process, person, resource, etc.) meet the requirements (established need or expectation, generally implicit or mandatory).

The business, planning, and control activities performed on a set of elements to achieve quality represent a QMS (Valdivies-Gomez and Aguilar-Quesada, 2018).

### **2.2.1 The purpose of a QMS in a testing laboratory:**

A QMS in attesting laboratory is a way of showing that the quality of the final test results can be relied upon. The presence of quality assurance, through the use of appropriate procedures and management methods, guarantees clients that errors, in test results, are minimized. The QMS provides the laboratory with measurement traceability, the opportunity of error prevention by the use of preventive actions and the possibility of initiating corrective action when errors are detected (Khodabocus, 2011).

### **2.2.2 Elements of quality management system:**

Quality management system is built up with quality documentation and quality system records. They are different documents and records, organized a hierarchical level. The top level includes business strategic document, quality policy. Quality policy expresses the top management objectives and commitment to business quality. The central of quality documentation is quality manual which must have strongest authority within the system and

also shows commitment from top management level to the quality system. The next level of quality includes standard operation procedures (SOPs). Standard operation procedures are more specified documents created for each section of the quality management system. Following SOPs are step-by-step operating procedures and work instructions, as well as any other necessary external guidelines. In the bottom of the documentation system are check lists, forms, records resulted from the quality management system (Bui, 2017).

### **2.2.3 Quality management system audit:**

Is one of the quality tools to assist organization to improve quality performance. They are commonly used in the effort to diagnose, maintain, and improve quality management system. The need to improve organization performance has been a major discussion issues due to competitive pressure in manufacturing industries. In order to achieve the higher competitiveness level, these organizations must be able to identify the current quality performance and realign their strategies, operations and process to improve the quality performance. Audit is one of the many tools that have been found useful to identify the current quality performance by diagnosing the opportunities for improvement and plan for improvement action (Hepner *et al.*, 2004). Purpose of the audit can be divided into compliance audit and management audit. Compliance audit look for conformance to the audit criteria, while management audit look for conformance to the audit criteria and the effectiveness of the process and opportunities for improvement in achieving organization goals. Example of conformance audit includes financial audit, tax audit, and regulatory audit. The management audits include manufacturing audit, product and process audit and improvement audit (Hepner *et al.*, 2004).

### **2.3 Terms and definitions:**

**Audit:** Systematic, independent and documented process for obtaining audit evidence and evaluating it objectively to determine the extent to which the audit criteria are fulfilled (ISO 19011, 2011).

**Audit criteria:** Set of policies, procedures, or requirements used as a reference against which audit evidence is compared (ISO 19011, 2011).

**Audit evidence:** Records, statements of fact or other information which are relevant to the audit criteria and verifiable (ISO 19011, 2011).

**Audit findings:** Results of the evaluation of the collected audit evidence against audit criteria (ISO 19011, 2011). Audit findings indicate conformity or non conformity and can lead to the identification of opportunities for improvement or recording good practices.

**Audit conclusion:** Outcome of an audit, after consideration of the audit objectives and all audit findings (ISO 19011, 2011).

**Audit client:** Organization or person requesting an audit (ISO19011, 2011).

**Auditee:** Organization being audited (ISO 19011, 2011).

**Auditor:** Person who conducts an audit (ISO 19011, 2011).

**Audit team:** One or more auditors conducting an audit, supported if needed by technical experts (ISO 19011, 2011).

**Technical expert:** Person who provides specific knowledge or expertise to the audit team. Specific knowledge or expertise is that which relates to the organization, the process or activity to be audited or language or culture, he does not act as an auditor in the audit team (ISO 19011, 2011).

**Observer:** Person who accompanies the audit team but does not audit, he is not part of the audit team and does not influence or interfere with the conduct of the audit. An observer can be from the auditee, a regulator or other interested party who witness the audit (ISO 19011, 2011).

Guide: Person appointed by the auditee to assist the audit team (ISO 19011, 2011).

Audit programme: Arrangements for a set of one or more audits planned (ISO 19011, 2011). For specific time frame and directed towards a specific purpose.

Audit scope: Extent and boundaries of an audit (ISO 19011, 2011).

Audit plan: Description of the activities and arrangements for an audit (ISO 19011, 2011).

Risk: Effect of uncertainty on objectives (ISO 19011, 2011).

Competence: Ability to apply knowledge and skills to achieve intended results. Ability implies the appropriate application of personal behavior during the audit process (ISO 19011, 2011).

Conformity: Fulfillment of requirement (ISO 19011, 2011).

Nonconformity: Non-fulfillment of a requirement (ISO 19011, 2011).

## **2.4 International organization for standardization/international electro technical commission (ISO/IEC 17025):**

### **2.4.1 Background:**

ISO is based global consortium in Geneva and has a membership of more than 90 national standardization body, was shortened (ISO) based on the Greek word "ISOS" which means "Equal". ISO creates documents that provide requirement, specification, guidelines or characteristics that can be used consistently to ensure that materials, product processes and services are fit for their purpose. It covers almost every industry, from technology to food safety, to agriculture and healthcare. It is an international organization for standardization (ISO) and the international electro technical commission (IEC) standard used by testing and calibration laboratories to provide a basis for accreditation of laboratory quality systems (Hahn and Christian, 2016).

#### **2.4.2 ISO/IEC 17025:2005 competence of calibration and testing laboratories:**

ISO 17025 establishes a set of requirements that must be met by entities performing tests and/ or calibrations, including sampling. This standard is used by laboratories that want to develop and implement a quality management system for their services and to achieve laboratory accreditation. It establishes a model for the evaluation of the technical competence of the laboratory through a third- party audit. ISO17025 applies to all laboratories, regardless of the number of employees or extent of the scope of testing or calibration activities and either for other organization. It covers tests based on standardized, none standardized or laboratory developed methods (Valdivies-Gomez and Aguilar-Quesada, 2018). ISO 17025 is formed by two groups of requirements:

- Management requirements: very similar to ISO 9001, they are related with the quality management of the laboratory (Valdivies-Gomez and Aguilar-Quesada, 2018).
- Technical requirements: a spec that influence directly on the results of laboratory testing and calibration activities (Valdivies-Gomez and Aguilar-Quesada, 2018). .

Comparing ISO 9001 and ISO/IEC 17025 requires that; technical requirements processes are documented. In other words, those factors that contribute to the accuracy, reliability and validity of tests and calibrations, such as the staff, environmental conditions, equipment, or samples, resource management specifically in terms of qualification and competence or infrastructure (to guarantee test conditions) are due to test and calibration specificity and sensitivity (Valdivies-Gomez and Aguilar-Quesada, 2018).

The two main sections of ISO 17025 are clause 4 and 5 which cover the two types of requirements (Valdivies-Gomez and Aguilar-Quesada, 2018). .

### **2.4.3 Management requirements:**

#### **2.4.3.1 Organization:**

It is legal identify that satisfies needs of the customer, protection of customers' information, electronic storage and transmission of data. Also responsibilities of key of organization that influence testing activities in addition personnel awareness of their duties and contribution to achievement of management system objectives appropriate communication process by top management regarding the effectiveness of management system (NQI, 2014).

#### **2.4.3.2 Management system:**

In management system there should be quality manual which contains policy, system programs, procedures and instructions communicated. The quality policy Issued by top management and includes defined objectives, commitment to comply with the standard and continual improvement. Role and responsibilities of technical manager and quality manager are defined in the quality manual (NQI, 2016).

#### **2.4.3.3 Document control:**

Procedure for controlling all documents (internal and external) authorized editions are available at location needed (right document at the right place). Invalid or absolute documents removed or assured against unintended use. The periodic review and revision should be identified. Changes to documents on computerized system are also controlled (NQI, 2016).

#### **2.4.3.4 Review of requests, tenders and contracts:**

Procedures for review the requirements including the method are defend and documented capacity and resource to meet the requirements and appropriate test method is selected meeting the customer's requirements (Gardner, 2017).

**2.4.3.5 Subcontracting of test and calibration:**

Means to commission the order including responsibilities for the work accepted by the laboratory to another laboratory establish procedure to demarcate the result of tests done by the laboratory and the result of test done by subcontractors (VLAC-VR 101, 2011).

