Investigating the Factors Affecting the Development of a Sustainable National Accreditation Body for Engineering and Technology Laboratories in North Africa.

TAREK ELSMUAI

School of Science and Technology

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Copyright Statement

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Abstract

Quality Assurance has become one of the prime factors for consideration by a customer whether a person or organisation in order to achieve highly competitive industrial activity. Within the developing countries there is limited awareness among the public regarding the role and purpose of accreditation. This constitutes a major constraint and it is one of several constraints for accreditation, specifically, in the Arab region.

The primary objective of a National Accreditation Body is to enable organisations to attain continuous performance improvement, maintain consistency, promote quality awareness and achieve the desired level of business excellence. However, a major issue arises as to the application of the NABs in different cultural and operational backgrounds, and how to take account of additional complexities of social systems. Therefore accreditation in the developing countries need to establish a new strategy on accreditation to be able to demonstrate the capability to compete internationally taking account of the difficulties, barriers, confidence and international acceptance.

The research was carried out in three phases. Phase one established a conceptual framework based on a literature review and a quantitative and qualitative study. It described seven important themes containing 94 variables as critical to a sustainable accreditation scheme. Phase two provided empirical studies of the Quality Assurance approaches adopted in a case study in Tunisia. The field research surveyed the selected samples from the Tunisian Accreditation Council (TUNAC) and Central Laboratories for Testing and Analyses' (LCAE) population using a questionnaire. The questionnaire was designed to examine satisfaction and motivation, as well as gauging the effectiveness of the TUNAC as determined by an analysis of the improvements that could be directly associated with its implementation of a sustainable accreditation scheme.

The questionnaires achieved over 84% response rate and the resulting data set was comprehensive and the analysis robust. An additional element of the research compared the results of the questionnaire results with the perceptions of the TUNAC management. In-depth analyses of the case study plus interviews with decision makers (TUNAC management) provided a context and guidance in the development of a sustainable accreditation framework. Then in Phase three the external PESTILE factors of North Africa were analysed and linked to the internal factors to construct and propose a sustainable accreditation framework. The analysis of the proposed framework has led to the development of a draft questionnaire to be used by prospective accreditation bodies as a measuring tool against its current accreditation process.

The main contributions of this research are the development of a sustainable accreditation framework, which was developed and cross validated and development of a PESTILE framework which has never been used before in developing sustainable frameworks. Moreover the findings of this study enrich the debate on accreditation and Quality Assurance in literature.

Publications

Journal Papers

- Elsmuai, T. and McCollin, C. (2014). Bayesian Modelling of a Quality Accreditation Network. International Journal of Quality Engineering and Technology. Vol. 4, No 3. Pp.181 – 199.

- Elsmuai, T. and McCollin, C. (2013). Development of Accreditation in the developing countries II. The Business Review Cambridge journal. Vol. 21, No,1, pp 224 - 229. ISSN 1553-5827.

Conference Papers

- Elsmuai, T. and McCollin, C. (2011). Development of a sustainable National Accreditation Body for Engineering and Technology Laboratories Accreditation in Libya**.** The 25th European Organisation for Quality Conference, Budapest, Hungary. June 20 – 23.

- Elsmuai, T. and McCollin, C. (2012). Investigating the factors affecting the development of a national Accreditation Body in North Africa. International Society of Science and Applied Technologies. Proceedings of the 18th ISSAT International conference on Reliability and Quality in Design. Boston, Massachusetts, U.S.A. July 26 – 28. ISBN: 978-0-9763486-8-9.

- Elsmuai, T. and McCollin, C. (2013). Development of Accreditation in the developing countries I. Education and Management Innovation. Proceedings of the 2nd International conference on Education and Management. (ICEMI 2013). Rome, Italy. February 24 – 25. DOI: 10.7763/IPEDR. V60. 31.

- Elsmuai, T. and McCollin, C. (2013). Development of Accreditation in the developing countries II. The Finance, Global Management, Economies and Information Technology Research conference. Proceedings of the 17th FGMEIT international conference, New York, U.S.A. May 23 – 26.

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Abbreviations

AFNOR	Association Francaise de Normalisation
ANSI	American National standards institute
BN	Bayesian Networks
BSI	British Standards Institute
CABs	Conformity Assessment Bodies
CEE	Central and Eastern European countries
COFRAC	French Accreditation Committee, Comite Francais d'Accreditation
CA	Conformity Assessment
DAG	Directed Acyclic Graph
DAkkS	German Accreditation Body (Deutsche Akkreditierungsstelle GmbH)
DIN	Deutsch Institute Fur Normung
EAC	European Accreditation of Certification
EAL	European Cooperation for Accreditation of Laboratories
EA	European Cooperation for Accreditation
EU	European Union
GATT	General Agreement on Tariffs and Trade
GDP	Gross Domestic Product
IAF	International Accreditation Forum
ILAC	International Laboratory Accreditation Cooperation
ISO	International Standards Organisation
IEC	International Electrotechnical Commission
LCAE	Central Laboratories for Testing and Analyses
LNCSM	Libyan National Centre for Standardisation and Metrology
LQA	Libyan Quality Award
MRA	Mutual Recognition Arrangements

MLA	Multilateral Recognition Arrangement
NAB	National Accreditation Body
NATO	North Atlantic Treaty Organisation
NBS	National Bureau of Standards
OHSAS	Occupational Health and Safety Advisory Services
PCA	Principal Component Analysis
PESTILE	Political, Economic, Social, Technological, International, Legal and Environmental analysis
QA	Quality Assurance
QC	Quality Control
QMS	Quality Management System
QS	Quality Standard
SAE	Society of Automotive Engineers
TBT	Technical Barriers to Trade
TQM	Total Quality Management
TUNAC	Tunisian Accreditation Council
UN	United Nations
UKAS	United Kingdom Accreditation Service
UNIDO	United Nations Industrial Development Organisation
WTO	World Trade Organisation

Chapter 1 - Thesis Background

1.1 Introduction

The last two decades have witnessed an obvious development of quality and Quality Assurance. This development was a result of many reasons such as international competition, globalisation, international open markets and customer satisfaction. The development of Quality from Quality Control to Quality Assurance to Total Quality Management to Six Sigma was developed due to industry and customer needs.

The development of international marketing and globalisation necessitate the need to reduce international barriers to trade between countries thus reducing unnecessary immigration procedures and quarantine stores of goods and preventing damage to goods. Therefore the efforts of both the International Accreditation Forum , the International Laboratories Accreditation Corporation and the ISO have introduced a new terminology called Accreditation which being internationally known as *Certified Once Accepted Everywhere.*

Accreditation is rapidly become an international passport for products, services and laboratories tests between countries. Evans and Lindsay (2005) claimed that suppliers who want to achieve international competitiveness must have ISO certification in foreign market as consumers will not buy from suppliers who are not certified to relevant standards especially in products that require safety assurance, e.g. medical devices and gas appliances.

This research reviews the available literature on Quality management and its introduction and implementation in the developing countries, [A *developing country is a nation with a lower living standard, underdeveloped industrial base and low Human Development Index relative to other countries* (ISI,2013)]. As North Africa countries are within the developing countries, previous research done in the developing countries should help to understand the situation and how to implement a Quality assurance system in these countries. Moreover it would help

in identifying main factors that drive or restrain the development of a sustainable National Accreditation Body in North Africa.

Libya does not have a national accreditation body. However its industry, laboratories and Quality Accreditation and Certification systems, will need a guiding model or framework so as to give confidence to customers and also to provide a competitive advantage for Libyan products in the international market. United Nations Industrial development programme UNIDO (2005) stated that; Libyan laboratories and industrial research centres need support and improvement in such areas as space management and in the placing of some equipment to meet the criteria and requirements of ISO/IEC 17025 Laboratory accreditation **.**

Previous research done in the developing countries should help to understand the situation and how to implement a Quality Accreditation system in these countries. The developing countries in general have an advantage in introducing and implementing a successful Quality scheme and may not repeat mistakes of the developed countries which have decades of experience in Quality management (Crosby, 1995). Therefore a study of Quality management in the UK and the development of the United Kingdom Accreditation Service, UKAS, will help in understanding the requirements, philosophies and theories to aid implementation of a sustainable National Accreditation Body in North Africa.

1.2 The need of the research

The main motivation for carrying out this research was through a workshop on promoting Libyan non-oil products in the international markets – particularly- EU markets chaired by the minister of commerce in Libya in 2009. The author came up with a conclusion that a national accreditation body in accordance with ISO/IEC 17011 should be researched to investigate criteria that meets Libyan needs as a developing country.

However, further investigation revealed that Tunisia has already established its own national accreditation body. This has led the author to consult literature and investigate the development of accreditation in both developed and developing countries. The significant finding was that the accreditation programs in Brazil and Zambia were established at the request of their governments with international assistance and resulted in transferring the characteristics of these international accreditation bodies to Brazil and Zambia without investigating local requirements of these developing countries. This scenario has resulted in financial and performance problems faced accreditation programs in Brazil and Zambia (Bukonda et al. 2002 cited in Montagu, D. , 2003).

There is no research that has examined the external environmental factors that affect the development of sustainable accreditation bodies in the developing countries, or has questioned the apparent growth of accreditation in the developing countries, particularly in North Africa. This research draws attention to this gap and seeks to widen the debate from a concentration on quality management and related Standards to include more generally applied quality assurance and accreditation.

The literature upon which this thesis is based confirms that quality management has increased very significantly over the past twenty years and continues to do so, moreover it revealed that there is growth in the application of standards to different areas of our daily life such as ISO 22000.

Although accreditation is little talked about, there are some researches done in the developed countries. Accreditation in the developing countries is still a new phenomenon and regardless of the fact that there are some developing countries that have already established their national accreditation bodies, a major issue arises as to the application of the national accreditation body in different cultural and operational backgrounds and how to take account of additional complexities of social systems (Elsmuai and McCollin, 2014).

From the literature review that has been explained in detail in chapter two, the researcher established the aim, objectives, research questions and developed the conceptual framework of this study which involves common types of barriers that affect any quality development programme. The research questions are the questions which identify the nature of the research problem that need to be focused on by the researcher.

1.3 Research Aims and Objectives

1.3.1 Research Aims

This research is concentrated on the development of Quality Assurance and Accreditation. The main aim of the research is to investigate the factors that affect the development of a sustainable National Accreditation Body in the North Africa context. The main focus of the study was to identify and develop an implementation framework to effectively introduce a sustainable national accreditation process.

The two main research aims are:

1. To investigate the factors that affect the development of a sustainable NAB in the developing countries with a particular focus on North Africa region.
2. To develop a conceptual framework that incorporates all critical factors to accreditation into a proposed sustainable accreditation framework that is appropriate to the North African context.

1.3.2 Research Objectives

In order to achieve these research aims, the following research objectives have been established as being critical for success:

1. To investigate the growth and development of quality and accreditation and whether there is any evidence that they deliver a sustainable accreditation scheme.
2. Analysing the Political, Economic, Social, Technological, International, Legal and Environmental external factors that affect setting up new businesses in Libya and Tunisia.
3. To undertake research into the Tunisian Accreditation Council to determine its ability to bring about sustainable organisational improvements and its suitability as a tool to implement the principles of a sustainable accreditation scheme.
4. To explore the possible future direction that the management of the TUNAC will take in relation to the creation of new driving improvement or the consolidation of existing strategy.

1.4 Significance of the study

It has been said that “Research can be considered as a voyage of discovery and whether anything is discovered or not-the essential feature is that it should make an original contribution to knowledge’’ (Yin, 2003).

This research investigates the development of sustainable national accreditation scheme in North Africa. The study meets the identified needs and addresses the gap in current literature on accreditation in developing countries. Moreover, this research aims to engage in the debate on the principles and practice of accreditation in the context of a developing countries in North Africa.

The methodology used in this research at various stages was to gain access to various relevant information and data and to analyse them appropriately. This was augmented by using triangulation to provide two independent sources of data and to cross validate the data by a quantitative approach.

The significance of this study is that:

1. It seeks to fill the gaps in the current literature debate on the prospects of accreditation by offering the first North African case study of its kind through using Bayesian modelling to map a quality accreditation network (Elsmuai and McCollin, 2014).
2. In addition, this study is the first to investigate both internal and external North African PESTILE environmental factors that affect the development of an accreditation scheme by using Analytical Hierarchy Process and pairwise analysis .
3. It contributes to the understanding of the development of accreditation in the developing countries by presenting an empirical and analytical study which will expand the literature in relation to accreditation.
4. It introduces a sustainable national accreditation scheme in North Africa.
5. It raises awareness of the importance of accreditation in the developing countries.

1.5 Preliminary research

The main motivation to initiate this research was because of the author's interest in furthering his studies augmented by the need to develop an accreditation scheme in Libya. The author's job as a quality specialist in an oil company in Libya has helped him to participate in local workshops chaired by Libyan policy makers on the future country movement towards international markets as shown in figure 1.1.

The main body of research was undertaken using a detailed questionnaire, complemented by a series of post-questionnaire interviews with managers and senior engineers to contrast their perceptions with those of the main population. These methodological approaches are developed in more detail in chapter 4.

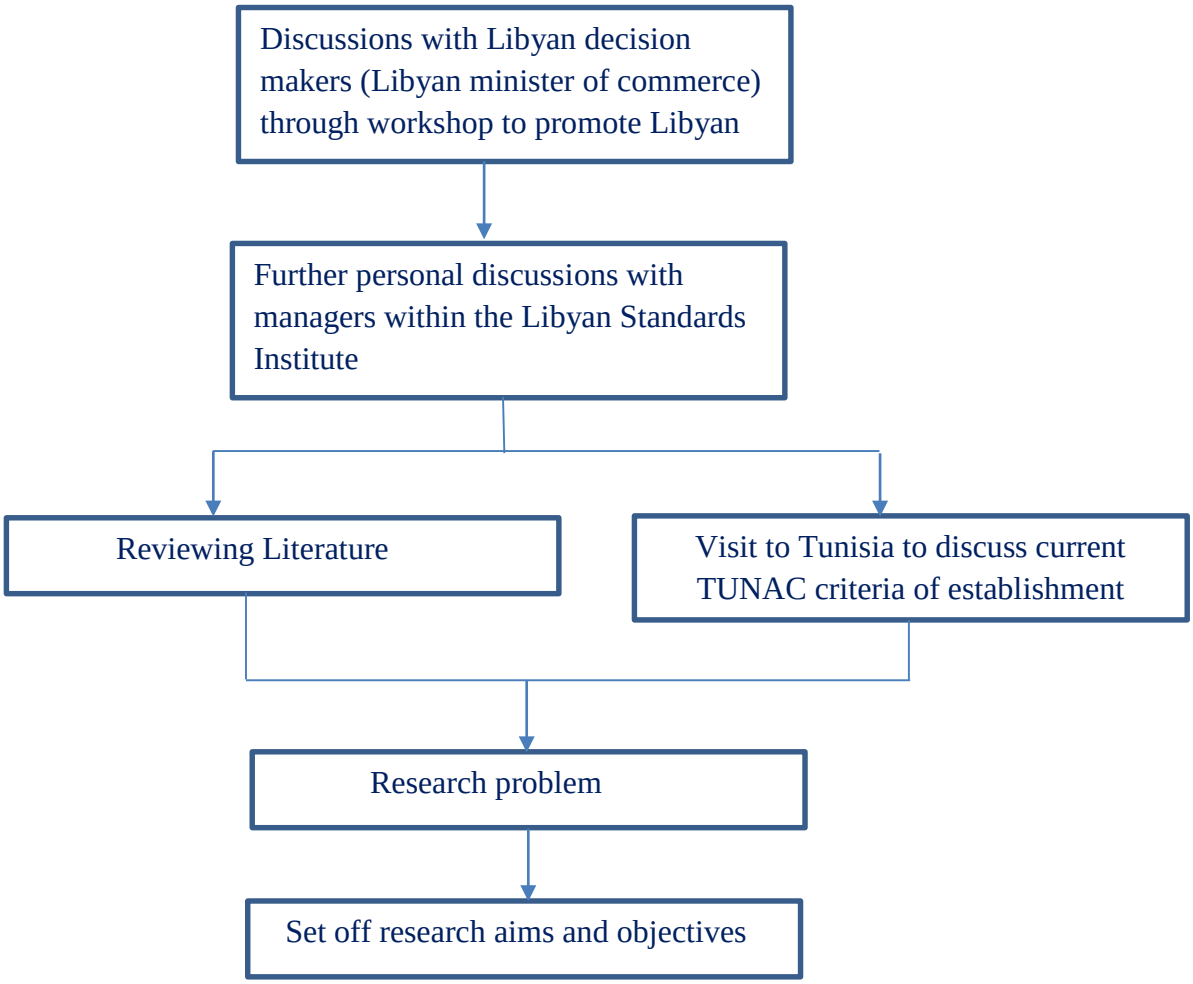

Figure 1.1; Development of the Research Problem

The development of a sustainable accreditation framework is closely linked to Quality Assurance and a proper understanding of the accreditation process is not possible without some examination of quality development. Therefore, a brief analysis of quality development is presented to support the research into accreditation.

A number of statistical techniques were employed to explore, explain and cross validate the data. These included Cronbach's Coefficient Alpha, frequency tests, histograms, cross-tabulations, Factor analysis, Kaiser-Meyer-Olkin Measure of Sampling Adequacy, Bartlett's Tests of Sphericity, Bayesian Belief Network, Analytical Hierarchy Process and Pairwise analysis. These are developed in more detail in Chapters 5.

The conduct of the research is illustrated in Figure 1.2, begins with a review of the literature covering the chronology and development of quality during the latter part of the twentieth century. The massive amounts of available relevant literature had to be refined down to proportions that are directly related to accreditation, while at the same time remaining relevant and up to date during the period of the research until the final thesis was finished.

The review of literature has led to the development of a conceptual framework which was the main source in designing and selecting the appropriate data collection methods and statistical analytical tools. Moreover the review of the literature has explored many areas of research gap i.e. sustainable accreditation and external PESTILE . This has led to the adoption of research methodologies to be used to generate primary data and methods of data analysis. The structure of the thesis's chapters and sub headings is based on the research framework.

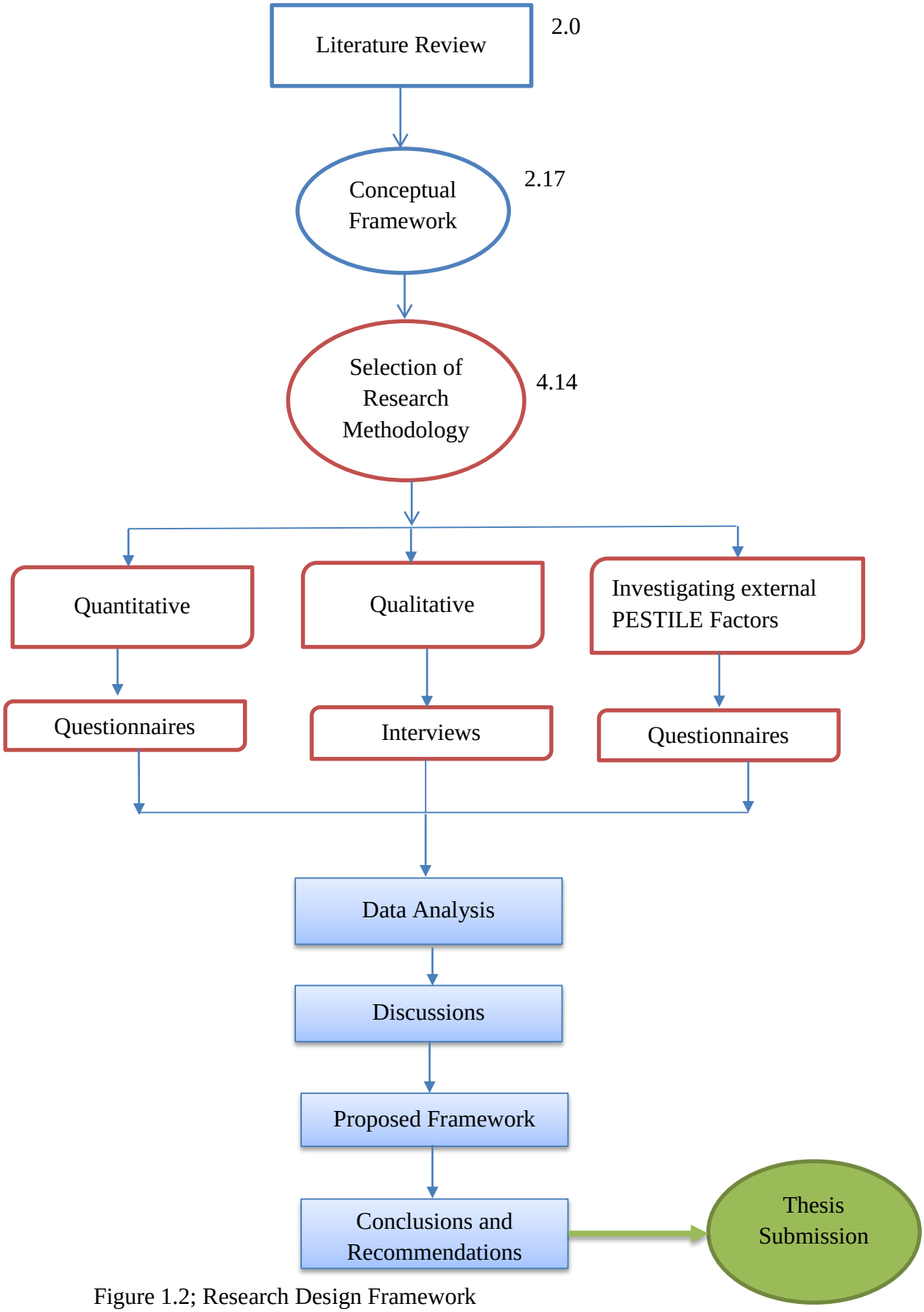

Figure 1.2; Research Design Framework

1.6 Thesis structure

The thesis consists of seven chapters as following:

Chapter one – introduce the importance of this research and identify the existing gap in research and the contribution made by this research to the knowledge.

Chapter Two – address the literature on quality development and accreditation development, also review the factors affecting accreditation.

Chapter Three – review the external PESTILE factors that could affect any proposed business in the developing countries.

Chapter Four – review the research methodology and justify the adapted research methodology for this research as per the research aim and objectives. Moreover discuss the data collection methods for this research and the design of the questionnaire and the interview.

Chapter Five – present the data collected from the empirical research and discuss the methods used for data analysis. Also draw conclusion on the various methods of data analysis used with cross validation of different methods.

Chapter Six – discuss the outcomes of the quantitative and qualitative approaches and link it to the literature and finally propose the suitable accreditation framework.

Chapter Seven – Provide a summary of the thesis, along with clear limitations of the research done, conclusions and directions for future work.

This first chapter has explained and introduced accreditation, the aim and objectives of this research, the need for this research, research justification, research design and development of the research problem. The next chapter will discuss and review literature on quality and accreditation development in the developing countries.

Chapter 2 - Accreditation and Quality: A Literature Review

2.1 Introduction

Product quality is a major factor in consumer satisfaction. This is true whether the purchaser is a person or a large organisation. Therefore, Quality Assurance has developed as one of the important factors for consideration in order to achieve highly competitive industrial achievement within local or international markets. This industrial achievement is augment by international accreditation of products and services. Within the developing countries specifically the Arab countries, there is limited awareness among the public regarding the role and purpose of accreditation which is a major constraint to businesses in the Arab region (Shihub, 2009).

There has been a rapid increase in international competition in the last two decades. This competition has forced the developed countries to adopt the philosophies in Quality Management such as Quality Control, Quality Assurance, Total Quality Management and Quality Management System. The developing countries, particularly the Arab countries, need to adopt and improve the pathways of the developed countries if they want to achieve a competitive advantage and form an effective international economic power. Most of the companies in North Africa, especially in Tunisia, know the importance of quality as a crucial motivation for emerging a competitive advantage both locally and internationally.
Sayeh, (2007) claimed that the rapid increase in international competition has led some Libyan companies to adopt and implement some of the quality standards, such as ISO 9001 Quality Management System as a guidance to promote organisational performance**.**

A National Accreditation Body is an approach available for assessing organisational performance and competence. Furthermore it is a means by which countries, nationally, can promote a quality awareness level.

The main objectives of a NAB are to assist organisations to achieve continuous performance, maintain stability and achieve the desired level of business excellence. However, NAB could face issues such as continuity and independency if it is initiated in different cultural and operational backgrounds without looking at the internal and external factors and the structure of the social system (Trompenaars, 1993).

Many developed countries have established their own national accreditation bodies, e.g. UK, France, Germany, USA, however, there is a gap between the developed and developing countries with different stages of the quality development. In the developed countries, the quality movement has been developing since the end of the Second World War. For instance, the Total Quality Management system has been a major factor in the planning and development of business in the US and Europe in the last 50 years (Anschutz, 1995). On the other hand, the developing countries such as Libya started the journey to quality in the nineties, by recognising quality initiatives and its effect on the development of organisational and management establishments (Zairi, 1996). This new trend to adopt quality initiatives in the Arab countries has followed the change that started to take place in economy policies to cope with the new movement towards international free markets as was the case of Dubai and Egypt (Youssef, 1996). Also senior management have become increasingly aware that quality is an important strategic path and considered as an important focus within organisation (Oakland, 2000). Most of the developing countries are still not prepared for the current challenges of the globalisation. Some of developing countries, e.g. Singapore, Malaysia, Taiwan, Dubai, have introduced a Quality Management System as a competitive advantage to help promoting a quality culture and provide facilities and policy environment such as privatisation, physical infrastructure and institutional support to support transformation and aid in launching entrepreneurship (Youssef, 2006).

Almost all of the development of NABs has taken place during the last 40 years or so in the developed countries such as UK, USA and Germany, for instance the American National Standards Institute has been doing accreditation since early 1970.

Until a few years ago, the accreditation activities of the European national accreditation bodies were handled separately by the European Accreditation of Certification and the European Cooperation for Accreditation of Laboratories. Nowadays these activities are being handled by national recognised accreditation bodies and coordinated by the European Cooperation for Accreditation (Slagter, and Loeber, 2001).

These national organisations have merged to form the European Accreditation (EA) which now covers all European conformity assessment bodies such as testing, calibration, inspection, certification of management systems, certification of products, certification of personnel and environmental verification under the European Eco-Management and Audit Scheme (European Accreditation, 2011).

Although the development of the accreditation framework can take account of the significant progress made in other countries in developing their NAB, therefore any proposed accreditation framework must take careful account of the precise nature of the North African industry and culture.

Today, in Libya, because of the globalisation pressure from the World Trade Organisation and opening the country to international competition, Libya as a country and Libyan companies specifically are facing severe international competition from international companies that are operating in the country especially in the oil and gas industry. If something is not done soon to promote quality culture in these companies, industry will certainly suffer (Youssef , 2006). Therefore an empirical research is required to identify factors that affect the development of a sustainable National Accreditation Body in the

context of a country such as Libya that has just opened its economy to foreign investment after enduring tough international sanctions over an extended period of time.

The scheme of accreditation of the certification bodies should have a clearly defined scope and should be consistent with a national and international standard system of industrial classification and can be extended periodically according to the needs of industry (Muse, 2008). In some countries, e.g. Libya, Algeria, the scope of accreditation is still limited to the QMS with ISO 9001 standards. In other countries, e.g. US, Japan, it has been stretched to include, for example, QS 9000 and ISO 14000 standards. The extension of accreditation to areas of an increased demand requires appropriate regulations be enacted to cover different areas, moreover the structure and size of the national accreditation body can be enlarged and strengthened through appropriate training being given to accreditors and auditors. The operative standards of the national accreditation body should comply with international standards. Since 2006, for example, all accreditation bodies that seek international recognition must adopt the ISO/ IEC 17011 standard. Governments should provide the financial resources for a limited period to support the establishment of the national accreditation body and properly qualify staff that are needed to apply and meet the requirement of ISO/ IEC 17011 (Guasch, 2007).

Preferably, there should be a single national accreditation body that is technically, operationally, and financially independent. Where accreditation tasks are spread over several organisations, companies experience additional costs because the requirements of accreditation usually vary across organisations. However, many countries do have more than one accreditation body to be able to cover not only the industrial sector but also the environment ISO 14001, Occupational Health and Safety BS OHSAS 18001, energy, and other areas. Where there is more than one accreditation body, it is important to establish the instructions, rules and functional scope of each accreditation body and establish procedures

for coordinating their operations.

Most countries have a single national accreditation body responsible for all areas of accreditation as the United Kingdom Accreditation Service, the French Accreditation Committee and the German Accreditation Body, however in other countries such as the United States there is more than one national accreditation body as the accreditation and metrology services are distributed to different organisations (Guasch, 2007).

Accreditation bodies in some of the developing Latin American countries tend to be involved in more activities where the accreditation body is responsible for certifying organisations against regulatory and voluntary standards as in Spain.

In Brazil, Chile, Colombia, and Peru, the accreditation body is combined with the national metrology institute. This may cause a problem if the accreditation and metrology functions are not clearly separated because the metrology institute provide a calibration services that could theoretically compete with the services of laboratory calibration ISO/IEC 17025.

In Chile and Peru, the national accreditation body is also the national standards body.

In the developed countries such as Spain and the United Kingdom, metrology and standardisation roles are usually performed by different organisations (Guasch, 2007).

Accreditation programmes in both Brazil and Zambia had significant problems in their later years due to overdependence on government involvement. In both instances accreditation programs were developed at the request of government with international assistance. However these accreditation programs had not achieved autonomy due to continuous changes in government view to accreditation and this has resulted in decreased support provided to accreditation bodies and as a result the continuation of those programs in Brazil and Zambia is uncertain (Bukonda et al. 2002 cited in Montagu, D. , 2003).

2.2 Quality definitions

The difficulty in defining quality as a generic phrase arises from the application of the word to aspects of Quality Control, Quality Assurance, Total Quality Control, Total Quality Management, Quality Management Systems and Business Excellence. As such the definition will be to a large extent dependent upon the category of quality being debated.

Quality is used to express ideas of class, luxury and expertise. Quality requirements composes of availability, delivery, reliability, maintainability and cost consideration (Oakland, 2000). The awareness of quality has changed in the last two decades. In the past, quality was measured by / or resulted from attaining some tolerance of defects. However nowadays it is defined as meeting customer requirements and goes further to customer expectations (Withers et. al, 2001). Quality has been defined by different quality gurus such as: Juran (1986) *"Fitness for purpose or use"*.

Deming (1986) *"Quality should be aimed at the needs of the consumer, present and future"*.

Feigenbaum (1991) *"The total composite product and service characteristics of marketing, engineering, and manufacture and maintenance through which the product and service in use will meet the expectation by the customer"*.

Crosby (1996) *"Conformance to requirements and conforming to specifications"*.

Due to globalisation and elimination of international barriers to trade of markets, quality increasingly has become an important major factor in achieving competitive advantages and this has led many businesses around the world to develop their competitive strategies (Madu,1997). Nowadays, the emerging markets in some of the developing countries provide a competitive environment which requires higher levels of quality, efficiency and service to enable industries to achieve internationally accepted quality levels.

According to ISO 9001 (2000,2008) quality is *"The degree to which a set of inherent characteristics fulfils requirements"*. By combining the definitions of quality and

requirements in ISO 9000/2000, quality can be further defined as *"The degree to which a set of inherent characteristics fulfils a need or expectation that is stated, generally implied or obligatory"* (Hoyle, 2001). Quality is an essential strategy in supporting and improving of competitiveness in businesses and it has been connected with customer satisfaction, expectations and continuous improvement.

2.3 Chronology of Quality development in the twentieth century

2.3.1 Inspection Era (1920)

This period was characterized by the concentration of quality activities exclusively on after-production inspection of finished product (Juran, 1995). In this period there was no concentration on taking preventive measure, however the main role was to screen out defective outputs before being delivered to a customer and there is neither customer satisfaction nor a supplier control process (Dale, et al, 2007).

Although an organisation had to address quality issues, the inspection department within organisation was exclusively responsible for conformance to quality specifications.

2.3.2 Quality Control Era

This period, from 1920 - 1926 is marked by growing use of sampling, control charts and different statistical process control techniques (Juran, 1995). The use of the statistical techniques promotes quality development and focused on product conformance through statistical processes rather than direct product inspection (Bregman, et al,1994).

Quality Control was the responsibility of manufacturing and engineering departments within organisations and there was an adoption for different terms such as trouble-shooting, self-inspection, product quality planning, document control and the introduction of procedural manuals in an attempt to standardise activities and outputs (Dale, et al, 2007).

2.3.3 Quality Assurance Era (1950)

Managing quality processes highlights the Quality Assurance period. Suppliers were incorporated into the quality process with third party supplier assessments becoming common (Dale, et al, 2007). Moreover this period involved the emergence of many new quality concepts such as quality costs, Total Quality Control, zero defects and reliability engineering, with a greater array of statistical tools in place, such as a failure mode and effect analysis, systems audits and quality planning.

2.3.4 Total Quality Management Era (1980)

This is where Quality Management became a central driving force in organisations that adopted Total Quality Management, it involves familiarisation and implementation of Quality Management concepts within every department in an organisation (Garvin, 1988). Indeed, the characteristic of the Quality Assurance era was Quality Management System standards and there is no indication that this era has come to an end.

2.3.5 The Excellence Era (1990)

The development of quality has led organisations to sustain major improvements, maintain high performance and goals towards being an Excellent-Sustainable organisation (Joseph and William 2004). Hence, this stage of quality development may now be well-known, it emphasises on a flexible organisation, responsive and able to adapt quickly to changes, responding to customer requirements and feedback and benchmarking against rivals. Quality Management aspects remain very significant in developing a sustainable business, although the concept has been broadened and is now often expressed in the language of business or organisational excellence (Sun et al. 2004). Quality Management has been merged and adapted into broader business management concepts, developing together towards an objective of building excellent sustainable organisations

2.4 The Quality Movement in the Arab Countries

In some Arab countries there are properly industrialised factories with reasonable skills, infrastructure and good access to foreign technology. Often, however, their industrial, technological development and export structures are weak and not linked to each other, moreover their management approach is not well developed and is affected by organisational culture and social life (Al- Zamany et al., 2002).

Although there are excellent efforts been made to develop standards in many Arabian Gulf countries such as United Arab Emirates, Bahrain and Saudi Arabia, recent studies, Al-Omaim, (2002); Al-Khalifa and Aspinwall (2000) in Qatar; Al-Zamany et al. (2002) in Yemen; Al-Khawaldeh (2002) in Jordan; Hesham Magd (2003) in Egypt; and, Najeh and Kara-Zaitri (2004), (2009) in Libya, have discovered that Arab countries generally still lag behind when it comes to ISO 9001 certifications and implementation if compared to developed countries. According to these studies, most of the Arab countries are still in the early stages of implementing Quality Management initiatives and Total Quality Management and share the same constraints such as:

- Lack of management commitment, vision and future planning.
- lack of long-term plans for staying in business and depend on quick fix solutions.
- Top management unawareness of Quality management.
- Inadequate information system and logistical difficulties due to inadequate suppliers.
- Pressures from competitors and foreign partners are the main reasons for seeking certification.

Zairi (1996) claimed that some Arab managers unfortunately believe that ISO 9000 certification would bring miracles and can lead to competitive advantages. He states that:

"All Arab countries have to deal with these levels of misconception and poor understanding. ISO 9000 is only a license to practice and only represents one pillar of the TQM philosophy. It is an essential element but not sufficient".

2.5 The state of Quality in Libya

Before the discovery of oil and gas in the early 1960s, Libya was one of the poor countries in Africa. Since then, the country has developed through linking petroleum, iron and steel industries. The country has committed to develop products that meet quality requirements of both local and international markets through the most appropriate and highest technology available (Hokoma, 2008).

In the 1970's the Libyan government built up many manufacturing complexes in partnership with some international companies such as Fiat, Exxon Mobile, BP…etc to produce different kinds of products, for example, food, metals, chemicals and petrochemicals. These organisations vary from each other in the wages, number of employees, top management qualifications etc. Some of these organisations such as petrochemicals are more strategic to the country because they have been built from the beginning to produce products for internal / external markets and have high mass production. Up to the 1990s the strategy of these organisations was to produce products for the local market in accordance with the Libyan market specifications. However, in the 1990s the Libyan government established the Libyan National Centre for Standardisation and Metrology to support the Libyan manufacturer producing products according to Libyan standards that have been issued as mandatory standards. In addition the LNCSM should control and monitor quality of the Libyan products and set up and help Libyan organisations to adopt Quality Management Systems (LNCSM, 2010).

Furthermore, in order to control the Libyan industrial organisations, the Libyan government has established the General Industrialisation Corporation to improve Libyan products' quality

and raise Libyan exports.

The Libyan government continuously supports the improvement of quality programs. The latest support from the Libya government to quality programs was the decree (427 / 2009) enacted by the government to launch the Libyan Quality Award to be celebrated and awarded annually to organisations who promote and follow quality standards (Libyan Government, 2010).

The review of the state of quality in Libya would help any future plans to implement a sustainable national accreditation body in Libya

2.6 Reason for ISO Certifications

Organisations in contemporary international business are facing challenges to improve their performance and reputation to ensure a position in the global competitive market. This should be done through improving quality, manufacturing processes, costs of products, and matching the outputs capacity with a customer satisfaction. This have led companies around the world to change old traditional quality and manufacturing processes and adopt a new way of business operation towards more effective quality systems (Hokoma, 2010).

According to Withers and Ebrahimpour (2001), the main reasons for ISO certification are:

- Improved quality.
- Achieving world class operations.
- Customer requirements.
- Increased market share.
- Cost reduction.
- Stream lined operations.
- Meeting company objectives.
- Efficiency improvement.

The British standard BS 5750 was the world first published national standard adopted internationally and known today as ISO 9001 standard (Oakland, 2004). It is widely accepted as the most popular reference for setting up an approach of quality management in organisation. According to (Kartha, 2002) "ISO 9001 standard is supposed to help companies identify mistakes, streamline their operations and to maintain a reliable level of quality". Viadiu, et al., (2006) claimed that ISO 9001 standard forms the base and to organise company's responsibilities with the objective of producing products or services that meet customer requirements.

Joseph Juran, one of the gurus of quality management believed that:

"*The standards (ISO 9000 series) are voluntary: they are not a legal prerequisite to selling products in Europe. They have been so cleverly marketed however, that whoever hopes to sell products in Europe must become registered as meeting the criteria of ISO 9000. Registration to ISO 9000 has become a de facto licence to market in Europe*"

(Juran, 2000).

A study by Erel and Ghosh (1997) investigated the status of ISO 9000 implementation in Turkey found that the driving factors in seeking ISO 9000 certification were: an opportunity to implement a quality management system, preparation into Total Quality Management, production improvement, improved customer satisfaction, means of certifying the quality system, increasing exports, increased competition, increasing market share and demand by customers.

Krasachol, (1999) stated that ISO 9001 has been accepted worldwide as a Quality Management System and its effects are far – reaching and Thailand is one of countries that have adopted it as a national standard. Oakland (2004) believes that a company's vision and mission commitment and policy are key factors in promoting successful business proficiency. He added commitment should be communicated and spread throughout the organisation.

Djerdjour and Patel (2000) cited in Awan et al (2009) perceived that the main motivator for ISO certification in Indian companies is marketing whilst in Pakistan, factors such as bigger market access, improved Quality image, reducing operations waste and meeting customer requirements are the main drives. Moreover Douglas et al, (2003) cited in Rusjan and Alic (2010) claimed that the main reason for ISO certification in the beginning of 1990s was external pressure from customers while at the end of the same decade the main reason was market share and increase in the international competition.

2.7 Quality management system (QMS)

ISO 9001 (2000) defined QMS as *"that part of the organisation's management system that focus on the achievement of outputs in relation to the quality objectives"*. Any organisation adopting a QMS should use the available ISO 9001 standard as guidance documents (Sharif, 2005). It is the quality of management that covers leadership, communication, team work, management of change and satisfying customers, moreover it contains continuous pursuit for opportunities to improvement (Laszlo, 2000).

The implementation of QM as a concept in any organisation needs top management commitment, however Quality Assurance ,the assurance of quality, comprises of e correction and prevention of problems as to provide customers with confidence that output of products are high quality.

Some of benefits in applying QM are customer satisfaction, improving product quality, increased productivity and reduced cost. National governments should play an active role in supporting and encouraging organisations to adopt a QM standard. Some countries have established national quality awards to encourage organisations to adopt a quality culture and provide a platform for sharing successful QM initiatives (Lee and Quazi, 2001).

A Quality Management System standard such as ISO 9001 series is the main element in the growth of conformity assessment awareness. Oakland (2000) stated that an appropriate QMS

can make an organisation's objectives mentioned in the quality policy achievable. This is usually done by a routine follow up and audit of the manufacturer's quality assurance system. The assessment and audit of an organisation' procedures is done by an independent third party auditor. The purpose of an independent third party audit is to support the manufacturer's claim, that its system of production is capable of delivering a product of reliable Quality with little or no defects (Sidney, 2003).

According to Perona (1998) cited in Ordoobadi, (2009) researchers have put large effort in different disciplines and domains to investigate the main factors that are affecting quality development. These factors are:

- Evaluation of customer requirements.
- Finished product's quality certification
- After- sales services.
- Product-process re-designs procedures.
- Supplier's quality assurance

A Quality Management System encourages organisations to analyse customer requirements, define the process that helps develop and supply a product that is acceptable to a customer and keeps these processes in control. Moreover it can provide a structure for continuous improvement and increasing the probability of satisfying customers and ensuring organisations supply products that meet customer requirements (Biazzo, 2005).

A study by Gyani (2008) showed that the creditability of a Quality Management System certification process raised a concern in a debate in the Indian Parliament in 2003. This is because many certification bodies were operating in India as franchisees of overseas certification bodies with little or no observation. Moreover the certification bodies were accused of issuing certificates to organisations, particularly of small industries without full compliance with the ISO 9001:2001 requirements. This issue raised in India complies with

Seddon's criticism of ISO 9000 as some companies believe that acquiring ISO certification creates pressure to comply with industry or organisation's procedures. Seddon mentioned ten main points criticising ISO 9000, the main points are; its status as a requirement for doing business diminished the chances of anyone inquiring whether it was doing any good; and instead of improving the quality and competitive advantage of organisations, ISO 9000 has made matters worse (Seddon, 1997).

2.8 Standards

A standard is a stipulator way of doing something. It represents an identical set of measures, agreements, conditions, or specifications between two or more parties (buyer – seller, manufacture – user, government – industry…etc.) (Spivak, 2001).

ISO defines a standard as a : "document established by consensus and approved by a recognised body, that provides for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree in a given context" (ISO, 2013).

Standards have a common look and feel that can be mystifying when first come across (Hibbert, 2007). There are different standards; even a standard on how to write standards with which good standards conform**.** Standards are widespread; however conformity assessment and accreditation are rarely talked about in normal discussion (Hunter, 2009).

Standards are traced back and it started with the beginning of industry development. As life became more difficult through things that people use, a need for some unity to simplify trade was required. Standards can be classified as mandatory which must be obeyed and voluntary where a consumer has a choice of compliance. It afford different social and economic benefits in all aspects of human life by guaranteeing Quality, safety, uniformity, conformity, reliability, economic proficiency both nationally and internationally (Pember, 2006).

Many aspects of people's daily lives depend on standards. They impact the products, food communication, means of travel, methods of work and play and many other things, also they serve societal aims by protecting health, safety and environment, e.g. ISO 14000, ISO 9001, BS OHSAS 18001, Six Sigma etc. (BSI, 2013).

Brunsson and Jacobsson, (2000) argued that standards create a strong part of global order in the modern world and life would be difficult without them. It aids coordination and cooperation internationally. Although standards create similarity and uniformity even among people and organisations far apart from one another, they are tools of control.

Mckay (2000) outlines the most important benefits of using standards as: simplification through the reduction of products variations and sizes; interchangeability of products due to size standardisation, reduced production costs, increased reliability of product, reduced purchase costs due to competition, improved customer satisfaction, increased product safety and reduced legal responsibility.

2.8.1 Types of standards

There are many forms of Standards such as physical items or units of weights and measurements. Also they could be written documents or published rules. For instance the metrological units such as the metal bar in the early times with two lines engraved on it defined the metre and the metal cylinder that defines the kilogram or the vessel which defines the volume **.** Standards applied in different areas such as units of measurements for products and processes, systems and services in a particular Quality Management System, and for health, safety, consumers and environment. It is a way of creating and applying rules for a specific approach to a specific activity for the benefit and cooperation of all parties involved. (Spivak, 2001).

2.8.2 Standardisation

The standard is the result of a specific standardisation work approved by a recognised authority to bringing reliability to a product or service. Frequent requests of scientists, engineers and the industrial community to establishing an organisation to develop and calibrate standards, resulted in establishing different standards Bureaus in different places in the world such as the NBS in the USA, the BSI in the UK and the AFNOR (Spivak, 2001).