**2.4.3.6 Purchasing service and supplies:**

Policy and procedure for choosing and buying service and supplies that when used. May affect the quality of tests and calibration (Gardner, 2017).

**2.4.3.7 Service to customer:**

Good communication and co-operation with customer refer to confidentiality agreement with customer and for clarification of support service preparation and packing of test items by customer are included. Allow the customer or their representatives to enter related place for the purpose of witnessing of tests. Inform the customer of any identified departure from policies and procedures on testing (VALC-VR 101, 2011).

**2.4.3.8 Complaints:**

Include policy and procedure for complaints, record complaints at the time of incoming and personnel responsible for investigation and resolution (VLAC-VR101, 2011).

**2.4.3.9 Control of nonconforming testing and/or calibration work:**

Nonconformity is defined as non fulfillment of requirements. Procedure what to do if an aspect test/calibration or result does not conform with procedure, the responsibilities for management of nonconforming work could reoccur corrective action procedure shall be followed (NQI, 2016).

#### **2.4.3.10 Improvement:**

Continual improving the quality management system by using the quality policy, quality objectives, audit results, analysis of data, corrective and preventive actions and management review (ISO/IEC 17025:2005).

#### **2.4.3.11 Corrective action:**

Corrective action is defined as action to eliminate the cause of detected nonconformity. Procedure for corrective actions when nonconforming work or deviations have been identified. Corrective action process starts with investigation of root cause of the nonconformity. Selection and implementation of the corrective actions to preventive recurrence (NQI, 2016).

#### **2.4.3.12 Preventive action:**

Is defined as action to eliminate the cause of potential non conformity. The preventive action can include risk analysis in the laboratory activities, observations for improvement in internal audit and customer suggestion in customer feedback. The combination of corrective and preventive action documented procedure into single QMS document is acceptable (NQI, 2016).

#### **2.4.3.13 Control of records:**

Procedure for controlling records through identification, access collection, indexing storage and disposal of quality and technical records (Gardner, 2017).

#### **2.4.3.14 Internal auditing:**

It covers policy and procedure for conducting internal audits for the activities to verify that operations continue to comply with requirements of management system. The internal audit program shall address all elements



of management system, including the technical procedures and proficiency test item preparation, storage, distribution and reporting activities. It is responsibility of quality manager to plan and organize audits (ILAC, 2007).

#### **2.4.3.15 Management review:**

The provider's top management shall periodically a review of the provider's management system. The review shall take the suitability of policies and procedures, report from management and personnel, outcome of internal audits, corrective and preventive action, assessment by external bodies, customer feedback, complaints and recommendations for improvement (ILAC, 2007).

#### **2.4.4 Technical requirements:**

##### **2.4.4.1 General:**

Many factors determine the validity and reliability of laboratory's calibration and testing (ISO/IEC 17025:2005).

##### **2.4.4.2 Personnel:**

Competence of all who operate specific equipment, perform tests/calibration, evaluate results sign reports/certificate. Qualified on basis of appropriate education, education, training, experience, skill, appropriate supervision of trainees (SANAS, 2015).

##### **2.4.4.3 Accommodation and environmental condition:**

Accommodation and environment to suitable testing/calibration control and record environmental conditions, effective separation between incompatible activities prevent cross contamination good housekeeping (NQI, 2014).

##### **2.4.4.4 Test and calibration methods and method validation:**

The laboratory uses appropriate methods and procedures for all tests/calibrations within its scope. Uses appropriate methods to meet customer needs prefer international, regional, or national standards. Agree

with customer on the use of non-standard methods, the method is validated before use uncertainty procedure for testing/calibration. Identification of the all components of uncertainty and reasonable estimation is attempted (NQI, 2016).

**2.4.4.5 Equipment:**

All required equipment and its software capable of achieving accuracy required. Calibrated/checked before use operated by authorized personnel, up to date instructions use, maintenance readily available (SANAS, 2015).

**2.4.4.6 Measurement traceability:**

Calibration laboratories, program to ensure traceability to international system of units (SI). Calibration providing confidence in measurement by establishing traceability to standard such as certified reference materials provided by competent supplier (SANAS, 2015).

**2.4.4.7 Sampling:**

Sampling plan and procedures, available at the location where sampling under taken customer required deviation, recorded in detail sampling data, results, communicated to all staff (SANAS, 2015).

**2.4.4.8 Handling of test and calibration items:**

Procedure for transport, receipt, handling, protection, storage, retention and disposal. Avoid loose/damage/storage, handling, preparation follow instruction, environmental conditions maintained, monitored and recorded (SANAS, 2015).

**2.4.4.9 Assuring the quality of test/calibration results:**

Procedures for quality control to monitor validity or results, data recorded; replicate test or calibrations using the same or different methods retesting/recalibration of retained items (NQI, 2016).

#### **2.4.4.10 Reporting the results:**

Reports shall be clearly, unambiguously in accordance with any specific instructions in the test or calibration method. Reporting shall include all information about customer, laboratory test/ calibration item. Such as name/address of laboratory and customer, report title, unambiguous identification, dates, method use, test results/units of measurement, page identification and authorizing signature (NQI, 2016).

#### **2.4.5 Main benefits of ISO 17025 accreditation:**

Benefits of ISO 17025 accreditation can be summarized as a systematic approach to control all its processes and well defined procedures and supporting documentation. Achieve international recognition of its technical competence, gain the confidence of customers and interested parties, as well as open doors to new market both locally and international. Greater quality awareness amongst employees and reduced defects, scraps, rework failures and service recovery. Have a better corporate image in the eyes of regulators, customers, employees as well as the society at large. Potential increase in business due to enhanced customer confidence and satisfaction. Saving in items of time and money due to reduction or elimination of the need for retesting of products. Better control of laboratory operations and feedback to laboratory as whether they have quality assurance system and are technically competent. Control laboratory methods validation. Increase of confidence in testing/calibration data and personnel performing work. Validity and appropriateness of test methods. Traceability of measurements and calibrations to national standards. Suitability, calibration, maintenance of test equipment and testing environment. Sampling, handling,

transportation of test items, quality assurance of test and calibration data (Consultant ISO 17025, 2017).

#### **2.4.5.1 Accreditation bodies:**

Behind all of the different standards that are available, there are the different industries that utilize them. There are establishments of both large and small, private and public, and universities/academic institutions that have achieved ISO/IEC accreditation for various processes and procedures. Accrediting institutions such as the international laboratory accreditation cooperation (ILAC) certifies accreditation bodies such as the American association for Laboratory Accreditation (A2LA), American National Standard Institute-National Accreditation Board (ANAB), Perry Jonson Laboratory Accreditation, Inc. (PJLA), and the National Voluntary Laboratory Accreditation Program (NVLAP) to name a few (ANSI, 2018). These accreditation bodies audit and accredit businesses and academic institutions under ISO guidelines and standards. The American National Standards Institute (ANSI) stated that accreditation is the process of evaluating the competence of a conformity assessment body, indicate that all ISO accredited laboratories and business establishments have demonstrated that the services they provide, management systems they have within their establishments, or products that they produce meet specified requirements (Oliver, 2018).

### **2.5 Auditing:**

#### **2.5.1 What is auditing?**

Auditing is defined as one site verification activity, such as inspection or examination, of a process or quality system, to ensure compliance to requirements. As defined in ISO 19011:2011-guide lines for auditing management system, an audit is systematic, independent and documented

process for obtaining audit evidence (records, statements of fact or other information which are relevant verifiable) and evaluating it objectively to determine the extent to which the audit criteria (set of policies, procedures or requirements) are fulfilled. Several audit methods may be employed to achieve the audit purpose. There are three different types of audits: process, product, and system. However, other methods such as a desk or document review audit may be employed independently or in support of the three general types of audits (ASQ, 2019).

### **2.5.2 Product audit:**

This type of audit is an examination of particular product or service, such as hardware, processed material, or software, to evaluate whether it conforms to requirements (i-e specifications, performance standards and customer requirements) (ASQ, 2019).