2.8.3 Specifications

Customer requirements are normally explained and detailed in product or service' specifications (McCollin and Disney, 2004). According to ISO "specification is a concise statement of a set of requirements to be satisfied by a product, a material or a process indicating whenever appropriate, the procedures by means of which it may be determined whether the requirements given are satisfied''. Oakland (2004) claimed that specification of a product or service is the most important feature of the quality of design. Specification could be a standard or a specific organisation'standard. If a product is tested and did not pass the test successfully as described in standard or specifications, then the product is not acceptable.

2.8.4 National and International Standardisation

Although standardisation was developed in the twentieth century, it started at a national level in the developed countries at the beginning of the last century (Spavik, 2001). For instance the British Standards Institution was created in 1901, the Deutsch Institute Fur Normung in 1917, the American National standards institute in 1918 and the Association Francaise de Normalisation in 1926.

The difference between national and international standard (s) is that national standard of specific country is applicable within its territory while international standard is accepted everywhere.

The ISO/IEC series, table 2.1, is a set of accreditation standards developed by international standards organisation and the International Electro - technical Commission. The International Laboratory Accreditation Cooperation (ILAC) was established in 1977 to develop laboratory accreditation procedures and practices and supports laboratory accreditation as an instrument to identify competent abilities. It promotes and maintains the use of Mutual Recognition Arrangements between accreditation bodies and ILAC members (ILAC, 1999).

The IAF was established in 1993 as a forum amid accreditation bodies of certification organisations. The IAF objective is to support the establishment of emerging accreditation programs to enable the use of accreditation to build a confidence in the conformity assessment process and facilitate global trade through conformity assessment certification (IAF, 2012). The IAF operates a Multilateral Recognition Arrangement where members of accreditation bodies recognise results of each other as equivalent in accordance with ISO/IEC Guide 6123 and ISO/IEC Guide 62 (IAF, 2012).

The recent efforts to encourage free international trade, the IAF/MLAs and the ILAC/MRA have been created to establish networks of certification and accreditation bodies that are recognised internationally (Muse, 2008); (Behrens and Wloka, 2010).

	Standard	Standardisation
1	ISO/IEC 17011:2004	General requirements for accreditation bodies accrediting conformity assessment bodies
2	ISO/IEC 17025:2005	General requirements for the competence of testing and calibration laboratories
3	ISO 15189:2007	Accreditation of Medical Laboratories
4	ISO/IEC 17020:1998	Inspection Bodies
5	ISO/IEC 17021:2006	Requirements for bodies providing audit and certification of management systems
6	ISO/IEC 17024:2003	certification program for individual persons
7	ISO/IEC Guide 65:1996	Bodies operating product certification systems
8	ISO/IEC 17040:2005	General requirements for peer assessment of conformity assessment bodies and accreditation bodies

Table 2.1; ISO/IEC International Accreditation's Standards

2.9 Conformity Assessment

There was a need to find a way that gives confidence to customers to confirm that manufacturer's products are conforming to specific standards. This should be done outside the organisation by an independent assessor "third party".

Sierra (1999) defined conformity assessment as any procedures used to determine that relevant requirements in technical regulations /standards are satisfied. This procedure may include sampling, testing and inspection. Conformity assessment is a comprehensive term of procedures by which products and processes are assessed and determined to conform to particular standards. The benefit of Conformity assessment for a manufacturer is that the added value for their products once accredited is accepted everywhere**.**

It is used worldwide to check whether products, services, materials, processes, systems and personnel are following requirements of standards. Thus it gives confidence and ease of access to world markets and provide local and international socio - economic benefits, particularly that relate to environment and health and safety issues (Squirrell, 2008).

There are three major tools that are used with conformity assessment as follows:

1- Laboratory accreditation: it is a process to recognise laboratory competence to provide confidence in the accuracy of data.
2- Product certification: it assures that a product conforms to specific requirements.
3- Quality system: it is a process that assures a supplier's quality system.

Conformity assessment and standardisation are separate processes. They are closely linked, however conformity assessment depends on the existence of unambiguous standards against which products, process and services are evaluated. Conformity Assessment enhances the value of standard by increasing the confidence of products (NRC, 1995).
Standards and conformity assessment effect 80% of international exports. This have encouraged businesses to comply with relevant standards to increase their competitive advantage (Muse, 2008). Furthermore market pressure has made manufacturers pursue third party certification to prove that a specific product complies with a relevant standard. Third party certification provides a link of confidence between provider and costumer. A provider wants to sell (x) product, a customer wants to assure that (x) product will satisfy a need such as service, quality, usability, etc. Third party certification is the means of providing confidence between the two parties.

The growth of industry in the developing countries and the increase in demand of international trade, increases the pressure on the developing countries to improve their quality culture and quality production. One of the essential requirements is to establish standardisation and quality assurance management that are required to achieve economic development and strengthen international competitiveness and to improve quality and productivity through modernised production. Moreover it is essential to promote smooth transfer of technology from developed to developing countries (Spivak, 2001).

In the developing countries, standardisation was initiated at a company or industry level, even before national standardisation. However in the developing countries it started first at a national level, however the activity of standardisation has not percolated down to industry level. In addition the industries in the developing countries have established mostly on imported know–how, design, technology, material and equipment from the developed countries, consequently there is significant demand on the developed countries standards. And this has resulted in few efforts made in the developing countries to develop company or industry standards (Spivak, 2001).

Agreements between countries to accept the national conformity assessment procedures in figure 2.1, have a great effect on facilitating international trade. A network of global Mutual Recognition Agreements will enable manufacturers to test products once and obtain certification and recognition everywhere (Bievre,2008)).

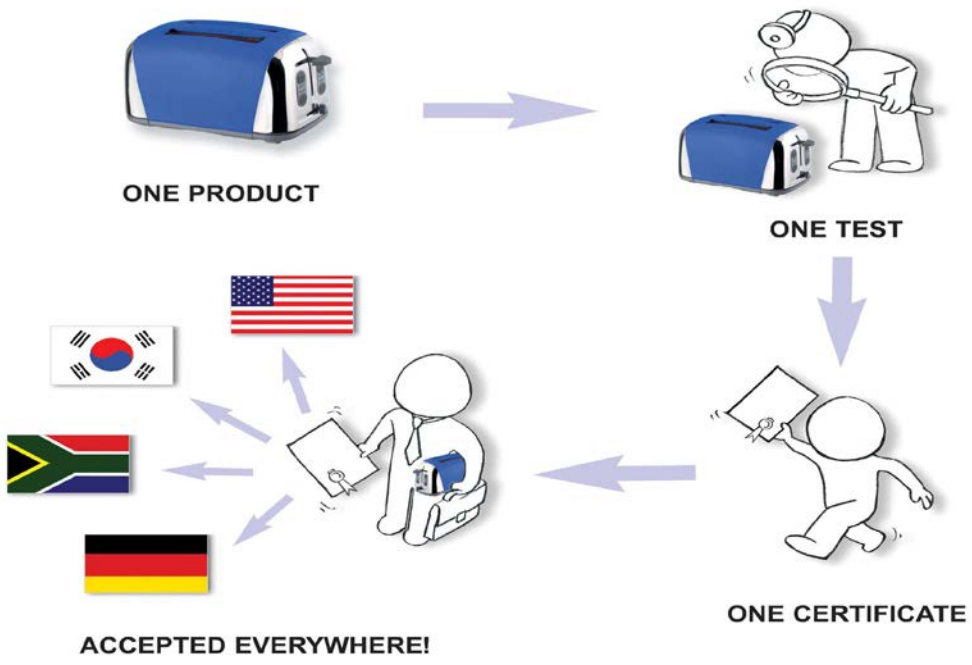

Figure 2.1: “One standard, one test, one certification accepted everywhere” Source IEC, (2008).
“An accreditation (wave) is going over the world: get accreditation or perish”. Bievre,(2008).

Conformity assessment comprises of four areas (see table 2.2), the first area is the manufacturer's declaration of conformity that is based on manufacturer's internal testing and quality assurance system. The Second is testing of products, parts and material which are performed by an independent laboratory. Independent testing adds value to a manufacturer's products as it is an external confirmation of in-company' results. The third area is certification, which is a formal verification by fair third party through testing and other means that a product conforms to specific standards.

The final area is the approval of a manufacturer's quality system through an independent auditor. The manufacturer's Quality Management System includes procedures, training and documentation to ensure consistency in product quality. A QMS is not assurance of product quality; rather it is a process for assessing product testing.

There are different names of conformity assessment such as manufacturer's declaration of conformity assessment, independent certification, laboratory accreditation, and quality system and these are all the key elements of international conformity assessment. Moreover Self-declaration of manufacturer's products such as those attached to product damage liability and market research are in the core of the EU international approach to conformity assessment in a controlled safety in the EU (Klenovsky, 2006).

		Third – Party Activities		
	Manufacturer's Declaration of Conformity	**Product Testing**	**Product certification**	**Manufacturing processes: Quality system Registration**
Level 1: **Assessment**	Manufacturer's own testing and Quality assurance By: Manufacturer	Testing of products, components, materials, etc. By: independent laboratory	Certification of products against a standard or set of standards By: Product certifier	Audit and registration of manufacturer's Quality assurance system (e.g. against ISO 9000 standards) By: Quality system registrar
Level 2: **Accreditation**	Acceptance By: customer or regulatory authority	Accreditation of laboratory's competence By: Laboratory accreditation program (private or government)	Accreditation of certifier By: certifier accreditation program (private or government)	Accreditation of Quality system registrar By: registrar accreditation program (private or government)
Level 3: **Recognition**	Acceptance By: customer or regulatory authority	Official recognition of laboratory accreditation program By: government	Official recognition of certifier accreditation program By: government	Official recognition of registrar accreditation program By: government

Table 2.2; Conformity Assessment framework (mechanism to ensure that products conform to standards. Source (NRC, 1995).

2.10 Product Testing and Certification

Any material, parts and products may be tested to verify its conformation to standards. Product testing includes various technical processes and competencies. The ISO defined a test as a technical operation that consists of the identifying of one or more characteristics of a given product, process or services according to a standard procedure.

Conformity testing is referred here to as compliance testing. It is a systematic examination of the extent to which any object conforms to a specified standard. The objective is to test for conformity and provide assurance of conformance (Holst, et al, 2001).

Product Certification is a procedure by which a third party gives written assurance that a product, process or service conforms to specified requirements.

Technical assessment of different certification bodies which is most important for their correct performance should be assessed by national accreditation bodies. Then certification bodies' authentication results in a formal certification of conformity to a relevant standard. This certificate can be used by manufacturers as evidence of comply with regulations, meet customer specification and boost product marketability. The certifier, third party, normally authorise manufacturers to print a certification mark on a product or packaging which is the property of certifier such as a Kite mark and/or CE marking of product quality assurance. Those Bodies who are subjected to certification / accreditation (see 2.11 and 2.12 below) achieve a real added value of any third party assessment (Klenovsky, 2006).

2.11 Reason for accreditation

Sidney, (2003) believes that in some developed economies such as in Europe, there has for many years been acceptance of the role of third party accreditation as it plays an important role in ensuring that testing and calibration laboratories produce competent measurements. Spivak, (2001) claimed that the term proficiency is used widely for laboratories to specify that a laboratory is entitled to carry out specific tests for some specified purposes. The validity of laboratory accreditation depends on independence of both manufacturers and organisations that may otherwise have influence to bias their test results.

Chalermchan et al, (2007) found that there are nearly 1000 health laboratories in Thailand which provide service to 65 million people. These laboratories have not been improved and its laboratory Quality system had little or no efforts to improve it according to international laboratory standards.

Another study by Kanitvittaya and Sukasi, (2010) showed that continuous efforts of quality improvement in Thailand medical laboratories will help laboratories meet international

quality standards such as ISO/IEC 17025. They observed that the number of certified laboratories was relatively low due to different reasons such as inadequate resources, lack of management commitment and insufficient equipment and material. Moreover Jovanovic, (2005) added that laboratory accreditation is difficult and expensive beyond national borders as it requires to follow strict international standards and inter-laboratory competence tests. Sharif, (2005) claimed that governments in the developing countries should have a vital role in sponsoring strategic quality planning through creating quality guidelines, eliminating unnecessary import and export restrictions and adopting and comply with international quality standards.

2.12 Accreditation

Through accreditation, an approved external testing body declares that a laboratory owns the ability to carry out specific analysis (Funk, et al, 2007). The primary purpose to establish an accreditation body is to provide accreditation services to its local market and to operate accreditation as a non-profit delivery process free from commercial drive (Drnovesk, 2008). Accreditation is procedures by which the competence of a laboratory to execute specified tests or measurements is satisfied against national or international standards (Hibbert, 2007); (Bievre, 2008); (Muse, 2008).

ISO 17000 (ISO/IEC, 17011) defines accreditation as procedures by which an alternative body gives formal recognition that a body or a person is competent to carry out specific tasks. Accreditation covers test, measurements, material used, equipment and personnel used in the process and once the accreditation is given, then the laboratory is certified to authorise test results with their accreditation status which gives confidence to customers (Kelly and Asce, 2007).

An accreditation body provides its recognition to the calibration laboratories by evaluating their competence and their compliance with the Quality requirements of ISO / IEC 17025

(Jacobson, 2004). According to Schmidt (2006), third party evaluation through accreditation or certification is today a pre-requisite in many countries.

According to Slagter and Loeber (2001), accreditation is an effective tool for implementing an internationally recognised Quality system in medical services and health care.

In Europe, the European accreditation (EA) is the main Body that coordinates and endorses the national recognised accreditation body in the European Union. Members of the EA are national accreditation bodies of the member countries. Accreditation granted under the EA umbrella by any of the national accreditation bodies is valid in all the European Union.

In international trade, figure 2.2, accreditation forms part of conformity assessment that leads to the acceptance of goods of one country by another through mutual recognition of manufacturing and testing procedures. (Muse, 2008).

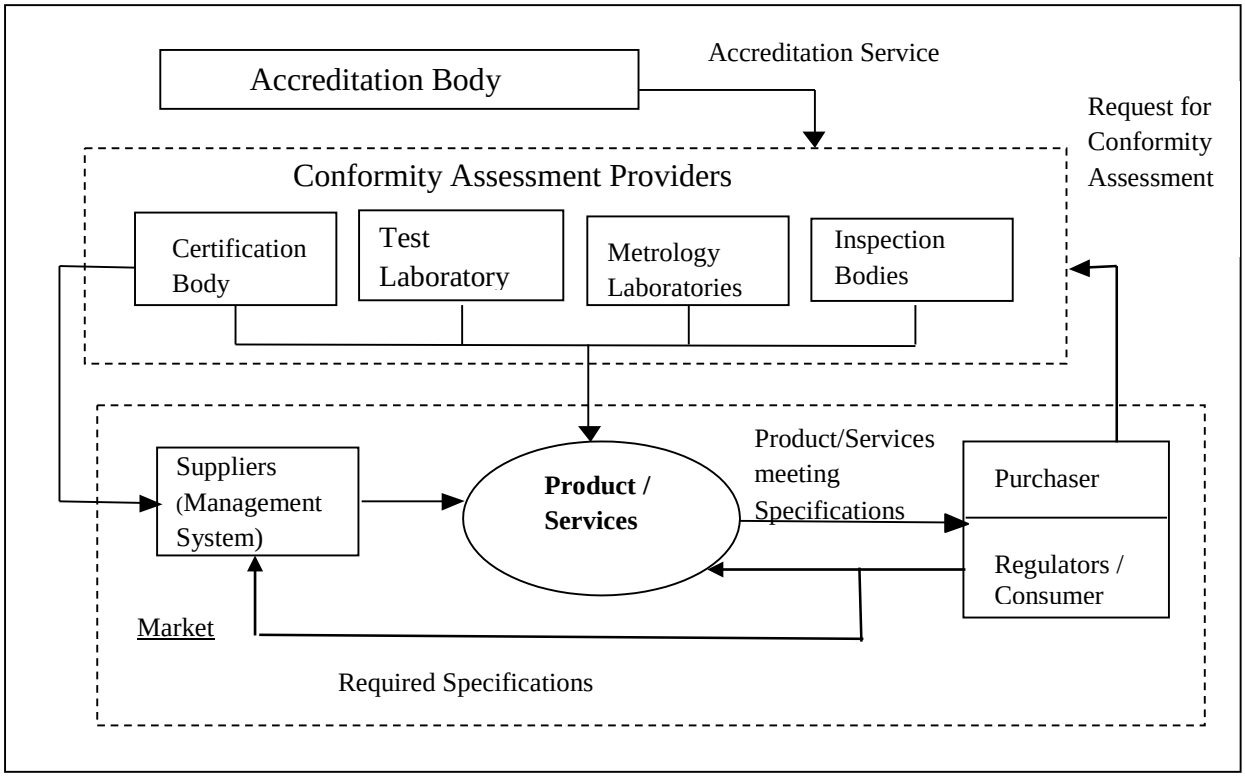

Figure 2.2; Rrelationship between the Accreditation Body, Conformity Assessment provider and customer. Source, World Trade Organisation (2000).

Ohtsubo, (1997) claimed that in the past, inter- countries' local certification bodies results were not recognised especially in the critical areas of health and safety, however the accreditation of certification bodies provide a thorough assessment, scrutiny and assurance that customers can depend on certificates issued by CABs through period assessment and Audit from accreditation body.

The main benefits of accreditation for suppliers of product, service and process are the release of burden of audits that might be required by each customer.

Within the structure of the accreditation body there should be a staff of qualified people including laboratory scientists (who are sometime working on part time schedule). The technical staff should have a high level of technical expertise in their field in order to evaluate and accredit a laboratory. The process of laboratory accreditation involves spending a couple of days on site by accreditation body team. This team observes laboratory work, search documentation and procedures and interview laboratory staff and finally a report is written which declares the status of laboratory's procedures to the relevant standards and whether improvement is needed to be done before laboratory is recommended for accreditation. Then a laboratory is allowed to display the logo of the accreditation body on its certificate and entered in a register of accredited laboratories (Hibbert, 2007).

2.12.1 The United Kingdom Accreditation Service (UKAS)

The UKAS is the only national accreditation body recognised by the British government to assess and provide accreditation according to internationally agreed standards. Accreditation by UKAS demonstrates the competence, impartiality and performance capability of these assessors. The UKAS is a non-profit- private organisation and independent of government but it is appointed as the national accreditation body and operates under agreement with the British government through the ministry of Business, Innovation and Skills (UKAS, 2012).

The UKAS roles are:

- Authorised by the ministry of Business, Innovation and Skills to use and grant the national, government recognition, accreditation symbols.
- It provides assurance of competence, impartiality and integrity of conformity assessment bodies.
- Reduces the need for suppliers to be assessed by each of their customers.
- Through mutual recognition, reduces the need for multiple assessments of suppliers and eliminates barriers to trade.

2.12.2 Certification

Certification is a process to assure that a product or service must meet predetermined requirements such as self-certification and third party certification. Self-certification is the process when a manufacturer assures that the product conforms to the label claim, an example is the motor oil viscosity defined by the Society of Automotive Engineers. Third party certification is a procedure in which manufacturer' conformity is validated by a third party competent body (Muse, 2008).

The main difference between accreditation and certification are: Accreditation is a formal recognition by an accreditation body to a technical competence of a conformity assessment body to perform specific services in accordance with specific standards and technical regulations, while certification is a procedure by which a third party gives assurance that a product, process, system or person conforms to specific requirements (UKAS, 2012).

2.12.3 Laboratory accreditation

Government and industry depends on the results of a test laboratory to direct government and business future decisions, therefore the data must be accurate and reliable. Laboratory, both

testing and calibration are essential in providing accurate outputs i.e. measurements and calibration (Squirrell, 2008).

Laboratory accreditation is one of a number of conformity assessment procedures that have been developed in recent years to assure the quality and safety of products and services (Locke, 1998). A laboratory should be accredited by an independent authority to test its competency in a specific area. Laboratory accreditation is not mandatory and does not necessarily inquire about lab technical competence. However if a lab is not accredited then it shows that it does not benefit from accreditation especially in the international markets. In addition customers of these non-accredited laboratories do not require laboratory accreditation.

According to Squirrell, (2008) some of the reasons that a specific laboratory may be applying for accreditation are, establishing credibility, show competence, proof of superiority over non accredited laboratories, and as a way of protecting against liability claims. In addition laboratory staff does not have the time and maybe the experience to do a thorough (2^{nd} party) evaluation of all their suppliers, therefore, the acceptance of a 3^{rd} party independent accreditation of providers is a sensible and cost effective solution.

The development of international trade and the movement of products between countries necessitates the need to test products to qualify their standards and to trace the accreditability of a test laboratory. Jovanovic, (2005) claimed that the development of an internationally recognised laboratory accreditation process, accompanied by a mutual recognition agreement is an important issue in Central and Eastern European countries.

2.12.4 Calibration

An instrument is calibrated at distinct periods in order to verify its accuracy. The calibration of an equipment or instrument is the determination and creation of a functional relationship

between a numerical measurement quantity and activity to be determined from data that are generally subject to random errors (Funk, et al, 2007).

It is clear that quality of measurements depends on implemented quality systems and consequently accreditation. Accreditation of a calibration laboratory will definitely remain one of the most important tools to assure the technical competence of calibration activities (Drnovesk, 2008).

2.12.5 Difficulty in calibration

Sharif (2005) in a study of ISO certification in Libya found that all the Libyan organisations hired a foreign contractor to carry out calibration and certification to mechanical and electronic equipment. This is due to unavailability of a locally accredited calibration body and as a result this has led to delays in calibration over time. In addition the calibration cost of some equipment was high compared to the price of the component. The delay in calibration is caused by the bureaucratic administration and financial procedures of the government organisations. The result of these delays have led some of local companies to use uncalibrated tools and gauges which may give errors in measurements and readings.

It can be understood that unavailability of a local calibration body in the country and use of uncalibrated tools and equipment will lead to incompliance with the international standard's requirements. Quinlan (1996) cited in Yahya and Goh, (2001) claimed that using uncalibrated tools and gauges is a barrier which causes failure of organisations in a certification audit.

2.12.6 Accreditation to ISO/IEC 17025

The ISO/IEC 17025 standard has general requirements for the competence of testing and calibration laboratories. The word calibration includes calibrating instruments such as balances, electrical equipment and utility meters. The standard was first published in 1978 as ISO guide 25 (ISO 1978) and after that as ISO/IEC 25 (ISO/IEC 1990) and in 2005 amended

to make alignment with ISO 9001:2000 (ISO/IEC, 17025). The ISO IEC 17025 is widely used by laboratories throughout the world for whoever wants to demonstrate competence whether by first party declaration at the request of a customer or by third party through external accreditation body (Squirrell, 2008).

2.13 International Trade

The relationship between standards, conformity assessment and global trade is becoming increasingly important. However international trade barriers, especially tariffs, has emerged since the end of Second World War.

Standards and conformity assessment are linked to these benefits of international trade. A united international standards through the WTO and MLA enhance the ease of product transfer around the world. For instance, when different countries have different technical standards for the same product, then manufacturers are required to produce multiple versions of the same product to different markets.

The World Trade Organisation has established the Technical Barriers to Trade (TBT) that aims to smooth international trade and remove all unnecessary or unjustified quality requirements mainly those relate to health, safety and environment and consumer protection (Behrens and Wloka, 2010).

In 1994, major multilateral trade agreements were made in the Uruguay round of the General Agreement on Tariffs and Trade (GATT, 2011). The Uruguay round made important progress in addressing the growth of non-tariff trade barriers, support the GATT provision on standards and conformity assessment that related to trade barriers. In addition, a new implementation scheme through the WTO involved work to support and implement multilateral agreements under the WTO (WTO, 2000). The benefits of open markets allow access to foreign markets and include access to different sources of technology and modern manufacturing techniques.

Trade within a country or across borders requires a mechanism to ensure the quality of goods and services are conforming to specific standards. According to Gyani, (2008) the GATT agreements on technical barriers to trade needs the technical competence of a specific body performing conformity assessment must be approved through the process of accreditation. The technical barriers to trade have many forms such as standards, technical regulations, conformity assessment measures etc. These measures (barriers) have been used in the past in some countries(due to political reasons) such as Libya, Tunisia and some other African countries to protect national industries. As a result, the local markets produced high price and low quality products and consumers were forced to buy these products since there was no alternative.

Awdalkream, (2007) claimed that many African companies have recently realised that producing low price products cannot guarantee gaining international market share. Moreover, due to growth of liberalisation of international markets and the release of unnecessary barriers to trade have resulted in more pressure on the African countries' industries to be more competitive in price and Quality to succeed even in the African local markets (Mersha, 2007). Henson and Loader, (2001) claimed that the progressive liberalisation of the world markets through successive rounds of the GATT negotiation and the establishment of WTO has created opportunities for developing countries to access developed countries markets more easily.

2.14 Conceptual framework

2.14.1 Factors emerged from Literature review

Nowadays it is obvious that customers increasingly prefer to buy products or services from a supplier that holds and comply with relevant ISO certification. This had led and encourages providers of services or manufacturers to have ISO certification (Johnson, et al. ,(1997) cited

in Woan and Lin (2008). Magd (2008) claimed that the main benefits from implementing the ISO certification are; improved documentation, improvement in the quality system efficiency and customer satisfaction. Customer satisfaction is considered by many scholars, Deming, (1986), Crosby, (1996), Oakland, (2004) and Zairi, (1996) as a major success factor in implementing quality management and as a base for a quality programme within any company. A study by Magd and Curry (2003) found that the main benefits of implementing ISO certification in different countries such as the UK, Egypt, Spain and Malaysia are: improved documentation procedures; better supplier choice; improved product/service Quality; improved company's image; improved exports and improvement in workforce motivation.

Magd (2008) stated that, in spite of the number of publications covering Quality programs and the amount of research done on quality development, little empirical research has been carried out in the Arab countries. Another study carried out by Khalifa and Aspinwall (2000) found that the awareness and understanding of quality in the developing countries is still at a low scale and factors that lead to implementing a successful Quality system are still undiscovered in most developing countries. Moreover another study carried out by Sayeh et al., (2005) stated that in order for Libyan organisations' quality programs to succeed many factors that encourage local culture should be taken into consideration such as building up teamwork, growth opportunities, decision making and planning. Aggelogianno et al., (2006) added that in order to implement a successful quality program in the developing countries two main important factors should be considered which are management commitment and cooperation of the workforce.

Another study on the reasons behind the slow implementation of quality programs in Libya revealed that failure in implementing quality programs and difficulties towards business excellence in the Libyan organisation can be related to many factors (Egnaibor, 2002):

- Management commitment;
- Human resource management;
- Information system;
- Organisational structure;
- Innovation support;
- Training;
- Research and development;
- Customer care strategy;
- Documentation procedures;
- Effective communication.
- Political influence

Egnaibor, (2002) also believes that little expertise of management staff in the Libyan organisations has resulted in some problems such as continuous change in management, old machines and equipment and shortage of production material.

Other factors such as low purchasing ability, shortage of products, foreign exchange restrictions, an incomplete infrastructure, unqualified leadership and insufficient knowledge are considered to be factors impeding the development of quality in the developing countries (Sandholm, 1999). Mersha (2000) believes that factors such as government involvement and control and insufficient local capital are the main difficulties that prevent the Sub Saharan African countries implementing a Total Quality Management.

To overcome quality problems in the developing countries, companies, industries and governments should work together to improve standardisation, certification, export opportunities, regulations, national development, education and training, foreign assistance, national infrastructure and professional cultures (Sandholm, 1999).

Vlachos et al. (2002) stated that to effectively implement the ISO/IEC 17025, there are a number of measures and factors that should be taken into consideration such as senior management support, training, documentation, laboratory test methods, audits' review and equipment validation method.

2.14.2 Government support and financial capacity

Prasad and Tata, (2003) claimed that the main barriers to quality development in developing countries were; inadequate training, lack of management commitment and employees motivation. In addition Karaszewski, (2004) found that the key impediments to implement a successful QMS in the developing countries were; bureaucratic legal procedures and improper technological infrastructure.

In some markets, e.g. EU market, it is mandatory to have an appropriate ISO certification in order to be qualified to export products or services to this market (Wiele et al., 2001). This has led some of the developing countries such as Malaysia to allocate financial support to help organisations implementing QMS and help acquiring ISO certification (Idris et al., 2004).

Morris et al., (2000) claimed that Government support to quality programs should be in forms of mandatory legislations and initiatives that help organisations implementing quality culture with their organisations, also through financial support and national awards for best companies complying with quality requirements.

Al-Zamany et al., (2002) in a study in the Yemeni organisations found that the appointment of managers is influenced and managed directly by the government. This has resulted in selection of inappropriate and unqualified persons for the job. Moreover factors such as lack of government support, financial capacity, tariff and trade barriers have affected the Yamani’s organisations in international competition . Glover and Siu (2000) claimed that

government involvement in public sector in some of the developing countries has resulted in featherbedding a system which made organisations overstaffed with low productivity.

In Indonesia, Amar and Zain (2002) found that the main difficulties encountering the Indonesian organisations in implementing QMS are; lack of sufficient funds and financial support to initiate QM driven activities.

A study by Magd (2008) in the Egyptian iron manufacturing organisations found that a lack of top management commitment and the lack of qualified personnel were the major barriers for implementation of ISO certification.

In some of the Arab countries, e.g. Syria, factors such as lack of financial resources and government support, unclear governmental policies and strategy, ISO standards awareness, competitive advantages and difficulty of international trading procedures are the main barriers to the ISO series standard's implementation in Syrian organisations (Tayyara et al., 2000).

2.14.3 Organisational Culture

To effectively establish and implement a quality program in a laboratory or organisation, an investigation and assessment of the existing organisational culture and management approach should be taken into account. Mclean (1992) cited in Sayeh (2007) mentioned that organisations are engraved in their environment and it is important to study environmental factors in a relevant region before setting-up a new strategy.

Maull et al (2001) claimed that culture comprises of beliefs, knowledge, morals, customs, habits and capabilities of staff to ease organisation' harmonisation. The organisational culture is how staff behave when changing an existing management system e.g. resistance to change to different management' style is considered as a common feature that emerges from any new change in organisation' strategy.

Van der Colff (2003) cited in Awadelkarim, (2007) found that there is an agreement among researchers about the effect of culture and economic environments in adopting any management strategy in the African countries.

Oakland (2004) defined business culture as the beliefs that encompass the organisation and was created by:

- People behaviours.
- Rules created by work groups.
- Principles adopted by the organisation

Management within an organisation needs to assure staff that any proposed change in management style within an organisation must be beneficial to the organisation. Management should investigate the existing organisational culture in order to implement a new process effectively**.** Schein, (1986) cited by Bellou (2008) stated that organisational culture refers to the deeper level of basic assumptions and beliefs that are shared by organisation' members which define a common overall view of the organisation' environment.

Davies and Nutley (2000) believes that organisational culture is an important factor of a successful organisational development as it increases quality of services. Moreover, human resource management is also considered as important factor in managing the employer-employee relationship. It involves the productive use of people in achieving the organisation's strategic objectives and satisfying staff needs.

Ghobadian and Gallear (2004) stated that factors that can influence organisation' culture are; education and training, employees participation in organisation development, improved communication, company' procedures and policies, rewards system and the performance of top management.

To successfully establish a quality program, a cultural change is required in order to replace the traditional methods and how the organisation's work is undertaken. Goetsch and Davis

(2000) stated that every organisation has separate cultures that react to change; they are; the promoters and the resisters. Therefore, organisation' culture is a key factor that needs to be taken into consideration when establishing a national accreditation body and implementing standards in any organisation.

2.14.4 Conceptual framework

As described earlier the existing literature suggests that the development of a sustainable national accreditation framework should consider the external factors i.e. PESTLIE analysis, this will be discussed in chapter four. Developing a sustainable accreditation framework requires considering whether people are doing their jobs properly and focusing on key factors to be benchmarked for a successful framework implementation.

Although the literature lacks any formally defined relationship between the aspects of NAB and culture dimensions, some studies as mentioned earlier, e.g. Awadelkarim (2007), Oakland (2004), justified the need to consider the issue of organisational culture in this research. The literature review focused on the difficulties of implementing quality management and accreditation framework in the developing countries where international and local organisational culture are different. Moreover, improvement approaches and models were found to be culturally affected as having built in culturally derived assumptions e.g. Egnaibor, (2002), Aggelogianno (2006). This situation has contributed to the failure of some of these approaches, such as Brazil and Zambia, when implemented in a culture different from their originated culture.

Different businesses' cultures in different countries have resulted in different philosophies and approaches towards national accreditation . Therefore an established NAB in a developed country would probably not suit an African country due to the cultural differences.

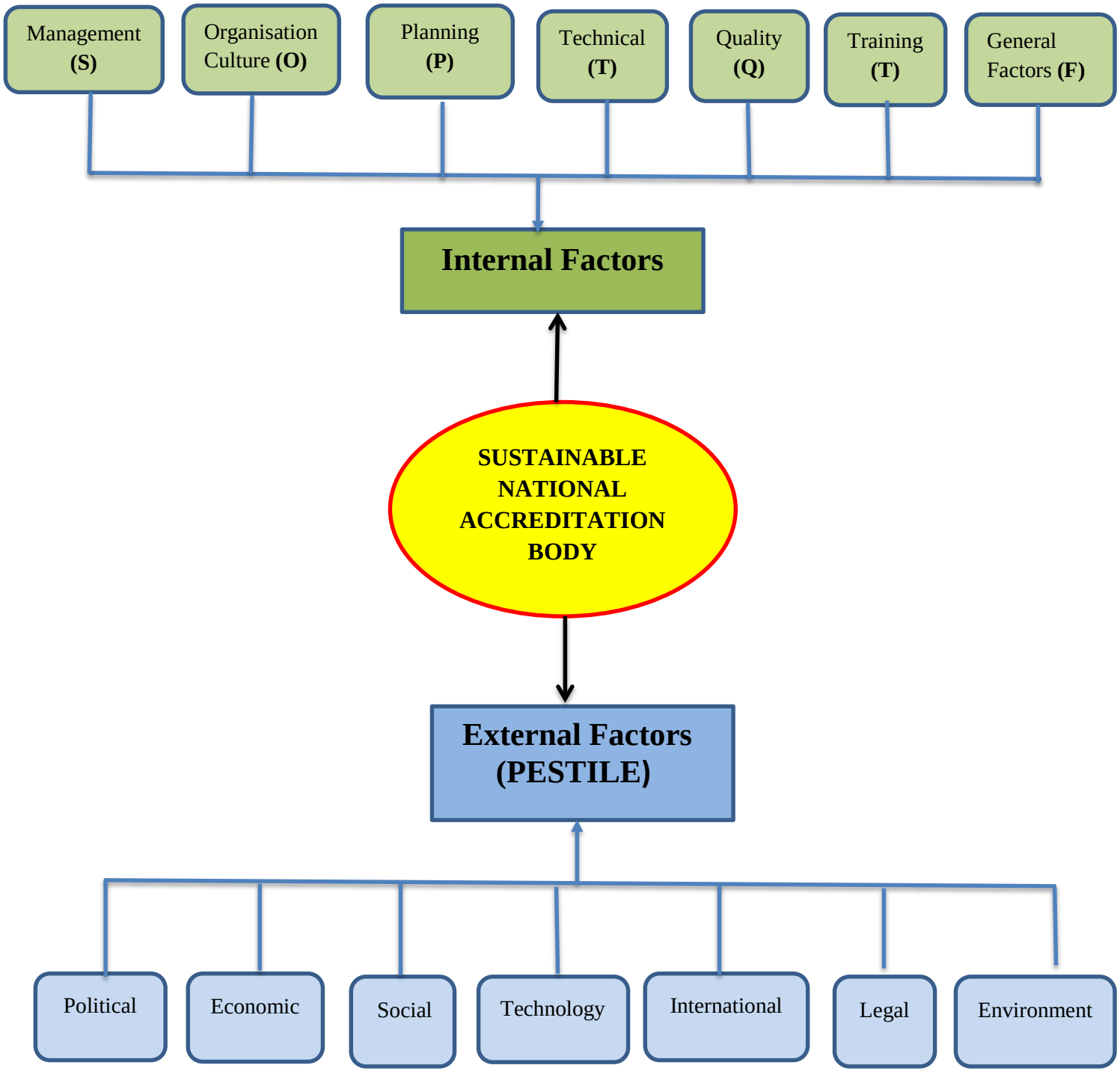

Figure 2.3; Conceptual Sustainable National Accreditation Body' framework.

Sekaran (2003) claimed that a conceptual framework is " a conceptual model that theories make logical sense of the relationships among the several factors that have been identified as important to the problem".

From the review of the literature the researcher can develop a conceptual theoretical framework. The conceptual research framework is represented in figure 2.3. There are two main themes of independent variables. These themes can be classified into internal and external variables that affect the development of accreditation bodies. The internal factors have seven main themes, they are;

Management;
Organisation Culture;
Technical
Planning;
Training;
Quality Development;
General / Critical Factors.

These main internal variables are furthered into sub-variables as shown in table 2.3.

Variable (S) Human resource and management
Clearness of job description.
Quality of supervision.
Loyalty and respect towards employees.
Advancements and promotion.
Rewarding for developing new ideas.
knowing and understand goals.
The promotion opportunities.
The amount of staff' payment.
Financial compensation.
Happy and proud to work.
Daily attendances
Variable (O) Organisation Culture
Relation with organisation.
Individuals/groups relationship.
Periodic meeting.
People behaviours.
Celebration of organisation related events.
Responding to changing. Adjustment to new requirements.
Effectiveness of team meetings.
Cooperation between departments.
Acknowledge to change.
Management future idea.
Variable (P) Organisation strategic planning
Deployment of policy and strategy.
Quality mission, vision and policy.
Communications procedures.
Strategy development.
Information development.
Variable (T) Recurrent Training
Training used to solve problems

Opportunities to use skills.
Managers trains employees
Process review and improvement.
Training is used as revenue.
Variable (Q) Quality Development
Meeting customer requirements.
Continuous Quality improvement.
Success depending on high Quality.
Understand customers' requirements.
Quality is important.
Staff knowledge of ISO/IEC 17025.
Commitment to excellent service.
Continuous company improvement.
Awareness of cost consciousness.
Established procedures are important.
Quality of equipment and resources.
Variable (F) General / Critical Factors
Employee's Training.
Top management commitment.
Effective communication.
Technical expertise on ISO17025 and 17011.
Documentation process.
Cooperation and commitment of work force.
International competition.
Pressure from customers.
Poor competitive environment.
Governmental support to accreditation.
Effective information.
People's attitudes towards accreditation.
Managers' experience
Resistance to change.
Financial capacity to meet accreditation cost.

Appropriate technical knowledge
Awareness of accreditation at the management level.
Variable (Y) Technical Factors
Physical conditions at work.
Availability of time, space and resources.
Internal and external pressure.
Confidentiality of customer's information.
Quality Policy and technical records.
Investigation to determine root causes of problems.
Periodic internal audits.
Methods of work fit for intended use.
Uncertainty in measurements.
Proper measurements and test equipment.
Capability and accuracy of equipment and software.
Procedures for equipment calibration.
Calibration of reference standards.
Sampling plans and procedures.
Using secondary reference materials.
Participation in inter-laboratory proficiency testing.

Table 2.3; Internal main and sub – variables.

Based on these studies the researcher can summarise that there are many factors investigated by many researchers, as explained earlier, that affect the successful implementation of a quality management program such as creating a driving force; training, quality awareness; top management commitment; management action to solve problems; government support to quality programs; lack of effective information system; effective communication; the major success factors to implement a successful quality program are not well-known in most developing countries; teamwork, education level. Furthermore cultural factors such as people's attitudes toward change and inappropriate managerial traditions are a critical factor. All these factors affect the establishment and implementation of any quality program in the developing countries.

The external factors are the external environment that could affect any national accreditation framework in the developing countries. In this research the PESTILE model has been adopted to further investigate the external environment of the proposed model. It denotes to Political, Economic, Social, Technology, International, Legal and Environment. The external factors will be explained and discussed in chapter four.

The impact and interaction of these internal and external independent variables will determine the dependent variable, which is, in this study, sustainable National Accreditation Body.

The conceptual framework gives foundation for the final framework (Najmi and Kehoe, 2000). Its primary purpose is to indicate the key factors that could encounter any NAB in the developing countries in the implementation of ISO/IEC 170211 and ISO/IEC 17025 standards. Moreover the framework is required to facilitate the investigation of which factors are important for achieving an outstanding sustainable accreditation performance and how these factors relate to NAB performance. The framework can also assist in determining how important these factors are when used to predict a national quality awareness.

The next chapter will review current environmental factors that could affect the development of new or current businesses in North Africa. This will include the current political situation, economic development, social behaviours and how affect work conditions and regulations, technological development, international relations, legal system and its integration with legislative system and finally current environmental situation and international environment treaties.

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CHAPTER 3 - PESTILE Analysis

3.1 Introduction

As this research is covering the developing countries in North Africa the researcher decided to review and analyse the Libyan and Tunisian environment as part of the North African countries (Egypt, Libya, Tunisia, Algeria and Morocco). The PESTILE environments are relatively similar in these countries. The recent example of environment in this region is the Arabic Spring that initiated in Tunisia in December 2010 and went through Libya to Egypt in January 2011 and finally hit Libya in February 2011. The result of the Arabic Spring is that it has changed the political system in this region.

3.2 The Libyan background to the case study

Libya is one of the Arabic nations that is located in North Africa with a population estimated to be six million and land area of 1,775,540 square km; it ranks as the 17th country in the world by size. It is located on the southern part of the Mediterranean Sea with 1770 km along the coast of the Mediterranean Sea. Libya shares borders with Chad and Niger from the south, Egypt and Sudan from the east, and Tunisia and Algeria from the west, Figure3.1**.**

Figure 3.1; Map of Libya and Tunisia. Source: Worldatlas.com (2012).

The history of Libya is rich in both culture and civilisation. It has been subjected to various international colonisations and foreign control that greatly affected the country's development. Historical and archaeological records revealed that Libya was occupied and ruled by the Phoenicians, the Romans and the Vandals from the 16th century to the beginning of the 20th century. Moreover Libya was part of' the Ottoman Empire till October 1911 when Italy invaded and conquered Libya as a colony. This Fascist invasion was met with violent resistance, led by the Libyan hero, Omar Elmuktar who led the resistance to the Italian invasion until it was suppressed in September 1931 (Gnieber, 1998).

During World War II, Libya was a major battlefield between Allied and Axis forces. Italian rule in Libya lasted till 1942, when Britain and France defeated Italy and occupied Benghazi and Fezzan respectively.

In December 1951, Libya was the first country to gain its independence through the United Nations and became a Kingdom governed by King ldris EI-Senowsi. In 1969 a Libyan army led by Colonel Muamar Gaddafi, led a coup against the monarchy and the legitimacy of the authorities and put in place a country with a socialist republic. On March 2nd 1977, the country's name was changed to the Socialist People's Libyan Arab Jamahiriya (Gnieber, 1998).

The Gaddafi's regime ruled Libya for 42 years, 1969-2011. During his rule, all the country's policies, laws and international relations were administrated by himself. Moreover the revolutionary committees, led and directed by him, controlled every single part of the country. The new history of Libya started by the Libyan people's revolution on February 17th 2011 and after eight months of resistance the Libyan people were able to overthrow the regime.

3.2.1 The Political structure of Libya

The political structure in Libya is important in addressing any organisational perspective development in Libya. Handy (1993) cited in Shihub (2009) believes that if any organisation is looking for a sustainable success, it should take into consideration the political structure in the country. The political administrative system in Libya has involved a dramatic change. The modern political history of Libya started in 1951 when the country had established the kingdom of Libya and drafted the first Libyan national constitution that was approved through a referendum and became the source of legislation for the period from 1951 till September 1st 1969 (Wallace et al, 2004).

During the Gaddafi's regime ruling, the country was under a new ideology and philosophy of ruling as stated in his ideology in which he claims a radical alternative to capitalism and communism. It is called the Jamahiriya or people's authority system and started to disassemble and change the country ministries and organisations into people's committees. In this system, the General People's Congress (Parliament) is on the top of the authority. The General People's Congress, theoretically, determines the authority's policies and forwards them to the General People's Committee (Prime Minster) (Sherief, 2010).

In practice, however, Libya's government was strictly military and the People's Committees were the hands of implementing the rules and decisions. It were established in widely divergent branches in universities, public and private businesses, and companies…etc. These Gaddafi's committees had serious effects on organisation' management and development of the country (Wright, 1982).

Although the basic structure of the Libyan society was extended family, the Gaddafi's regime had attempted to focus on the role of the clan, tribe and village within the Libyan society to make them active players in individuals and community's life.

This had affected on the criteria of selecting managers and decision makers (Prime minister)

in Libyan organisations during the Gaddafi ruling as it was influenced by an individual's family, kinship and tribe background and its relation to Gaddafi regime directly. This had led in the past 42 years to create a management on the basis of inappropriate and unqualified people in key positions (Elfathaly 1978).

Currently (between 2011 – 2014, at the time of study), the Libya political structure as shown in table 3.1, is still uncertain. The General National Congress' members were elected by the Libyan people in July 21st 2012. Its main role is to prepare and draft the Libyan constitution and prepare the country for the presidential and parliamentary elections. After the constitution is approved by the Libyan people, then it would be clear what the structure of the political system is in Libya.

3.2.2 Economic structure

The Libyan economy primarily depends on revenues from oil and natural gas and it has been based on an economic socialist structure since the Gaddafi's revolution in 1969. Nearly 90 % of the country's GDP comes from oil and gas revenues. Before the exploration of oil in 1955 Libya was ranked as one of the poorest countries in Africa. The oil boom that started in 1960s changed the country's life and changed the living standards for the Libyans. Libya daily oil production in 1970s meant it had the highest daily oil production in the world of three million barrels a day. Currently Libya has crude-oil reserves estimated at 36 billion barrels (Wallace, et al, 2004).

The small population of Libya and high oil revenues make it one of the highest per capita GDPs in Africa (11600 US $). Youssef (2006) mentioned that in 2005 the oil resources had contributed to 56 % of GDP, 97 % of the country's exports, 7.5% of government revenues and 95 % of export revenues (General Public Committee, 2005). However, 60 % of the

government expenses went to paying salaries for over staffed governmental labour (National Oil Corporation, 2005).

The Libyan oil and gas resources has supported the economic development and established modern facilities in several parts of the country, Table 3.2 below shows the general Libyan economic structure. The Libyan economy has expanded and developed from agricultural products to oil and natural gas industries, iron and steel. The more popular traditional crafts in Libya are carpets, pottery, leather, fabrics, and copperware (Youssef, 2006).
According to the UNDP (2005), Libya' GDP per capita would be very low if oil resources were discounted due to the current level of business competitiveness. The Libyan Public services including education, healthcare and other non-oil production contribute only 9% of Libya's GDP and employs 51% of the formal workforce.

The political ideology that Gaddafi adopted in the last forty years affected the economic development of the country. For instance his support to terrorism across the world such as Northern Ireland, South America, the Pan Am airplane bomb, La Belle night club in Germany, the UTA French airplane bomb…etc. made him isolated by the international community especially in the western countries. This isolation was supported by multiple sanctions started from the USA sanctions in 1982, the European Union economic commission's sanctions on Libya in 1986, the UN sanctions including flight embargo to and from Libya in 1992 and finally the UN sanctions and no fly zone over Libya in 2011. It is clearly obvious that Libya was under different International sanctions for a period of thirty one years from 1980 till 2011. These multiple sanctions were a result of Gaddafi policy with the international community. Furthermore it directly affected the economic development in the country in the last 42 years which also affected the oil production in the country. This resulted in Libyan daily oil production to decrease from 3 million BPD in 1970 to 1.6 million BPD in 2010 (National Oil Corporation, 2005).

Population	6.2 million (2010)
Population Growth	1.9 % (2010)
Land Area	1,760.000 sq. km, 1770 km of shoreline on the Mediterranean
Climate	Mediterranean in the northern coastal region to arid in the desert south.
Natural resources	Petroleum and natural gas
Current environmental issues	desertification; very limited natural fresh water resources;
Life expectancy	Total population: 65.44 years Male: 63.21 years Female: 67.78 years (1998 est.)
Currency	1 LD = $0.764 = 0.866 Euro
Gross Domestic Product (GDP)	$87.3 billion (2013)
GDP Real Growth Rate	4.2% (2010)
GDP Per Capita Income	$14,100 (2010)
Oil and Gas	Contributing to 70 % of nominal GDP and employing 3 % of workforce .
GDP Composition by Sector	Government, defence and social insurance: 7.29% - Real estate 5.83% - Construction: 4.71% - Manufacturing: 4.52% - Transport, storage and Telecom: 3.7% Agriculture and forestry: 1.09%
Inflation Rate (Consumer Prices)	6.1 % (2010)
Labour Force	1.5 million
Unemployment Rate	30 % (2004)
Exports	$ 44.86 billion
Imports	$ 17.83 billion
Ports and harbours	Tripoli, Al Khums, Benghazi, Darnah, Marsa al Burayqah, Misratah, Ra's Lanuf, Zawiya, Sirte and Tobruk.
Airports with paved runways	Tripoli, Benghazi, Sabha, Misratah, Sirte, Ra's Lanuf, Tobruk

Table 3.2; Libya profile **,** Source, International Monetary Fund, (2013).

According to Oxford Business group report (2010), the country has an unemployment rate of above 20 %. Import restrictions and inefficient resource allocation have led to periodic shortages of basic goods and foodstuffs. Furthermore due to climate conditions and most parts of the country being desert, there are limited agricultural outputs and this has led the country to imports of about 75 % of its food (CIA ,2012).

The Libyan authorities in the last forty years have adopted different economic ideologies. For instance, in 1978 the government eliminated private ownership and established a comprehensive socialist system, however, in 1988 encouragement was given to some private partnerships and cooperation in manufacturing and a move towards liberalisation.

In1993, some laws and decisions were issued from the Libyan Parliament and prime minister to establishing a shareholding and partnerships with some international companies especially in oil and gas, however, the country large organisations and industries were and still under government control (Wallace et al, 2004).

In 1994, the Libyan authorities put a plan to replacing foreign labour with Libyans to improve productivity and profitability in all sectors. However, this step of an effective liberalisation policy was unsuccessful due to unavailability of Libyan replacements especially in the strategic industries such as oil and gas industries and construction which is still run by foreign labour.

The banking system in Libya is still traditional and performs basic banking activities such as personal cash withdrawal and money saving. however it has undergone certain changes recently. The Libyan central bank regulates and controls all the national banks in the country. Indeed, Libya still has the 20th century system with no credit or debit cards, and no 24 hours services. In fact, the existing Libyan banking information systems are very poor while in 1960s and 1970s Libya had a number of European operated branches. These branches were nationalised and renamed to titles representing the state ownership. The Libyan Arab Foreign Bank is the country's only international banking business, established in 1972 (Wallace, et al, 2004). Libya has one private bank at present called the Bank of Commerce and Development that was established in 1997 and its business is growing rapidly. However, some European banks such as HSBC and Paris BNP Paribas have started negotiation with the previous

Libyan authority for operating their branches again in the country. Only Paris BNP Paribas was given permission by the Libyan government in 2002 to share the Sahara Bank in Libya.

Ramadan (2002) believes that the main weaknesses of the Libyan economy are the dependence on the oil and gas, poor top management efficiency and the lack of a highly trained and specialised labour force; also due to change to a liberal economic and social structure, there have been new emerging needs as a result of the current openness into international markets. Youssef, (2006) claimed that Libya has the resources but top management does not have skills of strategic management, also old bureaucratic procedures and the plenty of laws still restrain local and international entrepreneurship.

3.2.2.1 Economic development

According to Data Monitor report (2012), table 3.3, there are some challenges arising from the recent political unrest in Libya; however, despite the oil and gas resources, Libya has massive assets that are not fully engaged in its economy such as its location on the Mediterranean with a coast of 2000 km, unique history and culture, moderate climate and most importantly, people. Libya has traditionally been a country of traders, merchants, and entrepreneurs which links Europe to Africa. Recently Libya has decided to restore trading links and political relations with its international partners such as Italy, United Kingdom and Germany. This has been initiated mainly by Libyan businessmen and supported by the government by endorsing of the Law No 5 1997 which allowed foreign direct investment to be carried out in Libya. It also exempted those investors from paying taxes for a period up to five years (Oxford Business Group, 2010).

3.2.3 Social Structure

Different studies have been undertaken with a view to understanding the influence of culture on management practice. Culture is considered as a set of common beliefs, values and behaviour that are shared by people living in a society (Hofstede, 2010; Harris et al, 2004). Culture in the Arab world is closely linked to traditions and religion, as it relates to all aspects of people's daily life. However, people in this area are aware that beliefs and culture are quite diverse due to the effect of modern and historical economic and social differences (Muna, 1980 cited in Sherif, 2010).

The native population of Libya are mainly Arabs, however, there is a considerable influence of Berber origin in the west of Libya. Most of the Libyan society are Muslims and belonging to the Islamic Sunni branch. This is one of the reasons that makes Libya stable and united even after the end of the war against the Gaddafi.

The foreign workers, who also form part of the Libya society, are from different cultures such as African, Asian and European countries. The foreign workers in Libya are estimated to be more than two million and many of them belong to different religions such as Christian sects and Indo-Chinese religions. There are churches and places of worship for the majority of these religious groups, for instance the Christians visit church in Tripoli on Sunday and Buddhist also have their rights and are allowed by the law to practice their own worship (Terterov et al, (2002) cited in Sayeh (2007).

Health and education in Libya has improved by the impact of oil wealth during the years from 1970 to 1992. During this period, for instance, in 1992, 72 % of the adult population was literate, whilst there was one doctor per 3860 persons in 1965 to one doctor per 690 persons by 1992. On the other hand, the health indicators are poor in comparison with other similar country's incomes in the region. Many Libyan's laws have been passed to legalise relations between the two sexes and support females to have their rights similar to males.

Libya's law has opened all fields of work to women including the police and the army (Sayeh, 2007).

Laws dealing with women's liberation include their right to participate freely and equally in all legal, social, political, and economic activities. Females have the right to choose a spouse or to request an ending of a marriage. According to Libya's tradition, the family home belongs to the wife and in the case of a divorce, it is the husband who has to leave and look for an alternative place to live (Oxford Business Group, 2010).

Studies (e.g Tayeb (1996); Hofstede, (2010) have indicated that Arab countries have higher levels of loyalty towards community, paternalism, femininity, uncertainty avoidance, fatalism, and context dependence. These culturally oriented groups have arranged themselves in organisations in a number of ways such as individuals maintain and join the traditions of extended family and feel strong with their families and communities.

Table 3.4 below summarises main Libyan social impact and future challenges and opportunities. The main issue of future risks is the rise of extremists and terrorists coming from different countries and gathering in the East of Libya which threatens the Libyan social structure.

3.2.4 Technological Development

The development of modern technology and construction in Libya can be traced back to the 20th century during the Italian government. In fact, the process of modernisation has improved during the 20th century when the country established modern infrastructure facilities.

Italy did most of the Libyan’s infrastructure during the first half of the 20th century. The infrastructure development was in most of life aspects where Libya, for the first time, saw modern war machines and modern western life such as post offices, rail network and airports.

During the period from 1951 to 1969, the consecutive monarchy governments have had lots of essential infrastructures established in the country such as hospitals, airports, universities …etc.

From 1969 to 2011, the Gaddafi's consecutive governments did not develop most of infrastructure in Libya. The infrastructure still needs development to reach the standard of a modern western lifestyle; for instance, there is neither public transportation nor debt or credit card services. Also, the information system still has the 20th century basic system. The World Wide Web is not well established in Libya and does not benefit or facilitate people's daily life and people need to attend personally if they want to apply for application or service. The latest survey by the World Bank claimed that internet users in Libya is 19.9 Per 100 people (World Bank, 2013).

3.2.5 Infrastructure

Mersha (1997) cited in Curry and Kadasah (2002) suggests that in order to support industry in the developing countries, governments of these countries should provide an appropriate environment with a reasonable infrastructure.

The Libyan network of roads and highways are generally good and connect along the coast at a distance of 1775 km and most major cities of the country. There is a long paved road that connects Tripoli with Tunis at a distance of 170 Km and to Benghazi about 1000 Km and to Tobruq at the Egyptian borders of 1600 Km. Also there is another road that connects Sabha in the south of 600 Km and to Alkufra in the far south of 1700 Km. In all, Libya has about 25,000 km of roads, of which 56 % are paved (Ministry of Transportation, 2012).

The Libyan Airlines, national carrier, and Afriqiyah Airways provide both local and international flights and connect major cities of Libya to international destinations through Tripoli airport main Hub, Benghazi, Misratah and Sebha. In addition several international airlines such as British Airways, Lufthansa, Alitalia and Emirates serve Tripoli and Benghazi

airports. Some private airlines such as Buraq Air and United Air have emerged to serve local and international routes.

Currently, after the end of war in Libya, some international airlines such as British Airways, Lufthansa, Alitalia, Turkish Air, Etihad, Emirates, Austrian Airlines, Egypt Air and Air Malta have resumed their operations to and from Tripoli and Benghazi. This process (aiding the returning of international companies to Libya) aims to support Libya business and recover the daily oil production to its normal production before the war.

In 1996, Libya established two cellular network companies, Libyana and Almadar, which now covers most of the country, however their coverage is still limited and some areas in the south of the country are still uncovered by cellular networks. Table 3.5 below outlines current technological strengths in Libya and future risks that are facing Libya in terms of technological development.

3.2.6 Libya International Relations

Libya became a member of the United Nations in 1951 after the UN endorsed its independence. It held a non-permanent seat on the Security Council in 2008-2009. The Libyan international relations with the international community can be divided into three stages; the independence stage 1951 - 1969, the Gaddafi's regime stage 1969 - 2011 and the current Interim Government 2011 - onwards. In the independence stage, the consecutive Monarchy governments started to tie Libya with the international communities and Libya has been since that time a member in most of the international communities such as the Arab League, the African Union, UNESCO, FAO, ISO…etc. Furthermore, these governments had strong international relations with different countries. For instance during the period from 1955 to 1969, there were different military treaties with the United Kingdom, United States and France. These treaties allowed these countries to have different military bases and

headquarters in Tripoli, Benghazi and Tobruk.

The second stage started after the Gaddafi led the coup on September the 1st 1969. The country started a different philosophy in international relations. It was based on the Gaddafi vision and confidence that all the western countries are Colonialists and Imperialists. On this basis, Gaddafi started to make trouble and unbalance his international relations supported by the huge oil wealth of the country to support different international terrorist organisations in Europe, South America and Asia. The result of Gaddafi's Ideology of dealing with international communities during the last 42 years, from 1969 to 2011 can be summarised in the following main events that affected Libyan international relations :

- In 1977 the tension raised with Egypt led to war between Libya and Egypt.
- In 1978 Gadhafi being accused in Killing Immam Musa Elsader (Islamist scholar) of Lebanon.
- In 1980 he supported some Tunisian radicals who attacked the city of Gafsa Tunisia.
- During the years 1980 – 1987 he supported one of the militia in Chad and emerge Libya in war with Chad and sent tens of thousands of the Libyan army force there and invaded Chad. This resulted in thousands of Libyan and Chadian people killed and billions of dollars wasted.
- In 1980, Ronald Reagan, the USA president, issued multiple sanctions against Libya as the latter was accused of supporting international terrorism.
- In 1984, the Libyan special forces at the Libyan embassy in London fired at protesters in front of the embassy which led to the death of policewoman Joan Fletcher by a bullet from the Libyan Embassy.
- In 1986, the USA air forces with aid of the British air forces attacked Libya through air raids in Tripoli and Benghazi, as a result of the La Belle night club explosion in Germany that was commonly frequented by United States soldiers.

- In 1988, Pan Am 747 airplane flight 103 exploded over Lockerbie, Scotland with 273 victims. Gaddafi's regime and Intelligence agents were accused by the US and the British Government. Finally the International Justice Court found his regime guilty and responsible for the tragedy.
- In 1989, the Gaddafi regime was found guilty and responsible for the explosion of the French UTA airplane over Niger with179 people killed.
- During the years 1992 – 2001, Libya was under the UN Resolution 748 which imposed a flight embargo to and from Libya and also imposed sanctions on financial transactions and export of oil instruments to Libya.
- In 2001, during the negotiations to resume the diplomatic relations with Britain, Gaddafi's regime admitted its responsibility in supporting the Irish Republican Army (Guardian, 2011).

3.2.7 The current Libyan international relations (2011 – 2014)

The third stage of the Libyan international relations started when the Gaddafi decided to open fire into anti Gaddafi protesters who wanted improvement of their daily life and wages. The international community represented by Foreign Ministers of the UK and leaders from over 40 countries and organisations including the UN, the Arab League, the Organisation of the Islamic Conference, the European Union and NATO, met in a London conference on Libya on 29th March, 2011. The Conference and subsequent international group meetings in Doha, Rome, Abu Dhabi and Istanbul demonstrated the international community's continuing resolve and unity of purpose. This provided high-level political guidance in relation to the implementation of UNSC resolutions 1970 and 1973; support for the Libyan people in creating their political system; to choose their own future; and a forum for international discussion of humanitarian development and other assistance to Libya.

The Arab League decided on 27th August 2011 to allow the Libyan transitional government

to represent Libya at the meetings, also the UN General Assembly's decision on 16th September 2011 to welcome the Transitional government as the delegation of Libya to the General Assembly, marked the re-entry of Libya into the international community **(**Foreign and Commonwealth Office, 2011).

Table 3.6 identifies current and future prospects and challenges in Libya international relations. It is clearly obvious that the main risk is the UN resolution against Libya which would not be lifted until the UN is confident that there is no risk to civilians.

3.2.8 Legal Structure

During Gaddafi rule, the Libyan legal system excluded human rights and stripped Libyan citizens, political parties and activists of exercising their political rights. Any opponents against the regime or its clan were jailed for indefinite periods. In addition, the legal structure was endorsed according to Gaddafi's views. Judges and lawyers were not protected and could hardly fight back against the regime because they could be severely rebuked or directly threatened. In 2007, the Minister of Justice resigned on television, expressing his disagreement with the regime interventions in the country's legal system (Pomed, 2012). The current government determined to lead Libya through credible elections, however important challenges are facing the government such as the spread of weapons and unsecured borders. The June 2012 elections called Libyans to vote for a constitutional parliament after 43 years of life without a constitution. The Libyan people's expectations are high in terms of political rights and the term of economic improvements. Libya has to establish order and the current government must limit the spread of weapons in the country in order to make the legal system effective (ILAC, 2012).

3.2.8.1 Legal Framework

In the past, Gaddafi's speech was considered by the judiciary power as a source of legislation and must be implemented. This is why justice in Libya has not achieved independence between the legislative power and the judiciary power. For instance, Gaddafi's security forces have the power to kill any opponent without a trial. Daiff Al Gazal, Libya journalist criticised the regime in 1997, was found dead in the east of Libya with his fingers cut off. Moreover political trials are held in unknown places such as the people's court and revolutionary committees. The main source of law in Libya is Gaddafi's Green book. Currently, the Libyan legal system is based on a mixture of the Islamic, British, Italian and French civil laws. Because the country's constitution was suspended by Gaddafi in 1969, the current Government is still working to establish a panel from Libyan civil society to draft the constitution. The Libya court system is based on civil laws such as that in other countries and can be classified as trial and appeal courts. In trial courts a single judge usually hears disputes and determines the outcome while in appeal courts decisions that are made by the trial courts are reviewed and a final decision is made (Wallace and Wilkinson**,** 2004).

There are many issues that confront the development of the legal system in Libya, table 3.7 analyses the main challenges and opportunities after the Libyan revolution.

3.2.9 Environmental Policies

Alamin (2012) claimed that although Libya has little arable land, about 90% desert, there is a major environmental concern due to the depletion of underground water. The water depletion is caused by overuse in agricultural and industrial developments and as a result sea-water has penetrate into the coastal aquifers (Oleynik and Alexandar, 2006).

The main worries, table 3.8, are coming from the decreased level of water reservoirs in the desert and availability of surface water is extremely limited – there are no flowing rivers and

no lakes throughout the whole country.

The desertification of existing fertile areas is being combated by the planting of trees as windbreaks and establishing a massive water transferring project from large aquifers under the Sahara desert in the south to linking different areas in the country. This project called the Great Man made River is considered as one of the world's most expensive water supply projects, estimated at $30 billion (BBC, 2006).

The previous Libyan governments have participated and cooperated with the international community especially in the Mediterranean region to protect regional and international environmental issues such as Ozone and greenhouses' gases. Moreover, Libya is a member of many international environmental organisations dealing with desertification, marine dumping, nuclear and chemical test bans and ozone layer protection (Oleynik and Alexandar, 2006).

Summary of PESTILE analysis of Libya

Analysis of Libya's Political landscape	
Current Strengths	Current Challenges
■ Strong democratic system ■ High government effectiveness and regulatory quality.	■ Political instability ■ Row with Algeria
Future Prospects	Future Risks
■ Reform policies of the government ■ Expanding free trade agreements	■ Weak relations with Egypt ■ Strained relations with Qatar ■ Growing tensions with terrorism groups
Source: **Business Monitor International (2012).**	

Table 3.1; Current political state in Libya

Analysis of Libyan Economy	
Current Strengths	Current Challenges
■ Strong macroeconomic fundamentals ■ Prudent fiscal policy ■ Stable debt situation	■ High unemployment ■ High inflation
Future Prospects	Future Risks
■ Rise in state spending in 2011–12, 13 ■ Growth in tourism	■ Slowdown in economic growth ■ Weak Libyan Dinar
Source: **Business Monitor International (2012).**	

Table 3.3; Analysis of Libyan economy

Analysis of Libya's social system	
Current Strengths	Current Challenges
■ High human development score ■ A strong healthcare system	■ Poverty ■ Weakness in education system
Future Prospects	Future Risks
■ Increased spending on education and welfare in 2011–12	■ Low labour force participation rate ■ Rise of extremist and terrorists
Source: **Business Monitor International (2012).**	

Table 3.4; Analysis of Libyan Social system

Analysis of Libya's Technology landscape	
Current Strengths	Current Challenges
■ Developed technology-intensive industry ■ High R&D expenditure	■ Poor implementation of patent rights.
Future Prospects	Future Risks
■ Increase in number of patents ■ Research and Development collaboration with the EU	■ Increasing competition from emerging nations
Source: **Business Monitor International (2012).**	

Table 3.5; Analysis of Libyan Technology.

Analysis of Libya's International landscape	
Current Strengths	Current Challenges
■ Openness to international community ■ Active in international relations with West.	■ International terrorists gathering in the East of the country
Future Prospects	Future Risks
■ Join more international treaties ■ Cooperation with the UN	■ UN resolution 1970 and 1973
Source: **Business Monitor International (2012).**	

Table 3.6; Analysis of Libyan international

Analysis of Libya's legal system	
Current Strengths	Current Challenges
■ Business-friendly economy ■ Formal openness to foreign investment	■ Government intervention in the economy ■ Labour unions
Future Prospects	Future Risks
■ Tax incentives ■ Tax reforms	■ Legal impediments to growth
Source: **Business Monitor International (2012).**	

Table 3.7; Analysis of Libyan Legal.

Analysis of Libya's Environmental landscape	
Current strengths	**Current challenges**
■ International environmental commitments ■ Strong environmental laws and policies	■ Air and water pollution ■ Poor implementation of environmental laws ■ High waste generation
Future prospects	**Future risks**
■ Switch to non-polluting public transport ■ Leadership in clean technology ■ Focus on renewable energy	■ Water reservoirs and extreme weather conditions.
Source: **Business Monitor International (2012).**	

Table 3.8; Analysis of Libyan Environment

3.3 Review of current environmental issues in Tunisia

As this research is focusing on the development of accreditation in the North Africa it is important to review the current political, economic, social, technological, international, legal and environmental issues in Tunisia. The field study data collection has been carried out at the Tunisian National Accreditation Council and the Central Laboratories for Testing and Analyses due to the Arab spring during the data collection phase which prevented the author to collect data from Libya.

3.3.1 PESTILE Analysis of Tunisia – Political Factors	
External Factor	**Description**
Political	On January 14th 2011, following two weeks of uprising in Tunisia, president Zine el Abidine Ben Ali fled the country and a situation of unrest started in Tunisia. The departure of the Tunisian president was welcomed by widespread excitement and happiness within Tunisia. Although the autocratic regimes in North Africa and Middle East previously internationally viewed as secure and pro-West, the wave of unrest across this region has initiated international concern over future political stability in this region Following the national elections that were held on October 23rd to elect a National Constituent Assembly, The Constituent Assembly has assigned a transitional government and is expected to draft a new constitution in 2014. The regime's stability is an important key to bring international investors' confidence, however this confidence in the Tunisian market was shaken and the country could lose its place as Africa's fourth most stable country after Botswana, South Africa, Morocco (Monitor, 2013). According to Arieff (2011) Tunisia faces many challenges such as disputes over reform priorities, economic crisis, labour unrest, relatively impoverished areas especially in the south, remaining insecurity and the impact of events in neighbouring Libya present additional difficulties. The current situation in Tunisia raises a wide range of questions for the future of the country and the region. These relate to the struggle between reformists and rooted forces carried over from the former regime. The potential outline of the new political system in Tunisia is still unclear (Hibou et al, 2012).

3.3.2 PESTILE Analysis for Tunisia – Economic Factors	
Ext. Factor	**Description**
Economic	Population: 10.63 million (July 2011 est.) GDP $44 billion Urbanization rate: 67% of the population (2010) Life Expectancy: 75 years (2011 est.) Religion: Muslim: 98%, Christian: 1% Jewish and other, 1% Literacy: 78% (2008) Ease of doing Business 2012: 46 days Key Exports: clothing, semi-finished goods (notably spare automotive parts), textiles, agricultural products Key Imports: machinery and equipment, hydrocarbons. Major Trading Partners: France, Italy, Germany, Libya, China, Spain. Source (World Bank, 2012). In 2009, the World Bank cited Tunisia as a top regional reformer (Tunisian Government Portal, 2012). Libya is Tunisia's main regional economic partner, with more than USD 2 billion worth of trade in 2010. The current unrest in Libya will hit bilateral trade and direct investment as Libya is the fourth largest Arab investor in Tunisia, also it increased unemployment rate and the funds that come from Tunisian migrants in Libya as more than 90, 000 Tunisians were working in Libya before the uprising. The 2011 revolution has also affected tourism, foreign investment, Budget and increased deficits. Tunisia experienced economic contraction in the first quarter of 2011, and its central bank has predicted 0% growth in 2011, compared to 3.7% growth in 2010. Tourism revenues were apparently down by 40% and foreign direct investment by 60% in the first six months of 2011 (Tunisian Government Portal, 2012).

	The Tunisian economy and exports have mainly been driven by **t**extile, agriculture exports and tourism. The tourism sector is a major employer and previously provided 11% of the country's GPD and employs about 400,000 workers. Moreover, Phosphate ore reserves are significant and are the basis of a chemicals industry.
3.3.3 PESTILE Analysis for Tunisia – Social Factors	
Ext. Factor	**Description**
Social	The Tunisian uprising arose as a spontaneous social protest against unemployment and social injustice in the rural areas of the country. Almost daily demonstrations remain visible in public places through strikes. These protest movements are built around issues of employment, development, justice and transparency (Ministry of Social Affairs, 2012). Unemployment rate among young people from 18 to 29 almost rose to 30% in 2009, and soared to 45% in the case of higher education graduates. These figures appear credible as they are close to those provided by the World Bank in 2005 in which the rate of unemployment among senior technicians and those with masters degrees was close to 50% (World Bank, 2012). Tunisian authorities hope that an end to turmoil in Libya would stabilize border areas and eventually produce an economic recovery that would allow the Libyan market to reabsorb some of Tunisia's labour surplus. According to the African Development Bank's report (2012), the main social challenges in Tunisia are; privatisation of permanent work contracts; absence of social cover, pressures on wages and poor working conditions**;** poverty level, inequality remains a challenge; regional disparities are highlighted by the concentration of public services, investment, and economic activities in the coastal region; regional disparities resulted in higher unemployment in the rural areas which are also the poorest regions **(** African Development Bank , 2012).

3.3.4 PESTILE Analysis for Tunisia – Technological Factors	
Ext. Factor	**Description**
Technology	Tunisia is the second most technology advanced country in Africa after South Africa. It is connected with about 8 million mobile and 1.2 million landlines. Almost all Tunisians (91%) are equipped with mobile or land line telephones by two main companies, Tunisiana and Telecom offering GSM service and 12 Internet service providers (ISPs) with an international transfer rate of 1.4-5 Mbps. Other multinationals mobile telecommunication providers in Tunisia include Ericsson, Alcatel, and Siemens **(**Ministry of information and communication technologies**,** 2012). The social media such as Facebook and Twitter are used widely by Tunisians and it allowed protesters, particularly the young, to move quickly even in the absence of organised structured bodies and were effective in spreading information about the turmoil both within and outside the country **(** Ministry of information and communication technologies , 2012). According to World Bank report (2007), the transport sector contribute to 5.6% to the country's annual GDP. Tunisia Ex-Prime Minister Essebsi stated in May 2011 that Tunisia needs at least $5 billion international assistance per year for five years to finance infrastructure and creation of new jobs. The current Interim government also indicated that some assets seized from the Ex-president would be used for developing public projects. The Jasmine Plan that was approved by the interim government in September 2011 emphasised increasing public investments in infrastructure. There are seven international airports: Tunis, Monastir, Jerba, Tabarka, Tozeur, Sfax, Gafsa. Also there are eight commercial ports: Bizerte, La Goulette, Radès, Sousse, Sfax, Gabes, Zarzis and Skhira. Ports are equipped to handle Roll on-Roll off ferries and container ships. the road networks covering about 19,000 kilometres and 140 kilometres of four-lane highway. A program to construct nearly 450 kilometres of highway is planned for the next ten years. The rail network consist of 2,168 kilometres and covering most of the country and it handles about 13 million tons of products and 22 million passengers (Transport Portal Tunisia, 2012).

3.3.5 PESTILE Analysis for Tunisia – International Factors	
Ext. Factor	**Description**
International	After the end of 2011 revolution, the interim Tunisian government and other political leaders have stressed continuity in Tunisia's foreign relations and international agreements and commitments made during Ben Ali period. Moreover the government stated that it will protect and expand foreign direct investment and international trade including traditional partners in Europe. Relations with Turkey could also be bolstered. In September, Turkish Prime Minister Recep Tayyip Erdogan visited Tunisia as the first stop on a regional tour of countries affected by democratic uprisings; his public remarks emphasized the compatibility of Islam and democracy (Ministry of Foreign Affairs, 2012). Tunisia and the European Union have cemented a close relationship by means of an association agreement, aid, and loans. More than 60% of Tunisia's trade is conducted with Europe. The Association Agreement, which was signed in 1995 and entered into force in 1998, eliminates customs tariffs and other trade barriers on manufactured goods (Ministry of Foreign Affairs, 2012). Recent political uprising in Libya, which is Tunisia's first trading partner, have further affected Tunisia's economy. Regions in the south e.g. Ben Guardane and Tattaouine have hardly affected their strong trade and investment relations with Libya. Moreover, about 90,000 Tunisian workers in Libya are reported to have returned, adding more pressure on the Tunisian labour market (Ministry of Finance, 2012).

3.3.6 PESTILE Analysis for Tunisia – Legal Factors	
Ext. Factor	**Description**
Legal	Since 1956 the legal system in Tunisia has been based on French civil law and since then Tunisia has had a single united judiciary system. The Tunisian court structure consists of the regular civil and criminal courts including the courts of first instance; the courts of appeal; and the court of cassation; the highest appeals court; besides the military tribunals within the ministry of defence **(**Tunisian Justice portal **,** 2012). The 2011 constituent assembly election was successful in selecting the assembly with a voting rate of over 90%. The 217 elected members will be responsible for drafting a new constitution, choosing an interim government and setting the dates for parliamentary and presidential elections. The election is only the first step toward democracy and the new legal system focuses on ensuring a clear separation between the executive, legislative and judicial powers (World Bank, 2012). It is common knowledge in Tunisia in the previous government that many companies evade some or all of the taxes they are supposed to pay, moreover inaccurate statements, minimization of receipts and various frauds are common practices. It is also common, in order to require a completion of a particular transaction, to pay a bribe which is common in most of the government departments **(**Tunisian Justice portal , 2012). Earnings resulting from business operations; real estate; capital gains and transferable securities; life pensions; earnings derived from any paid work and any other earnings made in Tunisia are taxed. Tax scale applied to net annual earnings are: Tunisian Dinar %, Up to 1,500 - 0%, 1,501-5,000 - 15%, 5,001-10,000 - 20%, 10,001-20,000 - 25%, 20,001-50,000 - 30%, more than 50,000 - 35% (World Bank, 2012).

3.3.7 PESTILE Analysis for Tunisia – Environment Factor	
Ext. Factor	**Description**
Environment	Tunisia has a great variety of natural environments and enriched biodiversity that have supported national development and, as well as the differentiation of continental and marine ecosystems. The variety of the natural environment of Tunisia, its geographical and climatic contrasts, its moderate climate, Mediterranean and Saharan mixture make it one of the beautiful North Africa countries. The natural environment in Tunisia was exposed to extreme pressure during the second half of the 20th century due to dramatic demographic growth, non-sustainable natural resource use and industrial development in rural area. These reasons have diminished biological diversity and increased air pollution, in addition, increased water needs due to economic and social development have led Tunisia to focus on its available resources. Almost the entire country is threatened with desertification with the exception of the Northern region due to the fact that the general perception of the residents in the rural areas is to change these areas into an industrial complex (Ministry of Environment , 2012). Cultivated area covering most of land with different Mediterranean plants and trees such as olive tree, Palm tree, Fig, grapes almonds…etc. This green cover coupled with strict environmental protection measures issued by the preceding governments, contributed largely to protect the environment in Tunisia. Although the middle and northern parts of Tunisia are stricter in environmental issues, the southern area of Tunisia is less compatible with the environmental protection measures due to less awareness of people there (Ministry of Environment, 2012).

Comparison of Libya and Tunisia PESTILE

LIBYA	TUNISIA
Political	**Political**
Political instability from 2011 -2015	Political instability between 2011-2014
Changes in legislation.	Ineffective legislation
Row with Algeria and Qatar	Row with Qatar
Weak government	Terrorism threat
Economic	**Economic**
Low wages scale since 1981	Inequality in wages
Overcrowded government depts.	High unemployment level
Depends mainly on oil exports.	Very limited natural resources
Social	**Social**
Poverty in southern area	Undeveloped Rural area
Weak education system	Daily demonstrations.
Rise of terrorists	Terrorism threat in the southern area.
Technology	**Technology**
Lack of modern technology	Linked to international development
Undeveloped infrastructure	Limited funds delays Tech. improvement.
Unlinked to international development.	Undeveloped southern area.
International	**International**
Closed to international community	Opened to international community.
Lack of international treaties	Stable international relations.
International policies unfollowed.	International policies implied
Legal	**Legal**
No separation between judiciary and executive powers.	Limited separation between judiciary and executive powers.
High Tax evasion.	Limited Tax evasion
Very weak judiciary system	Strong judiciary system
Environment	**Environment**
Uncontrolled environment pollution.	Rise in environment pollution
Lack of linkage to international environment treaties such as Ozone.	Signed lots of environment treaties.
Desert in the northern area.	Scarce of water sources

Table 3.9: Comparison of PESTILE analysis between Libya and Tunisia

3.4 Extraction of PESTILE important factors in Libya and Tunisia

Reviewing the PESTILE analysis in North Africa, specifically Libya and Tunisia, the author was able to summarise and compare main important factors in each PESTILE category as shown above in table 3.9. These theoretical factors will be tested and ranked by respondents in three hierarchal importance, High, Moderate and Low. This will be discussed in details in chapter 5.

This chapter will discuss the metrological approaches used in this research with review of research methodology background to justify an appropriate methodology to be used in this research. This will help solving the research problem and collecting and analysing the data.

CHAPTER 4 - Research Methodology

4.1 Introduction

This chapter discusses the research methodologies and the methods of data collection. Research methodology is essential as it directs researchers on steps needed to be taken in order to meet the aims and objectives of the research, also identifying research philosophy, research strategy, research method and questionnaires' techniques to be used. Moreover it focuses on data collection processes such as questionnaires and interviews and explains the process of the pilot study, main study and measurement scales.

4.2 Research philosophy

Research philosophy depends on the way that a researcher view or thinking about the development of knowledge (Saunders, 2003). This research will try to answer questions relating to the development of a sustainable national accreditation body according to ISO/IEC 17011 and ISO/IEC 17025 laboratories accreditation in North Africa.

4.3 Identifying research need

The north African countries’ economy depend mainly on oil, industry and agriculture. For instance, the Libyan state has changed its economic policies and strategies since 1990 to explore out other sources of incomes rather than oil to support the economy. Also in Tunisia, the government plan to increase access to the European Union Markets.

The organisations, both in Libya and Tunisia, can share in the economy by exporting their products to the global market, where there are many competitors with products of good quality available.

Although some North African countries such as Tunisia has established its National Accreditation Body with support from the French Accreditation Body, continuation of Tunisian Accreditation body is in doubt as this body has been built by implementing the French Model. The case of Brazil and Zambia where these bodies were also established at the request of governments of both countries. Moreover, these two bodies has not achieved independence and depending on government support (Bukonda et al. 2002 cited in Montagu, D. , 2003). Thus the aim of identifying a sustainable framework for accreditation is paramount.

4.4 Research questions

The research questions are the questions which identify the nature of the research problem that needs to be focused on by the researcher. Research questions are important in building theory for case studies. In phenomenological research, the researcher is more likely to construct only one or two research questions (Collis and Hussey, 2003).

The aim of this research is *"investigating the factors affecting the development of a sustainable national accreditation body for the engineering and technology sector in North Africa"*, also the research questions used in the case study were 'how' and 'why' questions. In this research, why and how questions are to analyse the factors that affect implementation of a sustainable ISO/IEC 17000 standard in North Africa and what questions to identify them.

The important questions of this research are:

1)-What are the factors affecting the implementation of a sustainable ISO/IEC 17000 standards in North Africa?

2)-Why the factors to implementing the standards happened?

3)-How do the factors affect the implementation of ISO/IEC 17000 standard?

The first research question to be answered is: what are the main aspects to be considered in developing a sustainable national accreditation body in North Africa as developing countries, and is there a process for selecting the appropriate elements for its development putting in mind failure models in other developing countries with particular reference to the technical development, financial funding, Quality improvement, training, communication and cultural factors that affect the development of accreditation bodies, moreover, what is the relationship between accreditation and the factors that affect it?

4.5 Methodology

The research methodology can be defined as “theoretical support in different ways for many disciplines by academics dedicated to variety of research paradigm” (Kumar, 2005). Actually there are two research paradigms (Philosophies) ; positivism and interpretivism. Positivism applies quantitative and experimental methods that lead to statistical analysing to test hypothetical-deductive data (Collis and Hussey, 2009), (Saunders et al, 2003) and (Amaratunga et al., 2002). Alternatively the interpretivism paradigm applies qualitative naturalistic approaches to understand the reality of an object through analyse their action in a way that produce results for a researcher (Saunders et al, 2003).

Also, Saunders et al, (2003) believes that the best way to select and choose which method is appropriate to a research is by considering the research ‘onion’, figure 4.1. The research method is defined as a system or tool for creating and analysing data around a population such as group of people or a problem that needs to be discovered or investigated (Kumar, 2005).

Sekaran (2003) defines a research problem as "any situation where a gap exists between the

actual and desired state". According to Sekaran, the best way and source for responding to a practical problem is the technical practise that has been gained during dealing with different issues.

Saunders et al, (2009) claimed that research aims and objectives are the main elements that determine which appropriate research methodology is suitable for a research. However, in order to enable contribution to knowledge the research methodology needs to describe the approach and the research philosophies used to create new knowledge.

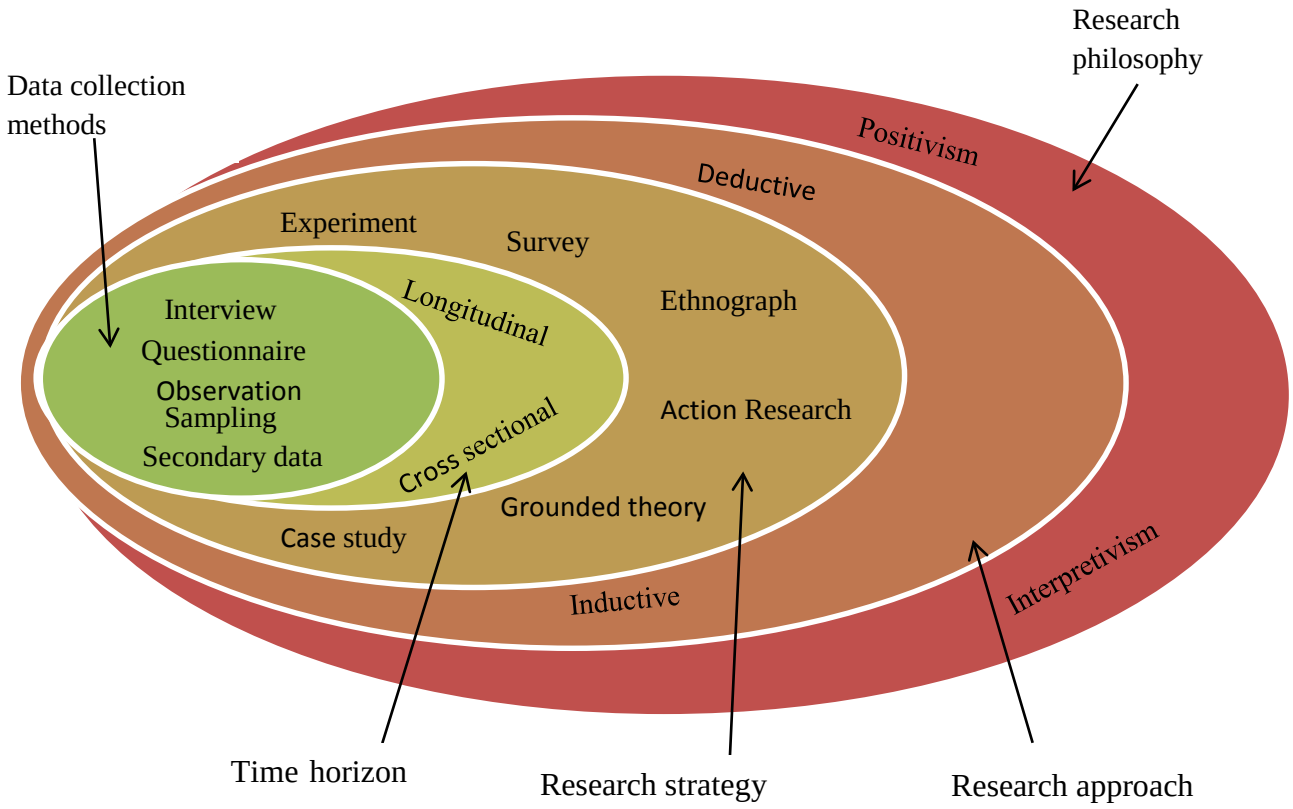


Figure 4.1; The research process 'onion' Source (Saunders, et al, 2003).

To proceed with the objective of investigating the factors affecting the development of a sustainable national accreditation body, a typical research approach needs to be adopted for this research to help ensure that the aims and objectives of the research will be met and its findings will be achieved. In this context, several research processes will be used, positivist

and interpretivist. These processes address major theoretical and philosophical approaches and cover different methods.

4.5.1 Choosing a research approach

A research approach may also be influenced by the types of data needed to answer the research questions. Based on data characteristics, the research approach can be categorised as qualitative, quantitative, or mixed (triangulation). According to Ticehurst and Veal (2000) this triangulation obtains its characteristics from the method of surveying by fixing the position of an object and measuring it from two different positions,

Qualitative research involves the study of a situation and makes very little use of numerical or statistical data, also it depends on verbal data that is based on subjective meaning given by interviewees or participants. In addition qualitative research focuses on analysis of hypothesis questions and change them to different themes and sub-questions while quantitative research or positivist research involves the study of samples or populations and it mainly depends on numerical data and statistical analysis. These two approaches are sometimes referred to as inductive (qualitative) and deductive (quantitative), moreover these two approaches are commonly matched into two research styles: quantitative and qualitative research (Cohen, et al, 2011).

4.5.2 Quantitative (Deductive) research

The quantitative approach tends to investigate the phenomenon from outside and through structured conceptual structure attempts to collect productive data. These data are the result of experiment or test (Saunders, et al, 2003).

Quantitative supposes the existence of facts that are somehow external and distinctive research strategy (Bryman and Bell, 2011). Quantitative research uses different methods of data collection such as questionnaires. However some researchers consider quantitative methods "as having a logical structure in which theories determine the problems to which

researchers address themselves in the form of hypotheses derived from general theories" (Williman, 2005).

Quantitative research uses data in a raw form that is when processed and analysed turned into information. It uses analytical methods such as graphs, charts and statistics that allow the researcher to understand sample's characteristics.

Quantitative data can range from simple amounts such as the frequency of occurrences to more complex data such as test scores.

Quantitative analysis techniques including creating simple tables or diagrams that illustrate the frequency of occurrence and using statistics to enable comparisons through establishing statistical relationships between variables (Saunders, et al, 2009).

4.5.3 Qualitative (Inductive) research

Researchers using qualitative research are concerned with working with qualitative data and emphasizing on verbal data and words by focusing on small groups than large samples as in quantitative research (Saunders, et al, 2003) and (Bryman and Bell, 2011). According to Hussey and Hussey (1997), qualitative research is " a study of which theory is developed from observation of empirical reality, consequently general conclusions are induced from specific cases". In other words, it involves learning by imitating upon particular previous experiences and through the creation of concepts and theories; future experience can be explained and predicted.

In qualitative research all knowledge is relative and there is a subjective element to all knowledge and research. According to Walliman (2005) qualitative research attempts to attain an inside view of the phenomenon and be as close as possible to the object being observed to extract valuable data. Furthermore it involves the practice of qualitative data such as tables, figures, gathered information, interviews, documents, and participant observation to

understand and explain problems, statistics, and a specific phenomenon. The results of qualitative data's analysis are usually emphasized on generating theories rather than testing them. Table 4.1 outlines the main differences between quantitative and qualitative approach.