### **2.5.3 Process audit:**

This type of audit verifies that processes are working within established limits. It evaluates an operation or method against predetermined instructions or standards to measure conformance to these standards and effectiveness of the instructions. A process audit may: check conformance to defined requirements such as time, accuracy, temperature, pressure, composition responsiveness amperage and component mixture, examine the resources (equipments, materials, people) applied to transform the inputs into outputs, the environment, the methods (procedures, instructions) followed, and the measures collected to determine process performance and check the adequacy and effectiveness of the process controls established by procedures, work instructions, flowcharts, and training and process specifications (ASQ, 2019).

#### **2.5.4 System audit:**

An audit conducted on a management system. It can be described as a documented activity performed to verify, by examination and evaluation of objective evidence that applicable elements of the system are appropriate and effective, and have been developed, documented, and implemented in accordance and in conjunction with specified requirements. A quality management system audit evaluates an existing quality management program to determine its conformance to company policies, contract commitments, and regularity requirements. Similarly, an environmental system audit examines an environmental management system, a food safety system audit examines a food safety management system, and safety system audits examine the safety management system. Some audits are named according to their purpose or scope (the scope of a department or function). The purpose of a management audit relates to management interests such as assessment of area performance or efficiency. An audit may also be classified as internal or external, depending on the inter relationships among participants. Internal audits are performed by employees of the organization. External audits are performed by an outside agent. Internal audits are often referred to as first-party audits, while external audits can be either second-party or third-party (ASQ, 2019).

#### **2.5.5 A first-party audit (internal audits):**

Internal audits should verify that the laboratory complies with ISO/IEC17025 and with internal technical and quality procedures. Internal audits are also an excellent preparation for external assessments and can help to continually improve the quality system (Lab Compliance, 2019).

### **2.5.6 A second-party audit:**

Is an external audit performed on a supplier by a customer or by a contracted organization on behalf of a customer. Second-party audits tend to be more formal than first-party audits, because audit results could influence the customer's purchasing (ASQ, 2019).

### **2.5.7 A third-party audit:**

Is performed by an audit organization independent of customer supplier relationship, and is free of any conflict of interest. Independence of the audit organization is a key component of a third-party audit. Third-party audits may result in certification, registration, recognition, an award, license, approval a citation, a fine, a penalty issued by the third-party organization or an interested party (ASQ, 2019).

### **2.5.8 Why audit?**

Possible reasons to audit: ensure compliance with ISO 17025, ensure compliance with organizational requirements, ensure compliance with regulatory requirements, ensure the quality management system is effectively implemented and maintained, auditing for improve performance, look for opportunities for improvement, look for best practices that could be applied in other areas, look for preventive action and look for outstanding emphasis on customer satisfaction (Cianfrani and West, 2013).

### **2.5.9 Performance audits versus compliance and conformance audits:**

Value-added assessments, management audits, added value auditing and continual improvement assessment are terms used to describe an audit purpose beyond compliance and conformance. The purpose of these audits are relates to organization performance. Audits that determine compliance and conformance are no focused on good or poor performance, yet. Performance is an important concern for most organizations. Key difference

between compliance audits, conformance audits is the collection of evidence related to organization performance versus evidence to verify conformance or compliance to a standard or procedure. An organization may conform to its procedures for taking orders, but if every order is subsequently changed two or three times, management may have cause for concern and want to rectify the inefficiency (ASQ, 2019).

### **2.5.10 What are the four phases of an audit cycle?**

1- Audit planning and preparation: audit preparation consists of planning everything that is done in advanced by interested parties, such as the auditor, the lead auditor, the client, the audit program manager, to ensure that the complies with the client's objectives. This stage of an audit begins with the decision to conduct the audit and ends when the audit itself begins.

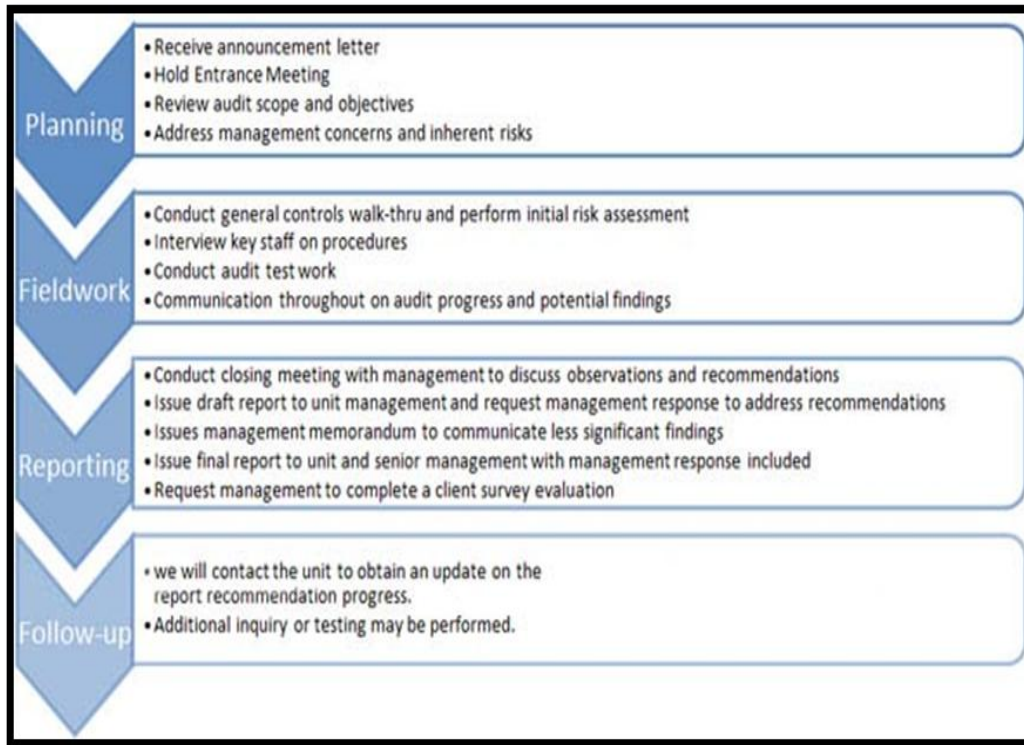
2- Audit execution: the execution phase of an audit is often called the fieldwork. It is the data-gathering portion the audit and covers the time period from arrival at the audit location up to the exit meeting. It consists of multiple activities including on-site audit management, meeting with the auditee, understanding the process and system controls and verifying that these controls work, communicating among team members, and communicating with the auditee.

3- Audit reporting: the purpose of the audit report is to communicate the results of the investigation. The report should provide correct and clear data that will be effective as a management aid in addressing important organizational issues. The audit process may end when the report is issued by the lead auditor or after follow-up actions are completed.

4- Audit follow-up and closure: according to ISO 19011, cluse 6.6,"the audit is completed when all the planned audit activities have been carried out or otherwise agreed with the audit client". Clause 6.7 of ISO 19011 continues



by stating that verification of follow-up actions may be part of a subsequent audit (ASQ, 2019).



**Figure (2.1): The four phases of an audit cycle (Grant, 2015)**

### **2.5.11 Follow-up audits:**

A product, process, or system audit may have findings that require correction and corrective action. Since most corrective cannot be performed at the time of the audit, the audit program manger may require a follow-up audit to verify that corrections were made and corrective actions were taken. Due to the high cost of a single-purpose follow-up audit, it is normally combined with the next schedule audit of the area. However, this decision should be based on the importance and risk of the finding. An organization may also conduct follow-up audits to verify preventive actions were taken as a result of performance issues that may be reported as opportunities for improvement. Other times organizations may forward identify performance issues to management for follow-up (ASQ, 2019).

## **2.6 Previous studies:**

Fadul (2014) studied the impact of implementing ISO/IEC 17025 in the quality of Sudanese laboratories services and the services reflect in the total quality of products and services in many sectors in Sudan, the study found that the services provided by national public health laboratory (NPHL) was low quality; there was no clear management system with unknown responsibilities inside NPHL, there was defect on the training method in side NPHL, and working environment inside NPHL was not suitable and not helped in correct testing results.