Quantitative Approach	**Qualitative Approach**
Deductive; testing of theory	Inductive; generation of theory.
The necessity to select samples of sufficient size in order to generalise conclusions.	less concern with the need to generalise.
Uses large samples	Uses Small samples
Uses of various controls, physical or statistical, so as to allow the resting of hypotheses**.**	Commitments to research in everyday settings to allow access to, and minimise reactive among the subject of research.
Concerned with hypothesis testing.	Concerned with generating theories.
Data is highly specific and precise.	Data is rich and subjective.

Table 4.1; Comparison between quantitative and qualitative approaches. (Saunders et al, 2011; p 127).

By comparing the two approaches it can be summarized that qualitative research is certainly suitable at generating data that is very detailed. Of course, there are quantitative researches that are detailed and involve collecting numerous numeric data, however, in detailed quantitative research the data tend to limit the analysis. For example when collecting a simple interval-level quantitative measure, the analyses are likely to be fairly determined and limited e. g., descriptive statistics, correlation, regression or multivariate.

According to Bryman (2001**)** and Denscombe (2007) when mixing the qualitative and the quantitative together in one research then the research strategy called triangulation enhances the research validity and provides the opportunity to support findings from different perspectives. The qualitative method will guide the quantitative approach and the quantitative method provides the response into the qualitative debates for further validity improvement.

4.6 Research strategy

A research strategy is a plan, structure and strategy for undertaking a research and how the research question would be answered (Saunders, et al, 2003). According to Saunders, et al, (2009) no research strategy is integrally superior or inferior to any other, consequently, what is most important is whether a chosen research strategy will assist in answering particular research question(s) and meeting research objectives.

The main research strategies' methods are; experiment, survey and case study. Choosing the appropriate research strategy depends on several elements within the study such as research question(s), objectives, the extent of existent knowledge, the amount of time and other resources available.

4.6.1 Case study

According to Saunders, et al, (2003), a case study is a strategy that involves undertaking empirical investigation of a current phenomenon within its real environment and. it is usually associated with questions starting with why, how and when that need to be answered (Yin, 2003). Within a case study approach, data can be collected either by questionnaires, interviews, observation or documentary analysis (Saunders, et al, 2009). A researcher who uses a case study approach would have the opportunity to generate a new hypothesis and this can be tested during the empirical investigation and data analysis.

As the case study approach can provide empirical investigation to a problem, this particular research is carried out using case study strategy in order to identify the factors that affect the establishment of a sustainable national accreditation body and ISO/IEC17025 laboratories accreditation in North Africa. The case study for this research will be at the Tunisian Accreditation Council and the Central laboratories for testing and analysis in Tunis. This case study offers a closer investigation of the problem and allow the researcher to explore factors.

4.6.2 Data collection

Information can be collected from either secondary or primary sources in order to provide insight into the research and identify sequences of progression.

4.6.2.1 Secondary Data

Secondary data can provide a background source of information for researchers and provide data to contribute and help in answering the research question (s) (Saunders, et al, 2009). Secondary data are all published data collected for the purpose of supporting a research and expand the available data base . Secondary sources such as library books, journals, reports, articles, magazines, electronic databases and the Internet, figure 4.2, can provide very useful background information and historical perspective for researchers. when using secondary data researchers would save cost and time through comparison of primary and secondary data (Kinnear and Taylor, 1996).

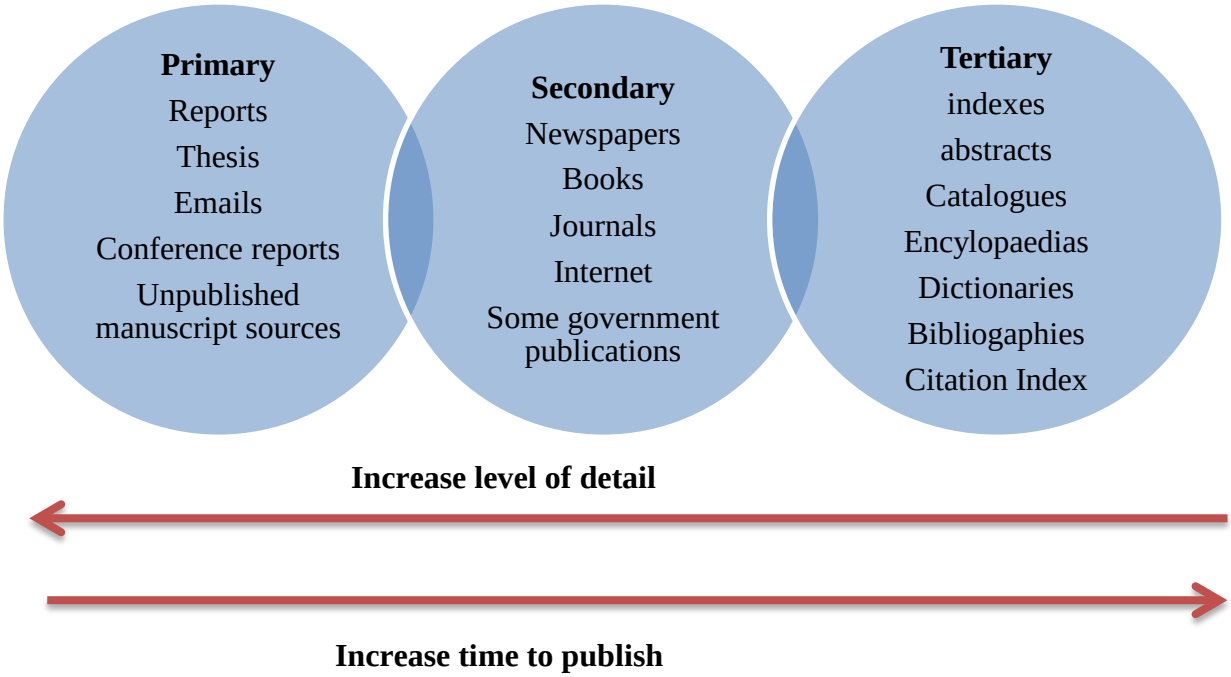


Figure 4.2, Literature sources available. Source (Saunders, et al, 2009).

To meet the main objectives of this research, secondary data are used as a source for collecting background information and help in identifying the main factors that affecting the development of a sustainable national accreditation body. Therefore, some of these data will be collected from journals, books, the Internet, United Kingdom Accreditation services, along with the use of survey questionnaires and semi-structured interviews. Besides relevant minutes of meetings, Libyan Centre for Standards and Metrology and Tunisian Accreditation Council publications, executive reports and Ministries business plans and annual reports and the Libyan and Tunisian governments white papers.

4.6.2.2 Primary Data

Primary sources of information such as questionnaires and qualitative techniques e. g., in-depth interviews provide new data on the research topic. Once the search of secondary data cannot satisfy the research needs then the researcher normally will find that primary data is the main source of information and data collection.

To meet the objectives of this research, primary data will be the main source for data collection as the secondary resources have little or no empirical data on accreditation. Although, collecting primary data in this research will be very difficult, the author has conducted a field study trip to Tunisia between July, 2nd and September, 2nd 2011 to conduct primary searches by using questionnaires and interviews.

4.7 Adopted approach for this research

In order to answer the research questions, conducting primary search and meeting the research objectives the researcher decided to adopt both the qualitative and quantitative approaches. As this research is diverse and due to shortage of empirical research in the field of accreditation, a quantitative approach will be used because of the speed in which

sufficiently large amounts of data can be collected. Also, by using a qualitative research it will be possible to contact a specific and limited sample to collect detailed verbal data through different methods such as interviews.

The quantitative will include; start with the research question and conceptual framework to form the questionnaire's themes and variables.

Administrate a questionnaire to a large sample of selected population to establish the extent to which they are satisfied with predetermined variables.

The qualitative research will include; interview decision makers (TUNAC management) about their views about possible causes of emerged factors from quantitative analysis. Either approach will yield valuable data about a sustainable accreditation framework.

4.7.1 Questionnaire

Burton (2000) stated that a questionnaire is increasingly becoming the most widely used survey instrument across many disciplines and considered as valuable tool to collect information about existing phenomena.

A well designed questionnaire should maximise the relationship between respondents reply and what exactly the author is trying to measure. Therefore, to design a reliable research strategy, researchers must be consistent in their approach to measurement by asking respondents exactly the same questions.

In order to satisfy the research's objectives, a reliably structured questionnaire should be designed which may be difficult to design and time consuming. It is usually addressed in the form of series themes and structured questions delivered to a population covering a wide range of respondents to fill out. In addition, the aim of this process is to explore factors such as personal attitude, opinions and feelings about a variety of issues, objects and situations. Furthermore, a well-designed questionnaire can be a reliable method of data collection

because it involves a sample (s) covering a large number of respondents, hence a considerable amount of information can be generated in short time.

According to Hague (1993) researchers should ask themselves four important questions before designing a questionnaire. These questions are;

- Will these questions be understood in the way it written?
- Can these questions interpreted to different ways?
- Are these questions likely to annoy or offend?
- Is there a better way of making a respondent understand questions in a simple form?

The pros and cons of using a questionnaire are that it can be delivered to people who are far to reach either by email, post or personal delivery and collection and allow respondents to read questions so that they can give precise answers. The cons of questionnaires are that they depends mainly on respondents replies, written instructions and limited motivation.

The author realises that, collecting data is very expensive and at the same time could be time consuming, therefore, the author has carried out a pilot study for the purpose of designing a set of closed questionnaires aimed at the core of the subject.
The author has designed and made the questions as short as possible, as these questions are useful since they are quick to answer (Byrman and Bell, 2011). This is because some people do not like to read long questions and therefore it is important to avoid respondents becoming bored; uninterested and not completing the questionnaire. This is seen as a significant factor by the author to aid increasing the response rate, in addition, a structured questionnaire provides a rapid and relatively inexpensive way to obtain information.

The questionnaire consists of four different sections as follows:

- Management;

- Organisational culture
- Technical factors;
- Strategic planning;
- Training
- Quality development
- Resources

The participants of this questionnaire have assessed the extent of importance of accreditation and laboratory accreditation practices with respect to their establishments and accordingly prioritise these factors based on their relevance for developing a sustainable NAB in north Africa. A questionnaire instrument that have 1-5 Likert scale has been designed as per literature review. The five-points response scale has the following classification: highly satisfied (5), satisfied (4), neutral (3), dissatisfied (2) and highly dissatisfied (1).
The main 7 components, management, organisation culture, technical, strategic planning, training, quality development and general factors / resources, are extracted, as mentioned in chapter two, from literature. The author was able to classify sub-components as per the conceptual framework.

4.7.1.1 Questionnaire design

A questionnaire is a form containing a set of questions, especially one addressed to a statistically significant number of subjects as a way of gathering information for a survey. In the case of a postal questionnaire it is possible to collect a great amount of data within a reasonable period of time and at an acceptable cost. However, it is not possible to get in-depth information or to have a discussion with respondents in specific areas.

The design of a questionnaire is a long process that requires careful attention. Burgess (2001) explained that the strength of the data analysis depends on the good design of the

questionnaire and on the data collection procedures. The questionnaire design should also address the needs of the research. So the questions asked should serve the research aim and objectives and be well prepared. A questionnaire is a powerful evaluation tool and should be well produced. It is important to consider that a questionnaire should be viewed as a multi-stage process starting with the definition of the aspects to be examined and ending with the interpretation of the results.

4.7.1.2 Question types

Hague (1993) stated that questions are usually classified into three types: these classifications are: behavioural, attitudinal and classification. Behavioural questions seek factual information, such as the occupation of respondents or how often they do something. Attitudinal types of questions ask what respondents thought of something. The third type of question is classification, which seeks to group respondents according to age, gender, etc. The researcher will use all three types of questions.

Most questions can be classified into two groups: closed or open-ended. A closed question involves offering respondents a number of defined response choices. They are asking to mark their response using a tick, cross, or circle etc. The choices may be such as a simple Yes/No, Male/Female; or may involve a range of different choices. According to Pallant (2010) closed questions are usually quite easy for respondents to answer and for a researcher to convert to a numerical format. On the other hand, open-ended questions typically begin with words such as "Why" and "How", or phrases such as "Tell me about. .. " Often they are not technically a question, but a statement which implicitly asks for a response. Thus most questions in this study are closed questions.

4.7.1.3 Sources of ideas in writing questions

The design of the questionnaire will be based on a review of the literature surrounding

ISO/IEC 17011, ISO/IEC 17025 , and on Quality management studies. In addition, clauses from ISO/IEC 17011 will be used in developing the questionnaire. The researcher also investigated previous studies in ISO 9001 and used them in addition to the literature review when designing the questionnaire.

4.7.1.4 Questionnaires structure

The questionnaire consists of two main parts. The first part is concerned with demographic independent variables such as the type of organisation, scope of the work, participant job title, education level, number of employees. In the second part, various factors that affect the establishment of national accreditation and laboratories' accreditation were arranged in seven themes for investigation. The development of each part of the questionnaire is explained below.

First part: demographic characteristics

In this part**,** participants of this questionnaire have been asked to give the type and the scope of their work, the education level and position in the laboratory of the respondent, the number of employees in the laboratories, the marital status and the gender of the employees.
These demographic data help the author to identify the respondents into groups which can be further investigated for the source of complaints for each group.

Second part: factors affecting accreditation

This part of the questionnaire consists of seven themes that are considered to be affecting the development of a sustainable accreditation scheme. Some of these factors are related to international standards such as ISO/IEC 17011 and ISO/IEC 17025 requirements and the other factors related to management, cultural, and strategic planning issues.

First, there are general questions in both technical and management themes such as leadership, policy, people attitude at work, human resources and what may cause

accreditation problems. Some of the factors in these questions relate to management systems such as: employees rewarding program, job satisfaction, information system, recurrent training, knowledge, Quality programs and internal audits.

Second, there are other questions that are related to technical factors such as laboratories' facilities, availability of corrective and preventive action, procedure to estimate uncertainty of measurements, assuring of test and calibration’s results and capability and accuracy of equipment.

Finally, the last theme is called critical factors which contains general questions that affect accreditation such as lack of management commitment, government support to accreditation programs, documentation, international competition, and pressure from customers, international competition, people's attitude towards accreditation .

In addition to the above questions, the author has added a space at the end of the questionnaire. This is intended to supply a space for the participants to express their feelings and comments on anything that have not been covered by the questionnaire that is thought to be important to accreditation. The questionnaire layout and structure that used in this study is explained in appendix (1).

4.7.2 Attitude scales

The questionnaire is planned to obtain the employees’ attitude in both the TUNAC and LACE, regarding whether they accept the listed factors as causing problems for laboratories' accreditation and whether they thought it practical to implement the suggestions put forward by the questionnaire in future. Thus, the adoption of Likert scales seemed appropriate.

4.7.2.1 Scales of measurement and Likert scale

A Likert scale needs a respondent to indicate the degree of agreement or disagreement with each of a series of statements related to the attitude object. Its primary objective is to ensure

that a statement is measured by the same range of assessment. Collis and Hussey (2009) claimed that the Likert scale has many advantages such as being relatively easy to construct, different statements can be provided in a list, does not take up much space, simple for both the respondent to complete and the researcher to code and analyse.

The use of scales instead of forced questions, such as yes/no questions helps in ascertaining the degree of agreement or the extent to which the respondent evaluated.
The research has employed factor analysis and principal component analysis by using ordinal scales of 5 points which establishes an ordered relationship between the persons or objects being measured. In the case of the Likert scale of 5 points, the researcher has used number 5 to represent the strongest agreement and number 1 to represent the weakest agreement with the statement given.

4.7.3 The covering letter

The covering letter gives the aim of the questionnaire and states the importance of the research. It also gives the name and address of the research institution. The letter also assures the confidentiality of the respondents and encourages them to reply. The covering letter is written on the letterhead of the School of Science and Technology, Nottingham Trent University, with the intention of giving the respondents a creditable initial impression.

4.7.4 Sample

A population is the whole set of objects or people that need to be investigated while a sample is a subset of a population. Sampling information can be collected from individuals, companies, families, etc. The advantages of sampling are; saving time, money and obtaining accurate data. Moreover, sampling can provides an estimation of population characteristics based on probability and a numerical measure of the accuracy.

Pallant (2010) claimed that sample size and the strength of the relationship among the variables are two main issues in considering how to determine whether a particular data set is suitable for factor analysis. While there is little agreement among authors concerning how large a sample should be, Saunders et al (2009) claimed that the larger sample size the better response rate. In a small sample the correlation coefficients among the variables are less reliable and tending to vary from sample to sample. Therefore, it is important to assess the size of a sample and try to be proportional of the total population. Obviously, the closer to 100 % the better. In this research, the author has tried to achieve representativeness of the sample by selecting respondents on an appropriate basis i.e., stratified random sample of the population and survey them in a pilot study and then draw conclusions about how the entire population would respond based on the responses from this randomly selected sample.

The sample size has been determined according to Newbold, (1988, p758) at 95% confidence interval must extend of 0.05 of each side of the population. Newbold claimed that it is better to specify the width of confidence intervals for the population rather than $\sigma^2\ \bar{x}$, therefore a 95% confidence interval for the population mean will extend approximate amount 1.96 $\sigma^2\ \bar{x}$ on each side of the sample mean i.e. the width of the confidence intervals $= \frac{0.05}{1.96} = 0.0255$

$$N = \frac{NP\ (1-p)}{(N-1)\sigma^2\ \bar{x} + P\ (1-p)}$$

The total population is 460, the population proportion P(1 – p) was replaced by the highest possible value , 0.025 for easier calculations, then n max = $\frac{.25N}{(N-1)\sigma^2\ \bar{x} + .25} =$

$\frac{.25 \times 460}{459 \times 0.02555^2 + .25} = 209.58$

level of certainty. Therefore the sample size at 95% confidence based on 0.05 extension on each side of the population is 209.58 samples.

4.7.5 Distribution of Questionnaires

In order to ensure a satisfactory sample size 210 questionnaires have been delivered to respondents at the TUNAC and LACE. The questionnaires have been sent with a letter details the aim of the study and the research institution. The questionnaire and covering letter have been first written in English and then translated to Arabic as the official language in Tunisia is Arabic.

Saunders et al. (2003) stated that the delivery and collection of the questionnaire differs from postal distribution in some aspects such as it involves higher costs, has a higher response rate, takes more time. Bayrman and Bell, (2011) claimed that a response rate of the delivery and collection method between 60-70% is acceptable. Therefore the researcher has decided to distribute the questionnaires via delivery and collection to obtain a higher response rate.

Calculation of actual response rate:

$$\textbf{Active response rate} = \frac{\textbf{Number of valid reposes} \quad \textbf{167}}{\textbf{total number approached} - \textbf{out of scope } \textbf{210} - \textbf{11}} = \frac{\textbf{167}}{\textbf{199}} =$$

84% Therefore 84% of the sample's population responded to the questionnaire

4.7.6 Interviews

The main purpose of undertaking qualitative research interviews is to extract direct data, see interviewed personnel' views on the topic being researched and to see why they have this particular view. Bryman, (1988) claimed that in order to obtain unbiased data, a researcher should design an unstructured interview where a of the little interviewee's guidance is permitted, moreover it gives an interviewee more autonomy in expressing their views.

The decision to use qualitative data through interviews in this research was to support the quantitative data and provide another perspective for testing the quantitative data through triangulation.

The interview questions have emerged after completing the quantitative analysis. The quantitative analysis through principal component analysis and Bayesian networks have emerged important factors that need to be tested through qualitative interviews with key personnel in both the TUNAC and LACE. The analysis of the qualitative data will be discussed in chapter five, data analysis.

Therefore, a series of semi structured interviews have been carried out to enable the author to collect data in a timely and efficient manner. The author has used this technique to improve relationship, reduce biases and allows interviewees to talk freely. The author recognises that in order to achieve an overall opinion, people who manage various departments in the TUNAC and LACE should be interviewed. those people are the head and Quality mangers of the TUNAC and LACE and accreditation manager at the TUNAC and laboratories testing and analysis manager at LACE.

The personal approach is time consuming and costly and could be impracticable if it covers a wide area. The author has decided to interview ten personnel from both the TUNAC and LACE and each interviewee has been tape-recorded, transcribed and coded.

The interviews were mainly concentrated on the following:

- National Accreditation and Laboratory accreditation concepts;
- The need for a sustainable National Accreditation Body;
- The potential for the implementation of a National Accreditation Body.

The interview layout is explained in the appendix (2)

4.7.7 Pilot study

Byrman (2011) emphasized the need to conduct a pilot study to test and consider its findings. The pilot study would also provide the researcher with the necessary accurate information upon which to build the next questionnaire. Pilot testing should include all aspects of the

questionnaire design, such as appearance, the covering letter, instructions, question layout, and the time taken to complete it.

Bell (2005) suggested that the researcher, when conducting a pilot test, could ask certain additional questions, such as how much time the questionnaire takes to answer; if the instructions are clear, and whether or not there is any ambiguity in the questions. The researcher might also ask the respondents if they felt they had any objections to answering any of the questions; whether or not there are any major elements that have not been covered; if the layout is appropriate; and finally, the researcher may ask for any comments.

The researcher will ensure that the questionnaire be reviewed by a specialist, Based on his comments, the researcher will make any recommended changes. Having designed the questionnaire, a pilot study questionnaire, appendix (3), has been conducted between July 2nd and July 15th 2011 through personal delivery and collection of 45 questionnaires to respondents in both the TUNAC and LACE. The response rate was 90% and the outcome of the pilot study has let the author test a sample of respondents and check their views and familiarization of questionnaire. The analysis of the pilot study will be explained in the next chapter.

4.8 Credibility of research findings

Byrman (2011) and Saunders et al (2009) claimed that in order to reduce the possibility of obtaining wrong answers to research questions, an attention should to be made on two aspects research design: reliability and validity

4.8.1 Reliability

Reliability is the degree to which data collection and analysis would produce consistent results and can be evaluated by asking the following three questions (Easterby-Smith et al. 2008:109):

- Will the measures produce the same results in other circumstances?
- Will similar explanations be reached by other spectators?
- Is there clearness in how logic was made from the raw data?

Bryman and Bell (2011) claimed that reliability is a particular issue associated with quantitative research as a researcher using this approach is usually concerned with whether data are stable and consistent or not. Reliability can be measured by three methods; test-retest, alternate questionnaire form and internal consistency. Because of resources available and time constraint the author has decided to use internal consistency by applying Cronbach's alpha coefficient. Reliability analysis will be discussed in chapter four data analysis.

4.8.2 Validity

Most researchers advocate the collection of data by more than one method as a means of ensuring its validity (Saunders, et al, 2003). Validity of research measurements is whether the findings are really about what they appear to be about and specifically linked with the conclusion's integrity that are produced by a research. According to Punch (2001) validity of the research measurement is a question of how a researcher knows that a specific instrument measures what is required or thought to be measured. Moreover, Punch specified four types of validity when testing a questionnaire instrument, they are: face, content validity, criterion-related validity and construct validity. Face validity refers to general feasibility; content validity refers to review by experts; criterion validity refers to validation of instrument when compared with other similar instruments and construct validity is a theoretical longitudinal evaluation of the survey instrument undertaken to verify its efficiency over time.

The researcher decided to subject a combination of validity research instruments, evolution and analysis, in this research. This was followed by a comprehensive literature review that

studied similar research instruments and it was subjected to a review by supervisors at Nottingham Trent University. It then passed through a thorough pilot progression before the final version of the main study questionnaire was approved.

The tests of validity that were applied were equitable in the conditions provided. In addition principal component analysis was used as a data reduction method to identify principal factors in main themes of the questionnaire and this was also performed as construct validity.

4.8.3 Bias in data collection and analysis

To eliminate bias in this research the researcher has adopted different techniques. These techniques and methods include selecting stratified random samples through random numbers from employees list. This method allowed the researcher to select an unbiased sample. The sample selected, therefore, can be said to be representative of the whole population. The second technique used two research strategies. The overall aim of using mixed methods was to make the research findings more reliable and valid, provide two independent ways of data verification and to reduce the level of inherent bias by comparing sets of data, i.e. data triangulation. Stake (2006), suggested that using more than one case study is important to assure an unbiased explanation and triangulated results through interviews will ensure the thoroughness of the developed theory.

Furthermore, the researcher overcame the bias in the data collected through interview by triangulating and interviewing different management levels in the case study. Therefore, the researcher has triangulated the findings of the quantitative data with the qualitative data independent data sources. This is sometimes referred to as a cross-check verification (Saunders, et al, 2009). Finally, the structure of Likert measurement scale of five points with statements worded both positively and negatively to safeguard against response bias in a specific direction has been done.

4.9 Data Analysis

Data analysis comprises many techniques such as examining, categorising and testing (Yin, 2003). Data analysis must be linked to research aim (s) and problem, in turn the selection of appropriate analytical method also must be linked to the nature of the research problem (Walliman, 2005). In order to analyse the quantitative and qualitative data it was necessary to employ data analyses software in SPSS for Windows, Version 19 and R project for statistical computation and Analytical Hierarchy process. This presented a formidable data input task with 167 respondents that took a considerable time to complete. When the initial data input was complete the dataset and questionnaires were given to an expert to check for errors in data input and any highlighted errors were subsequently corrected.

Several statistical techniques were used to assist in interpreting the data collected through the questionnaires. These were mainly descriptive statistical techniques intended to quantify associations between various questions asked and variations in the data. The descriptive statistical tools used to explore and explain the data includes cross-tabulations used at first stage to compare and contrast the association of a number of variables. These comparisons were subjected further to appropriate statistical techniques such as Cronbach's Coefficient Alpha, frequency tests, histograms, Principal component analysis, Kaiser-Meyer-Olkin Measure of Sampling Adequacy, and Bartlett's Tests of Sphericity. These are developed in more detail in chapter 5 data analysis. In the qualitative analysis, the analytical discourse analysis was used to analyse interviewees' responses to pre-determined questions.

In summary, the different methods for conducting a research were reviewed, such as the quantitative and qualitative approach. It was seen that each approach has its strengths and weaknesses. The necessity to adopt an effective methodology for this research was discussed. As well, the importance of questionnaires and interviews as an appropriate methodology for testing the research question of this research project was discussed.

In the next chapter data will be analysed by different methods through quantitative and qualitative methods. Moreover different statistical analytical methods will be used to provide meaning and explanation to the phenomena in question.

Chapter 5 - Data analysis

This chapter presents the analysis of the data collected from the questionnaire and the interviews. The main aim of analysing the data is to provide an empirical answer(s) to the research questions that emerged when initiating the research. In order to analyse the data and obtain reliable data different descriptive statistical analysing methods were used such as exploratory data analysis, principal component analysis and Bayesian belief networks.

The first part of the data analysis is the pilot study which aimed to test the sample and see whether the respondents at the TUNAC and the LACE are familiar with the questionnaire questions or not; also to check the suitability of the questions, the themes and variables of the questionnaire.

5.1 Pilot Analysis

The field study trip to Tunisia for data collection at the Tunisian accreditation Council and the Tunisian Central Laboratories for Testing and Analysis has been carried out during the period from July 4th till September 10th 2011. The first part of the field study was running a pilot questionnaire of a randomly select sample. This sample has covered 20 participants to see the quality and validity of questionnaire's questions before running the main questionnaires. The pilot questionnaire was administered to test its suitability, ranking system and the accuracy of the translation into Arabic.

In order to refine the questionnaire, the pilot study was conducted via several stages. Firstly, a pilot questionnaire was tested, and retested with the research supervisor and two experts from the University of Tunis. The majority of feedback received was positive and minor modifications were incorporated. The final version of the questionnaire which is the main questionnaire was distributed by the researcher to all targeted respondents and it discussed in the next part. The results of the pilot study is explained in appendix 3.

5.2 Main Data Analysis

In order to investigate the factors that affect the development of a sustainable national accreditation body, it was necessary to investigate both internal and external factors. Figure 5.1 illustrates the process of the data analysis including the internal and external factors. Within the internal factors both quantitative and qualitative approaches have been adopted to enhance and support the results given through triangulation methodology approach. Moreover within each approach different statistical methods were used to provide cross verification to the proposed accreditation framework.

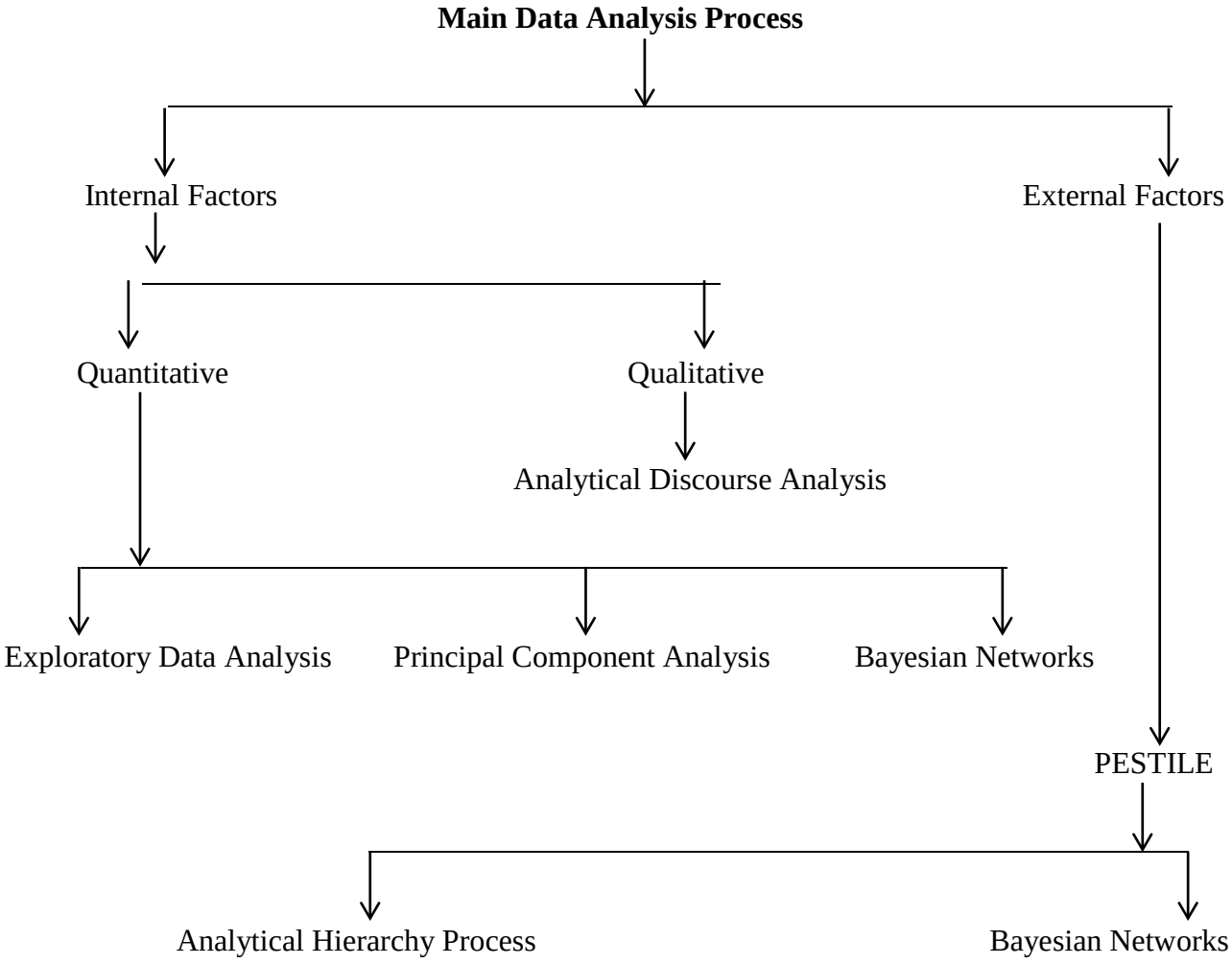


Figure 5.1; Sequence of data analysis

5.3 Demographic analysis of the sample

Based on the survey data that was collected from the field study in Tunisia, 167 usable respondents' data have been uploaded to SPSS version 20 for Windows according to their code book. The first stage was to analyse the demographic data of respondents which will help in understanding the respondent's background and specific group's interests.

The demographic results of the sample are shown in tables 5.1, 5.2, 5.3 and 5.4 respectively. Table 5.1, shows that the majority of respondents to the questionnaire are engineers both technical (28.1%) who have professional qualification and academic engineers (39.5%) who are not involved in professional experiences. Moreover the educational level of the respondents as shown in table 5.2 which shows qualifications of the respondents with 49.7% holding BSc degree, 22.2% MSc and 21.6% technical higher diploma. The type of work performed with the sample investigated shows that 30.5% of the sample are from calibration laboratories, 27.55 % are from the standards institute and 26.3% from testing laboratories. The last demographic data shown in table 5.4 is users of organisation which shows that 60.5% are from local Tunisian and other companies while 22.8% are foreign companies specifically from African companies.

		Frequency	Percent
Valid	Technical Engineer	47	28.1
	Engineer	66	39.5
	Technician	21	12.6
	Researcher	16	9.6
	Manager	17	10.2
	Total	167	100.0

Table 5.1; Occupation

		Frequency	Percent
Valid	Technical Diploma	36	21.6
	BSC	83	49.7
	MSc	37	22.2
	PhD	11	6.6
	Total	167	100.0

Table 5.2; Education Level

		Frequency	Percent
Valid	Calibration	51	30.5
	Testing	44	26.3
	Standards	46	27.5
	Chemical	14	8.4
	Petrochemical	8	4.8
	Total	163	97.6
Missing	other	2	1.2
	System	2	1.2
	Total	4	2.4
Total		167	100.0

Table 5.3; Type of work.

		Frequency	Percent
Valid	Local Companies	101	60.5
	Foreign Companies	38	22.8
	Personal	23	13.8
	Other	4	2.4
	Total	166	99.4
Missing	5	1	.6
Total		167	100.0

Table 5.4; Organisation' Users

5.4 Statistical methods used

Different descriptive statistical methods have been used in the quantitative analysis as shown in figure 5.2. Building an initial sustainable framework was through analysing the data through exploratory data analysis where the data was screened and clarified. The next step was to reduce the variables into important factors and components through principal component analysis. The last stage in the quantitative analysis was to see the interrelationship between the variables and extract the main drivers within a network through Bayesian belief networks (BBNs).

Qualitative data collected through semi structured interviews with management from TUNAC and LACE including five top management and line managers of both organisations

have been analysed by analytical discourse analysis to see their attitudes and perceptions about predefined variables that relate to a sustainable accreditation body. Moreover, the use of a qualitative approach was to support the quantitative data through research triangulation. This was followed by the external factors, PESTILE analysis, to see external environment and factors before building a sustainable National Accreditation Body's framework and establishing a sustainable accreditation process.

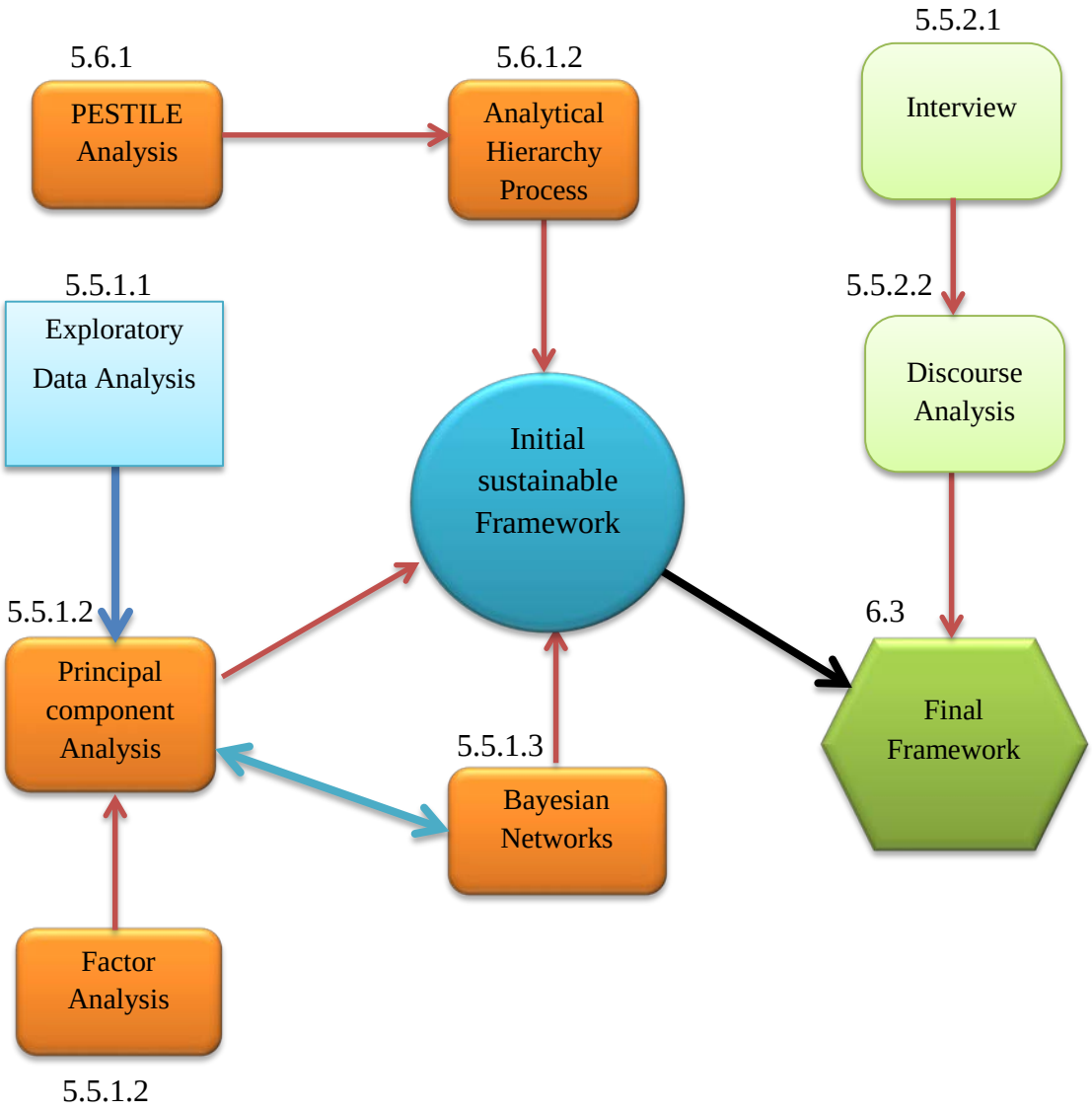


Figure 5.2; Process of building a sustainable accreditation body's framework (chapter headings presented).

5.5 Internal factors data analysis

5.5.1 Quantitative analysis

5.5.1.1 Exploratory data analysis

The first stage of the quantitative data analysis is exploratory data analysis to draw general conclusions about the data. Data from 167 respondents has been uploaded to Microsoft Excel and analysed for frequencies, distribution and satisfaction ranking as shown in spreadsheet tables 5.5 to 5.11.

Looking at the first theme (S) management satisfaction, table 5.5, it clearly shown that respondents have ranked the degrees of satisfaction according to Likert 5 points satisfaction (HD: highly dissatisfied, D: dissatisfied, N: neutral, S; satisfied, HS: highly satisfied) scale as explained earlier in chapter four. This has been weighted to three dimensions, satisfied (S), Dissatisfied (D) and Neutral (N). This will help understand the general satisfaction more accurately.

Tunisian Accreditation Council (TUNAC), Standardisation Institute (INNOBRI) and Central Lab. For testing and calibration (LACE)				
Variable (S) Management and job satisfaction		Percentage		
No	Description	D	N	S
S1	Job specified well.	40.96%	7.23%	51.81%
S2	Job supervision.	47.90%	12.57%	38.92%
S3	Respecting employees.	44.31%	17.96%	36.53%
S4	Awards and promotion are based on job performance.	46.71%	20.36%	31.74%
S5	Employees' developing and creation are rewarded.	45.50%	24.55%	29.34%
S6	Organisation' goals are clear.	43.71%	29.34%	26.34%
S7	Employees are working to achieve long term goals.	38.32%	31.74%	29.34%
S8	Employees are involved in decision making.	55.68%	21.56%	22.15%
S9	The promotions scheme.	55.69%	20.96%	23.35%
S10	The amount of monthly salary.	62.27%	16.17%	20.95%
S11	Employees' Financial compensation.	51.50%	19.76%	26.95%
S12	Satisfied to work in this organisation.	20.36%	17.96%	61.68%
S13	How many days do you work (1,2,3,4,5,6,7), are you happy with this?	20.96%	7.78%	70.66%

Table 5.5; Variable S

The author, for the ease explanation of the EDA, decided to merge HD and D in one column called satisfaction (D) and HS and S in one column called (S).

The dispersion of satisfaction in this group is at the dissatisfaction side as most of the respondents are dissatisfied with most of the variables in the management theme except three variables, S1 (51.81%), S12 (61.7%), S13 (70.7%) which represent job description and whether the respondent is satisfied to work in this organisation or not. However most of the dissatisfaction in variable S2 – S12 are due to financial incapacity and the organisation's future plans and goals.

The second theme which is (O) organisation culture, table 5.6, contains 12 variables. In this theme respondents are satisfied with two variables, O14 (49.12%) relation with staff leader and O18 (41.91%) celebration of organisation related events. While the other variables scored dissatisfaction as respondents feel the organisation is still lagging behind and there were no initiatives to even see the reasons behind improvement implementation within the organisation.

Variable (O) Organisational culture Characteristics		Percentage		
No	Description	D	N	S
O14	The relations with staff leaders.	36.52%	14.37%	49.12%
O15	The relationship of individuals within team works.	47.90%	14.37%	37.73%
O16	Attendance of periodic meeting.	53.29%	11.98%	33.53%
O17	People behaviours during meetings.	46.71%	22.75%	29.34%
O18	Celebration of organisation' related events.	35.33%	20.96%	41.91%
O19	Accreditation Body/Laboratory work to standardisation is working	45.50%	18.56%	34.73%
O20	Upgrading to new requirements taking immediate action by management.	50.89%	15.57%	32.93%
O21	Effectiveness of team meetings.	53.89%	10.78%	33.53%
O22	Effective communication between employees and management.	57.48%	10.78%	31.13%
O23	Co-operation Between different departments.	59.29%	13.77%	26.35%
O24	All employees acknowledge the need to cope with the ISO Requirements.	48.42%	17.37%	31.74%
O25	Clear management mission.	49.10%	15.57%	33.53%

Table 5.6; Variable O

The third theme is technical factors (Y) which encompasses 27 variables that are related to the technical side of the accreditation body, calibration and testing laboratories. It is clearly shown in table 5.7 that most of the respondents are satisfied with variables that are related to

customer satisfaction Y29, quality assurance Y33-Y37 and technical procedures of samples Y47-Y52.

However there are some variables that scored dissatisfaction. The dissatisfaction covers areas such as uncertainty in measurement Y39; (49.09%), calibration procedures Y44; (40.09%) , resources and infrastructure Y27; (52.08%), Y28; (48.48%) and Methods used within accreditation body / laboratories fit for intend use Y38; (48.49%).

Variable (Y) Technical factor:		Percentage		
No	Description	D	N	S
Y26	Physical conditions at work.	40.09%	12.5%	41.90%
Y27	Time and resources to do your job properly.	52.08%	11.3%	34.09%
Y28	Availability of space for doing all the activities.	48.48%	13.1%	34.10%
Y29	Protection from internal and external pressures.	37.00%	17.3%	43.69%
Y30	Confidentiality of customer's information and proprietary rights.	32.29%	15.5%	49.70%
Y31	Availability of utilities to use, such as electricity, water, gases ..etc.).	40.08%	10.7%	47.29%
Y32	Availability of a policy and procedure for corrective action.	43.69%	9.58%	42.48%
Y33	Procedures to determine root causes of problems.	42.49%	7.78%	44.89%
Y34	Procedures for preventive actions.	37.69%	10.2%	49.09%
Y35	Procedures for documentation.	35.89%	12.5%	50.20%
Y36	Security and confidentiality of records.	35.30%	12.5%	51.50%
Y37	Schedule and procedure of periodic internal audits.	40.09%	11.9%	46.10%
Y38	Methods used in Accreditation Body/Lab are proven to be fit for intended use.	48.49%	12.5%	35.80%
Y39	Procedures to estimate uncertainty of measurements in testing and calibration.	49.09%	9.58%	35.89%
Y40	Consideration given of all uncertainty.	48.49%	10.7%	32.89%
Y41	Proper measurement and test equipment.	38.30%	15.5%	35.29%
Y42	Capability/accuracy of equipment/software to perform intended tasks.	37.69%	13.7%	35.90%
Y43	Identity and documentation of equipment.	37.09%	15.5%	34.10%
Y44	Procedures for equipment calibration.	40.09%	13.7%	32.28%
Y45	Procedure for calibration of reference standards.	35.29%	19.2%	30.58%
Y46	Procedure for handling, transport, storage and use of reference standards.	29.29%	23.9%	28.09%
Y47	Sampling procedures.	28.19%	22.7%	28.69%
Y48	Procedures for transportation and protection of test and calibration items.	22.69%	22.2%	35.89%
Y49	Using of certified references.	24.59%	28.7%	31.09%
Y50	Participation in inter-laboratory proficiency testing.	27.49%	17.4%	40.08%
Y51	Results being accurately reported.	25.69%	16.7%	44.28%
Y52	Reports including information requested by customer.	29.39%	17.4%	46.68%

Table 5.7; Variable Y.