Another study done by Hamza (2015) in the impact of implementing ISO/IEC 17025-2005 standard and its role in improving the performance of the laboratories of Sudanese standards and metrology organization (SSMO), the study found that the awareness and perception of top managers of ISO helped them in the process of evaluation and measuring the system as well achieving intended results, work environment inside the laboratory was suitable and helped in correct testing results and provided implementing ISO system enhanced the performance and the quality of the laboratory of SSMO, there was a system to identify training needs and staff training, and the research was convinced that the (SSMO) was working to educate all employees and their knowledge of procedures for the application of ISO 17025-2005, the (SSMO) was maintained improvement measurement accuracy and ensuring the consistency of the results and ensuring that customer's needs were met in high level of quality.

A study done by Mohamed (2016) in the impact of implementation of ISO 17025 in chemical laboratories and aimed to detect the laboratories

performance before and after implementation of the ISO 17025, the study found that the effect of the ISO 17025 was clearly visible, the systems have been improved to the best.

Another study done by Bui (2017) in the implementation of quality management system to test laboratory in compliance with ISO/IEC 17025:2005 standard, the study aimed to serve the purpose of its commissioned company, to have a quality management system ready for accreditation. As the commissioned company was laboratorial based with different services of digital television testing services, it was required to follow ISO/IEC 17025:2005 standard. Therefore, the thesis objectives were how to successfully implement quality management system in conformance with the standard, set in the beginning of the project were achieved; the ISO/IEC 17025:2005 was fully examined.

### **2.7 Comparison between the present study and previous studies:**

The present study agreed with the previous studies in that; they all dealt with the impact of implementation of ISO/IEC 17025:2005 on the quality of services and products provided.

In addition to the above, the present study focused on impact of internal audit on improving quality system according to general requirements of ISO/IEC 17025:2005.

The previous studies dealt with the implementation of ISO/IEC 17025:2005 in general, while the present study dealt with clauses ten and fourteen in some details.

**CHAPTER THREE**  
**Materials and Methods**

## Chapter 3

### Materials and methods

#### 3.1 Study design:

It is a descriptive case study.

#### 3.2 Study area:

The study was conducted at National Leather Technology Center (NLTC) and Sudanese Standards and Metrology Organization (SSMO), Khartoum State- Sudan.

##### 3.2.1 National Leather Technology Center (NLTC):

NLTC was established in 1963 with technical assistance from food and agriculture organization (FAO) and United Nations Development Program (UNDP) under ministry of Animal resources. In 1993 the center was attached to Industrial Research and Consultancy Center (IRCC) under the Ministry of Industry as National Leather Technology Center (NLTC, 2016). The national leather technology center select some chemical test for accredited by Egyptian accreditation (EGAC) then the equipment and apparatus was calibrated from national institute of standards (NIS) and participation the proficiency testing. Accreditation body sends team to applicable the system and makes all the documents according to requirements of ISO 17025. The accreditation process of the quality control and assurance laboratory has been completed in 2015. The main objectives of NLTC are: training and consulting in all areas of manufacturing and design, applied research and development, technical, economic and environmental feasibility studies, provide consulting, technical and advisory service and quality control and assurance laboratory carries chemical and physical tests for all types of leather beside water and waste water produced within the processes also chemical tests for the tanning materials. The

national leather technology center select some chemical test for accredited by Egyptian accreditation (EGAC) then the equipment and apparatus was calibrated from national institute of standards (NIS) and participation the proficiency testing (NLTC, 2016).

### **3.2.2 Sudanese Standards and Metrology Organization (SSMO):**

In 1992-1993 Sudanese standards and metrology organization (SSMO) law was approved, to avoid duplication and enhance an efficient startup, in October 1994 a ministerial resolution has shifted department of weights and measures gold testing and hall-marking and quality control to SSMO. In 2007 the foundation orders the Sudanese standards and metrology organization (SSMO) and law was approved, in 2008 the new law of standards and specification was approved and came into enforcement by the approval of the executive regulations in 2009. In 2009 the law of import and export inspection for the services, products conformities and the marketing of products and service was approved and came into enforcement by the SSMO board, according to all the above mention regulation and laws, the laboratories have entity that can be held legally responsible and the laboratories have been formally established, the SSMO is the sole autonomous authority for all standardization activities in the Sudan. The Main objectives of SSMO and SSMO testing laboratories are: protection and awareness of consumers, strengthening national economy, improve of national products and services, adoption of philosophy of quality assurance and enforce implementation, standardization of commodities, monitoring quality of imports and exports, satisfaction of customers, who are concerned with laboratories testing, and or SSMO services, achievement of quality work within testing (Mohamed, 2016).

### **3.3 Study population:**

The study was conducted on laboratory employees at National Leather Technology Center and Sudanese Standards and Metrology Organization.

### **3.4 Sample size:**

The targeted sample of this research was the total population of the laboratories employees (30), (15) from SSMO and (15) from NLTC but the actual sample number was 26 (13 from each) who had respond to the questionnaire.

### **3.5 Study period:**

The study was conducted during the interval from August 2018 to August 2019.

### **3.6 Data collection tools:**

In general, the procedures used for collecting the data and all the needed information in this study, were the observations, that were get it from questionnaire, so, a questionnaire (appendix) was used as the basic tool. The quantitative survey consisted of questionnaire contain three hypothesis that cover the research questions which distributed for laboratories employees. The study depends on the questionnaire as a key to offer gathering information from the study population.

### **3.7 Data analysis:**

The data obtained were analyzed using the Statistical Package for Social Sciences (SPSS). To achieve the objectives of the study, statistical methods were used the frequency distribution of the answers, the percentages, Person correlation coefficient, Spearman-Brown equation for calculating reliability coefficient, median and Chi-square test for the significance of differences between the test results considering all other variables. Then data were presented in tables.

### **3.8 Ethical consideration:**

Study permissions were obtained from College of Graduate Studies- Sudan University of Science and Technology, then from Management of National Leather Technology Center (NLTC) and Sudanese Standards and Metrology Organization (SSMO) to carrying out the study in their laboratories. Also, permission was taken from all individuals before being included in the study. Each individual was informed on the nature of the study.



# **CHAPTER FOUR**

## **Results**

## Chapter 4

### Results

#### 4.1 General characteristics of study population:

The study was conducted on 26 study subjects, 12 (46.2%) were males and 14 (53.8%) were females. The age ranged between 20-50 years old. Regarding the occupation of study subjects, 8 (30.8%) were technicians. Regarding the academic qualification, 13 (50.0%) were having M.Sc. Regarding the years of experience, 9 (34.6%) were having experience less than 5 years. Regarding the training on the standard of efficiency of the performance of calibration and testing laboratories ISO/IEC 17025:2005, 10 (38.5%) were very good.

#### 4.2 The statistical reliability and validity of the pre-test sample about the study questionnaire:

The results showed that all reliability and validity coefficients for pre-test sample individuals about each questionnaire's hypothesis and for overall questionnaire were greater than (50%) and some of them were nearest to one. This indicated that the high validity and reliability of the answers, so, the study questionnaire was valid and reliable and that gave correct and acceptable statistical analysis (table 4.1).

**Table (4.1): The statistical reliability and validity of the pre-test sample about the study questionnaire**

Hypotheses	Reliability	Validity
First hypothesis	0.75	0.87
Second hypothesis	0.75	0.87
Third hypothesis	0.72	0.85
Overall	0.83	0.91

**4.3 The results of the first hypothesis (There is a statistically significant relationship between implementation of the internal audit methodology and implementation of the quality system according to the requirements of the standard for the efficiency of the performance of the calibration and testing laboratories ISO/IEC 17025:2005):**

**4.3.1 The frequency distribution for the respondents' answers about the questions of the first hypothesis:**

The results indicated that the most frequency distribution for the respondents' answers about the questions of the first hypothesis was (22) for strongly agree for the statement (The internal audit methodology contributes to ensuring the effectiveness of the quality system) (table 4.2).

**Table (4.2): The frequency distribution for the respondents' answers about the questions of the first hypothesis**

No.	Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly disagree
1	The internal audit methodology contributes to the identification of deficiencies in the quality system.	20	5	1	0	0
2	The internal audit methodology contributes the difficulty of implementing certain points in the procedures.	15	10	1	0	0
3	The internal audit methodology benefits from the view of the beneficiary of implementation procedures.	13	9	1	3	0
4	The implementation of the internal audit methodology leads to easy understanding and application of procedures and work instructions.	18	7	1	0	0
5	The internal audit methodology contributes to increasing the efficiency of procedures and work instructions.	17	8	1	0	0

6	The internal audit methodology contributes to ensuring the effectiveness of the quality system.	22	3	1	0	0
7	The internal audit methodology contributes to increasing the effectiveness of the procedures and work instructions.	15	10	1	0	0

### **4.3.2 The median of respondents' answers about the questions of the first hypothesis:**

The results showed the calculated value of the median for all respondent's answers, of the 1<sup>st</sup> question was (5), this value means that, most of the respondents were strongly agreed with that “The internal audit methodology contributes to the identification of deficiencies in the quality system”. For the 2<sup>nd</sup> question was (5), this value means that, most of the respondents were strongly agreed with that “The internal audit methodology contributes the difficulty of implementing certain points in the procedures”. For the 3<sup>rd</sup> question was (4), this value means that, most of the respondents were agreed with that “The internal audit methodology benefits from the view of the beneficiary of implementation procedures”. For the 4<sup>th</sup> question was (5), this value means that, most of the respondents were strongly agreed with that “The implementation of the internal audit methodology leads to easy understanding and application of procedures and work instructions”. For the 5<sup>th</sup> question was (5), this value means that, most of the respondents were strongly agreed with that “The internal audit methodology contributes to increasing the efficiency of procedures and work instructions”. For the 6<sup>th</sup> question was (5), this value means that, most of the respondents were strongly agreed with that “The internal audit methodology contributes to ensuring the effectiveness of the quality system”. And for the 7<sup>th</sup> question

was (5), this value means that, most of the respondents were strongly agreed with that “The internal audit methodology contributes to increasing the effectiveness of the procedures and work instructions” (table 4.3).

**Table (4.3): The median of respondents’ answers about the questions of the first hypothesis**

No.	Statement	Median	Result
1	The internal audit methodology contributes to the identification of deficiencies in the quality system.	5	Strongly agree
2	The internal audit methodology contributes the difficulty of implementing certain points in the procedures.	5	Strongly agree
3	The internal audit methodology benefits from the view of the beneficiary of implementation procedures.	4	Agree
4	The implementation of the internal audit methodology leads to easy understanding and application of procedures and work instructions.	5	Strongly agree
5	The internal audit methodology contributes to increasing the efficiency of procedures and work instructions.	5	Strongly agree
6	The internal audit methodology contributes to ensuring the effectiveness of the quality system.	5	Strongly agree
7	The internal audit methodology contributes to increasing the effectiveness of the procedures and work instructions.	5	Strongly agree
	Overall	5	Strongly agree

#### **4.3.3 Chi-square test results for respondents’ answers about the questions of the first hypothesis:**

The calculated value of Chi-square for the significance of the differences for the respondents' answers in the 1<sup>st</sup> question was (19.92) which was greater than the tabulated value of Chi-square at the degree of freedom (2) and the significant value level (1%) which was (9.21), this indicated that, there were statistically significant differences at the level (1%) among the answers of the respondents, which supported the respondents who had strongly agreed with that “The internal audit methodology contributes to the identification of

deficiencies in the quality system”. In the 2<sup>nd</sup> question was (10.69) which was greater than the tabulated value of Chi-square at the degree of freedom (2) and the significant value level (1%) which was (9.21), this indicated that, there were statistically significant differences at the level (1%) among the answers of the respondents, which supported the respondents who had strongly agreed with that “The internal audit methodology contributes the difficulty of implementing certain points in the procedures”. In the 3<sup>rd</sup> question was (13.08) which was greater than the tabulated value of Chi-square at the degree of freedom (3) and the significant value level (1%) which was (11.35), this indicated that, there were statistically significant differences at the level (1%) among the answers of the respondents, which supported the respondents who had strongly agreed with that “The internal audit methodology benefits from the view of the beneficiary of implementation procedures”. In the 4<sup>th</sup> question was (14.85) which was greater than the tabulated value of Chi-square at the degree of freedom (2) and the significant value level (1%) which was (9.21), this indicated that, there were statistically significant differences at the level (1%) among the answers of the respondents, which supported the respondents who had strongly agreed with that “The implementation of the internal audit methodology leads to easy understanding and application of procedures and work instructions”. In the 5<sup>th</sup> question was (13.00) which was greater than the tabulated value of Chi-square at the degree of freedom (2) and the significant value level (1%) which was (9.21), this indicated that, there were statistically significant differences at the level (1%) among the answers of the respondents, which supported the respondents who had strongly agreed with that “The internal audit methodology contributes to increasing the efficiency of procedures and work instructions”. In the 6<sup>th</sup> question was

(26.85) which was greater than the tabulated value of Chi-square at the degree of freedom (2) and the significant value level (1%) which was (9.21), this indicated that, there were statistically significant differences at the level (1%) among the answers of the respondents, which supported the respondents who had strongly agreed with that “The internal audit methodology contributes to ensuring the effectiveness of the quality system”. In the 7<sup>th</sup> question was (10.69) which was greater than the tabulated value of Chi-square at the degree of freedom (2) and the significant value level (1%) which was (9.21), this indicated that, there were statistically significant differences at the level (1%) among the answers of the respondents, which supported the respondents who had strongly agreed with that “The internal audit methodology contributes to increasing the effectiveness of the procedures and work instructions” (table 4.4).

**Table (4.4): Chi-square test results for respondents’ answers about the questions of the first hypothesis**

No	Statement	Degree of freedom	Chi-square value
1	The internal audit methodology contributes to the identification of deficiencies in the quality system.	2	19.92
2	The internal audit methodology contributes the difficulty of implementing certain points in the procedures.	2	10.69
3	The internal audit methodology benefits from the view of the beneficiary of implementation procedures.	3	13.08
4	The implementation of the internal audit methodology leads to easy understanding and application of procedures and work instructions.	2	14.85
5	The internal audit methodology contributes to increasing the efficiency of procedures and work instructions.	2	13.00
6	The internal audit methodology contributes to ensuring the effectiveness of the quality system.	2	26.85
7	The internal audit methodology contributes to increasing the effectiveness of the procedures and work instructions.	2	10.69

#### **4.3.4 The frequency distribution for the respondents' answers about all questions of the first hypothesis:**

The study showed that there were 120 (65.9%) answers were strongly agreed about all questions that related to the first hypothesis, 52 (28.6%) answers were agreed on that, 7(3.8%) answers were neutrally about that, while 3 (1.6%) answers were disagreed about that (table 4.5). The value of Chi-square test for the significant differences among these answers was (195.19) which was greater than the tabulated value of Chi-square at the degree of freedom (3) and the significant value level (1%) which was (11.35), this indicated that, there were statistically significant differences at the level (1%) among the answers of the respondents, which supported the respondents who had strongly agreed with the first hypothesis. The results showed that the first hypothesis was fulfilled.

**Table (4.5): The frequency distribution for the respondents' answers about all questions of the first hypothesis**

Answer	Number	Percentage (%)
Strongly agree	120	65.9
Agree	52	28.6
Neutral	7	3.8
Disagree	3	1.6
Total	182	100.0



**4.4 The results of the second hypothesis (There is a statistically significant relationship between implementation of the internal audit methodology and the number of cases of non-conformity of the quality system according to the requirements of the standard for the efficiency of performance of the calibration and testing laboratories ISO/IEC17025:2005 and readiness for accreditation):**

**4.4.1 The frequency distribution for the respondents' answers about the questions of the second hypothesis:**

The results showed that the most frequency distribution for the respondents' answers about the questions of the second hypothesis were (19) for strongly agree for the statement (The implementation of internal audit methodology leads to the reduction of errors and diffraction in the quality system) (table 4.6).