The fourth theme is strategic planning (P) table 5.8. Within this theme the respondents are satisfied with one variable out of five. Variable P53, deployment of policy and strategy, scored a satisfaction rate of (52.10%) while the other variable P54 – P57 have scored the highest dissatisfaction rank within the 3 point scale.

The fifth theme is Training (T) and it has five variables T58 –T62. As shown in table 5.9 most of the respondents are dissatisfied with all variables.

Variable such as T59 clearly shows that respondents disagree that they have the opportunity to use their skills, explore and invent freely within their organisation while in the variables T58 –T62 respondents are dissatisfied due to lack of training and organisation promoting of employee development.

Variable (P) Strategic planning and communication.		Percentage		
No	Description	D	N	S
P53	Deployment of policy and strategy.	31.80%	11.4%	52.10%
P54	Quality mission, vision and policy	44.90%	12.6%	39.50%
P55	Communications with other team in the organisation.	52.70%	8.4%	37.10%
P56	Strategy development	53.90%	10.8%	32.90%
P57	Information / Instructions coming from formal way (in-house bulletin, email.	52.10%	12.0%	33.50%

Table 5.8; Variable P

Variable (T) Training and knowledge.		Percentage		
No	Description	D	N	S
T58	Employees being trained to use a wide range of problems solving tools.	46.10%	16.8%	34.10%
T59	Employees having opportunities to use their skills effectively in their job.	41.90%	21.0%	34.10%
T60	Managers training employees to use their skills and talents.	43.70%	24.0%	28.80%
T61	Staff involved in continuously reviewing and improving process	43.70%	23.4%	31.20%
T62	Training is used as revenue.	44.90%	21.6%	28.80%

Table 5.9; Variable T

The sixth theme is quality development (Q). This theme has thirteen variables Q63 –Q75 as shown in table 5.10. Looking at the ranking of variables in this theme, it can be summarised

that the dispersion of agreement is on the dissatisfaction side as respondents are dissatisfied with the quality perceived procedures with the organisation, however there are some variables which have scored highly scores such as Q73, awareness of cost consciousness of the company, Q72, continuous company improvement and Q74, established procedures are important..

The final theme is general or critical factors (F). Variables under theme (F) are not external factors, the external factors are classified under the external PESTILE factors.
This theme includes eighteen variables, F76 –F94, as shown in table 5.11 and these variable are all internal variables. In this theme a scale of three points has been used to rank the variables as critical, important and less important. The reason behind that was to know the classification of most important factors to the accreditation body. The two variables which score lower in the C column rather than I column are; F82, cooperation and commitment of work force, and F84, pressure from customers.

Variable (Q) Quality Programmes		Parentage		
No	Description	D	N	S
Q63	Emphasis on meeting customer needs when planning.	41.30%	21.0%	34.10%
Q64	Continuous Quality improvement.	41.90%	19.8%	34.70%
Q65	Customers' satisfaction is important for long-term success.	37.10%	26.9%	31.20%
Q66	Success in the market place depends on high Quality, products and services.	33.50%	21.6%	41.90%
Q67	Employees understand customers' requirements.	32.90%	21.6%	43.70%
Q68	Organization of laboratory meets customer needs	34.10%	18.6%	44.30%
Q69	Quality is more important than volume of sales.	38.30%	18.0%	40.70%
Q70	Staff knowledge of ISO/IEC 17025 and 17011 is enough.	37.10%	13.2%	46.70%
Q71	Commitment to excellent customer service.	44.90%	13.8%	38.30%
Q72	Continuous company improvement.	49.10%	21.0%	27.50%
Q73	Awareness of cost consciousness of the company	52.70%	23.4%	22.80%
Q74	Established procedures are important.	47.90%	19.2%	28.20%
Q75	Quality of equipment and resources do the work.	40.10%	24.6%	30.50%

Table 5.10; Variable

General / Critical Variables (F) Factors.		Percentage		
No	Description	C	I	L
F76	Employee Training and education.	83.2%	16.8%	0%
F77	Top management commitment and involvement	77.8%	17.4%	4.8%
F78	Rapid and effective communication.	56.3%	35.9%	7.8%
F79	Technical expertise on ISO 17025 and 17011 implementation.	59.3%	30.5%	10.%
F80	Time and resources.	61.1%	31.1%	7.8%
F81	Documentation process.	49.7%	37.1%	12%
F82	Cooperation and commitment of work force.	41.3%	43.1%	15%
F83	International competition.	45.5%	33.5%	20%
F84	Pressure from customers.	34.1%	37.1%	29%
F85	Ready market and poor competitive environment.	43.7%	38.9%	17%
F86	Governmental support programs to accreditation.	63.5%	26.3%	10%
F87	Effective information.	52.7%	31.7%	15%
F88	People's attitudes towards accreditation.	44.3%	40.1%	16%
F89	Experience amongst managers.	46.1%	38.3%	15%
F90	Resistance to new responsibilities/job loss.	37.1%	34.1%	27%
F91	Role of middle managers as motivators and transmissions.	52.7%	34.7%	12%
F92	Financial capacity to meet the accreditation cost.	55.1%	33.5%	11%
F93	Appropriate technical knowledge amongst workers.	59.9%	31.7%	8%
F94	Awareness of accreditation at the management level.	59.3%	34.1%	6%

Table 5.11; Variable F

To summarise, the exploratory data analysis has explained and presented the data in such a way that general conclusions can be generated in respect to the general satisfaction of the seven themes. Where most of data dispersed at dissatisfaction side of the scale, it meant that respondents felt that these variables are still lagging behind and not considered or implemented within the organisation.

The exploratory data analysis in this research was a helpful analytical tool in providing a clear representation and classification of frequencies, dispersion and scale of satisfaction. However with the EDA it is impossible to extract or draw conclusions about the most important variables, therefore it was necessary to cross validate with other statistical methods In the next section, the data will be analysed through principal component analysis to reduce the data into less factors and components and arrange the data into main components to see the most important components that could affect accreditation bodies in the developing countries.

5.5.1.2 Principal Component Analysis

5.5.1.2.1 Reliability analysis

Sample size needed linked to the required factor loading was consulted in this research and followed the guidance given by Hair, et al (2009) as shown in table 5.12.

In this research, the reliability of the scales used in the questionnaire was assessed by an internal consistency statistic, table 5.13, Cronbach's alpha coefficient (Pallant, 2010). Internal consistency is based on the idea that items comprising a scale should show high levels of internal consistency. The higher the correlation among items in each scale the greater is the alpha value. High correlation implies that high scores on one question are associated with high scores on the other questions.

Cronbach's alpha coefficient is related to scale length; the longer the scale, the higher the alpha value and alpha ranges from 0 to 1. A scale of 5 points should bring an alpha of more than 0.70, which means that the scale shares about half of its variance with a hypothetical alternative scale.

Factor Loading	Sample Size Needed for Significance
0.30	350
0.35	250
0.40	200
0.45	150
0.50	120
0.55	100
0.60	85
0.65	70
0.70	60
0.75	50

Table 5.12; Guidelines for Identifying Significant Factors' Loading, Source: Hair et al, (1998, p.112).

Title	Theme	Questions	No of variables	Cronbach' Alpha
S	Management	1-13	13	.860
O	Organisation	14-25	12	.781
Y	Technical	26-52	27	.906
P	Planning	53-57	5	.802
T	Training	58-62	5	.792
Q	Quality	63-75	13	.797
F	External Factors	76-94	19	.863
All		94	94	.943

Table 5.13; Reliability analysis of the sample.

Table 5.13 contains the results of the Cronbach' Alpha internal consistency reliability analysis. In order to use PCA and other statistical analytical methods the minimum Alpha score should be 0.7. The scores obtained in table 5.13 for variables S, O, Y, P, T, Q and F are more than 0.7.

5.5.1.2.2 Component Analysis

In order to reduce a number of variables to a smaller numbers of factors then factor analysis or principal component analysis (PCA) is the statistical technique that is used for this purpose. The PCA main task is to analyse the correlations between variables and determine the correlation of the variables and find the pattern of a large number of factors to see if they can be condensed into smaller sets of components that can be understood by a common label. In this research PCA was applied in this study to represent the relationship among the 94 variables by reducing them into components containing factors that share common ground. The Likert scale is an ordered, one-dimensional scale from which respondents choose one option that best aligns with their view. The 94 variables in the survey were made on a five-points Likert scale where 1 indicate highly dissatisfied and 5 indicated that the respondent

was highly satisfied with a statement. The 94 variables of the questionnaires were inter correlated and subjected to an exploratory factor analysis (EFA) based on the principal component analysis with application of varimax rotation and eigenvalues that are greater than 1 by using SPSS for Windows package version 19.0 to detect the factors' structure within the variables.

Inspection of the correlation matrix revealed that the Kaiser-Meyer-Oklin (KMO) reached .685 (more than 0.5) and the Bartlett's test of sphericity reached (.000).

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	.685
Sig.	.000

Table 5.14; KMO Test.

According to Kaiser (1974) and Norusis (2011) KMO value should be greater than 0.5. The value of this study is 0.685 which is good (Field, 2005). High KMO measures allow more meaningful analysis to be obtained. Significant test results obtained by Bartlett's test of sphericity indicated that PCA can be applied to this study.

The PCA was used to produce number of components based on the criterion that the eigenvalue for each component must be more than one. This method can be referred also as Kaiser's criterion.

The PCA derived 25 components as shown in Table 5.15.

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	20.281	21.575	21.575	20.281	21.575	21.575	5.416	5.762	5.762
2	7.887	8.391	29.966	7.887	8.391	29.966	5.094	5.419	11.181
3	3.764	4.004	33.970	3.764	4.004	33.970	4.163	4.429	15.609
4	3.253	3.461	37.431	3.253	3.461	37.431	3.944	4.196	19.805
5	3.058	3.253	40.684	3.058	3.253	40.684	3.478	3.700	23.504
6	2.710	2.883	43.567	2.710	2.883	43.567	3.457	3.678	27.182
7	2.537	2.699	46.265	2.537	2.699	46.265	3.186	3.390	30.572
8	2.319	2.467	48.733	2.319	2.467	48.733	3.175	3.378	33.950
9	2.289	2.435	51.168	2.289	2.435	51.168	2.936	3.123	37.073
10	2.078	2.211	53.379	2.078	2.211	53.379	2.716	2.889	39.962
11	1.969	2.095	55.474	1.969	2.095	55.474	2.642	2.810	42.773
12	1.911	2.033	57.507	1.911	2.033	57.507	2.619	2.786	45.559
13	1.773	1.887	59.393	1.773	1.887	59.393	2.608	2.774	48.333
14	1.684	1.792	61.185	1.684	1.792	61.185	2.562	2.726	51.059
15	1.540	1.639	62.824	1.540	1.639	62.824	2.529	2.691	53.750
16	1.517	1.614	64.438	1.517	1.614	64.438	2.347	2.497	56.247
17	1.457	1.550	65.988	1.457	1.550	65.988	2.344	2.494	58.741
18	1.410	1.500	67.488	1.410	1.500	67.488	2.336	2.485	61.225
19	1.311	1.395	68.883	1.311	1.395	68.883	2.291	2.437	63.663
20	1.295	1.378	70.260	1.295	1.378	70.260	2.265	2.410	66.073
21	1.215	1.293	71.553	1.215	1.293	71.553	2.260	2.404	68.477
22	1.154	1.228	72.781	1.154	1.228	72.781	2.130	2.266	70.742
23	1.134	1.206	73.987	1.134	1.206	73.987	1.943	2.067	72.809
24	1.107	1.178	75.165	1.107	1.178	75.165	1.825	1.942	74.751
25	1.070	1.138	76.303	1.070	1.138	76.303	1.459	1.552	76.303
26	.989	1.052	77.355						
27	.934	.993	78.348						

Table 5.15; Total Variance Explained - Extraction Method: Principal Component Analysis.

Initial statistics from a PCA were used to draw a scree plot. The graphical plot image provides the eigenvalue for each component extracted. The point of interest is where the curve begins to flatten out. It can be seen that the elbow' begins to appear between the 22nd and 25th components. This indicated a clear change in the steepness of the curve at the 25th component, as shown in figure 5.3. The vertical axis of figure 5.3 represent Eigenvalue.

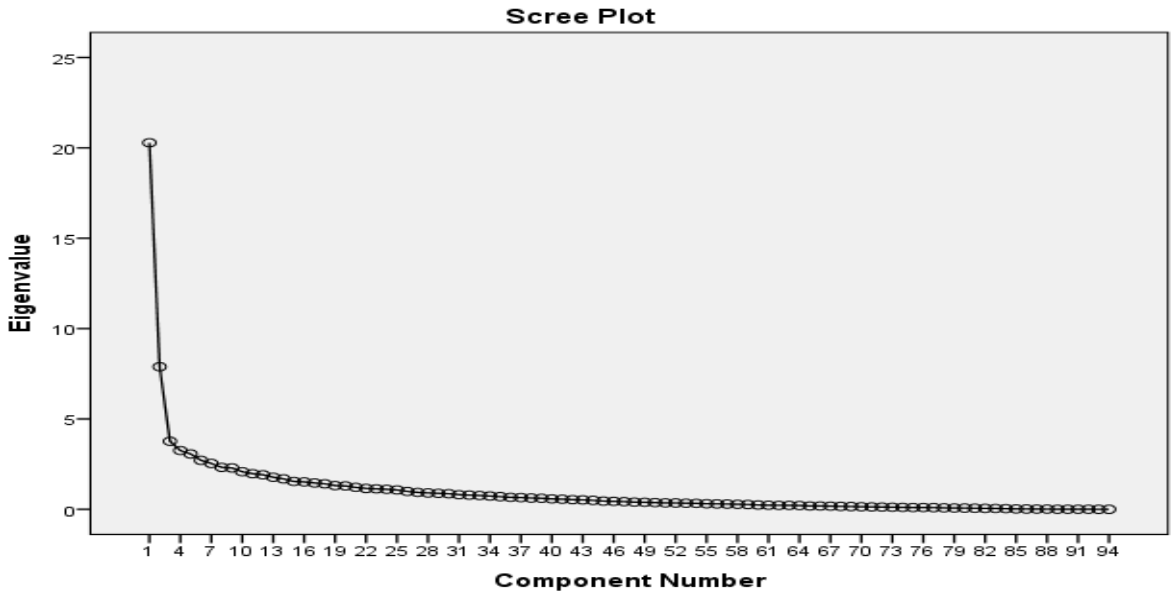


Figure 5.3; Scree plot

The Scree test method allows the selection of an appropriate number of factor extractions and it is generally considered to be the most suitable technique. In order to determine the number of factors needed to represent the data, 25 components encompassing 84 variables, measuring the accreditation's sustainability as shown in Appendix 4, Kaiser- Meyer- Olkin components loadings, were extracted with eigenvalues greater than 1.00, accounting for 76.3% of the total item variance (Kline, 1998).

Due to the fact that some of the variables loaded in the 25 components are sharing some of their characteristics and in order to reduce the components to less number of components that cover all the 25 components the author has decided to rearrange and label the loaded components. The reselection criteria was based on selecting factors that have loadings of 0.5 or higher, the sample size, criteria of the significance of factor loadings and gathering variables that have the same characteristics into one group (Hair, 2009). Therefore, the 25 components have been reduced into 7 main components containing 40 variables as shown in table 5.16.

Kaiser- Meyer - Olkin Measure of Sample Adequacy. (KMO test) = .685		
	Component One Employment Development / Criteria eigenvalue = 20.281	**Rotated component loading**
S9	The promotion opportunities	**.866**
S10	The amount of payment you get	**.794**
S5	Employees rewarding for developing new ideas	**.750**
S8	Involvement of employees in decisions making	**.744**
S4	Advancements and promotion is on the basis of job performance only	**.729**
S11	Financial compensation	**.721**
S7	Clarity of long term goals to all employees	**.687**
	Component Two Uncertainty in Management Abilities eigenvalue = 7.887	
F89	Experience amongst managers.	**.843**
Y39	Existence of procedure to estimate uncertainty of measurements in testing / calibration.	**.832**
Y38	Methods used proven to be fit for intended use.	**.644**
F88	People's attitudes towards accreditation.	**.633**
F90	Resistance to new responsibilities/job loss.	**.545**
Y42	Capability and accuracy of equipment and software	**.505**
F92	Financial capacity to meet the accreditation cost.	**.499**
Y50	Participation in inter-laboratory comparison or proficiency.	**.582**
	Component Three Project Planning eigenvalue = 3.764	
F86	Governmental support programs to accreditation.	**.809**
Y36	Security and confidentiality of records	**.803**
F83	International competition.	**.823**
Y37	Schedule and procedure of periodic internal audits.	**.696**
Y35	Procedures for Quality and technical records	**.616**
F87	Effective information	**.532**
F84	Pressure from customers.	**.811**
	Component Four Repeatability and Reproducibility eigenvalue = 3.253	
T60	Managers train employees to use their skills and talents.	**.761**
T61	Staff involved in continuously reviewing and improving process.	**.680**
T59	Employees having opportunities to use their skills effectively in their job.	**.678**
T58	Employees being trained to use a wide range of problems solving tools.	**.614**
T62	Training is used as revenue.	**.539**
	Component Five Staff eigenvalue = 3.058	
S2	The Quality of supervision	**.800**
S3	Loyalty and respect towards employees	**.779**
S1	Clearness of job description	**.772**
	Component Six Resourcing eigenvalue = 2.710	
F94	Awareness of accreditation at the management level.	**.838**
Y44	Establishment of procedures for equipment calibration	**.833**
Y41	Availability of the proper measurement and test equipment	**.549**
F91	Role of middle managers as motivators and transmissions.	**.529**
F78	Rapid and effective communication.	**.759**
O24	All employees acknowledge the need to change	**.528**
	Component Seven Culture Change eigenvalue = 2.537	
O18	The events which are celebrated in this organisations	**.729**
O19	In this laboratory changing is faster and immediate	**.628**
O17	The people behaviours during meetings	**.567**
O21	Effectiveness of team meetings	**.556**

Table 5.16; Extracted Kaiser- Meyer – Olkin components loadings

Component 1 has eigenvalue of 20.281**,** the factors that loaded highly on component 1 seem to be all relating to different aspects of job and employment criteria therefore, component 1 was given the label ‘ Employment Development / Criteria. This component containing 7 variables such as S9 the promotion opportunities (.866), S10 the amount of payment you earn (.794) and S5 employees rewarded for developing new ideas (.750) and S8 involvement of employees in decisions making (.744) table 5.16.

In component 2 there are 8 variables loaded with eigenvalue = 7.887. All loadings seems to be relating to management and uncertainty therefore this component was given the label ‘Uncertainty in Management Abilities and it has these variables; F89 experience amongst managers (.843), Y39 existence of procedure to estimate uncertainty of measurements in testing and calibration (.832).

The main items in component 3 are covering safety and security of information and support to accreditation programmes with eigenvalue = 3.764. Therefore this component was labelled ‘Project Planning’ and it includes these variables; F86 governmental support programmes to accreditation (.809), Y36 security and confidentiality of records (.803), F83 International competition (.823).

Items in component 4 has eigenvalue equal to 3.253. This component seems to relate to recurrence of training to use skills and improve abilities so this component was given the label ‘Repeatability and Reproducibility’ and it has; T60 managers training employees to use their skills and talents (.761), T61 staff involved in continuously reviewing and improving process (.680) and T59 employees having opportunities to use their skills effectively in their job (.678).

Variables loaded in component in 5 has eigenvalue of 3.058 and it has items covering human resources, therefore this component was labelled ‘Staff’ and it has these items; S2 the Quality of supervision (.800), S3 loyalty and respect towards employees (.779) and S1 clearness of job description (.772).

Resources available are prevailing the component 6 with eigenvalue equal to 2.710 therefore this component was labelled ‘Resourcing’. It has variables such as F94 awareness of accreditation at the management level. (.838) and Y44 establishment of procedures for equipment calibration (.833).

Component 7 has loaded eigenvalue equal to 2.537 and was labelled ‘Culture Change’ as it include variables such as; O18 the events which are celebrated in this organisations (.729) and O19 change is faster and immediate in laboratory (.628).

Based on the PCA analysis, seven components comprising 40 variables were formed. These components have revised the conceptual framework that was discussed earlier in chapter two literature review (Table 2.3). These seven components as explained in table 5.16, are directly affecting the development of a sustainable accreditation body. However in order to know the interrelationship between these all variables then it is important to use Bayesian belief networks to see the interrelationship between the 94 variables and extract the parent and child drivers. These will be later coupled with the PCA results to extract main components.

5.5.1.3 Bayesian Belief Networks Analysis (All Variables)

A Bayesian belief network (BBN) is a graphical model known as a directed acyclic graph (DAG) popular in statistics, machine learning and artificial intelligence. A BBN can effectively represent and compute a joint probability distribution over a set of random variables (Pearl, 2000 cited in Kenett et al, 2011).

The DAG consists of two sets: the nodes and the directed edges. The nodes represent random variables and are drawn as circles labelled by the variable names. The edges represent direct dependencies and are represented by arrows between nodes. For instance, an edge from node Xi to node Xj represents a statistical dependence between the corresponding variables. Therefore, this arrow indicates that a value of variable Xj depends on the value of variable Xi. As a result, node Xi is then the parent of Xj and similarly, Xj is the child of Xi. These

terms of family extension are often used to define the set of nodes as a node is easily reached from a directed path (Kenett and Salini, 2012).

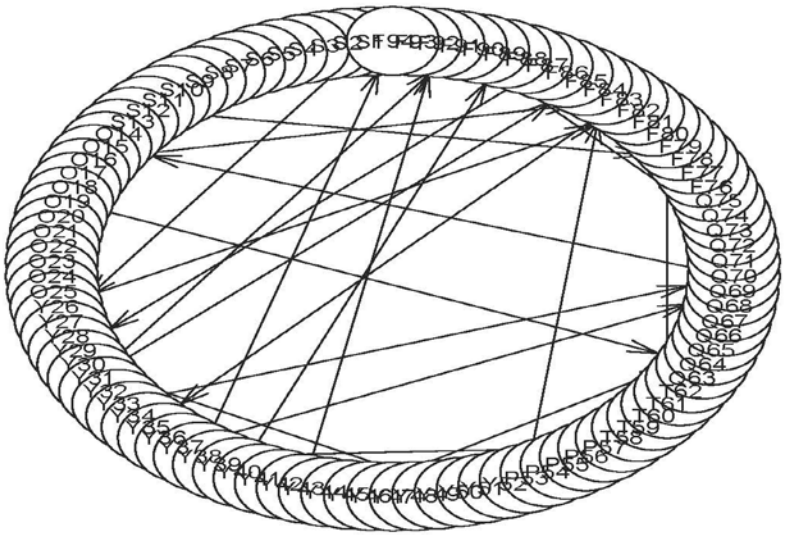
A questionnaire with n questions delivering responses can be considered random variables X1, X2, … Xn. Some of these variables, q of them are responses to general questions such as overall satisfaction, culture change and technical ability. These variables are considered as target variables.

Based on the structure of the acyclic graph there is no node can be its own ancestor or its own descendent. Such a condition is of vital importance to the joint probability of different nodes. Whilst the arrows represent direct causal connection between the variables, the reasoning process can be applied to a BN by spreading information in any direction. BNs have been used to map cause and effect relationships between survey variables. This approach has proved very powerful. It offers the ability to perform probabilistic inference for prediction and diagnostics which can be spontaneously understood (Salini and Kenett, 2009). The application of BNs to the TUNAC and LACE data is presented in Figure 5.4.

In order to reach the goal of plotting a BN, a score-based method was applied. The score-based method yields a series of prospective Bayesian Networks, calculate a score of each candidate and return the prospective BN with the highest score. The produced score represents an indicator for the BBN probability that have been generated from a sample. The chosen network, which best fits the sample, will be based on the highest score obtained and on the assumption that the dataset shapes a correct representation of the “true” network, N (Perucca and Salini, 2014).

For each question there are five satisfaction scores ranking from 1 (highly dissatisfied) to 5 (highly satisfied)**.** The data is analysed with a basic BBN presented in Figure 5.4. The network combines background information with a learned network generated using the Hill-Climbing algorithm implemented in R software and the library bnlearn (Scutari, 2010). Due to the high number of variables used in this test the plot of the BBN was not clear, therefore

the author has decided to use components loadings from the analysis used in the PCA, moreover the seven main nodes will be analysed separately as explained in figures 5.5 - 5.11 respectively. The structure of the network is explained below.



Network Structure:

Nodes:	94
Arcs:	93
undirected arcs:	0
directed arcs:	93
Learning algorithm:	Hill-Climbing

Figure 5.4; Bayesian network – hill – climbing- learned via Score-based methods

The main BBN in fig. 5.4 is hard to read because it comprises of 94 variables in one network, therefore a separate network for each variable was formed for ease interpretation. The above network comprises of 94 variables classified into 7 main nodes, S, O, Y, P, T, Q and F. The explanation of tests and number of directed and indirect arcs are explained below.

As far as BN analysis is concerned, a brief description of each network, jointly with the AIC score employed in the selection of the best performing algorithm is necessary to understand the network . The Hill-climbing algorithm leads to the networks represented in figures 5.5 to 5.13. This representation gives an idea about the relationships between the variables included

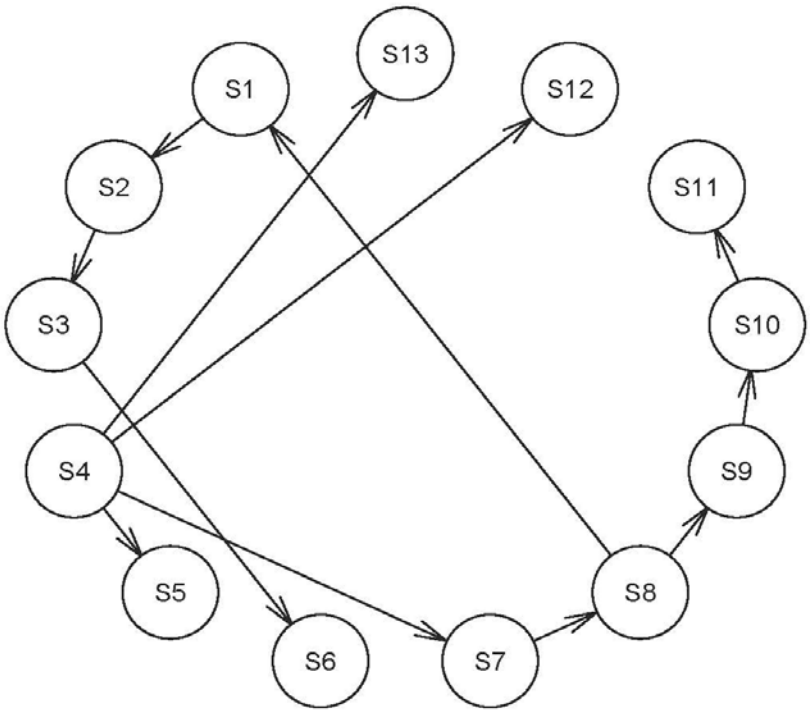
in the network.

The BBN output comprises a series of conditional probability tables, one for each node, i.e. one table for each variable included in the analysis. Because the BBN output is huge, only the main drivers conditional probability table is explained in table 5.17 and the rest of the conditional probability tables are in appendix 7.

Looking at the sub-networks, the first sub network is node (S) 'Management and promotions' which contains 13 variables, S1-S13. As shown in figure 5.5, it clearly shows that variable (S4) 'awards and promotion' is the main driver for management and promotions. From (S4) links exist to employees developing and creation (S5), proud to work for this company (S12) and satisfaction with working days (S13). hence these three variables directly depend on S4. This was confirmed by the conditional probability results of the BBN, table 5.17, which clearly shows that the dissatisfaction percentage of variable S4 is 66%.

The arrows in figure 5.5 are generated from the driver's variables based on the conditional probability of the BBNs.

For variable S13, number of days worked per week, respondents felt that they (45%) satisfied with number of days they work per week (5 days / week). Unlike other Arab countries such as Libya employees in this country work 6 days per week. This would help the author in the future submitting a business plan for a perspective sustainable accreditation body.



Model:

[S4] [S5|S4] [S7|S4] [S12|S4] [S13|S4] [S8|S7] [S1|S8] [S9|S8] [S2|S1] [S10|S9] [S3|S2] [S11|S10] [S6|S3]

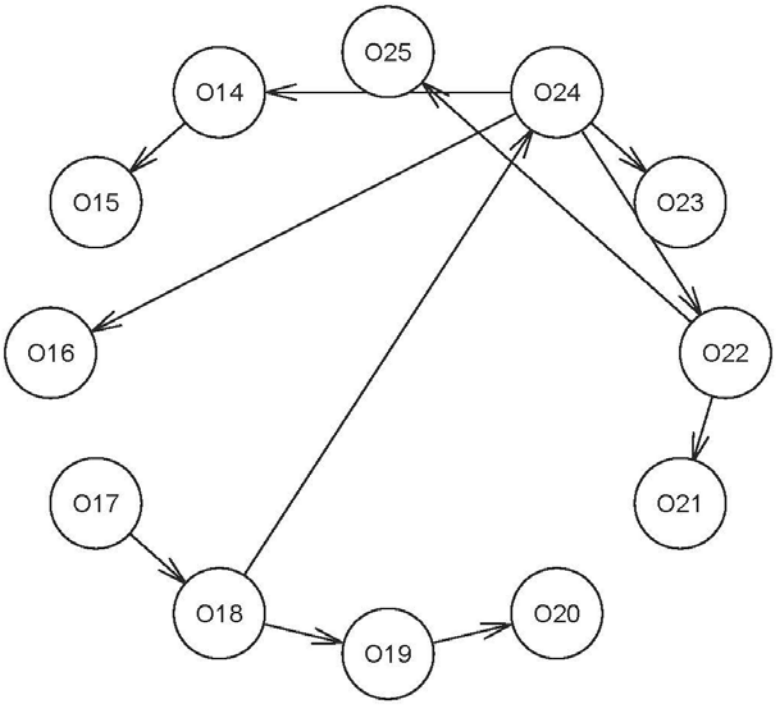
Network structure:

Nodes:	13
Arcs:	12
undirected arcs:	0
directed arcs:	12
Learning algorithm:	Hill-Climbing

Figure 5.5; Bayesian network of node(S).

The main drivers (arrows come from a driver) in node (O) are; people behaviour during meetings (O17) with 75 %, dissatisfaction in table 5.17**,** and the need to change and cope with the international requirements for accreditation bodies (O24) 63% dissatisfaction as

shown in figure 5.6 and table 5.17 respectively.



Model:

[O16] [O17|O16] [O18|O17] [O19|O18] [O24|O18] [O14|O24] [O20|O19] [O22|O24] [O23|O24] [O15|O14] [O21|O22] [O25|O22]

Network Structure:

Nodes:	12
Arcs:	11
undirected arcs:	0
directed arcs:	11
Learning algorithm:	Hill-Climbing

Figure 5.6; Bayesian network of node (O)

S13					
S4	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.000	0.250	0.0000	0.1666	0.000
Dissatisfied	0.666	**0.666**	0.000	0.1333	0.1333
Neutral	0.000	0.083	0.166	0.300	0.266
Satisfied	0.000	0.000	0.500	0.333	0.466
Highly Satisfied	0.333	0.000	0.333	0.066	0.133
O16					
O17	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	**0.75**	0.000	0.100	0.176	0.000
Dissatisfied	0.000	0.454	0.100	0.176	0.000
Neutral	0.200	0.000	0.600	0.0588	0.000
Satisfied	0.200	0.484	0.200	0.588	0.000
Highly Satisfied	0.000	0.060	0.000	0.000	1.000

O18					
O24	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.285	0.000	0.375	0.068	0.000
Dissatisfied	0.000	0.631	0.250	0.448	0.333
Neutral	0.000	0.210	0.375	0.103	0.000
Satisfied	0.142	0.157	0.000	0.379	0.333
Highly Satisfied	0.571	0.000	0.000	0.000	0.333

Y37					
Y38	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	**0.75**	0.000	0.20	0.00	0.00
Dissatisfied	0.00	0.714	0.400	0.354	0.00
Neutral	0.25	0.142	0.200	0.129	0.00
Satisfied	0.000	0.142	0.200	0.483	0.00
Highly Satisfied	0.000	0.00	0.000	0.032	1.00
Y41					
Y44	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	1.000	0.06	0.000	0.04	0.00
Dissatisfied	0.000	0.66	0.285	0.27	0.00
Neutral	0.000	0.06	**0.714**	0.227	0.00
Satisfied	0.000	0.20	0.00	0.363	0.00
Highly Satisfied	0.000	0.00	0.00	0.090	1.00
P56					
P55	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.45	0.068	0.00	0.00	0.00
Dissatisfied	0.363	**0.72413793**	0.500	0.166	0.00
Neutral	0.090	0.00	0.000	0.00	0.000
Satisfied	0.090	0.20	0.500	0.833	1.00
Highly Satisfied	0.00	0.00	0.000	0.000	0.00
P57					
T58	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.423	0.18	0.00	0.100	0.500
Dissatisfied	0.14	0.51	0.200	0.200	0.00
Neutral	0.14	0.03	**0.800**	0.100	0.00
Satisfied	0.14	0.185	0.000	0.550	0.00
Highly Satisfied	0.142	0.07	0.000	0.050	0.500
Q64					
Q63	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	**0.750**	0.04	0.181	0.1666	0.000
Dissatisfied	0.00	0.64	0.181	**0.083**	0.000

Neutral	0.00	0.2	0.27	0.250	0.00
Satisfied	0.00	0.080	0.27	0.50	0.500
Highly Satisfied	0.250	0.040	0.09	0.00	0.50
	T61				
F80	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Critical	1.00	0.500	0.455	0.857	**0.8**
Important	0.00	0.250	0.54	0.142	0.16
Less Important	0.00	0.250	0.00	0.00	0.00
	F78				
F76	Critical	Important		Less Important	
Critical	0.82	**0.88**		0.16	
Important	0.176	0.115		0.83	
Less Important	0.000	0.00		0.00	

Table 5.17; Conditional Probability table of main parent nodes

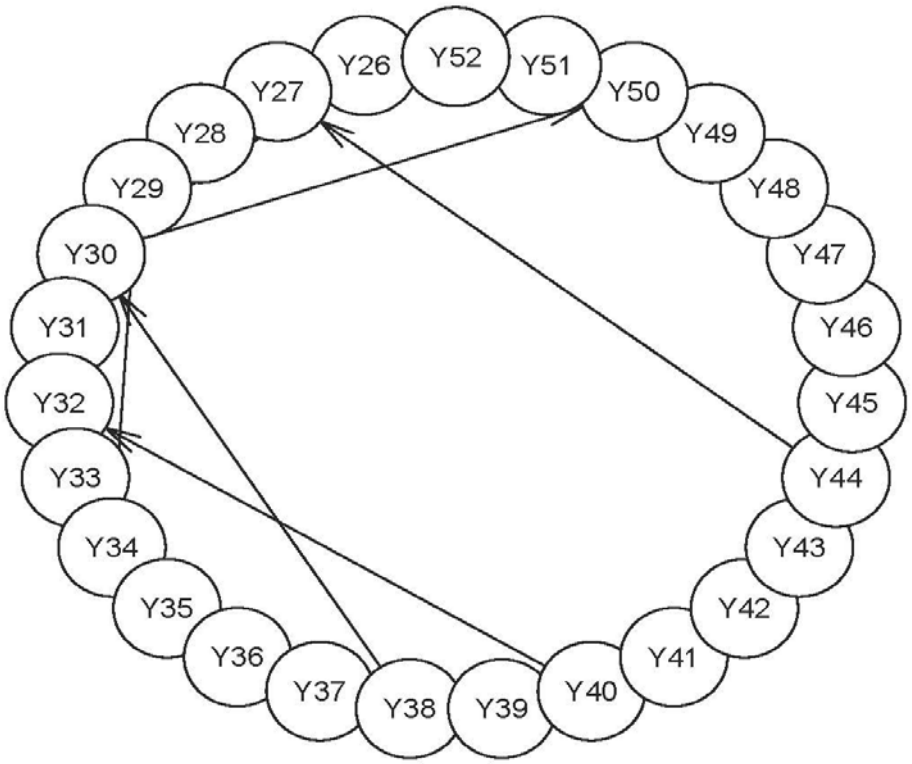
Fit of methods for use (Y38) 75% highly dissatisfied**,** uncertainty in measurements (Y40) 69% dissatisfied and establishment of calibration procedures (Y44) 71% neutral are seen as drivers for node (Y) technical, figure 5.7.

Within node P, Figure 5.8, communication (P55) 72% dissatisfied is the main driver.

Lack of communication between other departments teams within the organisation delays the company development as declared by different participants in this study. Employees' being trained to use a wide range of problem solving tools (T58) 80% neutral, is seen as the main driver within node T, as shown in figure 5.9.

Within node Q, figure 10, there are four drivers; meeting customer needs when planning (Q63), continuous company improvement (Q72), Cost consciousness (Q73) and 'Importance of established procedures' (Q74).

The general factors, node F, figure 5.11, highlights two main drivers 'Training (F76) and Time and resources (F80) which back up the previous links in nodes (S) management and (T) general factors.



Model:

[Y35] [Y36|Y35] [Y37|Y36] [Y38|Y37] [Y30|Y38] [Y39|Y38] [Y26|Y30] [Y40|Y39] [Y50|Y30] [Y32|Y40] [Y41|Y40] [Y43|Y40] [Y51|Y50] [Y33|Y32] [Y42|Y41] [Y44|Y41] [Y52|Y51] [Y27|Y44] [Y31|Y33] [Y34|Y33] [Y45|Y44] [Y28|Y27] [Y29|Y34] [Y46|Y45] [Y47|Y46] [Y48|Y47] [Y49|Y47]

Network Structure:

Nodes: 27

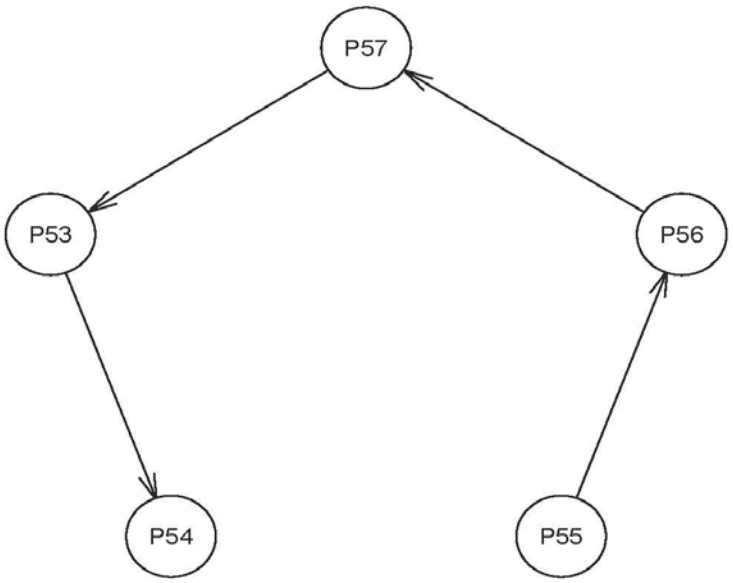
Arcs: 26

undirected arcs: 0

directed arcs: 26

Learning algorithm: Hill-Climbing

Figure 5.7; Bayesian network of node (Y)



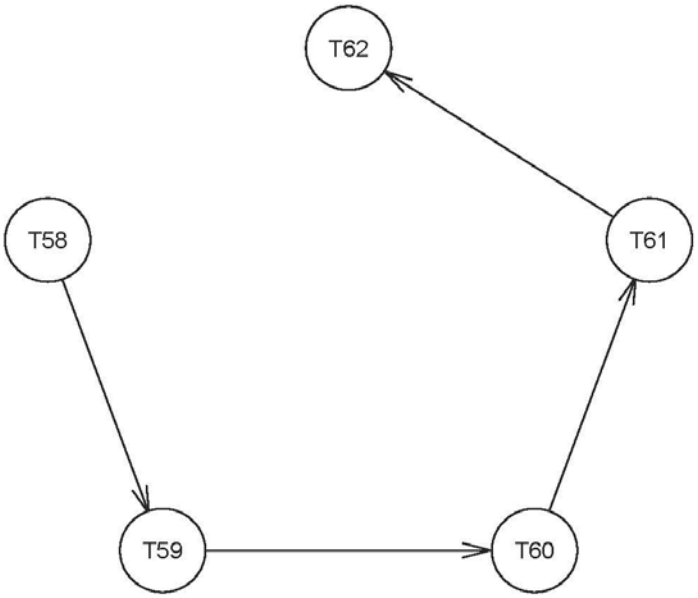
Model:

[P55] [P56|P55] [P57|P56] [P53|P57] [P54|P53]

Network Structure:

Nodes:	5
Arcs:	4
undirected arcs:	0
directed arcs:	4
Learning algorithm:	Hill-Climbing

Figure 5.8; Bayesian network of node (P)



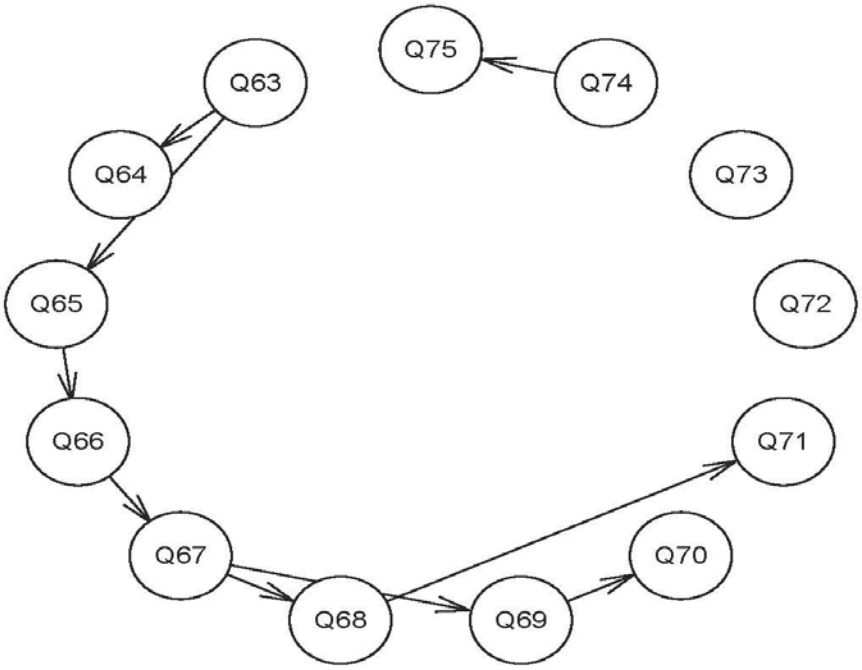
Model:

[T58] [T59|T58] [T60|T59] [T61|T60] [T62|T61]

Network Structure:

Nodes:	5
Arcs:	4
undirected arcs:	0
directed arcs:	4
Learning algorithm:	Hill-Climbing

Figure 5.9; Bayesian network of node (T)



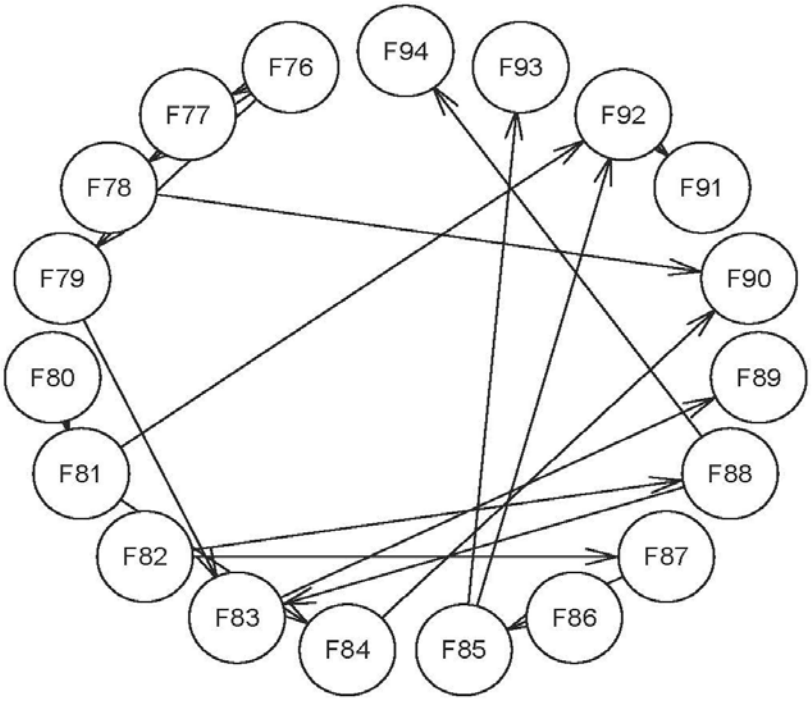
Model:

[Q63] [Q72] [Q73] [Q74] [Q64|Q63] [Q65|Q63] [Q75|Q74] [Q66|Q65] [Q67|Q66] [Q68|Q67] [Q69|Q67] [Q70|Q69] [Q71|Q68]

Network Structure:

Nodes:	13
Arcs:	9
undirected arcs:	0
directed arcs:	9
Learning algorithm:	Hill-Climbing

Figure 5.10; Bayesian network of node (Q)



Model:

[F76] [F80] [F82] [F86] [F77|F76] [F78|F76] [F79|F76] [F81|F80] [F87|F82] [F88|F82] [F83|F79:F88] [F84|F81] [F85|F87] [F94|F88] [F89|F83] [F90|F78:F84] [F92|F81:F85] [F93|F85] [F91|F92]

Network Structure:

Nodes:	19
Arcs:	18
undirected arcs:	0
directed arcs:	18
Learning algorithm:	Hill-Climbing

Figure 5.11; Bayesian network of node (F)

5.5.1.3.1 Bayesian Modelling of Accreditation framework

The component diagram is in figure 5.12 was redrawn as in figure 5.13 so that lines do not overlap. This identifies culture and technical as the main drivers. 'The events which are celebrated' and 'Acknowledgement of the need to change' are the main drivers of culture (O). There are many technical factors (Y) relevant however 'Fitness of methods for use' and 'Establishment of calibration procedures' are seen as drivers. From culture, a link to planning (P) exists specifically with 'Communications with other teams within the organisation' and culture also links to training (T) specifically 'Tools training'. From (P), a link exists to 'Job promotion as a function of performance' and the(P) links to quality (Q) highlights 'Meeting customer needs when planning (–QFD)', 'Continuous company improvement', 'Cost consciousness' and the 'Importance of established procedures'. The link from technical to general factors (F) highlights (T), 'Time and resources' which back up the previous links.