**Table (4.6): The frequency distribution for the respondents' answers about the questions of the second hypothesis**

No .	Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly disagree
1	There is a procedure for adjusting and implementing the internal audit of the quality system.	16	8	2	0	0
2	The internal audit procedure is understandable and easy to implement.	9	15	1	1	0
3	The quality manger reviews the management procedures to ensure that they comply with the requirements of the standard for the efficiency of calibration and testing laboratories ISO/IEC17025:2005.	15	10	1	0	0
4	The technical manager	12	13	1	0	0

	reviews technical procedures to ensure that they comply with requirements of standard for the efficiency of calibration and testing laboratories ISO/IEC17025:2005.					
5	The implementation of internal audit methodology leads to the reduction of errors and diffraction in the quality system.	19	6	1	0	0
6	The implementation of internal audit methodology leads to the reduction of cases of non-conformity by the accreditation body.	17	8	1	0	0
7	The implementation of the internal audit methodology contributes to the follow-up of the diffraction that may appear in the procedures and work instructions.	14	11	1	0	0

#### **4.4.2 The median of respondents' answers about the questions of the second hypothesis:**

The calculated value of the median for the respondents' answers of the 1<sup>st</sup> question was (5); this value means that, most of the respondents were strongly agreed with that "There is a procedure for adjusting and implementing the internal audit of the quality system". For the 2<sup>nd</sup> question was (4), this value means that, most of the respondents were agreed with that "The internal audit procedure is understandable and easy to implement". For the 3<sup>rd</sup> question was (5), this value means that, most of the respondents were strongly agreed with that "The quality manger reviews the management procedures to ensure that they comply with the requirements of the standard

for the efficiency of calibration and testing laboratories ISO/IEC17025:2005”. For the 4<sup>th</sup> question was (4), this value means that, most of the respondents were agreed with that “The technical manager reviews technical procedures to ensure that they comply with requirements of standard for the efficiency of calibration and testing laboratories ISO/IEC17025:2005”. For the 5<sup>th</sup> question was (5), this value means that, most of the respondents were strongly agreed with that “The implementation of internal audit methodology leads to the reduction of errors and diffraction in the quality system”. For the 6<sup>th</sup> question was (5), this value means that, most of the respondents were strongly agreed with that “The implementation of internal audit methodology leads to the reduction of cases of non-conformity by the accreditation body”. For the 7<sup>th</sup> question was (5), this value means that, most of the respondents were strongly agreed with that “The implementation of the internal audit methodology contributes to the follow-up of the diffraction that may appear in the procedures and work instructions” (table 4.7).

**Table (4.7): The median of respondents’ answers about the questions of the second hypothesis**

No.	Statement	Median	Result
1	There is a procedure for adjusting and implementing the internal audit of the quality system.	5	Strongly Agree
2	The internal audit procedure is understandable and easy to implement.	4	Agree
3	The quality manger reviews the management procedures to ensure that they comply with the requirements of the standard for the efficiency of calibration and testing laboratories ISO/IEC 17025:2005.	5	Strongly Agree
4	The technical manager reviews technical procedures to ensure that they comply with requirements of standard for the efficiency of calibration and testing laboratories ISO/IEC 17025:2005.	4	Agree
5	The implementation of internal audit methodology leads to the reduction of errors and diffraction in the quality	5	Strongly Agreed

	system.		
6	The implementation of internal audit methodology leads to the reduction of cases of non-conformity by the accreditation body.	5	Strongly Agree
7	The implementation of the internal audit methodology contributes to the follow-up of the diffraction that may appear in the procedures and work instructions.	5	Strongly Agree
	Overall	5	Strongly Agree

#### **4.4.3 Chi-square test results for respondents' answers about the questions of the second hypothesis:**

The calculated value of Chi-square for the significance of the differences for the respondents' answers in the 1<sup>st</sup> question was (11.38) which was greater than the tabulated value of Chi-square at the degree of freedom (2) and the significant value level (1%) which was (9.21), this indicated that, there were statistically significant differences at the level (1%) among the answers of the respondents, which supported the respondents who had strongly agreed with that "There is a procedure for adjusting and implementing the internal audit of the quality system". In the 2<sup>nd</sup> question was (21.38) which was greater than the tabulated value of Chi-square at the degree of freedom (3) and the significant value level (1%) which was (11.35), this indicated that, there were statistically significant differences at the level (1%) among the answers of the respondents, which supported the respondents who had agreed with that "The internal audit procedure is understandable and easy to implement". In the 3<sup>rd</sup> question was (11.62) which was greater than the tabulated value of Chi-square at the degree of freedom (2) and the significant value level (1%) which was (9.21), this indicated that, there were statistically significant differences at the level (1%) among the answers of the respondents, which supported the respondents who have strongly agreed

with that “The quality manger reviews the management procedures to ensure that they comply with the requirements of the standard for the efficiency of calibration and testing laboratories ISO/IEC17025:2005”. In the 4<sup>th</sup> question was (10.23) which was greater than the tabulated value of Chi-square at the degree of freedom (2) and the significant value level (1%) which was (9.21), this indicated that, there were statistically significant differences at the level (1%) among the answers of the respondents, which supported the respondents who had agreed with that “The technical manager reviews technical procedures to ensure that they comply with requirements of standard for the efficiency of calibration and testing laboratories ISO/IEC17025:2005”. In the 5<sup>th</sup> question was (19.92) which was greater than the tabulated value of Chi-square at the degree of freedom (2) and the significant value level (1%) which was (9.21), this indicated that, there were statistically significant differences at the level (1%) among the answers of the respondents, which supported the respondents who had strongly agreed with that “The implementation of internal audit methodology leads to the reduction of errors and diffraction in the quality system”. In the 6<sup>th</sup> question was (14.85) which was greater than the tabulated value of Chi-square at the degree of freedom (2) and the significant value level (1%) which was (9.21), this indicated that, there were statistically significant differences at the level (1%) among the answers of the respondents, which supported the respondents who had strongly agreed with that “The implementation of internal audit methodology leads to the reduction of cases of non-conformity by the accreditation body”. In the 7<sup>th</sup> question was (10.69) which was greater than the tabulated value of Chi-square at the degree of freedom (2) and the significant value level (1%) which was (9.21), this indicated that, there were statistically significant differences at the level (1%) among the

answers of the respondents, which supported the respondents who had strongly agreed with that “The implementation of the internal audit methodology contributes to the follow-up of the diffraction that may appear in the procedures and work instructions” (table 4.8).

**Table (4.8): Chi-square test results for respondents’ answers about the questions of the second hypothesis**

No.	Statement	Degree of freedom	Chi-square value
1	There is a procedure for adjusting and implementing the internal audit of the quality system.	2	11.38
2	The internal audit procedure is understandable and easy to implement.	3	21.38
3	The quality manger reviews the management procedures to ensure that they comply with the requirements of the standard for the efficiency of calibration and testing laboratories ISO/IEC 17025:2005.	2	11.62
4	The technical manager reviews technical procedures to ensure that they comply with requirements of standard for the efficiency of calibration and testing laboratories ISO/IEC 17025:2005.	2	10.23
5	The implementation of internal audit methodology leads to the reduction of errors and diffraction in the quality system.	2	19.92
6	The implementation of internal audit methodology leads to the reduction of cases of non-conformity by the accreditation body.	2	14.85
7	The implementation of the internal audit methodology contributes to the follow-up of the diffraction that may appear in the procedures and work instructions.	2	10.69

**4.4.4 The frequency distribution for the respondents’ answers about all questions of the second hypothesis:**

The results showed that there were 102 (56.0%) were strongly agreed about all questions that related to the second hypothesis, 71 (39.0%) answers were agreed on that, 8 (4.4%) answers were neutrally about that, while 1(0.5%) answer was disagreed about that (table 4.9). The value of Chi-square test for

the significant differences among these answers was (158.88) which was greater than the tabulated value of Chi-square at the degree of freedom (3) and the significant value level (1%) which was (11.35), this indicated that, there were statistically significant differences at the level (1%) among the answers of the respondents, which supported the respondents who had strongly agreed with the second hypothesis. The results showed that the second hypothesis was fulfilled.

**Table (4.9): The frequency distribution for the respondents' answers about all questions of the second hypothesis**

Answer	Number	Percentage (%)
Strongly agree	102	56.0
Agree	71	39.0
Neutral	8	4.4
Disagree	1	0.5
Total	182	100.0

**4.5 The results of the third hypothesis (There is a statistically significant relationship between implementation of the internal audit methodology and the continuous improvement of the quality system and increased customer satisfaction):**

**4.5.1 The frequency distribution for the respondents' answers about the questions of the third hypothesis:**

The results showed that the most frequency distribution for the respondents' answers about the questions of the third hypothesis were (18) for strongly agree for the statement (Internal audit leads to improves performance) (table 4.10).

**Table (4.10): The frequency distribution for the respondents' answers about the questions of the third hypothesis**

No.	Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly disagree
1	Internal audit contributes to the detection of diffraction before it affects the quality operations.	12	11	2	0	1
2	Internal audit enables opportunities for continuous improvement.	14	11	1	0	0
3	Internal audit helps identify best practices.	12	13	1	0	0
4	Internal audit leads to improves performance.	18	7	1	0	0
5	Internal audit contributes to focus on customer satisfaction.	15	9	2	0	0

**4.5.2 The median of respondents' answers about the questions of the third hypothesis:**

The calculated value of the median for the respondents' answers of the 1<sup>st</sup> question was (4); this value means that, most of the respondents were agreed with that "Internal audit contributes to the detection of diffraction before it affects the quality operations". For the 2<sup>nd</sup> question was (5), this value means that, most of the respondents' were strongly agreed with that "Internal audit enables opportunities for continuous improvement". For the 3<sup>rd</sup> question was (4), this value means that, most of the respondents were agreed with that "Internal audit helps identify best practices". For the 4<sup>th</sup> question was (5), this value means that, most of the respondents' were strongly agreed with that "Internal audit leads to improves performance". For the 5<sup>th</sup> question was (5), this value means that, most of the respondents' were strongly agreed



with that “Internal audit contributes to focus on customer satisfaction” (table 4.11).

**Table (4.11): The median of respondents’ answers about the questions of the third hypothesis**

No.	Statement	Median	Result
1	Internal audit contributes to the detection of diffraction before it affects the quality operations	4	Agree
2	Internal audit enables opportunities for continuous improvement	5	Strongly Agree
3	Internal audit helps identify best practices	4	Agree
4	Internal audit leads to improves performance	5	Strongly Agree
5	Internal audit contributes to focus on customer satisfaction	5	Strongly Agree
	Overall	5	Strongly Agree

#### **4.5.3 Chi-square test results for respondents’ answers about the questions of the third hypothesis:**

The calculated value of Chi-square for the significance of the differences for the respondents’ answers in the 1<sup>st</sup> question was (15.54) which was greater than the tabulated value of Chi-square at the degree of freedom (3) and the significant value level (1%) which was (11.35), this indicated that, there were statistically significant differences at the level (1%) among the answers of the respondents, which supported the respondents who had strongly agreed with that “Internal audit contributes to the detection of diffraction before it affects the quality operations”. In the 2<sup>nd</sup> question was (10.69) which was greater than the tabulated value of Chi-square at the degree of freedom (2) and the significant value level (1%) which was (9.21), this indicated that, there were statistically significant differences at the level (1%) among the answers of the respondents, which supported the

respondents who had strongly agreed with that “Internal audit enables opportunities for continuous improvement”. In the 3<sup>rd</sup> question was (10.23) which was greater than the tabulated value of Chi-square at the degree of freedom (2) and the significant value level (1%) which was (9.21), this indicated that, there were statistically significant differences at the level (1%) among the answers of the respondents, which supported the respondents who had agreed with that “Internal audit helps identify best practices”. In the 4<sup>th</sup> question was (17.15) which was greater than the tabulated value of Chi-square at the degree of freedom (2) and the significant value level (1%) which was (9.21), this indicated that, there were statistically significant differences at the level (1%) among the answers of the respondents, which supported the respondents who had strongly agreed with that “Internal audit leads to improves performance”. In the 5<sup>th</sup> question was (9.77) which was greater than the tabulated value of Chi-square at the degree of freedom (2) and the significant value level (1%) which was (9.21), this indicated that, there were statistically significant differences at the level (1%) among the answers of the respondents, which supported the respondents who have strongly agreed with that “Internal audit contributes to focus on customer satisfaction" (table 4.12).

**Table (4.12): Chi-square test results for respondents’ answers about the questions of the third hypothesis**

No.	Statement	Degree of freedom	Chi-square value
1	Internal audit contributes to the detection of diffraction before it affects the quality operations.	3	15.54
2	Internal audit enables opportunities for continuous improvement.	2	10.69
3	Internal audit helps identify best practices.	2	10.23
4	Internal audit leads to improves performance.	2	17.15
5	Internal audit contributes to focus on customer satisfaction.	2	9.77

**4.5.4 The frequency distribution for the respondents’ answers about all questions of the third hypothesis:**

The results showed that there were 71 (54.6%) answers were strongly agreed about all questions that related to the third hypothesis, 51 (39.2%) answers were agreed on that, 7 (5.4%) answers were neutrally about that, while 1 (0.8%) answer was strongly disagreed about that (table 4.13). The value of Chi-square test for the significant differences among these answers was (106.68) which was greater than the tabulated value of Chi-square at the degree of freedom (3) and the significant value level (1%) which was (11.35), this indicated that, there were statistically significant differences at the level (1%) among the answers of the respondents, which supported the respondents who had strongly agreed with the third hypothesis. The results showed that the third hypothesis was fulfilled.

**Table (4.13): The frequency distribution for the respondents' answers about all questions of the third hypothesis**

Answer	Number	Percentage (%)
Strongly agree	71	54.6
Agree	51	39.2
Neutral	7	5.4
Strongly disagree	1	0.8
Total	130	100.00

**4.6 Summary of Chi-square test for the respondents' answers about all hypotheses:**

According to the values of Chi-square test, the results showed that the first hypothesis was fulfilled with first order according to the first largest value of Chi-square (195.19). The second hypothesis was fulfilled with second order according to the second largest value of Chi-square (158.88). Lastly, the third hypothesis was fulfilled with third order according to third largest value of Chi-square (106.68) (table 4.14).

**Table (4.14): Summary of Chi-square test for the respondents' answers about all hypotheses**

No.	Hypothesis	Chi-square value
1	There is a statistically significant relationship between implementation of internal audit methodology and implementation of quality system according to requirements of standard for efficiency of performance of calibration and testing laboratories ISO/IEC 17025:2005.	195.19
2	There is a statistically significant relationship between implementation of the internal audit methodology and the number of cases of non-conformity of the quality system according to the requirements of the standard for the efficiency of performance of the calibration and testing laboratories ISO/IEC 17025:2005, and readiness for accreditation.	158.88
3	There is a statistically significant relationship between implementation of the internal audit methodology and the continuous improvement of the quality system and increased customer satisfaction.	106.68

## **CHAPTER FIVE**

### **Discussion, Conclusion and Recommendations**

## Chapter 5

### Discussion, conclusion and recommendations

#### 5.1 Discussion:

The present study showed that the most frequency distribution for the respondents' answers about the questions of the first hypothesis was (22) for strongly agree for the statement (The internal audit methodology contributes to ensure the effectiveness of the quality system). Also, the present study showed that the value of the median for the respondents' answers about the all questions that related to the first hypothesis was (5). This value, in general, means that most of the respondents have strongly agree with all what mentioned about the first hypothesis. The results reflected that the most frequency distribution for the respondents' answers about the questions of the second hypothesis were (19) for strongly agree for the statement (The application of internal audit methodology leads to the reduction of errors and diffraction in the quality system). The value of the median for the respondents' answers about the all questions that related to the second hypothesis was (5). This value, in general, means that most of the respondents have strongly agree with all what mentioned about the second hypothesis. The present study showed that the most frequency distribution for the respondents' answers about the questions of the third hypothesis were (18) for strongly agree for the statement (Internal audit leads to improves performance). The value of the median for the respondents' answers about the all questions that related to the third hypothesis was (4). This value, in general, means that most of the respondents have agree with all what mentioned about the third hypothesis. The findings from the present study were in disagreement with findings obtained by Fadul (2014) who found that the services provided by national public health laboratory (NPHL) was low

quality; there was no clear management system with unknown responsibilities inside NPHL, but the findings of the present study were in agreement with the findings of Hamza (2015) who found that the awareness and perception of top managers of ISO helped them in the process of evaluation and measuring the system as well achieving intended results, work environment inside the laboratory was suitable and helped in correct testing results and provided implementing ISO system enhanced the performance and the quality of the laboratory. Also, the results obtained from the present study were in agreement with results obtained by Mohamed (2016) who found that the effect of the ISO 17025 was clearly visible; the systems have been improved to the best.