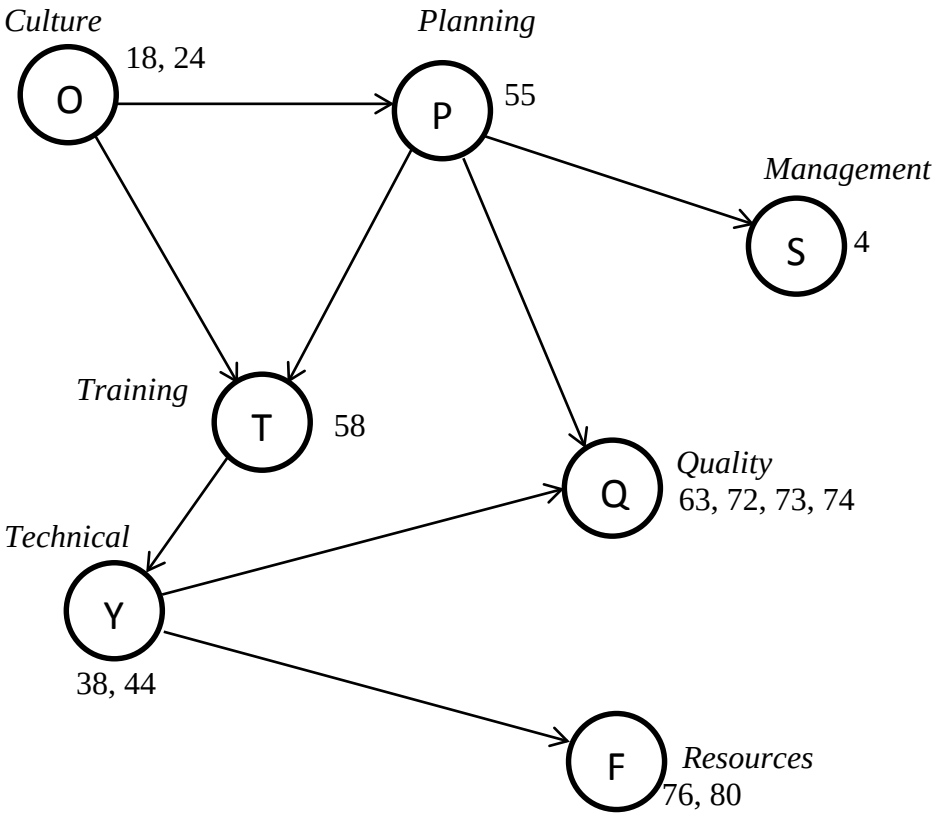


Figure 5.12; Bayesian Modelling of Accreditation framework - components diagram. (Numbers represent variables)

Model:

[O] [Y] [P|O] [F|Y] [S|P] [T|O:Y:P] [Q|Y:P]

Nodes:	7
Arcs:	8
undirected arcs:	0
directed arcs:	8
Learning algorithm:	Hill-Climbing

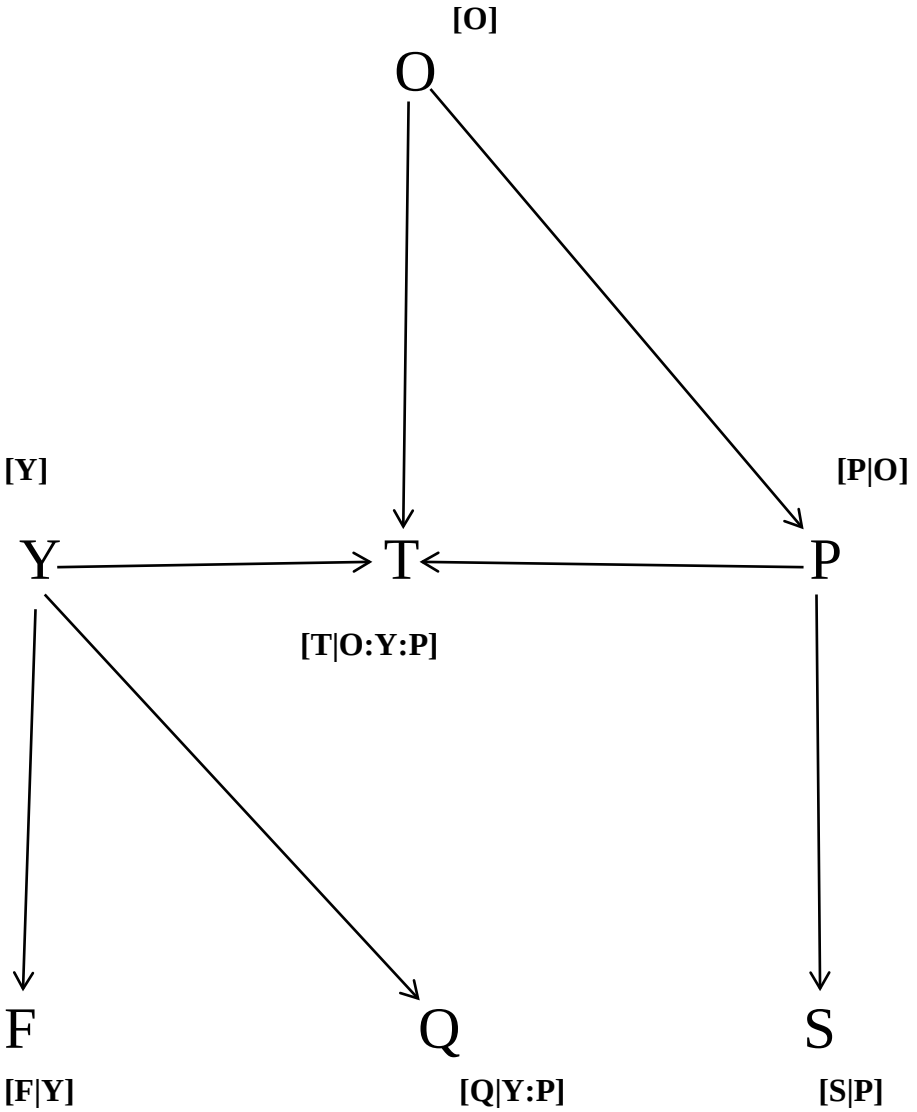


Figure 5.13; Graphical representation of Bayesian network

It is clearly obvious from figure 5.13 that nodes (O) change and (Y) resources, are the main two drivers in the BN as the all other nodes are depending directly / indirectly to (O) and (Y). This is confirmed in the literature and the theoretical framework presented in chapter two.

5.5.1.3.2 Linking PCA analysis with Bayesian networks

By combining the results of the previous PCA analysis with the BN analysis then it is possible to draw the main components and variables that affect the sustainability of accreditation bodies in the developing countries.

Looking at the structure of the main two components below, the first components encompassing technical (TE), planning (PL) and planning + resources (PR). This PCA1 was given the label Administrative as it comprises of components that are related to management and administration of a company. However, in the second driver, PCA2, the components look like they are all dealing with people as it includes communications (COM), Training + Resources (TR), Planning / Resources and Organisation culture change (CH). Therefore it is clearly obvious from the PCA and Bayesian analysis that change (CH) and Technical (TE) are the main drivers for a sustainable accreditation body.

Drivers structure:

PCA1 = TE + PL + PR ⟶ **Administrative**

PCA2 = COM + TR + PR + CH ⟶ **People**

Acronyms;

(CH) = Organisation Culture Change;

(TE) = Technical;

(PL) = Planning;

(PR) = Planning + Factors (Resources); (TR) = Training / Resources; (COM) = Communication;

To summarise the BN analysis it clear that the Hill-Climbing Algorithm has yielded the highest scores for each network. By combining the single BNs with the component network for all nodes it is clear that nodes Change (O) and Technical (Y) are the main drivers for a sustainable accreditation body.

Having discussed the quantitative data through the statistical methods then it beneficial to cross validate the quantitative findings with a predefined qualitative approach. The next section will discuss the qualitative findings through analytical discourse analysis.

5.5.2 Qualitative Analysis

The aim of the qualitative data is to further investigate the results of the questionnaire through interviews conducted in the workplace with 10 respondents selected through a sampling method.

The qualitative data consist of interviews with key decision makers (TUNAC management) from the TUNAC and the LACE. The structure of the interview is supplied in appendix 2. The themes were formed according the questionnaire's results and were used to augment the questionnaire results through triangulation. The result of the interview analysis is explained below.

5.5.2.1 Discourse Analysis

> *"it is a particular way of talking about and understanding the world or an aspect of the world"* (Jorgensen and Phillips, 2002).

In the recent years discourse analysis became a modern term that has been used in many fields such as scientific texts and debates. The use of language within the discourse analysis allows creation of representations of reality through the contribution in constructing a reality and trying to understanding the current phenomenon. By constructing reality meanings

representations, physical objects are real and exist and they all only achieve meaning through discourse (Jorgensen and Phillips, 2002).

However, in many cases, underlying the word ‘discourse’ Discourse analysis is not just one approach, but a series of interdisciplinary approaches that can be used to explore many different domains in many different types of studies.

A discourse analysis is based on different specific details of speech such as action and gesture. Moreover it depends on arguments of judgement on what is to be included in the transcript. Such judgement depends on the researcher / analyst’s knowledge of how language and context are analysed (Gee, 2010). It has been for years been used as a powerful institutionalised tool in talking that regulates and reinforces action and thereby exerts power. (Wodak and Meyer, 2009).

The relationship between the phenomenon of interest and a particular discourse strand(s) is very important in refining the discourse analysis. However, this relationship sometimes is not straightforward because the phenomenon includes different discourse strands.

5.5.2.2 Analysis of the main themes of the qualitative approach

Based on the discourse analysis of the interviews with managers and engineers from the TUNAC and the LACE. the following themes were discussed in detail and the discussion below analyses the main points raised during the interview. The first process was to transcribe the tape-recorded dialogue and then extract the main issues that are believed to be important and directly affecting the sustainability of the accreditation bodies in North Africa. The discussion and interpretations of main interview themes are explained below.

Q1. What does the word "Accreditation" means to you?

Interviewees agreed that accreditation is increasingly becoming the most important tool for countries in international trade. Most of them acknowledged the need to spread wide the

culture of international accreditation which would enhance the quality of products and services. They added that accreditation culture is still misunderstood by many people especially local customers, some of them, who still do not know the benefit of accreditation. Within the TUNAC and LACE, the interviewed personnel agreed that insisting on learning and an adopting national accreditation programme with different governmental organisations would help with raising the accreditation awareness level within the Tunisian territories.

Q2. Has your organisation implemented a formal accreditation or Quality management system?

According to the head of TUNAC, first they have implemented ISO 9000 as a quality system to improve their organisation, after that they started internal processes to plan to adopt national accreditation programs to support exportation of Tunisian products such as agriculture, fishery and industrial raw materials into Europe. This was achieved by help from the French accreditation body. Currently they have achieved ISO/IEC 17011 and have been approved by IAF to accredit customers within the Tunisian territory.

On the other side, the head of the LACE confessed that ISO/IEC 17025, Laboratory accreditation has been endorsed to the LACE. He added, all their laboratories across the Tunisian territory are approved according to ISO/IEC17025, moreover, auditors from the TUNAC and other international organisations visit their organisation regularly to check compliance with relevant international standards.

Q3. To what extent are resources available to support organisation strategies?

Interviewed personnel from TUNAC and LACE explained the way that their organisations are administrated. It is in a such a way as in the other developing countries where government administrates public organisation both financially and managerially. They added, limited funds are assigned to TUNAC and LACE and as a result staff development and a widening accreditation scheme have been affected. However, their organisations, recently, started to

provide accreditation services such as accrediting and auditing some laboratories in some African countries. This step opened a new fund resource.

In terms of physical resources their laboratories are equipped with instruments and devices that are calibrated regularly according to their attached manuals. Also reference materials are properly stored and checked with external reference material on a specified time scale. The only problem, they mentioned here, is human resources which is difficult to develop and create a qualified staff.

Q4. Difficulties faced by your organisation in the introduction of accreditation?

Senior engineers and top management of both organisations claimed that implementation procedures of both ISO/IEC17011 and ISO/IEC17025 were very difficult as it was seen by some government department as unbeneficial. Therefore the first step was to convince these government departments of the benefit of accreditation to the national gross product. The other difficulties are in setting up the accreditation body which was impossible to initiate without the help provided from the COFRAC in different areas including human development. In addition, TUNAC top management mentioned that government support and bureaucratic procedures within government departments and awareness of accreditation are the main difficulties. The LACE senior engineers mentioned that poor communication with laboratories across the country, customers' awareness and lack of modern instruments and devices are other difficulties.

Q6. Does your organisation implement a policy for awarding and supporting staff?

According to top management in both organisations, staff are encouraged to develop and create within their departments. There are awards, sometimes, given to some of the staff who achieved high records in terms of behaviour, education and work commitment. However these awards are limited to availability and in this case the organisation awards merits of

achievements which for some staff is below their expectations. On the other hand, senior engineers from both organisations raised the issue of awarding and financial compensation and salaries which , as they claimed, very low. This reason had led qualified employees to

leave to organisations abroad in the Arab Gulf countries.

The head of the TUNAC acknowledged the need to raise staff salaries, however they are governed by the ministry of industry and any scheme to increase salaries must be first approved by the prime minister which is not visualised in the near future.

Q7. Who is responsible for driving improvement in your organisation?

Five mangers from the TUNAC were interviewed including the top management. They insisted that line managers and consultants within the TUNAC determined weaknesses and strengths within the organisation and submit a report to the head of TUNAC. They added, however, the action to approve and implement any improvement need to be approved by head of TUNAC. Consequently, these improvements, if agreed by the head of TUNAC, need to be further approved by the ministry of industry to allocate the required funds which is a long bureaucratic process. On the other hand, LACE laboratories' manager cleared that he and quality manager are the two people who are responsible for organisation development. However, two senior engineers from the LACE claimed that although there is noticeable development in the area of adopting international standards that related to laboratories accreditation, some drawbacks such as bureaucratic procedures and time taken to adopt new international requirements are the main issues in the LACE.

Q8. To what extent is the top management committed to accreditation and Quality issues?

The structure of the TUNAC is in such a way that is an integral part of the ministry of industry in Tunisia. The head of the TUNAC claimed that within the organisation all staff acknowledge the need to develop the organisation. However, she added, TUNAC is not

independent of government organisation and they need to have approval for all plans which sometimes are ignored by the ministry of industry. Although top management in both organisations are committed to developing a national accreditation program, some difficulties such as awareness and importance of accreditation, financial capacity and customer requirements are the major impediments.

Q9. To what extent does your organisation use teams in analysing processes for improvement? Interviewed top managers at the TUNAC said that there are different steering groups within the organisation. Each group is assigned for a specific task such as strategic planning and international standards amending groups. These groups are chaired by senior engineers and are responsible for analysing data coming from different customers in its field such as laboratory accreditation, product accreditation…etc. these steering groups then are required to submit a technical report to line manager detailing organisation current performance and future proposed improvements. Moreover, there are monthly group meetings to address current and the future organisation situation and propose plans for development.

Q10. To what extent does your organisation use Quality Tools?

What was surprising to top management in both organisations admitted that quality tools such as flow charts, Cause and-effect diagrams, PDCA cycle…etc. have not been used before, instead they following the requirements of both ISO/IEC 17011 and ISO/IEC 17025 and asked for help, sometimes from part time consultants and even the French Accreditation Body. The reason behind this is because most of the staff assigned to both organisations have not gained intensive training courses in Quality Management and problem solving tools. Most of the staff acknowledge the need to raise the awareness level within the TUNAC and the LACE and focus on annual recurrent training in the area of Quality Management.

However, the head of the TUNAC said that they know the problem of limited qualified staff within their organisation, however they have hired part time staff to fill the gap of doing the job properly.

Q11. What is the role of managers and supervisors in training activities in their departments?

Training opportunities in both TUNAC and LACE is limited by funds available and assigned by the ministry of industry which controls the two organisations. However top managers claimed that training plans are approved each year to fill gaps of human resources and organisation requirements. Moreover, when there are opportunities of training which are sometimes offered by international organisations such as IAF and ILAC, some line managers and engineers attend these meetings. However, an interviewed junior engineer from the LACE said that training opportunities are allocated to managers and supervisors and junior engineers have limited training opportunities abroad especially those organised by regional organisations or IAF and ILAC.

Q12. Are methods used within your organisation fit for purpose of use?

Senior engineers in both organisations acknowledged that methods used, for instance, in TUNAC are lacking new developments with problems solving especially related to current and future prospects. Moreover, one senior engineer from TUNAC claimed that due to lack of training, encouraging employees for developing and awareness of accreditation at the national level have led to a noticeable delay in implementing other accreditation schemes and enlarging the current accreditation program to cover all the Tunisian territories.

Within the LACE laboratories, top management acknowledged the need to upgrade the instrument and devices used with the latest produced in the field of testing and analysis. However, the current used methods within the laboratories are accredited according to ISO/IEC 17025 and periodic visits are undertaken by different local and international

organisations.

Q13. Ares your organisation's standards revised on a regular basis by using data collected?

Senior managers at TUNAC claimed that international standards from IAF such as ISO/IEC 17011 are implemented with amendments from the Tunisian Standards Institute. However, time taken to adopt and implement new updates to standards are seen as bureaucratic procedures and this linked directly to reasons such as organisation culture and inappropriate / unqualified people assigned for job. However, revision of standards based on data collected is the responsibility of the Tunisian Standards Institute. Although there are regular meetings between TUNAC and Tunisian Standards Institute to discuss current problems encountering local customers, no evidence of linking data collection to amending standards took place recently.

5.5.2.3 Variables extracted using analytical discourse analysis

Based on the analytical discourse analysis 3 themes containing 9 drivers were extracted. These themes are explained in table 5.18 below. By using the analytical discourse analysis, main themes can be extracted. This method depends on ideas discussed in the dialogue**,** however the use of the analytical discourse analysis is directly linked to questions that were raised in interview. Therefore, the main concentration of the interview was on three main subjects, they are; Resources, Management commitment and Strategic planning as explained in table 5.18.

Resources	•V1. Resources available to support organisation's strategy. •V2. Using Quality tools and teams in analysing process for improvement. •V3. Availability of Quality steering and accreditation group. •V4. Difficulties in implementing accreditation.
Management commitment	•V5. Top management commitment to accreditation. •V6. Role of managers and supervisors in training activities. •V7. Management role in ensuring data Quality
Strategic Planning	•V8. Current strategy for accreditation. •V9. Evaluation of training effectiveness. •V10. Using data to make decisions and future predictions. •V11. Standards are revised on regular basis through data collected. •V12. Reasons for establishing accreditation.

Table 5.18; Main themes of qualitative analysis

The first theme covers drivers that are related to resources available for the TUNAC and LACE, therefore this theme was named Resources and contains four drivers. These factors are; V1 supporting organisation's strategy, V2 using tools and teams for planning and improvement, V3 accreditation steering group and V4 difficulties facing the organisation

The second theme consists of drivers that are mainly linked to management ability, hence this theme was labelled management commitment and it has three factors. These factors are; V5 management commitment, V6 managers commitments to train staff and V7 managers role in ensuring quality of data.

The last theme was labelled strategic planning as it contains drivers that are related to planning. Within this theme there are five factors extracted from the dialogue with the

interviewees from both organisations. These factors are; V8 organisation's current accreditation strategy, V9 using quality tools and analysing processes for improvement, V10

making future decisions based on data analysis, V11 revision of organisation standards are based on data collected from customers, V12 what reasons for setting up national accreditation programme.

The internal data analysis, both quantitative and quantitative, has led to the extraction of critical factors that are seen by respondents as directly affecting the development of a sustainable accreditation process in the developing countries. However the external PESTILE factors make the development of any accreditation body in these countries (especially the critical external environmental factors such as political situation) are important in setting up any proposed model. These factors will be discussed in the next section.

5.6 External Factors

5.6.1 PESTILE Analysis

Reviewing the current environmental conditions in some of the North African countries such as Tunisia and Libya in chapter 3 has concluded with the main theoretical critical factors. These factors were ranked by the respondents as shown in table 5.19 believed to be, as claimed by some authors, critical factors that affect the situation in the region. Moreover these political, economic, social, technological, international, legal and environmental conditions are critical and need to be investigated before setting up or initiating any new business or strategic development in this region.

Factors that were extracted from chapter 3, PESTILE analysis, as shown in table 5.19 have three impact factors: high, medium and low. Respondents from the two Tunisian organisation have ranked these factors according to their importance for each group.

There are some factors that have earned high importance such as political instability in north Africa P1, limited sources of GDP E2, raising in the education level S1, local social development and work behaviour S2, infrastructure improvement T2, International politics

I1, Coping with international treaties I2, Separation between judiciary and executive power L1, Efficiency of the juridical system L2, comply with environmental legislations EN1 and Pollution elimination L2.

Based on the respondents' ranking of the PESTILE, factors have emerged according to its criticality and degree of importance to the accreditation bodies in the developing countries. However, with theoretical ranking it is difficult to establish a dependable criteria of selection of factors. Therefore the author decide to further analyse the theoretical PESTILE factors through Analytical Hierarchy process (AHP), pairwise analysis and Bayesian network to see the interrelation ship between variables.

Respondents of TUNAC and LACE were asked to rank the PESTILE and sub – PESTILE factors according to their importance as shown in in Appendix 5.

For the purpose of this research there were two questionnaires delivered to the respondents. The first one was to find out the impact of the theoretical PESTILE factors, High, Medium and Low as shown in table 5.19.

In order to use the AHP it was necessary to input numerical data. Therefore the second questionnaire incorporated numerical data input from 1-9 as shown in table 5.20.

5.6.1.1 Theoretical ranking of the most important PESTILE factors in Libya and Tunisia

PESTILE category	PESTILE factor	Impact High /Medium / Low
Political	**P1-** Political instability in North Africa.	H
	P2- Changes in legislations toward open market.	M
	P3- Corruption and bureaucracy.	M
Economic	**E1-** inequality in wages	M
	E2- Limited sources of GDP	H
	E3- International investment	M
Social	**S1-** Raising in the education level	H
	S2- Local social development and work behaviours	H
	S3- Entrepreneur spirit	L
Technical	**T1-** Technology development	M
	T2- Infrastructure improvement	H
	T3- Linkage with international development	M
International	**I1-** International politics	H
	I2- Cope with international treaties	H
	I3- Openness into international markets	M
Legal	**L1-** Separation between judiciary and executive power	H
	L2- Efficiency of the juridical system	H
	L3- Tax evasion	L
Environment	**EN1-** Comply with environmental legislations	H
	EN2- Pollution elimination	H
	EN3- International treaties	M

Table 5.19**;** PESTILE Ranking

5.6.1.2 Analytical Hierarchy Process

The first step in the AHP, was to rank the main PESTILE factors according to table 5.20. The scale importance ranges from 1-9.

importance	Definition	Explanation
1	Equal importance	Two elements contribute equally to the objective
3	Moderate importance	Experience and judgment slightly favour one element over another
5	Strong Importance	Experience and judgment strongly favour one element over another
7	Very strong importance	One element is favoured very strongly over another, its dominance is demonstrated in practice
9	Extreme importance	The evidence favouring one element over another is of the highest possible order of affirmation
2,4,6,8 can be used to express intermediate values, 1.1, 1.2, etc. for elements that are very close in importance		

Table 5.20; ranking guide, Source; Saaty, T. (2008).

Respondents from TUNAC were asked to rank the main PESTILE factors according to their importance to the development of a sustainable accreditation body in a scale ascending from 1 – 9 with 9 as extreme importance, 3 and below as moderate importance as shown in table 5.21.

Objective **External factors affecting the accreditation body**

Matrix	Political	Economic	Social	Technological	International	Legal	Environment	Normalized principal eigenvector
Political	1	7	5	4	3	4	2	31.92%
Economic	1/7	1	9	7	6	3	3	24.02%
Social	1/5	1/9	1	1/5	1/6	1/7	1/3	1.73%
Technological	1/4	1/7	5	1	9	7	6	18.87%
International	1/3	1/6	6	1/9	1	5	1/5	7.34%
Legal	1/4	1/3	7	1/7	1/5	1	9	9.25%
Environment	1/2	1/3	3	1/6	5	1/9	1	6.88%

Table 5.21; Ranking of main PESTILE factors

By using the AHP, it was possible to apply the pairwise analysis for the main PESTILE factors as explained in table 5.21. Each factor was compared with the rest of the factors as priority importance A – B. For instance Political has scored 7 points at importance as economic which means political is 7 times more important than economic, details of pairwise matrix are explained in appendix 5.

AHP Analytic Hierarchy Process n= 7 Input 1
Objective External factors affecting the accreditation body

Please compare the importance of the elements in relation to the above objective and fill in the table: Which element in each pair is more important, **A or B**, and **how much** more important it is. (Use the scale 1-9 as given below)

	Element
1 3 5	Political 2- Economic Social 4- Technological International 6- Legal 7- Environment

	Element A		**B**	**Important**	**Intensity** (1-9)
1	Political	compared with	Economic	A	7
2			Social	A	5
3			Technological	A	4
4			International	A	3
5			Legal	A	4
6			Environment	A	2
7					
1	Economic	compared with	Social	A	9
2			Technological	A	7
3			International	A	6
4			Legal	A	3
5			Environment	A	3
6					
1	Social	compared with	Technological	B	5
2			International	B	6
3			Legal	B	7
4			Environment	B	3
5					
1	Technological	compared with	International	A	9
2			Legal	A	7
3			Environment	A	6
4					
1	International	vs	Legal	A	5
2			Environment	B	5
3					
1	Legal	vs	Environment	A	9

Table 5.22; Analytical Hierarchy Process of PESTILE factors

Furthermore, by using pairwise matrix, table 5.21, it was possible to rank factors and extract eigenvalues through squaring the matrix and sum mainly the rows totals. Then the sum of iterations is divided by each row to obtain the eigenvalues for each factor (Saaty, 2008). Political factors has scored 31.9% as a prime important factor among the other factors as shown in table 5.23. The second score is economic with 24%, the third is technological 19% and the forth is legal with 9%.

	Analytic Hierarchy Process (8x8 Matrix)								
	Power Method (Dominant Eigenvalue)								
	1	2	3	4	5	6	7	**Iterations**	**Normalisation**
1	1	7	5	4	3	4	2	11.18	**0.319**
2	0.14	1	9	7	6	3	3	8.42	**0.24**
3	0.2	0.11	1	0.2	0.17	0.14	0.33	0.61	**0.017**
4	0.25	0.14	5	1	9	7	6	6.61	**0.188**
5	0.33	0.17	6	0.11	1	5	0.2	2.57	**0.073**
6	0.25	0.33	7	0.14	0.2	1	9	3.24	**0.092**
7	0.5	0.33	3	0.17	5	0.11	1	2.41	**0.068**
Sum (col)	2.67	9.087	36	12.62	24.36	20.25	21.53		

Table 5.23; Explanation of AHP Eigenvalue extraction

It is clearly obvious that political stability in North Africa is the prime factor in the external factors that affect sustainability of accreditation bodies in this region. This factor has recently been seen as a critical factor since 2011 when the uprising in North Africa affected the political stability in this region. Although the economic factors in this region has not been severely affected in Tunisia, Egypt and Libya, respondents felt that opening new doors for international investments of different types such as direct investment and franchise would improve GDP in these countries as well as wages and job opportunities.

The third and fourth most important factors are technology and legal. These factors considered by the respondents as medium importance which means they need to be considered and evaluated by governments of these countries in North Africa.

5.6.1.3 Pairwise Analysis of PESTILE sub-factors

5.6.1.3.1 Political

Pairwise analysis for political sub-factors as shown in table 5.24, revealed that within the political factors political instability in North Africa scored the highest percentage of 60.2%. corruption and bureaucracy 32.4% and last in scale is changes in legislations 7.5%. Respondents felt that political instability coupled with daily protests and demonstrations which delay normal daily working hours of government public organisation must be first addressed in order to give confidence to local and foreign investors.

n= **3** Number of criteria (3 to 8)

Objective **Pairwise Political**

	Element	Weights
1	Political instability in NA	**60.2%**
2	Changes in legislations	**7.5%**
3	Corruption and bureaucracy	**32.4%**

Matrix	Political instability in NA	Changes in legislations	Corruption and bureaucracy	Normalized principal eigenvector
Political instability in NA	1	5	3	60.18%
Changes in legislations	1/5	1	1/7	7.46%
Corruption and bureaucracy	1/3	7	1	32.36%

Table 5.24; Political

5.6.1.3.2 Economic

Analysis of the economic sub-factors discovered that limited sources of the national GPD was the prime factor within the economic factor with score of 70.5%, table 5.25. In addition, international investment has scored 23.4% with medium importance and 6.1% for inequality in wages as low importance to the sustainability of the accreditation bodies.

n= **3** Number of criteria (3 to 8)

Objective **AHP Economic**

	Element	Weights
1	Inequality in wages	**6.1%**
2	Limited sources of GDP	**70.5%**
3	International investment	**23.4%**

Matrix	Inequality in wages	Limited sources of GDP	International investment	Normalized principal eigenvector
Inequality in wages	1	1/5	1/9	6.06%
Limited sources of GDP	5	1	7	70.50%
International investment	9	1/7	1	23.44%

Table 5.25; Economic

5.6.1.3.3 Social

The third factor in the PESTILE is social factors and this pairwise analysis comprises three sub-factors. As clearly shown in table 5.26, raising in the education level has been ranked as the most important sub-factor with eigenvalue score of 73.8%. local social development was ranked second in the social most important scale with medium importance 17% and lastly low importance was entrepreneurship spirit 9.2%.

n= **3** Number of criteria (3 to 8)

Objective **AHP Social**

Table	Element	Weights
1	Raising in the education	73.8%
2	Local social development and work behaviours	17.0%
3	Entrepreneurship spirit	9.2%

Matrix

	Raising in the education	Local social development and work behaviours	Entrepreneurship spirit	Normalized principal eigenvector
Raising in the education	1	7	5	73.83%
Local social development and work behaviours	1/7	1	3	17.02%
Entrepreneurship spirit	1/5	1/3	1	9.15%

Table 5.26; Pairwise analysis of Social sub-factors

5.6.1.3.4 Technology

Looking at the AHP pairwise analysis of technology sub-factors table 5.27, the most important sub-factor is infrastructure improvement which scored 72.2% as the most important sub-factor followed by technology development 22.7% as medium importance. Respondents felt that infrastructure and technology improvement is very important to the accreditation bodies in terms of communication development, laboratories establishment and improving technology.

n= **3** Number of criteria (3 to 8)

Objective **AHP Technology**

	Element	Weights
1	Technology development	**22.7%**
2	Infrastructure improvement	**72.2%**
3	Linkage with international development	**5.1%**

Matrix	Technology development	Infrastructure improvement	Linkage with international development	Normalized principal eigenvector
Technology development	1	1/5	7	22.71%
Infrastructure improvement	5	1	9	72.19%
Linkage with international development	1/7	1/9	1	5.10%

Table 5.27; Pairwise of Technology sub-factors

5.6.1.3.5 International

Within the international sub- factor table 5.28, international politics was seen as the highest important factor with score of 52.4%. this sub-factor is very important as countries international politics is very important in addressing its directions and cooperation with the international community. For instance the case of Libya in the last thirty years was seen by many respondents as an example of international politics. This also linked to openness to international markets 34.2%, which depends on international politics.

n= **3** Number of criteria (3 to 8)

Objective **AHP International**

Table

	Element	Weights
1	International politics.	**52.4%**
2	Cope with international treaties.	**13.4%**
3	Openness into international market.	**34.2%**

Matrix

	International politics	Cope with international treaties	Openness into international market	Normalized principal eigenvector
International politics	1	2	3	52.41%
Cope with international treaties	1/2	1	1/5	13.39%
Openness into international market	1/3	5	1	34.20%

Table 5.28; Pairwise of International sub-factors

5.6.1.3.6 Legal

As the case of some of the developing countries as explained in chapter 3, efficiency of the juridical system in any country is the backbone for development. With 67.2% weighting importance, table 5.29, respondents ranked this sub-factor as highest importance with the insist on separation between the judiciary and executive powers being 26.5%.

n= **3** Number of criteria (3 to 8)

Objective **AHP Legal**

Table	Element	Weights
1	Separation between judiciary and executive power	26.5%
2	Efficiency of the juridical system	67.2%
3	Tax evasion	6.3%

Matrix	Separation between judiciary and executive power	Efficiency of the juridical system	Tax evasion	Normalized principal eigenvector
Separation between judiciary and executive power	1	1/3	5	26.54%
Efficiency of the juridical system	3	1	9	67.16%
Tax evasion	1/5	1/9	1	6.29%

Table 5.29; Pairwise of Legal sub-factors

5.6.1.3.7 Environment

The last factor in the PESTILE analysis is environment and it is very important to be analysed in order to set-up a new framework or strategy in any country. Three more important sub-factors that emerged from the environmental theoretical analysis in chapter three, are pollution elimination 58.2%, as highly important followed by local and international legislations 30.9%. Joining international environmental treaties was seen as low importance with 11% as shown in table 5.30.

n= **3** Number of criteria (3 to 8)

Objective **AHP Environment**

Table

	Element	Weights
1	Comply with environmental legislations.	**30.9%**
2	Pollution elimination.	**58.2%**
3	International treaties.	**10.9%**

	Comply with environmental legislations	Pollution elimination	International treaties	Normalized principal Eigenvector
Comply with environmental legislations	1	1/2	3	30.90%
Pollution elimination	2	1	5	58.16%
International treaties	1/3	1/5	1	10.95%

Table 5.30; Environment

5.6.1.4 Analysis of PESTILE using Bayesian Network

In order to cross validate the results of the AHP with another statistical analytical method, Bayesian networks were used to plot the interrelationship between the main PESTILE faxctors as shown in figure 5.14. With the use of non linear principal component analysis (NLPCA), data from respondents as shown in appendix 1 have been loaded to SPSS 19 to extract NLPCA. The main components then were imported through R statistics to plot the bayesian network for the PESTILE main components. It was then possible to plot the network with the eigenvalues for all components from high to low importance as shown in table 5.31.

It can be observed that political factors is most highly important and the main driver in the network with eigenvalue importance 4.7, moreover, political influence economic (2.3) and technology (0.004) factors, however economic also influence international (0.002) and social influences international and technology (0.014) factors, therefore the main drivers in the Bayesian analysis are political, economic and social.

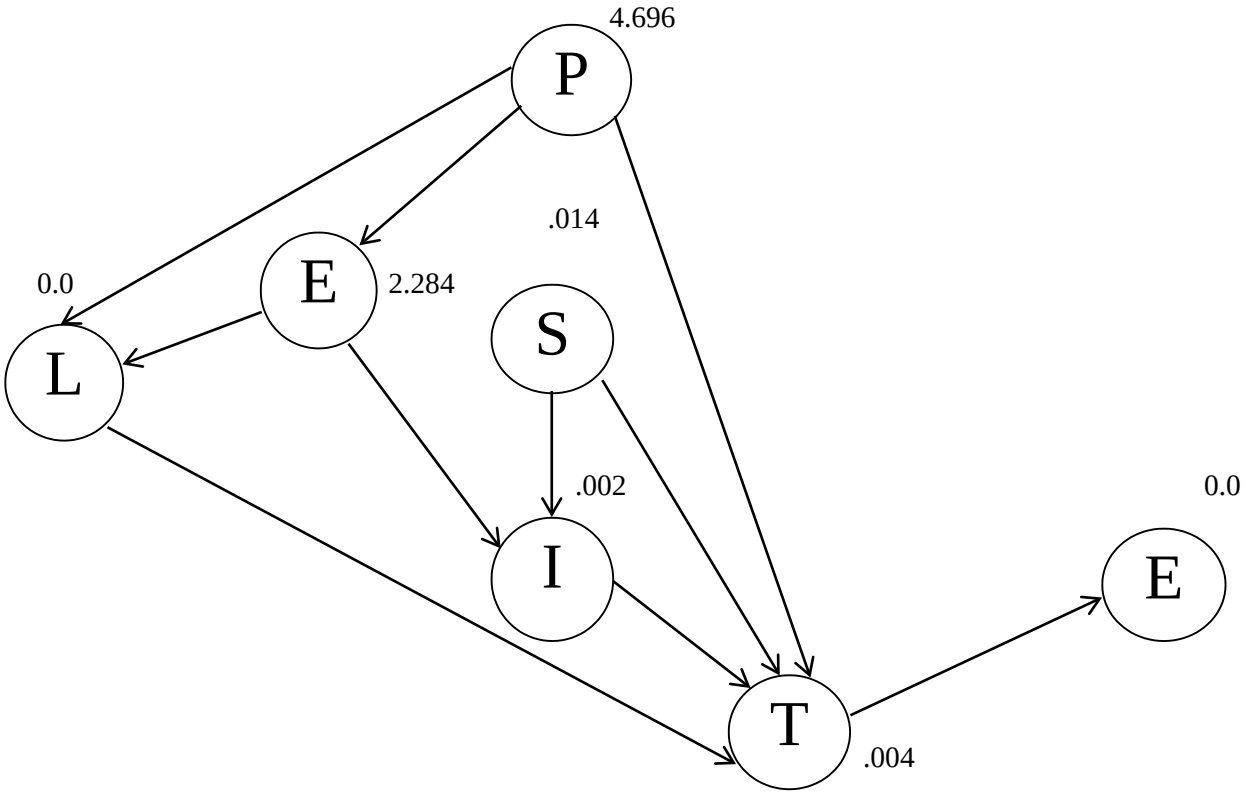


Figure 5.14; Bayesian modelling of PESTILE factors (numbers represent eigenvalue).

	Political	Economic	Social	Technology	International	Legal	Environment
Political	1.000	.927	.663	.979	.924	.273	.557
Economic	.927	1.000	.891	.977	.998	.105	.211
Social	.663	.891	1.000	.789	.893	.538	.240
Technology	.979	.977	-.789	1.000	-.979	.089	.402
International	.924	.998	.893	.979	1.000	.108	.216
Legal	.273	.105	.538	.089	.108	1.000	.940
Environment	.557	-.211	.240	.402	.216	.940	1.000
Dimension	1	2	3	4	5	6	7
Eigenvalue	4.696	2.284	.014	.004	.002	.000	.000

Table 5.31; Correlations Transformed Variables.

5.6.1.4.1 Pairwise of sub-factors using Bayesian

The pairwise analysis of the sub-factors of PESTILE have revealed that the political dimension is dominating the network drivers as shown in figure 5.15. The domain knowledge permits researchers to draw an arc to a variable from each of its direct causes i.e. visiting Africa may cause tuberculosis (Kenett and Sailini, 2011).

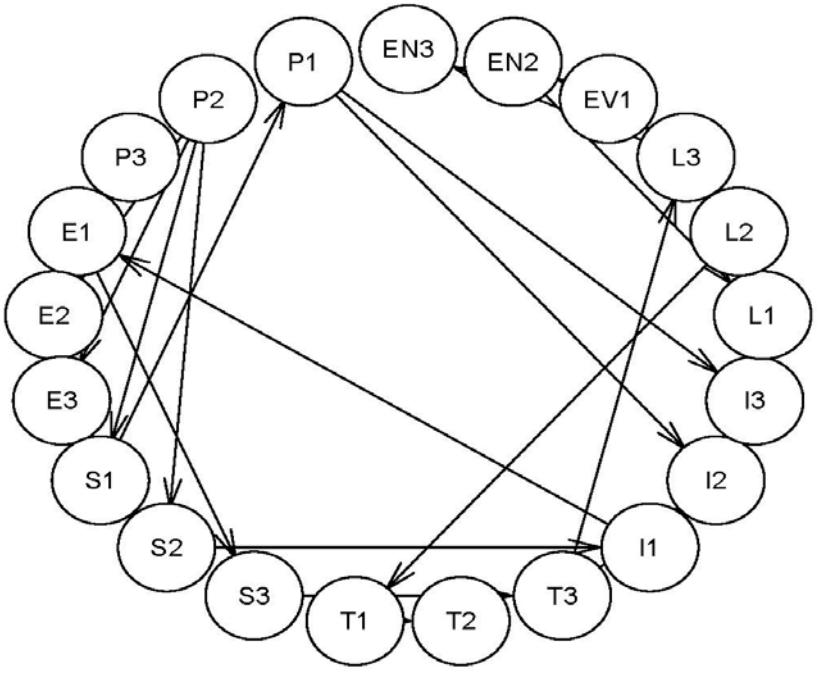


Figure 5.15; Diagnostic distribution of PESTILE sub - variables

The first driver node P2- Changes in legislations toward open market-links to S1- Raising in the education level and E2 - Limited sources of GDP and E3- International investment. Also there is a link from I1- International politics to E1- inequality in wages to S3- Entrepreneur spirit and also links to T3- Linkage with international development.

Node L2- Efficiency of the juridical system- influences node T1- Technology development, moreover node EN2- Pollution elimination influence L1- Separation between judiciary and executive power as shown below.

P2 → S1 → P1 → I1 + I2

P2 → E2

→ E3

I1 → E1

E1 → S3 → T3

L2 → T1 → T2

EN2 → L1

Reviewing the PESTILE analysis methods explained above it is possible to plot a PESTILE model with main critical factors that affect accredition bodies in North Africa. Figure 5.16 explains the main PESTILE and sub-PESTILE factors arranged in hierarchy order. The extraction of the main important factors was based on the egienvectors from the AHP and cross verification with Bayesian analysis as explained earlier.

Within the sub-PESTILE factors the main two important factors are; P1 Political instability in North Africa 60 % and P3 corruption and bureaucracy 32%. The main important sub factors with Economic are E2; limited sources of GDP 70% and E3; international investment 23%. Infrastructure improvement T2; 23% and Technology development T1; 72% are the two most important sub factors within the variable Technology. Efficiency of the juridical system L2;

67% and Separation between judiciary and executive powers L1; 27% are main important factors within factor Legal.

Having reviewed the PESTILE and sub PESTILE factors it can be summarized that external PESTILE factors are directly affecting the development of accreditation bodies in the developing countries. Moreover linking the above discussed factors to the current accreditation bodies, specifically, in North Africa helps in developing a sustainable model.