## **5.2 Conclusion:**

The study concluded that implementation of the internal audit methodology have impact on the improvement of the quality system and increased customer satisfaction according to the requirements of ISO/IEC17025:2005 in the study areas.

## **5.3 Recommendations:**

Based on the results of the study recommended that:

- The internal audit methodology should be benefited from the view of the beneficiary of the application procedures.
- The internal audit procedure should be understandable and easy to implement.
- Internal audit should be contributed to the detection of diffraction before it affects the quality operations.



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# **APPENDICES**



اولاً: البيانات الشخصية:

الرجاء وضع علامة (√) امام الاجابة المناسبة:

1. الجنس:

ذكر  أنثى

2. العمر:

اقل من 30 سنة  30-40 سنة

41-50 سنة  اكثر من 50 سنة

3. المؤهل العلمي:

بكالوريوس  دبلوم عالي

ماجستير  دكتوراه

4. سنوات الخبرة:

اقل من 5 سنوات  5 سنوات و اقل من 10 سنوات

10 سنوات و اقل من 15 سنة  15 سنة فأكثر

5. مدى تدريبك على المواصفة القياسية لكفاءة أداء معامل المعايرة و الاختبار ISO:IEC

:17025:2005

متوسط  جيد

جيد جداً  ممتاز

6. المسمى الوظيفي:

تقني  مهندس

مدير قسم  رئيس قسم

.....اخرى



ثانياً: قياس متغيرات الدراسة:-

الرجاء وضع علامة (√) امام مستوى الموافقة المناسب:

الفرضية الأولى: هناك علاقة ذات دلالة إحصائية بين تطبيق منهجية المراجعة الداخلية وتطبيق نظام الجودة وفقاً للمتطلبات العامة للمواصفة القياسية لكفاءة أداء معامل المعايرة والإختبار

ISO/IEC17025:2005

العبارة	اوافق بشدة	اوافق	محايد	لا اوافق بشدة
1/ تساهم منهجية المراجعة الداخلية في تحديد أوجه القصور في نظام الجودة				
2/ تساهم منهجية المراجعة الداخلية في تحديد صعوبة تطبيق بعض النقاط في الإجراء				
3/ تستفيد منهجية المراجعة الداخلية من رأى المستفيد من تطبيق الإجراء				
4/ تطبيق منهجية المراجعة الداخلية يؤدي إلى سهولة فهم وتطبيق الإجراءات وتعليمات العمل				
5/ تساهم منهجية المراجعة الداخلية في زيادة كفاءة الإجراءات وتعليمات العمل				
6/ تساهم منهجية المراجعة الداخلية في التأكد من فاعلية تطبيق نظام الجودة				
7/ تساهم منهجية المراجعة الداخلية في				

					زيادة فاعلية الإجراءات وتعليمات العمل
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الفرضية الثانية: هناك علاقة ذات دلالة إحصائية بين تطبيق منهجية المراجعة الداخلية وعدد حالات عدم المطابقة لنظام الجودة وفقاً للمتطلبات العامة للمواصفة القياسية لكفاءة أداء معامل المعايرة والإختبار ISO/IEC 17025:2005 و الاستعداد للأعتداد

العبارة	أوفق	أوافق بشدة	محايد	لا أوافق	لا أوافق بشدة
1/ يوجد إجراء لضبط وتطبيق المراجعة الداخلية لنظام الجودة					
2/ إجراء المراجعة الداخلية مفهوم وسهل التطبيق					
3/ يقوم مدير الجودة بمراجعة الإجراءات الإدارية للتأكد من توافقتها مع متطلبات المواصفة القياسية ISO/IEC 17025:2005					
4/ يقوم المدير الفني بمراجعة الإجراءات الفنية للتأكد من توافقتها مع متطلبات المواصفة القياسية ISO/IEC 17025:2005					
5/ تطبيق منهجية المراجعة الداخلية يؤدي إلى تقليل الأخطاء والحيود في نظام الجودة					
6/ تطبيق منهجية المراجعة الداخلية يؤدي إلى تقليل حالات عدم المطابقة من قبل جهة الإعتماد					
7/ تطبيق منهجية المراجعة					

					الداخلية يساهم في متابعة معالجة الحيود الذي قد يظهر بالإجراءات وتعليمات العمل
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الفرضية الثالثة: هناك علاقة ذات دلالة إحصائية بين تطبيق منهجية المراجعة الداخلية والتحسين المستمر لنظام الجودة وزيادة رضا العملاء

العبارة	أوافق	أوافق بشدة	محايد	لا أوافق	لا أوافق بشدة
1/ تساهم المراجعة الداخلية في إكتشاف الحيود قبل ان يؤثر في جودة العمليات					
2/ تمكن المراجعة الداخلية من التعرف على فرص التحسين المستمر					
3/ تساعد المراجعة الداخلية في التعرف على أفضل الممارسات					
4/ تؤدي المراجعة الداخلية لتحسين الأداء					
5/ تساهم المراجعة الداخلية في التركيز على رضا العملاء					

**Appendix (2):**



**Sudan University of Science and Technology**  
**College of Graduate Studies**



Mr./Mrs. ....

**The subject: Questionnaire**

The researcher prepares scientific research as one of the requirements for obtaining a master's degree in Total Quality Management and Excellence entitled:

**The Impact of Internal Audit on Improvement of Quality System  
Regarding ISO 17025 in National Leather Technology Center and  
Sudanese Standards and Metrology Organization, Khartoum State-  
Sudan**

Please note that the data obtained will be used for the purpose of scientific research only and will be treated with strict confidentiality



## Secondly: Measuring the study variables

Please put (√) mark in the answer square that suits your opinion:

### The first hypothesis:

There is a statistically significant relationship between implementation of the internal audit methodology and implementation of the quality system according to the general requirements of the standard for the efficiency of the performance of the calibration and testing laboratories ISO/IEC 17025:2005

No.	Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly disagree
1	The internal audit methodology contributes to the identification of deficiencies in the quality system					
2	The internal audit methodology contributes the difficulty of implementing certain points in the procedures					
3	The internal audit methodology benefits from the view of the beneficiary of the implementation procedures					
4	The application of the internal audit methodology leads to easy understanding and implementation of					

	procedures and work instructions					
5	The internal audit methodology contributes to increasing the efficiency of procedures and work instructions					
6	The internal audit methodology contributes to ensuring the effectiveness of the quality system					
7	The internal audit methodology contributes to increasing the effectiveness of the procedures and work instructions					

**The second hypothesis:**

There is a statistically significant relationship between implementation of the internal audit methodology and the number of cases of non-conformity of the quality system according to the efficiency of performance of the calibration and testing laboratories ISO/IEC17025:2005 and readiness for accreditation.

No.	Statement	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1	There is a procedure for adjusting and implementing the internal audit of the quality system					
2	The internal audit procedure is understandable and easy to implement					
3	The quality manger reviews the management procedures to ensure that they comply with the requirements of the standard for the efficiency of calibration and testing laboratories IO/IEC17025:2005					
4	The technical manager reviews technical procedures to ensure that they comply with requirements of standard for the efficiency of					



	calibration and testing laboratories ISO/IEC17025:2005					
5	The implementation of internal audit methodology leads to the reduction of errors and diffraction in the quality system					
6	The implementation of internal audit methodology leads to the reduction of cases of non-conformity by the accreditation body					
7	The implementation of the internal audit methodology contributes to the follow-up of the diffraction that may appear in the procedures and work instructions					

**The third hypothesis:**

There is a statistically significant relationship between implementation of the internal audit methodology and the continuous improvement of the quality system and increased customer satisfaction.

No.	Statement	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1	Internal audit contributes to the detection of diffraction before it affects the quality operations					
2	Internal audit enables opportunities for continuous improvement					
3	Internal audit helps identify best practices					
4	Internal audit leads to improves performance					
5	Internal audit contributes to focus on customer satisfaction					