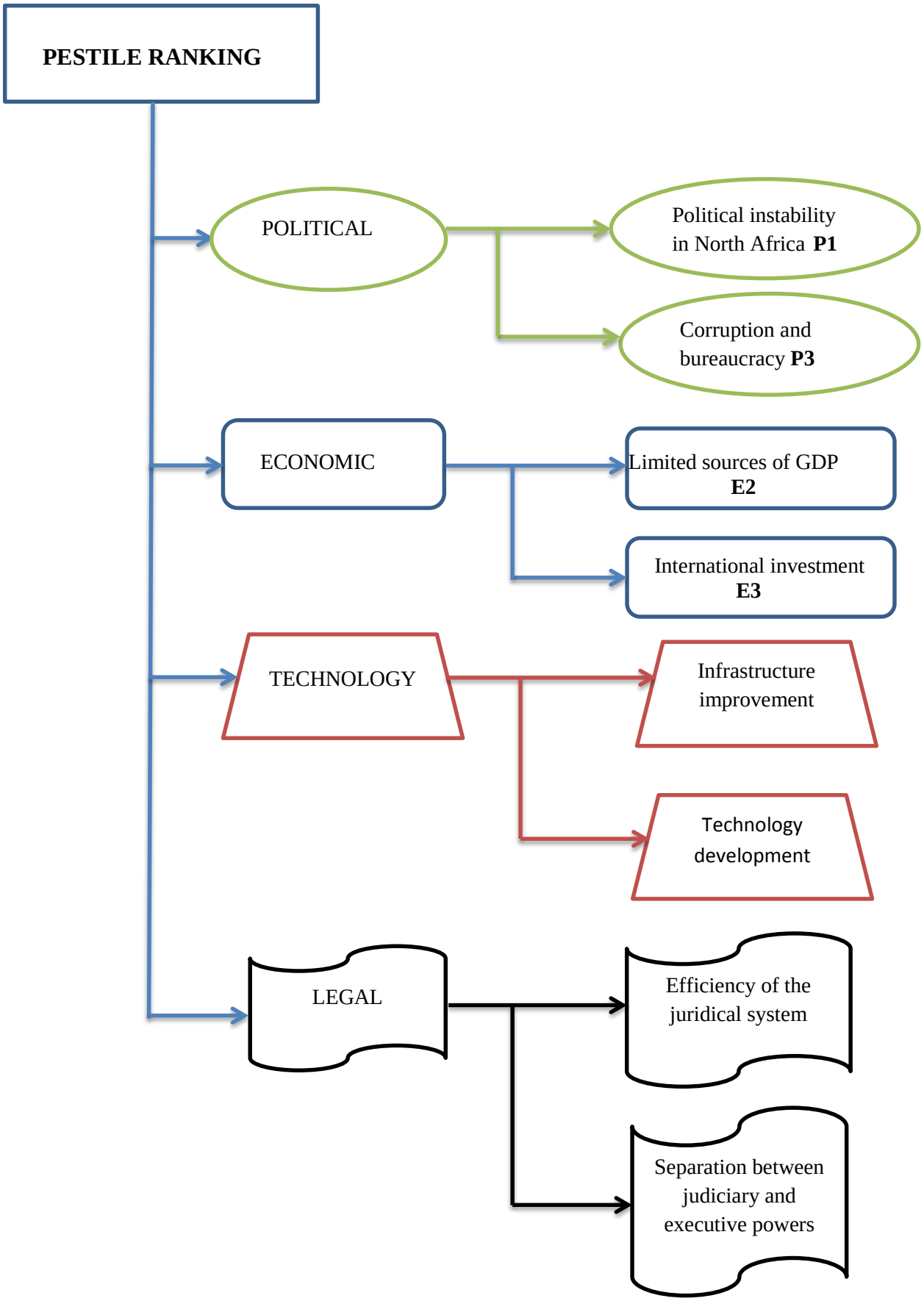


Figure 5.16; PESTILE ranking

5.7 Initial sustainable accreditation framework

Having reviewed the internal and external factors that could affect the sustainability of accreditation bodies with cross validation of different analytical tools then it possible to build an initial accreditation framework. By linking external and internal factors, the initial accreditation framework figure 5.17 containing both analytical methods with the factors extracted.

It should be noticed that internal qualitative analysis will be linked directly to the accreditation framework according to figure 5.2; Process of building a sustainable accreditation body's framework.

The method adopted in building the initial accreditation framework is based on linking the analytical method and factors extracted by this method to clearly explain how these factors extracted and to be easily linked to previous discussion.

The factors shown in figure 5.17 are self-explained as they are the result of the previous statistical analysis of data. Looking at the internal factors it is clearly shown that organisation culture was highlighted by both PCA and Bayesian analysis as a critical factor. The difference between PCA factors and Bayesian factors is that within the PCA the factors are covered under themes while in the Bayesian factors are self-represented such as O, Y and P.

The external PESTILE data analysis has emerged main important PESTILE and sub - PESTILE factors. The main P. E. T. L factors are; Political; P1 and P2; Economic E2 and E3; Technology; T2 and T1, Legal; L2 and L1. These internal and external factors, according to the empirical study, are directly linked to accreditation bodies in the developing countries.

This initial accreditation framework will be re-structured by adding the qualitative analysis which then will be possible to plot the proposed sustainable accreditation framework which will be discussed in chapter 6.

Initial sustainable Accreditation Framework

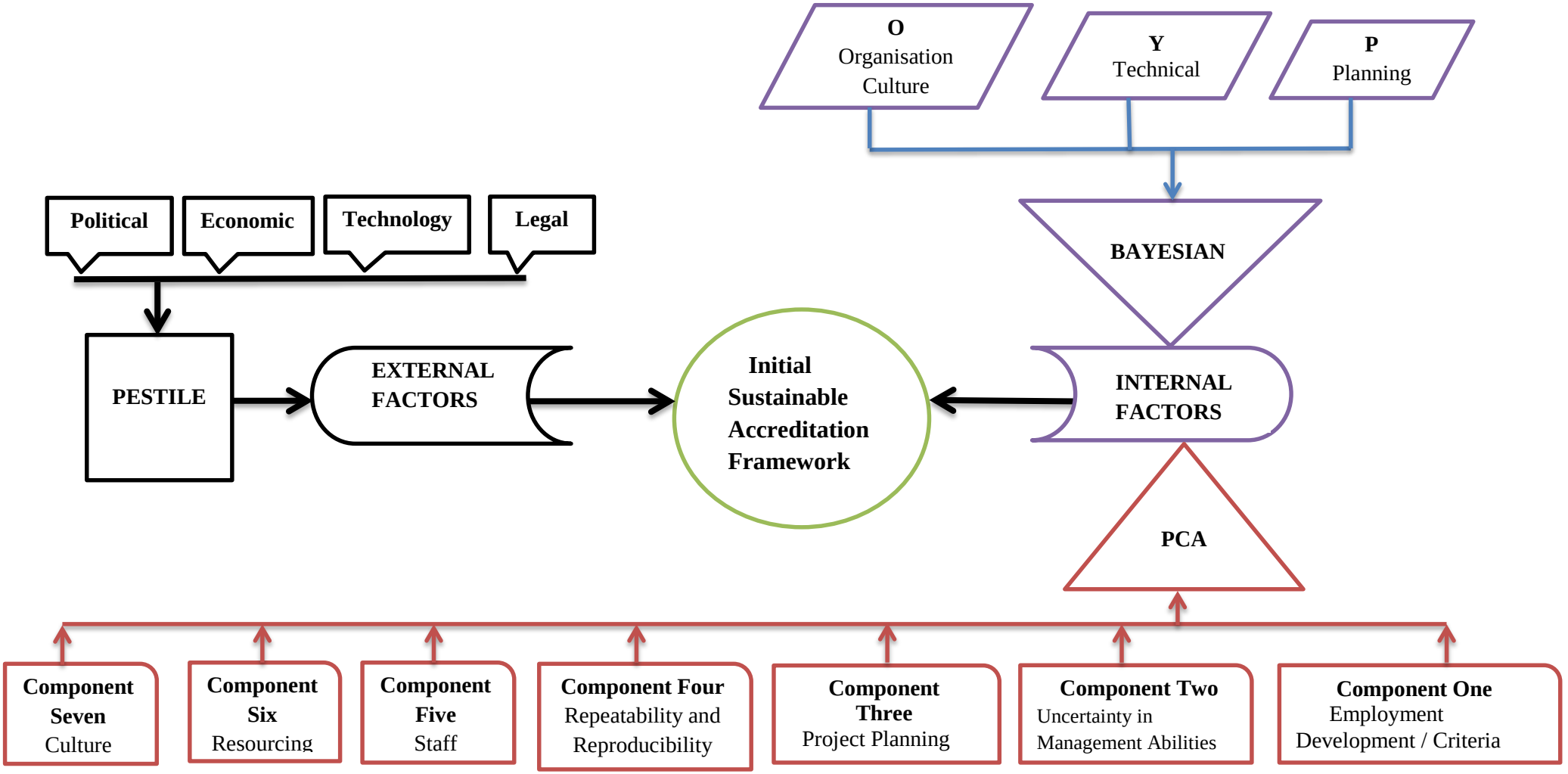


Figure 5.17; Initial accreditation framework

5.7.1 Summary

To summarise, chapter 5 has discussed different data analysis methods used to deal with both quantitative and qualitative data that were collected from an empirical study in existing established accreditation bodies in North Africa.

The first data analysis is the internal analysis and has covered the exploratory data analysis where data classified and filtered according to frequency and satisfaction which gave a visual representation of data. This was followed by principal component analysis to reduce variables to less factors and combine factors with the same correlation into the same component. The next step in the data analysis was to see the interrelationship between the variables by using Bayesian analysis which extracted the most important factors based on conditional probability.

The second data analysis is the qualitative analysis which comprises of different qualitative themes that have been analysed by Discourse analysis. The discourse analysis extracted the main factors.

The last part in the data analysis was external data analysis where PESTILE external variables were tested both theoretically through chapter 3 and analytically through Analytical Hierarchy process and Bayesian analysis. The PESTILE analysis has led to primary research and results.

It was important to use cross validate with another statistical analytical method to verify both results and give credibility to the findings. The author has covered a considerable number of variables that were considered by scholars and respondents, in the pilot study, as critical to a sustainable accreditation body. The findings from the quantitative analysis were retested by focusing on interviews with decision makers (TUNAC management) and managers and

senior engineers from the TUNAC and LACE to highlight the main issues and verify whether the quantitative findings are credible or not.

The next chapter, discussion, will discuss the quantitative and qualitative findings and will be linked to literature to see what is the unique difference in setting up a sustainable accreditation framework in North Africa.

Chapter 6 - Discussions and Proposed framework

6.1 Introduction

This chapter discusses chapter 2, 3 and the data analysis in chapter 5. The discussion will include both internal data, which covers quantitative, qualitative, and external data, which includes the PESTILE analysis. This will be validated through the literature review in chapter 2 and PESTILE analysis in chapter 3. This will lead to the development of the proposed framework of a sustainable national accreditation body in North Africa.

The discussion of findings will start with the EDA findings as initial results include frequencies and satisfactions scales. This will be followed by PCA to diminish variables to more important factors and gather them into main components. Having completed the PCA it was important to see the interrelationship between variables in order to extract the lead variables through Bayesian belief networks.

Then the effect of external PESTILE factors which are important before setting or improving any accreditation body in the developing countries will be discussed. The PESTILE findings from the analysis in chapter 5 will be linked to the theoretical findings in chapter 3.

The final discussion will include the qualitative analysis as a cross validation of the quantitative findings. Then the proposed framework will be discussed and this will be compared with the theoretical framework in chapter 2.

This research has identified new factors that were not identified before that affect the development of quality and accreditation in the developing countries. This has been done through primary research of both internal and external factors.

The main research question addressed in chapter 1 is the need to investigate the factors that affect the development of a sustainable accreditation body in North Africa. The word ‘sustainable’ in this research means to explore and undertake a primary research in North

Africa to see the reasons beyond establishing a current body and how to prevent such bodies in the developing countries from breakdown, putting in mind that the establishment of such bodies in some North African countries and in other developing countries was based on following the models of the developed countries without looking to specific requirements and differences in external and internal characteristics.

6.2 Discussion of findings

In this part the discussion will include discussion of findings from internal and external findings and draw general conclusions about these findings.

6.2.1 Findings from internal data analysis

Findings of internal data analysis have covered quantitative and qualitative aspects. In the quantitative discussion it will include exploratory data analysis, principal component analysis and Bayesian belief network. In the qualitative findings it will include analytical discourse analysis.

6.2.1.1 Exploratory data analysis findings

The first analytical method used to clarify the quantitative data and provide clear representation and filtration of data was the EDA. By using the EDA it was possible to clearly understand the distribution and frequency of data in regard to satisfaction to predetermined variables. The method that was used to draw initial conclusions on the EDA results was to highlight the highest degree of satisfaction or dissatisfaction as ranked by the respondents. Therefore, according to this rule it was possible to see the general dispersion of data which shows, as shown in chapter 5, towards dissatisfaction . This gave a first impression of how the respondents satisfy or dissatisfy the questionnaire's questions and also showed that all the questionnaire 7 themes are important as within each theme there is more

than 40% satisfaction / dissatisfaction which means it is more important to investigate. However the use of the EDA cannot draw reliable conclusions and extract the most important variables as the degree of satisfaction or dissatisfaction are close. Therefore the author has used the principal components analysis to reduce the data into less factors and merge them into main components.

6.2.1.2 Discussion of Principal component Findings

The use of the PCA helped in diminish the 94 variables into 48 variables based on factor loading of 0.5 and higher. However looking to the standard tools of the PCA which include the Scree test and Eigenvalue of 1 and above there are 25 components containing 48 variables. The author has looked at the components and their variables and the first impression is that some of the components can be merged into one new theme and hence reduce the number of the components to less components. Based on this the 25 components were reduced, by merging similar variables, into 7 main components contain 40 variables and the discussion below will cover these seven components.

6.2.1.2.1 Employment Development / Criteria

This component was loaded with the highest eigenvalue of 20.3 which shows the importance of employment criteria to the respondents. Within this component all variables cover employment criteria and human resource management. According to Sayeh (2006) in order for an organisation to achieve its goals through highest employee potential, it should adopt a human resource development program including employee's compensation and rewarding scheme.

Respondents felt very disappointed within this component as, according to the questionnaire, their organisation lack human resources improvement initiatives and this has affected achieving organisation goals and employees' development.

6.2.1.2.2 Uncertainty in Management Abilities

Factors emerged under this component are all related to management commitment ability to manage and administrate an organisation for long term plans without failure or loss in its capabilities. In regard to the developing countries this has been investigated by different scholars such as AI-Zamany et. al (2005) who claimed that lack of management commitment is one of the reasons for the failure of Quality programmes in some of the developing countries. Moreover Mersha, (1997) cited in Curry et. al (2002) recommended that Governments in developing countries should support upper managers of public organisations and provide a dependable infrastructure for industry and appropriate environment for setting up long term strategic plans.

Although uncertainty in management ability is a current issue in Libya and Tunisia due to different reasons such as unclear long term plan, unqualified managers in some organisations because they are appointed directly from government, lack of modern technology and people awareness toward accreditation, however the recent intention of these countries to widen its income resources has led to focus on investigating the reason behind lack of management capabilities in order to improve lead managers capabilities.

6.2.1.2.3 Project Planning

All factors gathered under this component were loaded more than 0.5 which means that respondents ranked this component as directly linked to current accreditation problems in North Africa. Factors in this component are shared by government and organisation government. However, the management of this organisation, as declared during the interview, claimed that all the plans need to be approved by government, moreover without a resource allocated from government all the plans are delayed.

Sayeh (2005) in a study on the critical success factors investigation for developing a TQM self-assessment model for the Libyan industry found that strategic planning is a major critical success factor. Therefore management should look to both short term and long term plans and investigate the current organisation's development. This includes customer satisfaction, source of information, conformance to ISO 9001 and position of the organisation within the international competition.

6.2.1.2.4 Repeatability and Reproducibility / Staff

Factors related to recurrence training and staff development are a real concern for respondents as they feel that they have limited opportunities in recurrent training to develop their skills. Moreover employees, within some developing countries, have little or no opportunities to use their skills effectively because of absence of job description and bureaucratic procedures.

Najeh et al (2005) found that the critical Quality factors in Malaysia, Palestine, Saudi Arabia, Kuwait and Libya are;

Employee commitment and enthusiasm;

response to employee suggestions;

continuous improvement through managers;

staff development.

These barriers actually were created by unqualified management of some developing countries including Libya and Tunisia. As in other developing countries absence of direct communication and effective periodic team meetings with management have resulted in many problems in these countries such as ineffective and non-productive employees which has led to massive over staffing in government public organisations.

Marshall (2006) outlined the importance of a well-structured, educated and trained staff in achieving the organisation objectives. He insisted on the following criteria to be considered with an organisation in order to satisfy its staff and customers;

- Skilled staff should be deployed in the delivery and assessment of each task.
- There should be appropriate recruitment, selection of staff and job allocation criteria and procedures and clear job descriptions.
- responsibilities for all grades of staffing are clearly and appropriately allocated.
- There should be a system reviewing staffing arrangements periodically and findings are acted upon.
- An organisation should ensure that everyone eligible has an equal chance of benefiting from its services.
- There should be equal opportunities for all staff.

6.2.1.2.5 Resourcing

Availability of physical and financial resources are deemed by both management and employees as a critical factor to the successful implementation of the accreditation process within the developing countries. In addition qualified human resources especially middle managers as motivators for employees is considered as essential factor. This because the role of middle manager is vital in linking management with employees and translating management/employee requirements into effective procedures. This agrees with Karaszewski, (2004) who found that among key barriers to implementing a successful QMS in the developing countries is improper technological infrastructure and lack of well-established facilities.

6.2.1.2.6 Culture change

Organisation culture change has been discussed by different authors such as Al-Zamany (2002), Zairi (1996), Sayeh (2007), and Eqnaibor (2002) in the developing countries that cover quality management, Total Quality Management, Critical success factors, ISO certification and implementation in the African countries. These authors claimed that studying local culture within an organisation is a critical success factor before implementing a new strategy Awadelkarim, (2007). This because work culture is different from country to country, moreover social relations directly affect work environment.

Although the need to change management style is sometimes necessary to adopt a new strategy in an organisation, management should be assured that this change is beneficiary to the organisation strategic planning. Furthermore, employee reaction to job change, behaviour during meetings and effective response to new roles and duties from management are a critical part in organisation culture change Eqnaibor (2002).

6.2.1.3 Findings of the Bayesian Analysis

The main aim of using Bayesian analysis within the quantitative analysis was to see the interrelationship between the variables and to extract the driver components.

The main three drivers according to the Bayesian analysis as described in figure 5.12 are; Organisation culture change (O), Technical and Infrastructure (Y); Planning (P).

6.2.1.3.1 Organisation culture change

This component is similar to the findings from the PCA analysis, however the Bayesian discussion will include just the main drivers. Within organisation culture sub-factors**,** Factors O17 and O24 were main parent drivers. This shows that 75% of respondents are dissatisfied with people behaviours during meetings which directly linked with culture in African countries that focus on personal agenda rather than organisation's goals. However the second

driver within change O24, the need to change, showed that 63% of respondents are dissatisfied with organisation plans to change. This is because respondents are uncertain about these plans if available as they feel that the need to change plans are talked only at management level and employees are not involved in these discussions. Although organisation change has dominating the drivers, it would be impossible to set up new strategy within an organisation without changing culture.

6.2.1.3.2 Technical and Infrastructure (Y)

According to the Bayesian analysis Y38, method proven to be fit for intended use, and Y44, establishment of procedures for equipment calibration are the two main sub-drivers for driver Y. Methods used within an organisation for calibration, testing and calibration are not modern technologies and are still using, for instance, analogue instruments and devices which consume time. Moreover reference material and inter-laboratory proficiency testing are not considered by management of the organisation. This is linked to Y44 establishment of procedures which showed 75% of respondents are neither satisfied nor dissatisfied. The reason behind that could be due to that awareness of accreditation, disclosure of confidential information or of recurrent training/knowledge.

6.2.1.3.3 Planning (P)

The main driver within planning is P55 communications within team work in the organisation. About 72% of respondents were dissatisfied as they feel that communications between departments and teams are limited and there are no effective problem solving teams between different departments. However the only traditional formal way of communication that is still existing is paper work by formal correspondence used between departments. Moreover, the lack of information technology has directly affected the development of communication in the organisation.

6.2.2 Summary of the quantitative analysis

Based on the analytical methods used in the quantitative analysis conclusions can be drawn on the most critical factors. By combining the results of these methods then the following factors are believed to be critical to a sustainable accreditation body framework.

The first critical component (PCA1) emerged from the PCA analysis and the Bayesian analysis is administrative, it includes Technical (TE), Planning (P) and Planning + Resources (PR). It is given the name administrative because all its factors are controlled by organisation top management and these factors need be considered as they are directly linked to a successful sustainable accreditation body.

The second component is People and it was labelled (PCA2). It includes the following factors;

Communication (COM), Training + Resources (TR), Planning + Resources (PR) and Organisation culture change (CH). The factor PR also forms part of the PCA1, this is because planning and resources depend on both first management commitment and second the availability of effective human resources within the planning department.

However in terms of the critical factors to a sustainable accreditation body in North Africa, the two main important factors are organisation culture change (CH) and Technical (TE). This was based on the Bayesian analysis described in chapter 5 which showed that Change and Technical are the two drivers in the network based on the conditional probabilities.

6.2.3 Discussion of the qualitative analysis

As explained before in chapter four, research methodology, the aim of using the qualitative approach in this research is to cross validate the quantitative approach and to provide a triangulation which supports the research findings.

The qualitative analysis has emerged with three most important themes, these themes are; Management commitment; Strategic planning and Resources. These three themes are believed to be, according to the interviewees, as critical to the accreditation.

The first theme management commitment was supported in the quantitative analysis and considered as a critical factor. It covers factors such as top management commitment to accreditation, role of manager in training and movement role in ensuring quality of information and data. Although top management of both organisations are aware of some difficulties within their organisations such as ineffective suitable accreditation, independence from the ministry of industry and resource are still coming from government.

Strategic planning was ranked by the interviewees as the second most important theme to accreditation. Planning was also considered as a critical factor through the quantitative analysis. Interviewees were raised important factors within strategic planning, these factors are;

- Current strategy for accreditation.
- Evaluation of training effectiveness.
- Using data to make decisions and future predictions.
- Standards are revised on regular basis through data collected.
- Reasons for establishing accreditation.

These factors show that interviewees felt that there is uncertainty in management abilities and future strategic plans. The uncertainty is because the support is still coming from the COFRAC and the author has not found either future strategic plans or research done to investigate and predict the current state and future of the TUNAC.

This also linked to resources which were raised in every discussion by interviewees as a critical factor. This is because the TUNAC has not, financially, achieved independence from

government, moreover the availability of human resource with the TUNAC has been directly affected by insufficient salaries paid by government, about (£500pm) which has led many employees to leave the TUNAC and the LACE and find jobs in the Arabian Gulf countries such as Qatar and Dubai.

The head of the TUNAC admitted that the establishment of the Tunisian accreditation body was with help and under supervision from the COFRAC. Moreover, there was no study done before to investigate the strengths and weaknesses of the accreditation bodies in the developing countries. As in other developing countries, the setting up of a new body is depending on what is done so far in the developed countries and the transfer of the structure of the same body to a developing country without looking to the difference in the factors discussed earlier.

6.2.4 Discussion of the external PESTILE analysis

By using the external PESTILE analysis it was possible to investigate the external environmental factors that affect the accreditation body. The reason in choosing PESTILE not SWOT analysis is that this research is investigating a sustainable body, not looking for competitors as it is one national body within a country (e.g. UKAS, COFRAC) and PESTILE analysis is more relevant and specific with this research as these environmental external factors need to be considered by governments in the developing countries.

The analysis of the current PESTILE environment in North Africa specifically Tunisia and Libya, has resulted in theoretical factors. These factors were ranked by respondents according to degree of importance to a sustainable accreditation body, then further analysed by analytical hierarchy process and Bayesian analysis.

The analytical hierarchy process has ranked the importance of data according to its eigenvalue. The first analysis was the PESTILE main factors and the first high priority factor was Political which achieved an eigenvalue of 32% . This reflects the current unrest and unstable political situation in North Africa. Respondents felt that without a stable long term political perspective it impossible to establish new businesses, for instance the current political situation in Tunisia, Libya and Egypt has led many international companies such as British Petroleum, Shell and Exxon Mobile to suspend their operations in these countries.
In addition the spread of weapons, daily labour strikes and inexperience in the democratic practice has forced many armed militias to threaten the elected authorities in these countries.
In regard to pairwise analysis of the sub – political factors it shows political instability in North Africa as the main concern with 60% eigenvalue followed by corruption and bureaucracy 32%, in government public organisation. The corruption is a consequence of an ineffective legal system and includes tax invasion which became a normal procedure in many government organisations especially in Libya.

The economic factor was ranked as the second important factor with eigenvalue of 24%. The earlier discussion of the issues that emerged from the political factors has directly affected the economic development in these countries. Because these countries depend mainly on its natural resources and tourism to boost its economy, the political unrest is mainly responsible for economic stability and sources of income. Furthermore these countries depend on direct government support, therefore without economic instability it is impossible to set up or develop a new strategy or business.
The main sub factors within the economic factor are; limited sources of GDP 70.5% and international investment 23.4%. Limited national resources have been seen as a threat to social stability as people of these countries are waiting for their salaries at the end of each

month and the government is required to pay a massive over-staffed public organisation. Moreover the Tunisian and the Libyan governments recently announced that they might be unable to pay salaries of people due to insufficient funds.

Technology is the third important factor with eigenvalue of 19%. The current undeveloped laboratories and limited qualified people in these laboratories made respondents rank this factor as very important to a sustainable accreditation body. The operation of a national accreditation body depends on well and modern equipped laboratories according to ISO 17025 laboratories accreditation. These laboratories are the backbone of the accreditation body as to be able to check whether a specific applicant for ISO certification is compliant with relevant ISO requirements including readiness of laboratories and establishments. Improving infrastructure was ranked as the most important sub factor within technology with eigenvalue of 72% followed by technology development 23%. A well-developed national infrastructure contains a dependable information technology, well established transportation system and a reliable utility and services system. However, the lack of well-developed infrastructure has affected and delayed different sustainable development programs especially in Libya.

The last important factor is Legal which achieved 9% Eigenvalue. Having discussed the three above mentioned factors, respondents felt that the legal factor fell fourth in priority. Although there is a legal system in these countries, the separation between the judiciary and executive powers , eigenvalue 26.5 %, and inefficiency of the juridical system, eigenvalue 67.2%, remains a debatable issue between different political parties and civilian societies in these countries. Respondents claimed that an independent and strong legal system including an independent appeal system such as the Financial Ombudsman and the High Court in the UK

will give confidence to both local and international investors. Moreover it would assist in decreasing corruption and establishing a pathway in merging local organisations into international organisations such as International Accreditation Forum and the International Laboratory Accreditation Cooperation through adherence to local and international relevant ISO requirements and protection of producers' trademarks.

The discussion above covered the four high priority PESTILE factors and sub – factors. As mentioned in chapter 5 the other PESTILE factors which scored little eigenvalues were discarded as respondents felt that these factors have little impact on a sustainable accreditation body in North Africa.

These four factors have given the name PETL which represent Political, Economic, Technology and Legal. The four external environmental factors will be linked to the sustainable accreditation framework.

6.3 Proposed sustainable accreditation framework

The structure of the proposed sustainable accreditation framework figure 6.1; is based on the conceptual framework in chapter 2, different analyses methods of internal quantitative, qualitative data and external PESTILE factors. The building of the proposed framework was based on the selection of critical factors emerging from different cross validated methods as discussed earlier in chapter 5.

Although there are many important factors that were extracted by the PCA, the Bayesian analysis of the data has resulted in specific critical factors, Organisation culture change, Technical factors and Planning, and these factors are the main internal drivers for the framework and directly affect the national accreditation.

The external PESTILE factors were also categorised by AHP and the Bayesian analysis. Political and Legal are the main external drivers for the sustainable framework. However,

Economic and Technology are forming a sub – drivers and are directly affected by the Political component. These are the components comprising of critical factors, as shown in figure 6.1, that need to be consulted by the decision makers (TUNAC management, Libyan prime minister) and the politicians before setting any proposed accreditation framework in the developing countries.

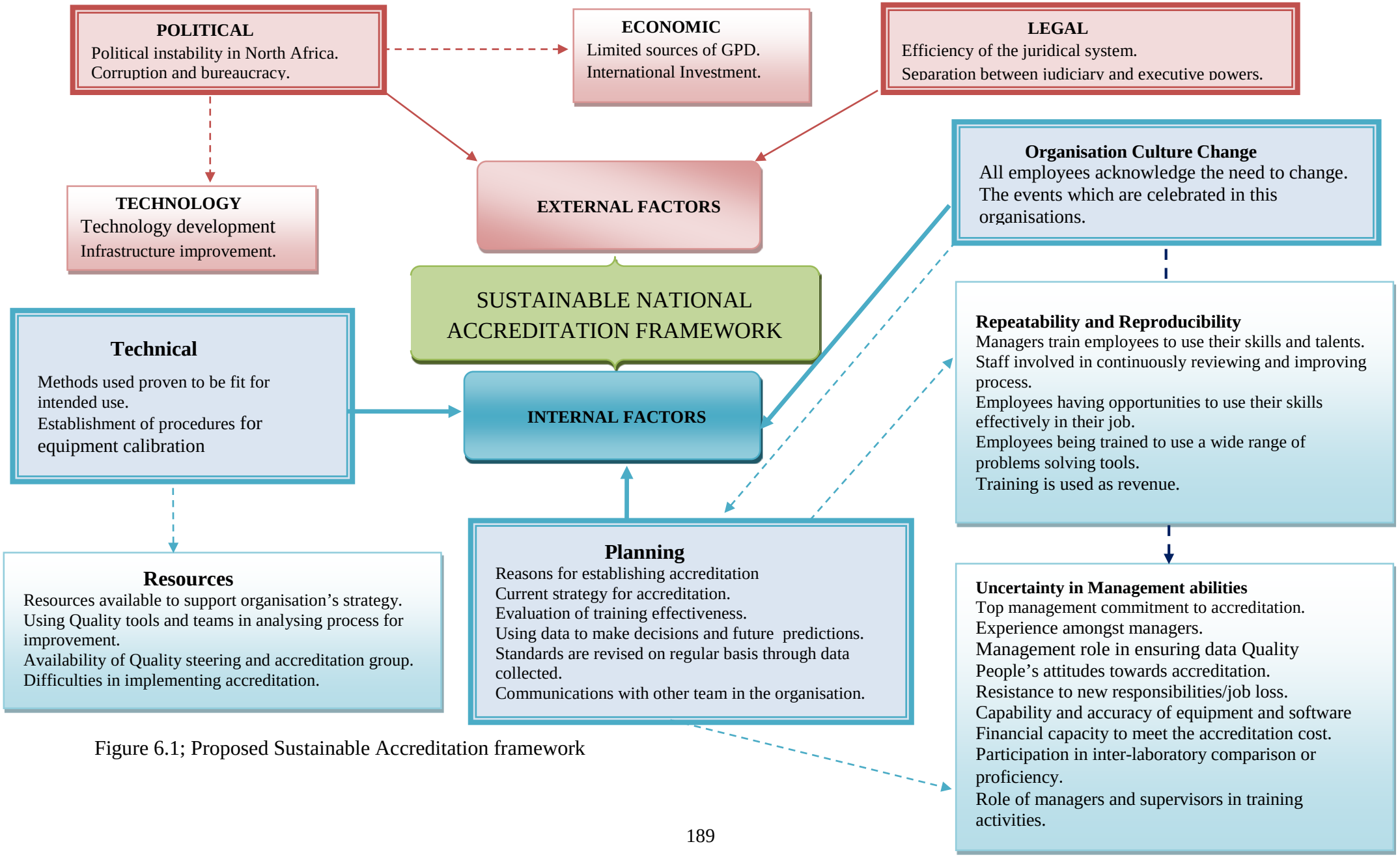


Figure 6.1; Proposed Sustainable Accreditation framework

6.4 General discussions

Accreditation in general is a new phenomenon in the developing countries. However developing a sustainable national accreditation framework is new research even in the developed countries. Moreover the different research methodologies used and the statistical analysis tools coupled with the external PESTILE analysis support the findings of this research.

Although accreditation has been adopted for many years in the developed countries, there are few publications that discuss issues with accreditation. At the start of this research the author was struggling to find secondary data or empirical researches that discuss national accreditation. however, limited publications and consultation of literature including Quality Assurance has helped in gathering factors that are believed to be important to developing a quality assurance framework. This was supported by undertaking primary research to collect primary data from an existing accreditation body in the developing countries.

On the other hand, Tunisia has already established its accreditation body, however the establishment of the Tunisian body was made by the French Accreditation body.

It was necessary to undertake an empirical research in one of the developing countries that has already established its own accreditation body and collect primary data based on a conceptual framework extracted from literature review. The feature that was planned in building this framework is to be sustainable and not to face the challenges that encountered accreditation bodies in Brazil and Zambia.

Based on the conceptual framework and the appropriate research methodology, the research adopted a triangulation research strategy. The quantitative primary data collected through questionnaires were analysed by different analytical statistical tools to (1) draw different

conclusions, (2) cross validation of results and (3) interrelationship between factors and extract drivers.

The results of the quantitative analyses were also cross validated through the qualitative research through predetermined semi structured interviews. This was to support and retest the findings of the quantitative analyses.

In order to validate the findings of the qualitative data, two statistical analytical methods were used. This has shown that the interviews results support the quantitative results as per the conceptual framework in chapter 2.

Having found the internal critical factors that affect a sustainable accreditation framework then it was necessary to investigate the external environment which is necessary to be investigated before setting up any new business or framework to validate its workability and sustainability. The findings of the PESTILE analysis were also cross validated by two statistical methods and have led to external primary research with most important factors that affect any new business in North Africa.

The research methodologies and approaches used in this research coupled with primary research in one of the developing countries and external environmental factors made it unique and unprecedented with such research in the past.

Previous research has tended to concentrate on proposing frameworks or strategies without drafting questionnaires to be used by a prospective company as a guide for conformance. In the next section the author will draft a questionnaire that can be extracted from the proposed framework and can be used by prospective accreditation bodies as a road map for development.

6.5 Proposed Questionnaire for a sustainable accreditation

Based on the conceptual questionnaire that was discussed in chapters 2,3 and 5, and the proposed framework in figure 6.1, the author has designed a draft questionnaire to be used as a reference and guidance tool for any prospective accreditation bodies to determine if they are in a fit state to proceed and check their current accreditation status.

The aim of the questionnaires shown in table 6.1 and table 6.2 respectively, is to evaluate the readiness to develop a sustainable national accreditation body and evaluate laboratory knowledge.

6.5.1 Questionnaire structure

The questionnaire consists of two main parts. Part 1 covers external PESTILE variables that are believed to be affecting directly sustainable accreditation bodies. The main sections of this part are the external drivers of the proposed framework in figure 6.1.

Part two of the questionnaire shown in table 6.1 covers the internal drivers of the proposed framework shown in table 6.2. These internal drivers are clustered under 7 main themes and encompass 28 critical factors.

The scoring system adopted for this questionnaire is three point fit scale. The reason behind that is the need to confirm which of these factors are accomplished and verified and which are not.

Scoring system

1	2	3
Yes	No	Do not know

6.5.2 Questionnaire on Factors Affecting a sustainable Accreditation Body

Please put "**x**" in the box that expresses your opinion based on the scoring system described above.

Part (A) External influences

Section (1)	**Political**			
Factor Elements		**1**	**2**	**3**
P1	Political Instability			
S2	Corruption and Bureaucracy			
Section (2)	**Economic**			
Factor Elements		**1**	**2**	**3**
E1	Limited sources of GPD**.**			
E2	International Investment			
Section (3)	**Legal**			
Factor Element		**1**	**2**	**3**
L1	Efficiency of the juridical system			
L2	Separation between judiciary and executive powers.			
Section (4)	**Technology**			
Factor Element		**1**	**2**	**3**
T1	Technology development			
T2	Infrastructure improvement.			

Table 6.1; External Factors

Part (B) Internal influences

Section (5)	**Organisation Culture Change**			
Factor Elements		**1**	**2**	**3**
O1	All employees acknowledge the need to change.			
O2	The events which are celebrated in this organisations.			
Section (6)	**Technical**			
Factor Elements		**1**	**2**	**3**
Y1	Methods used proven to be fit for intended use.			
Y2	Establishment of procedures for equipment calibration.			
Section (7)	**Planning**			
Factor Elements		**1**	**2**	**3**
P1	Reasons for establishing accreditation.			
P2	Current strategy for accreditation.			
P3	Evaluation of training effectiveness.			
P4	Using data to make decisions and future predictions.			
P5	Standards are revised on regular basis through data collected.			

P6	Communications with other team in the organisation.			
Section (8)	**Repeatability and Reproducibility**			
	Factor Elements	**1**	**2**	**3**
R1	Managers train employees to use their skills and talents.			
R2	Staff involved in continuously reviewing and improving process.			
R3	Employees having opportunities to use their skills effectively in their job.			
R4	Employees being trained to use a wide range of problems solving tools.			
R5	Training is used as revenue.			
Section (9)	**Uncertainty in Management abilities**			
	Factor Elements	**1**	**2**	**3**
U1	Top management commitment to accreditation.			
U2	Experience amongst managers.			
U3	Management role in ensuring data quality.			
U4	People's attitudes towards accreditation.			
U5	Resistance to new responsibilities/job loss.			
U6	Capability and accuracy of equipment and software.			
U7	Financial capacity to meet the accreditation cost.			
U8	Participation in inter-laboratory comparison or proficiency.			
U9	Role of managers and supervisors in training activities.			
Section (10)	**Resources**			
	Factor Elements	**1**	**2**	**3**
S1	Resources available to support organisation's strategy.			
S2	Using quality tools and teams in analysing process for improvement.			
S3	Availability of quality steering and accreditation group.			
S4	Difficulties in implementing accreditation.			

Table 6.2; Internal Factors

These two parts of the questionnaire need to be addressed by prospective accreditation bodies, furthermore different parts of this questionnaire should be considered by relevant departments within accreditation bodies. However the internal part of this questionnaire should be addressed by decision makers (TUNAC management, Libyan prime minister) to road map future strategic plans.

By answering this questionnaire , a prospective accreditation body can map current barrier(s), weakness(s) and strength(s). Moreover it can be amended and used as reference for an organisational performance checklist.

6.6 Summary

The research of the literature has shown that Accreditation's growth has been significant, despite the pluralist and contingency theorists advocating a less mechanistic approach to management. The growth of Accreditation is closely linked to quality development and International Trade, although the philosophies of each may be contradictory. Existing Accreditation Standards continue to evolve and new Standards are devised that encompass new areas of management activity.

The main outcome of this research has been the development and testing of a proposed framework and a questionnaire for selecting improvement initiatives. This framework can assist prospective accreditation bodies to thoroughly choose a suitable improvement plan for their organisation. The conceptual framework underpinning the proposed framework was grounded in quality management and organisational culture change, Technical and PESTILE literature, which creates a comprehensive framework.

The next chapter will summarise the research findings and make conclusions on outcomes of this research. Moreover it will make recommendation to policy maker of future opportunities based on this research and specify prospects on future research.

CHAPTER 7 - Conclusions and Recommendations

7.1 Chapter outline

This chapter concludes the thesis by describing the achievements of the research, meeting research aims and objectives, difficulties and limitation of this research, contribution to knowledge and suggestions of where other researchers could build upon this foundation.

7.2 Summary of the research findings

The main outcome of this research has been the development and clarification of a sustainable framework and a decision aid for selecting improvement initiatives. This framework can assist managers to systematically choose suitable improvement programmes for their company. The conceptual background underpinning the selection framework was grounded in quality management, organisational structure, strategic planning, and operations strategy literature, which provide a comprehensive set of selection views.

The research methodological approach was based on structuring a draft questionnaire based on a conceptual framework and then further amended as per the pilot study (from respondents) recommendations. Then the final format of main questionnaire, Appendix 2, was adopted and used in the main field study in this research.

The proposed framework was developed in three phases: establishing a conceptual framework based on literature review, developing a framework, and testing the framework through qualitative approach.

Firstly**,** detailed literature studies explored the influential factors of quality management approach, and established the initial conceptual background. The literature revealed that the development of quality practices and awareness of international standardisation and ISO

certification in the developing countries, specifically Arab countries, are considered slow (Awadelkarim, 2007). The reasons behind that, as explained in chapter 2, can be classified as lack of culture change and uncertainty in management. These factors are extracted from different articles claimed to be critical to any quality practice in the developing countries.

For instance Shihub (2009) claimed that the two main issues impeding quality development in the Arabic countries are lack of familiarisation of ISO standards and lack of adequate training to implement ISO standards. Moreover the scarcity of empirical research on accreditation programmes in the African and Arabic countries have contributed to management abilities in these countries as the author discovered in his field study in Tunisia in 2011.

Secondly, a case study followed by interviews with managers and lead engineers all provided in-depth knowledge of accreditation and quality practices in the organisations concerned. Then a comprehensive framework was constructed, which was theoretically and empirically grounded. The framework indicated internal and external important criteria: Technical, Resource, Planning, uncertainty in management abilities, Repeatability and reproducibility, organisation culture change, Political, Legal, Economic and Technology factors.

They were then incorporated with a qualitative results, which provided a structured process and a logical evaluation method for the selection of the critical factors. Results from the proposed framework demonstrated high practicability, usability, and utility of the decision aid and the selection framework as it were extracted through primary research..

The literature research did not identify a definition of a generic sustainable accreditation scheme that was in common use and could be utilised to guide this research. Indeed, there was no clear taxonomy of factors that are critical to accreditation to underpin the definition process. Therefore, the first task of this research, as detailed in chapter 2, was to establish a

workable taxonomy of critical themes and use this to categorise the various factors involved. This enabled the key components of accreditation themes to be identified as a prelude to establishing a framework.

The investigation of the PESTILE environmental external factors adopted in this research were not reflected in research undertaken to date. The methodological approach used for the external factors was based on reviewing the current PESTILE environment in two North African countries. This was followed by building a theoretical PESTILE framework based on critical environmental factors extracted from the literature. Then it was necessary to test this framework through respondents in these countries to prioritise factors in the theoretical framework. The cross validation of different statistical methods to validate PESTILE results have augmented the originality of the sustainable accreditation framework.

It important to clarify and contrast the state of the political situation in the UK and North Africa and its affect to a sustainable accreditation body. The findings of this research found that political stability in North Africa is critical factor. In contrast political situation in the UK is not a critical factor because of the stability of the political system in the UK.

7.3 Meeting the research aims and objectives

The process of management is defined as *"deciding what should be done and then getting other people to do it"* Rosemary Stewart, (1963) cited in Marshal (2006).

The adopted research methodology, quantitative, qualitative and external PESTILE factors, used in this research was identified in chapter four to answer the research question (s), aim (s) and objectives. The research was successful in answering the research questions set off in chapter 1 through questionnaires and interviews conducted through a case study in Tunisia. Also the research aim and objectives were achieved by the conceptual framework and a case study strategy.

The primary objectives of this research were summarised in chapter 1 and were addressed in the following ways:

1. To investigate the growth and development of quality and accreditation and whether there is any evidence that they deliver a sustainable accreditation scheme.

In addressing the first objective this research has focussed attention on many quality practices and ISO Standards background in both developed and developing countries and its confusing range of Standards-setting bodies such as ISO, ISO/IEC and ILAC.

The literature research identified the origins of the main critical factors through a chronological background that includes quality management and quality assurance and accreditation and draws upon the literature to show the linkages between them. Attention was drawn to the disparity between research into ISO 9001, ISO 17011 and the integration of these standards to develop an accreditation scheme and organisation culture responsibly, with the absence of empirical research into the interaction between these factors and those of external PESTILE factors.

In so doing it has highlighted the dilemma that policy makers face when trying to decide between the different international standards to be adopted as a national strategic development without the benefit of a clear road map to guide them through the maze of international standards that are promoted by various leading industrial countries. Such a road map should come from research into sustainable accreditation of which there is none and this research provides a first step by providing a classification of critical factors to accreditation to categorise internal and external factors and then providing a definition of a generic quality accreditation network for research purposes.

2. To analyse the Political, Economic, Social, Technological, International, Legal and Environmental external factors that affect setting up new businesses in North Africa.

In addressing the second objective it was necessary to undertake a comprehensive theoretical PESTILE review of developing countries in North Africa. This has led to the development of a generic PESTILE framework based on hierarchy and Bayesian analysis. The use of the PESTILE framework benefits the sustainable accreditation framework in that it provides a base for successful implementation of a sustainable accreditation scheme.

This research has therefore tried to refocus the integration debate beyond the technical aspects of integration that have dominated the literature, by highlighting that there are a number of environmental barriers that must be investigated and these possible tensions must be acknowledged and addressed if a viable generic framework is to emerge in the future.

3. To undertake research into the Tunisian Accreditation Council to determine its ability to bring about sustainable organisational improvements and its suitability as approach to implement the principles of a sustainable accreditation scheme.

The main focus of this thesis was to explore critical factors to a sustainable accreditation. This was an important and major piece of research that has achieved the following:

In view of the absence of any other published research into a sustainable accreditation scheme, it was important that the research undertaken as part of this project was comprehensive and robust. Consequently, the entire population was surveyed and a methodology applied that was designed to deliver a high rate of response. In the final analysis a response rate of 84% was achieved, which provided reliable data that enabled a wide range of statistical analysis to be undertaken. The results of the research are therefore authoritative and have been extensively cross-validated to identify significant factors that answered the questions posed by this research aim. These results were comprehensively laid out in chapter

5 and suggest that the current accreditation scheme in North Africa has not achieved sustainability.

4. To explore the possible future direction that the Management of the TUNAC will take in relation to the creation of new driving improvement or the consolidation of existing strategy.

The final objective of the research was achieved by undertaking semi-structured interviews with management and lead engineers from TUNAC who were willing to participate to compare their perceptions with the views of the main population of the research. Notwithstanding the limitations presented by the small sample and methodology adopted for this part of the research that have been set out in detail above, the interviewees who did contribute are the policy makers of the TUNAC and in a unique position to influence the strategic planning of the TUNAC and endorse ways to improve. This is a very important relationship that has a direct bearing on the way that the results of the interviews with the policy makers are interpreted.

Although the management of TUNAC and policy makers of the ministry of industry in Tunisia recognise the importance and benefits of improving current organisation performance, there are some critical factors that need to be addressed by the general policies of the country. The interviewees highlighted benefits of this research as the first to investigate accreditation development in the developing countries and recommendations of this research will be sent to the policy makers to be considered for possible future development.

It was necessary to discuss the above mentioned principles of what has been achieved from this research in order to benefit from its recommendations in reengineering current processes adopted by the organisation. The future directions of the TUNAC, as outlined by the head of the TUNAC, is uncertain in the near future due to uncertainty in the government's short term plans as a result of recent political change in the region.

7.4 Contributions to knowledge

The original motivation for this research was stimulated by an awareness of the imposition of international barriers on countries that have not yet been accredited to relevant international standards.

The work of previous research into accreditation was not sufficient, yet as this research has revealed, the focus of this previous research was confined to specific standards such as ISO/IEC 17025 and there has been no previous research into a sustainable accreditation body as an entity according to ISO/IEC 17011. This research has identified this gap and has given important recommendations to decision makers (TUNAC management, Libyan prime minister) towards providing a more rounded and encompassing view of accreditation by defining and providing the term sustainable accreditation framework. There was also a perception that the trend for adopting the QMS-ISO 9001 in different developing countries is pointed towards a movement that would eventually seek to establish recognition and emergence of their products in international markets. The research clarified this perception and this thesis contributes to the debate on the future of quality development in the developing countries.

This research into a sustainable accreditation scheme in North Africa provides valuable empirical evidence of the results of the only identified attempt to map most of the key functions of current management practices within an sustainable framework.
It suggests integration of many of the standards and philosophies i.e., ISO 9001, TQM national quality award and other similar standards in the developing countries to form a distinctive example of a national development quality scheme.

The research includes additional novelty through investigating PESTILE factors by contrasting the perceptions of the managers implementing ISO/IEC 17011 Standard with the

perceptions of the main population of the research tasked with monitoring that implementation and provides empirical evidence of the major differences between these perceptions that existed.

It has drawn attention to the significant adoption of standards and QM on an increasingly international basis over the last forty years;

It has alerted other researchers to the absence of any independent research into a sustainable accreditation scheme during this prolonged period of its development and consolidation.

- It has exposed national accreditation to detailed and critical review.
- It has clarified its effectiveness as an integrated management development road map;
- It has tested its effectiveness as a quality assurance implementation tool;
- It has drawn attention to where this research compliments research into other quality initiatives;
- It has identified a number of areas that would benefit from further research.

7.5 Difficulties and Limitations

During the course of this research there were some difficulties faced by the author specifically during reviewing literature and collecting data, these are summarised below.

- The scarcity in literature of empirical researches on accreditation and the unique nature of the research put extra burdens on the researcher to review a large number of topics on different approaches, practices and cultures applied. This large extent of literature review took a considerable amount of time to structure a conceptual framework.

- The data were collected during the political crisis in North Africa and the author was unsure in obtaining a high response rate (84%).
- Contacting management of organisations was a difficult task as it required passage through bureaucratic procedures.
- The drying up of financial support from Libyan government forced the author to work part time to support his family and completing his research.

7.5.1 Limitations of the research

The author assumed that all the respondents were knowledgeable enough in Quality principles and tools to enable them to give, to their best, true answers. However during the questionnaires and interviews briefings, the researcher noticed that some of the respondents were not well familiar with the extent to which internal and external factors are important in setting up sustainable quality initiatives. This is because the organisation recurrent training was mostly focused only on ISO 17011 implementation.

The focus of the research has been limited to the engineering and technology sector as including a national accreditation body that covers all sectors such as personnel and inspection coupled with external PESTILE investigation is affected by time constraint of the PhD timescale and available resources.

The applicability of the findings to situations and accreditations bodies outside the developing countries context remains unclear whether or not this applicability would extend to the developed countries. In addition the large number of variables used in this study was time consuming to deal with and hence different cross validated statistical methods were used in order to justify the selection criteria of the reduced variables. This was due to the unavailability of a previous test variables to use and any future studies on this area should reduce the variables size.

7.6 Recommendations for future research

This research has introduced the concept of sustainable accreditation and the research of the international accreditation acceptance phenomenon should be given wider attention than has not been the case in the past. This research suggested that future studies should include other sectors of accreditation such as personnel and inspection to produce an integrated National Accreditation Body.

Further research is needed to implement the findings of this empirical research into a business plan that sets out criteria for implementation for specific requirements.

Areas of further research could include a comparative study to compare the findings of this study with a study in the developed countries to see the differences between developed and developing countries including the PESTILE analysis.

The findings of the Bayesian analysis highlighted that organisation culture change, technical and strategic planning are main drivers for a sustainable accreditation framework, therefore further research is required to explore the influence of the cultural environment and to see how to compromise between employees' social values with organisation policies and practices.

The limitation of this research may establish a basis for prospective research and further investigation to compare and contrast the findings of this study with an existing national accreditation body.

Finally, in order for the Libyan government to benefit from the weaknesses of other accreditation bodies and to be able to compete in providing accreditation services to African countries the researcher suggests that an integrated body should include the result of this study with a further study into SWOT analysis to see strengths, weaknesses, opportunities and threats in the African region.

References

Abbas, A. (1996). Organisational development in the Arab world. The journal of management development. Vol.15, No.5, pp.4-21.

African Development Bank, (2012). Tunisia: Economic and Social Challenges Beyond the Revolution. [Online] Available at; http://www.afdb.org/fileadmin/uploads/afdb/Documents/Publications/Tunisia%20Economic%20and%20Social%20Challenges.pdf. [Accessed 15 February 2012].

Alamin, S. (2012). Development of a sustainable water management strategy in the Alwahat area of Libya. PhD thesis, Nottingham Trent University.

Aggelogianno "D et al ., (2006) . Implementation of Quality management system according to the ISO 9000 family in a Greek small-sized winery: A case study. *Food Control*, 18 (9), pp1077-1085.

Al-Khalifa, K.N. and Aspinwall, E.M. (2000). The development of Quality management in Qatar. Total Quality management. Vol.12, No. 3, pp194.

Alani, R. A. and Ilusanya, G. (2008). Accreditation outcomes, Quality of and access to university education in Nigeria. Quality assurance in education journal. Vol. 16 No. 3, 2008.

Anschutz, Eric (1995), TOM America, Mcguinn & McGuire Publishing Inc., USA.

Antony, J., Leung, K., Knowles, G. and Gosh, S. (2002). Critical success factors of TQM implementation in Hong Kong industries. International journal of Quality and reliability management. Vol. 19, No.5, pp.551-566.

Al-khawaldeh, K. (2002) TQM and labor productivity in Jordanian industrial companies TQM Magazine, 14, pp 248-262.

Al-Omaim, N. (2002) An empirical investigation of total Quality management implementation in the Kingdom of Saudi Arabia, Unpublished PhD thesis, Bradford, University of Bradford. UK.

Al-Zamany Y., Hoddell E. and Savage B., (2002), "Understanding the difficulties of implementing Quality management in Yemen", The TQM Magazine, Vol.14, No.4, PP.240-247.

Amar K. and Zain M., (2002), "Barriers to implementing TQM in Indonesian manufacturing organisations", The TQM Magazine, Vol. 14, No.6, Pp 367-372.

Amaratunga, D., Baldry, D., Sarshar, M. & Newton, R. (2002). Quantitative and qualitative research in the built environment: application of “mixed” research approach, Work Study, 51(1): 17-31.

Arieff, A. (2011). Political transition in Tunisia, Congressional research service. [Online]

Available at: Political Transition in Tunisia [Accessed 12 February 2012].

Awadelkarim, K. S. A. (2007). The development of Quality management in Sudan: An empirical study of implementation factors. PhD thesis, The University of Nottingham.

Awan, M. U., Raouf, A., Ahmad, N. and Sparks L. (2009). Total quality management in developing countries: A case of pharmaceutical wholesale distribution in Pakistan International Journal of Pharmaceutical and Healthcare Marketing. Vol. 3. No 3. Pp 363-380.

Baidoun, S. (2003). "An empirical study of critical factors of TQM in Palestinian organizations". Logistics information management, vol.16 No.2, pp156-71.

BBC, (2006). Libya's thirst for 'fossil water'. [Online] Available at: http://news.bbc.co.uk/1/hi/sci/tech/4814988.stm. [Accessed 6 April 2012].

Behrens, F., and Wloka, M. (2010) How IAF and ILAC manage the recognition of regional accreditation groups: the peer evaluation system of IAF and ILAC for regional accreditation groups. Accreditation Quality Assurance. Springer-verlag, 15: pp. 57-66.

Bell, J. (2005). Doing your research project: A Guide for first-time researchers in education, health and social science. 4th ed. McGraw-Hill International. Berkshire England.

Bellou, V.,(2008). Identifying organizational culture and subcultures within Greek public hospitals. Journal of Health Organisation and Management, 22 (5), pp.496-495.

Biazzo, S. (2005).The new ISO 9001 and the problem of ceremonial conformity: How have audit methods evolved? Total Quality Management. Vol. 16, No. 3, pp. 381-399.

Bievre, P. D. (2008) Does accreditation ensure competence in measurements? Accreditation and Quality Assurance Journal. Springer-verlag, Vol, 16. No, 1. pp. 1-2.

Blunt, P., and Jones, M.L. (1992), Managing organizations in Africa. Walter de Gruyter, Berlin.

Bogdan, R. C. and Biklen, S. K. (1998),'Qualitative research for education: An introduction to theory and methods, Allyn and Bacon, Boston.

Brinkmann, K. (1997) how to achieve world-wide mutual recognition of calibration and test results – or: who accredits the accreditor? Springer-verlag, 2: 224-233.

Brunsson, N. and Jacobson, B. (2000) A World of Standards. Oxford University press. New York.

Bryman, A., (1988), Quantity and Quality in Social Research. Unwin Hyman. London.

Bryman, A (2001). Social Research Methods. Oxford University Press. Oxford.

Bryman, A. and Bell, E. (2011). Business research methods. Oxford University Press. 3rd

edition. Oxford.

BSI (2013). Standards matter to consumers: how standards benefit us all, every day. [Online] Available at: http://www.bsigroup.co.uk/LocalFiles/en-GB/consumer-guides/resources/BSI-consumer-brochure-standards-matter-to-consumers-UK-EN.pdf. [Accessed 17 November 2013].

Burton, D. (2000). Research training for Social Scientists: a handbook for postgraduate research. Sage. London.

Burges, T. (2001). A general introduction to the design of questionnaires for survey research. University of Leeds. http://iss.leeds.ac.uk/downloads/top2.pdf

Business Monitor International (2012). Libya In-depth country-focused analysis. [Online] Available at: http://www.businessmonitor.com/libya . [Accessed 20 November 2013].

Chalermchan, W., Pitak, S. and Sungkawasee, S. (2007), "Evaluation of Thailand national external Quality assessment on HIV testing", International Journal of Health Care Quality Assurance, Vol. 20 No. 2, pp. 130-40.

CIA Report (2012) Report on Libya, [Online] Available at: https://www.cia.gov/library/publications/the-world-factbook/geos/ly.html. [Accessed 2 February 2012].

Cohen, L. and Manion, L. (1994) Research Methods in Education, Routledge, London.

Cohen, L., Manion, L. and Morrison, K. (2011). Research Methods in Education, 7th edition, Routledge, London

Collis, J. and Hussey, R. (2003), Business Research: A Practical Guide for Undergraduate and Postgraduate Students, Palgrave Macmillan, , Hampshire.

Collis, J. and Hussey, R. (2009). Business Research: A Practical Guide for Undergraduate and Postgraduate Students. 3rd edition, Palgrave Macmillan, Hampshire.

Cortez, L. (1999). The implementation of accreditation in a chemical laboratory. Trends in analytical chemistry, vol. 18, #. 9-10.

Creswell, J. W. (2003) Research design: qualitative, quantitative and mixed method approaches 2nd ed. Sage Publications.

Crosby, P.B. (1995). Quality without Tears. McGraw-Hill, New York, NY.

Crosby P., (1996), "Quality is Still Free: Making Quality Certain in Uncertain Times", McGraw-Hill, New York, USA.

Curry, A and Kadash, N. (2002) Focusing on key elements of TQM-evaluation for sustainability, The TQM Magazine, vol. 14, No. 4, pp. 207-216.

Dale, B. G., Wiele, T. and Iwaarden, J. V. (2007). Managing Quality, 5th ed. Blackwell Publishing, Oxford, UK.

Davies, T. & Nutley, M., (2000). Organisational culture and Quality of health care. Quality in Health Care, 9 (2), pp.111-119.

Dayton, N. A. (2001). Total Quality management critical success factors, a comparison: The UK versus the USA. Total Quality management. Vol.12 No.3, pp.293 – 298.

Deming W., (1986), "Out of the Crises", Cambridge; Cambridge University Press.

Denscombe, M. (2007). The good research guide for small –scale social research project. 3rd edition. McGraw –Hill Education. Berkshire.

Drnovesk, J. (2008) on the specific experience of national metrology institute with national accreditation bodies. Accreditation Quality assurance. Springer-verlag, 13: 321-325.

Easterby-Smith, M., Golden-Biddle, K., and Locke, K. (2008). Working with pluralism: determining quality in qualitative research. Organisational Research Methods, 11(3): 419-429.

Edwik, A., A. (2007). Oil Dependency, Economic, Diversification and Development: A Case Study of Libya. PhD thesis. The University of Salford.

Egnaibor, K. (2002), Barriers of TQM Implementation in Libyan Industry, Proceedings of Training for Quality Conference, Benghazi, Libya.

Elsmuai, T., and McCollin, C. (2014). Bayesian Modelling of a Quality Accreditation framework. International journal of Quality Engineering and Technology. Vol, 4 No, 3, pp, 181 – 199.

Elfatthaly, I. (1978). Political Development and Bureaucracy in Libya, 2nd edition, Lexington,
Mass, GB.

Erel, E. and Ghosh, J.B. (1997). “ISO 9000 implementation in Turkish industry”. International journal of operation and production management.Vol.17, No12, pp.123 46.

European Accreditation (2012). [Online] Available at:
http://www.european-accreditation.org. [Accessed 20 January 2012].

Evans, J., Lindsay, W. (2005).The Management and Control of Quality. Thomson South-Western, Ohio

Feigenbaum, A.V. (1991) Total Quality control, 3rd edition. McGraw-Hill, New York.

Field A. (2005) Discovering Statistics Using SPSS, 2nd ed., London.

Foreign & Commonwealth Office (2011). Libya: country profile. [Online] Available at:

http://www.fco.gov.uk/en/global-issues/mena/libya/ [Accessed 6 February 2012].

Funk, W., Dammann, V. And Donnevert, G. (2007) Quality Assurance in Analytical Chemistry Second Edition. Wiley-VCH Verlag GmbH and co. KGaA. Germany.

Garvin, D. (1988). Managing Quality: The Strategic and Competitive Edge, The Free Press, New York.

Gallear, D. and Ghobadian, A. (2004). An empirical investigation of the channels that facilitate a total Quality culture. Total Quality Management, 15(8): 1043-1067.

GATT (2011). The Uruguay Round. [Online] Available at: http://www.wto.org/english/thewto_e/whatis_e/tif_e/fact5_e.htm. [Accessed, 11/May/2011].

General Public Committee, (2005) Annual Congress report, Tripoli, Libya.

Gee, J. P. (2010). An introduction to discourse analysis: theory and method. 3rd edition. Routledge Taylor and Francis group. London, UK.

Gnieber. O. K. (1998) "World class manufacturing techniques: Their potential and Transferability in the context of a developing country (Libya). PhD thesis. University of Bradford.

Glover L. and Siu N., (2000), "The human resource barriers to managing Quality in china", International Journal of Human Resource Management, October, Pp.867-882.

Goetsch, D. & Davis, S. (2000). Quality Management: Introduction to Total Quality Management for Production, Processing and Services. 3 ed. New Jersey, USA.: Prentice Hall.

Gosen, J., Babbar, S. and Parsad, S. (2005).” Quality and developing countries: the role of international and organizational factors”. International journal of Quality and reliability management. Vol.22, No.5, pp.452-464.

Guasch, j., l. (2007) Quality systems and standards for a competitive edge. The International Bank for Reconstruction and Development / the World Bank, Washington, DC.

Guardian (2011). Muammar Gaddafi timeline. [Online] Available at: http://www.theguardian.com/world/2011/oct/20/muammar-gaddafi-timeline [Accessed 20 November 2012].

Gyani, G. (2008) Effectiveness of QMS certification process. Total Quality Management, Vol. 19, No. 3, pp. 236-279.

Hague, P. (1993). Questionnaire design: the market research series. Kogan Page Ltd. London.

Hair, J., William, B., Babin, B.,and Anderson, R. (2009). Multivariate Data Analysis,7th Edition. Prentice Hall. NJ.

Harris, P. R., Moran, R. T. and Moran, S. V (2004) Managing Cultural Difference-Leadership

Strategies for a New World of Business, Elsevier Butterworth - Heinemann, pp. 106-273.

Henson, S., and Loader, R. (2001) Barriers to agriculture exports from developing countries: The role of sanitary and phytosanitary requirements. World Development. Vol, 29, No.1, pp, 85-102.

Hibou, B., Meddeb, H. and Hamdi, M. (2012).Tunisia after 14 January and its social and political economy. Euro-Mediterranean human rights network Available at: [Online] Tunisia after 14 January and its social and politic [Accessed 25 March 2012}.

Hibbert, D., B. (2007) Quality assurance for the analytical chemistry laboratory. Oxford University press, Inc. New York.

Hofstede G.H. and Minkov M. (2010) Cultures and Organisations: Software of the Mind, London: Intercultural cooperation and its importance for survival.3rd edition. McGraw- Hill. New York.

Hokoma, R., Khan, M., and Hussain, K. (2008). Investigation into the implementation stages of manufacturing and Quality techniques and philosophies within the Libyan cement industry. Journal of Manufacturing Technology Management. Vol. 19, No.7, pp.893- 907.

Hokoma, R., Khan, M., and Hussain, K. (2010). The present status of Quality and manufacturing management techniques and philosophies within the Libyan iron and steel industry. The TQM journal. Vol.22 No. 2.

Holst, E., et al, (2001). On conformity testing and the user of two stage procedures. International Statistical Review. Vol, 69, No.3. pp. 419-432.

Hoyle D., (2001), "ISO 9000: Quality system handbook", 4th edition, Butterworth-Heinemann, Oxford, UK.

Hufbauer, G., C., et al, (1995) Standards, conformity assessment and trade into the 21st century. National Academy press, Washington DC.

Hunter, R. D. (2009) Standards, conformity assessment, and accreditation for engineers. CRC press Taylor and Francis group. USA.

Hurd, W. L. (1992). Quality in the Asia Pacific". International journal of Quality and reliability management. Vol.9, No.3, pp.14-20.

Hussey, J. and Hussey, R. (1997), Business Research: A Practical Guide for Undergraduate and Postgraduate Students, Macmillan Press, London,

IAF **(**2012). IAF after 20 years. [Online] Available at: http://www.iaf.nu/articles/IAF_after_20_years/311 [Accessed 02 January 2012].

Idris M., Suliman A. and Othman M., (2004), "Simplifying the Process of ISO 9001:2000 Auditing Using Expert System Technology", 9th International Conference on ISO 9000 and TQM, 5-7 April 2004 at the Siam-City Hotel, Bangkok, Thailand.

IEC (2008) conformity assessment for developing countries, 3rd ed, Switzerland.

ILAC (1999). Transition to ISO/IEC 17025:2005. [Online] Available at: https://www.ilac.org/transitionto17025_2005.html {Accessed on 01/06/2010}.

ILAC, (2012). (International Legal assistance consortium). Libya - Rule of law priorities. [Online] Available at: http://www.ilac.se/download/reports_documents/mission-reports_documents/Libya_ff_report_111221.pdf. [Accessed 5 March 2012].

International Monetary Fund, (2013). Libya, [Online] Available at: http://www.imf.org/external/pubs/ft/scr/2013/cr13150.pdf [Accessed 16 May 2013].

ISI (2013). Developing Countries. [Online] Available at: http://www.isi-web.org/component/content/article/5-root/root/81-developing. [Accessed on 09/05/2011].

ISO (2013). Standards. [Online] Available at: http://www.iso.org/iso/home/standards.htm [Accessed 20 May 2013].

ISO 9001 standard, (2000), "Quality management systems-Requirements", International Organisation for Standardization, Geneva, Switzerland. [Online] Available at: http://www.iso.org/iso/catalogue_detail?csnumber=21823 [Accessed on 05 July 2010].

ISO/IEC 17011(2011). Accreditation Bodies-General requirements. [Online] Available at: https://bsol.bsigroup.com/Bibliographic/BibliographicInfoData/000000000030036994 [Accessed 20 July 2011].

ISO/IEC 17025(2011). Laboratory Accreditation-General Requirements. [Online] Available at: https://bsol.bsigroup.com/Bibliographic/BibliographicInfoData/000000000030159674 [Accessed 20 July 2011].

Jacobson, S. (2004) accreditation of calibration laboratories to normative documents: diversity or standardisation. Springer-verlag, 9:427-428.

Jorgensen, M. and Phillips, L (2002). Discourse Analysis as Theory and Method. sage publications. London, UK.

Jovanovic, M. (2005) comparative analysis of laboratory accreditation in Bulgaria, Lithuania, Slovakia and Serbia and Montenegro. Springer-verlag, 10: 125-129.

Joseph, A.D. and William, W.B. (2004). Juran institute's Six Sigma Breakthrough and beyond: quality performance breakthrough methods, McGraw-Hill, London.

Juran, J. M. (1986). "Quality Trilogy". Quality progress. Vol.19 No. August, pp19-24.

Juran, J. M. (1995). A history of managing for Quality. ASQC Quality press. Wisconsin.

Juran J. and Godfrey A. (2000) Juran's Quality Handbook. McGraw-Hill International

Editions, 5th edition, New York.

Kaiser, H. (1974) An index of factorial simplicity. Pschometrika, Vol. 39, No. 1, 31–6.

Kanitvittaya, S. and Sukasi, U., et al (2010) laboratory Quality improvement in Thailand's northernmost province. International journal of Health Care Quality Assurance. Vol, 23 No. 1, pp. 22, 34.

Karaszewski, R. (2004), "Factors Limiting Diffusion of Quality Management Systems", 9th International Conference on ISO 9000 & TQM, 5-7 April 2004 at the Siam-City Hotel, Bangkok, Thailand.

Kartha, C. P. (2002). "ISO 9000:2000 Quality management systems standards: TQM focus in the new revision". The journal of American Academy of business. September. pp.1-6.

Kelly, W. and Asce, P. (2007) Certification and accreditation in civil Engineering. Journal of Professional Issues in Engineering Education and Practice. Vol, 133, No. 3, pp. 181-187.

Kenett, R. Perruca, G. Salini, S. (2011) Bayesian Networks in modern analysis of customer satisfaction surveys; John Wiley and Sons, Chichester: UK.

Kenett, R. and Salini, S. (2012) Modern analysis of customer surveys: with applications using R. John Wiley and sons, Ltd.

Kenett, R. and Salini, S. (2011). Modern analysis of customer surveys: with applications using R. John Wiley and Sons. NY

Kinnear, T. C. and Taylor, J. (1996). Marketing Research, An Applied Approach, 5th edition, McGraw-Hill inc, United States,

Klenovsky, P. (2006) Conformity assessment and metrology: update on the state of affairs. Accreditation Quality Assurance. Springer-verlag, 11: pp. 525-533.

Kline, P. (1998) An Easy Guide to Factor Analysis, Routledge, London.

Krasachol, L. (1999). "The development of Quality management in Thailand". PhD thesis. The University of Nottingham.

Kumar, R. (2005). Research Methodology : A Step-by-Step for Beginners. 2nd edition. SAGE Publications, Limited, London.

Lai, T. Y. (1996). "Management strategy for manufacturing industry: Kaizen, reengineering or ISO 9000?" Proceedings of Pacific conference on manufacturing, Seoul, pp.417-8.

Laszlo G., (2000), "ISO 9000-2000 version: implications for applicants and examiners", The TQM Magazine, Vol.12, No.5, Pp.336-339.

Lee P. and Quazi H., (2001), "A methodology for developing a self-assessment tool to measure Quality performance in organisations", International Journal of Quality &

Reliability Management, Vol.18, No.2, Pp.118-141.

Libyan Government (2010). Libyan Quality Award. [Online] Available at: www.gpc.gov.ly [Accessed 20 June 2010].

LNCSM (2010). Libyan National Centre for standardization and Metrology. [Online] Available at: http://www.lncsm.org.ly/saturn_8870/lncsm.html [Accessed on 12 October2010].

Locke, J. (1998) Development of laboratory accreditation in the United States. Springer-verlag, 3: 356-361.

Madu C., (1997), "Quality Management in developing economics", International Journal of Quality Science, Vol.2, No.4, Pp.272-291.

Magd, H. A. E. and Curry. (2003). "An investigation of ISO 9000 adoption in Saudi Arabia". Managerial auditing journal. Vol. 21, No.2, pp.132-47.

Magd, E., (2008). ISO 9001 :2000 in the Egyptian manufacturing sector: perceptions and perspectives. Quality & Reliability Management, 25 (2), pp.173 - 200.

Marshall, H. (2006). Evaluating management standards: empirical research into the Scottish Quality Management System (SQMS). Ph. D. thesis, University of Stirling.

Maull R. Brown P. and Cliffe R. (2001) Organisational culture and Quality improvement, International Journal of Operations and Production Management, Vol. 21, No. 3, Pp. 302- 326.

McCollin, C. and Disney, J. (2004). An availability study for a SME. Total Quality Management, Vol, 15, No. 3, pp 391-403.

McKay, A. (2000). "Should the Survey Measure Total Household Income?" In Designing Household Survey Questionnaires for Developing Countries: Lessons from 15 Years of the Living Standards Measurement Study, ed. M. Grosh and P. Glewwe. Washington, DC: The World Bank.

Mersha. T. (2000). "Quality, competitiveness' and development in sub – Saharan". Industrial management and data systems. Vol.100, No.3, pp119-124.

Mersha, T. (2007). Narrowing ISO certification gap in Africa. International journal of productivity and Quality management. Vol. 2 No.1; pp 65-80.

Ministry of Environment, Tunisia. Environment report. [Online] Available at : http://www.environnement.gov.tn/index.php?option=com_content&task=view&id=78&Itemid=97._[Accessed 6 March 2012].

Ministry of finance, Tunisia. [Online] Available at: http://www.douane.gov.tn . [Accessed 7 February 2012].

Ministry of foreign affairs, Tunisia. [Online] Available at: http://www.diplomatie.gov.tn/index.php?id=4&L=2. [Accessed 7 March 2012].

Ministry of information and communication technologies, Tunisia). [Online] Available at: http://www.mincom.tn/index.php?id=11&L=2. [Accessed 8 February 2012].

Ministry of Social Affairs, Tunisia. [Online] Available at: http://www.social.gov.tn/index.php?id=3&L=1. [Accessed 3 February 2012].

Ministry of Transportation, Libya. Transportation infrastructure in Libya. [Online] Available at: http://www.ctt.gov.ly. [Accessed 16 March 2012].

Montagu, D. (2003). Accreditation and other external Quality assessment systems for health care. Health Systems Resource Centre. London.UK.

Morris A., Crawford J., Carter D. and Mazotta F., (2000), "Management decisions for effective ISO 9000 accreditation", Management Decision, Vol.38, No.3, Pp.182-193.

Monitor (2013). Africa's best 10 countries named. [Online] Available at: http://www.monitor.co.ug/News/Africa-s-best-10-countries-named/-/688324/2016336/-/hdk91y/-/index.html. [Accessed 20 November 2013].

Muse, R. (2008) What's in a Name: Accreditation vs. Certification? Available on { http://anab.org/media/4332/muse.pdf} Accessed on 15/10/2010.

Najeh, R. and Kara-Zaitri, C. (2004) An empirical investigation of critical Quality factors in Libyan organisations, the national conference on Total Quality Management in Libya, Society for Quality Management, Tripoli, Libya.

Najeh, R., I. (2006). A road map for the effective adoption of total Quality management in Libyan oil industries. PhD thesis. The University of Bradford.

Najeh, R. and Chkib K.Z. (2007). A Comparative Study of Critical Quality Factors in Malaysia, Palestine, Saudi Arabia, Kuwait and Libya. Total Quality Management. Vol. 18, Nos. 1–2, 189–199, January–March 2007.

Najmi, M. and Kehoe, D. (2000). An integrated framework for post-ISO 9000 Quality development. International Journal of Quality & Reliability Management, 17 (3), pp.226-258.

Naoum, S. G. (1998) Dissertation Research and Writing for Construction Students, Butterworth-Heinemann, Oxford.

National Oil Corporation, (2005). Annual Report 2004-2005, Tripoli, Libya.

Ndaba, J. (2001). "An empirical study of TQM implementation in Southern African Development Community (SADC), context: A proposed model of best practice' PhD thesis, Bradford University.

Neergaard, P. (1999). Quality management: a survey on accomplished results. International

journal of Quality and reliability management. Vol.16, No.3, pp.277 – 289.

Newbold, P. (1988). Statistics for business and economics. 2nd ed. Printice Hall Inc. NJ.

Nizam, M. and Tannock, J. (2005). TQM best practices: Experience of Malaysian SMEs. Total Quality management. Vol.16, No.4, pp.491 – 503.

Norussis, M.J. (2011) IBM SPSS Statistics 19 Guide to Data Analysis, 1st edition. Pearson Prentice Hall. NJ.

NRC (1995). Standards, Conformity Assessment, and Trade into the 21st Century. National Academy Press, Washington DC.

Oakland J. S. (2000), "Total Quality management - Text with cases", 2nd Edition, Butterworth-Heinemann.

Oakland, J. (2004) Oakland on Quality Management. Elsevier Butterworth-Heinemann. Oxford.

Ohtsubo, T. (1997) The Japan Accreditation Board for conformity assessment –Introduction to the Japan accreditation system. Accreditation Quality Assurance. Springer-verlag, 2: pp. 111-114.

Oleynik, I. S., Alexandar, N. (2006). Doing business and investigating in Libya guide. 2nd Edition. International Business Publications, Washington, USA.

Ordoobadi, S. (2009). Application of Taguchi loss functions for supplier selection. International journal of supply chain management. Vol. 14 No: 1, pp.22 - 30

Oxford Business Group, (2010). The Report: Libya 2010. Oxford Business group. ISBN: 978-1-907065-23-1.

Paccioni, A. et al (2008). Accreditation: a culture control strategy. International journal of health care Quality assurance. Vol.21 No. 2, 2008.

Pallant, J. (2010). The SPSS survival manual: A step-by-step guide to data analysis using SPSS for Windows (version 15). 3rd edition. McGraw-Hill International , Berkshire.

Pember, M. (2006).Sorting out the standards: what every records and information professional should know. Records Management Journal, Vol. 16, No. 1, pp. 21-33.

Perucca, G., and Salini, S. (2014). Travellers' Satisfaction with Railway Transport: A Bayesian Network Approach. Quality Technology and Quantitative management, Vol. 11, No. 1, pp. 71-84.

Pomed, (2012). The Revolution and the Law in Libya. [Online] Available at: http://pomed.org/wordpress/wp-content/uploads/2012/02/POMED-Notes-The-Revolution-and-the-Law-in-Libya.pdf. [Accessed 22 February 2012].

Prasad S. and Tata J., (2003), "The role of socio-cultural, political-legal, economic and

educational dimensions in Quality management", International Journal of Operations and Production Management, Vol.23, No.5, Pp.487-521.

Punch, K. (2001). Introduction to social research: quantitative and qualitative approach. Sage publications ltd. London.

Ramadan, A. (2002). Human Resource Planning and Staffing Practice in Libyan Public Sector Organisations. PhD. Thesis, Liverpool John Moores University, UK.

Rusjan, B. and Alic, M. (2010). Capitalising on ISO 9001 benefits for strategic results. International Journal of Quality and Reliability Management. Vol. 27 No. 7, pp. 756-778.

Saaty, T. (2008). Decision making with the analytic hierarchy process. Int. J. Services Sciences, Vol. 1, No. 1. PP. 83 – 98.

Salini, S. and Kenett, R. (2009) New Frontiers: Bayesian networks give insight into survey-data analysis, Quality Progress, pp.31-36.

Salaheldin, I. S. (2003). The implementation of TQM strategy in Egypt: a field – force analysis. Total Quality management. Vol.15, No.4, pp.266 – 274.

Sandholm, L. (1999). Section 37. Quality in Developing Countries. In Juran, J.M. and Godfrey, A.B. (Eds.) Juran's Quality Handbook. 5th Ed. New York: McGraw-Hill.

Saunders, M., Lewis. P. and Thornhill, A. (2003). Research Methods for Business Students. 3rd edition, Prentice Hall. Edinburgh.

Saunders, M. N. K., Lewis, P., and Thornhill, A. (2007) Research methods for business students 4th ed. London: Financial Times/Prentice Hall.

Saunders, M., Lewis. P. and Thornhill, A. (2009). Research Methods for Business Students. 5th edition. Prentice Hall. Edinburgh.

Sayeh, F.S., Dani, S. and Swain, E. (2005) 'TQM management culture within Libya The National Conference on Total Quality Management in Libya Tripoli, Libya, The Society for Quality Management

Sayeh, F., S. (2007) Investigating the factors affecting the development of A National Quality Award (NQA) In Libya. PhD thesis. Loughborough University.

Schmidt, A. et al (2006) surveys on the accreditation of providers of proficiency testing and external Quality assessment schemes. Springer-verlag, 11: 379-384.

Scutari, M. (2010). Learning Bayesian Networks with the bnlearn-R- Package. Journal of Statistical Software, Vol,35. No. 3, pp. 1-22.

Seddon, J. (1997). In pursuit of quality, the case against ISO 9000, Oak Tree Press. Dublin, Ireland.

Sekaran, U. (2003) Research Methods for Business. A Skill Building Approach,

4th edition, Hoboken, NJ: John Wiley and Sons.

Sharif, I. M. (2005). The Barriers Affecting the Implementation of Quality Management System-ISO 9000 in Libyan Manufacturing Public Sector Organisations. PhD Thesis, the University of Salford.

Sharif, I. M. (2009). Total Quality management in Libya: A study of its use in the electrical power generation industry. PhD thesis. Glasgow Caledonian University.

Sherif, K. F. (2010). Total Quality management and construction project in Libya. PhD thesis. The University of Plymouth.

Shihub, T., R. (2009). An investigation of the attitudes of laboratory staff to the establishment of accredited laboratories in the Libyan chemical and petrochemical industries. PhD thesis, University of Salford, Salford, UK

Sidney, S. (2003).The role of independent laboratory association in the standards, metrology, Quality assurance and accreditation environment. Accreditation Quality Assurance. Springer-verlag, 8: 272-275.

Sierra, E. (1999).The Quality-related international trade agreements of the World Trade Organisation and their implications for Quality professionals. The TQM Magazine. Vol, 11, No.6, pp. 396-401.

Slagter, S. and Loeber, J. G. (2001) Accreditation of medical laboratories in the Netherlands. Clinica Chimica Acta 309 (2001) 155-161.

Spivak, S. M. And Brenner, f. C. (2001) Standardization Essentials: principles and practice. Marcel Dekker, Inc. New York.

Squirrell, A. (2008) Conformity assessment: providing confidence in testing and calibration. Springer-verlag, 13: 543-546.

Stake, R. (2006). Multiple case study analysis. The Guilford press, New York.

Sun, H., Li, S., Ho, K., Gertsen, F., Hansen, P. and Frick, J. (2004), “The trajectory of implementing ISO 9000 standards versus total quality management in Western Europe”, International Journal of Quality & Reliability Management, Vol.21, No.2, pp.131-153.

Tantoush, J. O. et al (2009). The impact of sanctions on buyer – supplier relationship within the Libyan oil industry. International journal of Energy sector management. Vol. 3 No. 2, 2009.

Tannock, J. and Ahmed, K. S. (2008). Quality management in the Arabic speaking countries. Journal of transnational management. Vol. 13 (3). 2008.

Tayeb, M. H. (1996) The Management of a Multicultural Workforce, Wiley, Chichester.

Tayyara G. Nasser A. and Ghadban G. (2000).The Quality and its role in economic

development. [Online] Available at: http://www.mafhoum.com/syr/articles/tayara/tayara.htm [Accessed on 06 April 2011].

Terterov, M. and Wallace, J. (2002), Doing Business With Libya", Kogan Page Ltd, 120 Pentonville Road, London N1 9JN, England, UK.

Terziovaski, M. and Samson, D. (1999). The link between total Quality management practice and organizational performance. International journal of Quality and reliability management. Vol.16, No.3, pp.226 – 237.

Thiagarajan, T., Zairi, M. and Dale, B. G. (2001)." A proposed model of TQM implementation based on an empirical study of Malaysian industry" International journal of Quality and reliability management, Vol, 18, No.3, pp.289-306.

Ticehurst, G. W. and Veal, A. J. (2000). Business Research Methods: a managerial approach, Longman, Pearson Education Limited.

Transport Portal Tunisia, [Online] available at: http://www.transport.tn/index.php?option=com_content&view=article&id=56&Itemid=71&lang=ar. [Accessed 4 February 2012].

Trompenaars, F., (1993), Riding the Waves of Culture: London: Economic Books.

Tunisian Government Portal. [Online] Available at: http://www.tunisie.gov.tn/index.php?option=com_ministeres&Itemid=382&task=view&id=12&lang=arabic [Accessed 11 February 2012].

Tunisian Justice portal. Justice in Tunisia. [Online] Available at: http://www.e-justice.tn/index.php?id=3. [Accessed 9 February 2012].

UKAS (2012) What is Accreditation? [Online] Available at: http://www.ukas.com/about-accreditation/What_is_Accreditation/What_is_Accreditation.asp [Accessed on 20/01/2012].

UNIDO (2005). Laboratories Accreditation Program in Libya, Industrial Research Centre, United Nations Industrial Development Program, UNIDO. [Online] Available at http://www.un.org/africa/osaa/reports/UN%20folder2006-UNIDO.pdf [Accessed on 15/07/2010].

UNDP, (2005) Programme on Governance in the Arab Region, Libya Judiciary. [Online] Available at: http://unpan1.un.org/intradoc/groups/public/documents/un/unpan023273.pdf

Vlachos, N.(2002). Is ISO/IEC 17025 accreditation a benefit or a hindrance for the testing laboratories? The Greek experience. Journal of Food Composition and Analysis, 15, pp.749-757.

Viadiu, F., and Saizarbitoria, I. H. (2006). "ISO 9000 and ISO 14000 standards: An international diffusion model". International journal of operation and management. Vol.26, No.2, pp.414-165.

Wallace, J. and Wilkinson, B. (2004). Doing business with Libya. Kogan page Ltd. London.

Warwood, S. J. and Roberts, P. A. B. (2004). A survey of TQM success factors in the UK. Total Quality management.vol.15. No.5, 1109 – 1117.

Walliman, N. (2005). Your Research Project. 2nd edition. Sage Publications Ltd. London.

Withers, E. B. and Ebrahimpour, M. (2001) Impacts of ISO 9000 registration on European firms: a case analysis. Integrated Manufacturing Systems, 12, pp 139-151.

Wiele A., Williams A., Brown A. and Dale B. (2001), "The ISO 9000 series as a tool for organisational change: Is there a case", Business Process Management Journal, Vol.7, No.4, Pp.323-331.

Woan-Yuh, J, and Lin, C., (2008). An integrated framework for ISO 9000 motivation, depth of ISO implementation and firm performance: The case of Taiwan. Manufacturing Technology Management, 19 (2), pp.194 - 216.

Wodak, R. and Meyer M. (2009). Methods of critical discourse analysis. 2nd edition. Sage publication limited. London, UK.

World Bank (2012). Unemployment rate in Tunisia. [Online] Available at: http://search.worldbank.org/all?qterm=unemployment+in+tunisia [Accessed 20 August 2012].

World Bank (2013). Internet users. [Online] Available at: http://data.worldbank.org/indicator/IT.NET.USER.P2 [Accessed 20 January 2013}.

Wright, J. (1982) Libya: a modern history. Croom Helm, Bechenham.

WTO (2000). work programme on non-tariff measures. Available at: http://www.wto.org/english/news_e/pres00_e/pr198_e.htm[Accessed 03 August 2010].

Yahya S., Goh W., (2001), "The implementation of an ISO 9000 Quality system", International Journal of Quality & Reliability Management, Vol.18, No.9, Pp.941-966.

Yin, R. (2003). Case study research – design and methods. Sage publication, California.

Youssef, S. (2006). Total Quality Management Framework for Libyan Process and Manufacturing Industries. PhD thesis. Cranfield University.

Youssef, Samir M., (1996), Structural Reform Programme of Egyptian state-Owned Enterprises, Journal of Management Development, 15, 5.

Zairi, M., (1996), Economic Development and Global Competitiveness: Why Should Arab Managers Take Note of Total Quality management, The Fourth Arab management conference, 16-18 July, University of Bradford, UK, pp. 408-23.

Appendix 1: Questionnaire

Investigating the factors affecting the development of a sustainable National Accreditation Body in the developing Countries

Dear respondent…..

I am reading for a PhD degree entitled as above at the School of Science and Technology, Nottingham Trent University in the United Kingdom. This research is conducted under the supervision of Dr Christopher McCollin and Dr Eugene Lai

The questionnaire aims to investigate the factors that affecting the development of a sustainable accreditation body in the developing countries. Tunisian accreditation council and Laboratories sector are the main focus for this study as an example of the developing nations. Please answer all questions as honestly as possible. All information given will be treated confidentially and will be used for the purpose of this study only. Indeed, the result of the questionnaire will be kept confidential and the researcher guarantees that the identity of the respondent will not be disclosed to any other persons at any time.

An important part of this empirical research is the analysis of the questionnaire; this is to be sent to key organisation in Tunisia. Your assistance in completing the attached questionnaire will be highly appreciated. All responses will remain absolutely confidential. In return the researcher will send you a summary analysis of the questionnaire, which I hope be useful for you. I will collect your filled questionnaire in person. So, if you need any help with this questionnaire, do not hesitate to contact me.

Thank you for completing this questionnaire, your support and co-operation is highly appreciated.

Mr Tarek Elsmuai
PhD Researcher
School of science and Technology
Nottingham Trent University
00447828223693
Tarekelsmuai@yahoo.co.uk
N0140441@ntu.ac.uk

NOTTINGHAM TRENT UNIVERSITY

التحقيق في العوامل التي تؤثر على انشاء هيئة اعتماد وطنية مستدامة في البلدان النامية

عزيزي المشارك في الاستبيان....

انا طالب احضر للحصول على درجة الدكتوراه بعنوان 'على النحو الوارد أعلاه' في كلية العلوم والتكنولوجيا ، جامعة نوتنغهام ترنت في المملكة المتحدة. هذا البحث يجري تحت إشراف الدكتور كريستوفر مكولين والدكتور يوجين لاي.

الاستبيان يهدف إلى التحقيق في العوامل التي تؤثر على انشاء هيئة اعتماد وطني مستدامة في البلدان النامية. مجلس الاعتماد الوطني التونسي ومختبرات القطاع ستكون هى التركيز الرئيسي لهذه الدراسة كمثال على الدول النامية.

الرجاء الإجابة على جميع الأسئلة وبصراحة ممكنة. سوف تعامل جميع المعلومات المقدمة بسرية تامة وسوف تستخدم لأغراض هذه الدراسة فقط والباحث يضمن عدم كشف هوية أي شخص مشارك في هدا الاستبيان في أي وقت.

الجزء المهم من هذا البحث التجريبي هو تحليل الاستبيان ، الذي سيتم إرساله إلى هيئة الاعتماد الوطنى والمختبرات في تونس وسيتم مساعدتكم في استكمال الاستبيان المرفق. في المقابل فإن الباحث سيرسل لكم تحليلا موجزا من الاستبيان ، والتي آمل أن تكون مفيدة بالنسبة لكم.

سوف أقوم بجمع الاستبيان شخصيا، لذا إذا كنت بحاجة إلى أي مساعدة في هذا الاستبيان، لا تترددوا في الاتصال بي.

شكرا لملء هذا الاستبيان.

دعمكم وتعاونكم هو محل تقدير كبير

Mr Tarek Elsmuai
PhD Researcher
School of science and Technology
Nottingham Trent University
00447828223693
Tarekelsmuai@yahoo.co.uk N0140441@ntu.ac.uk

Name of Participant…….. Date……
Signature……...

Part A: Research Characteristics

Demographic characteristics:

الجزء الاول خصائص البحث

This section in the questionnaire is about you

Please put a **(√)** in the categories that apply to you

الرجاء قراءة الاسئلة الاتية والاجابة بوضع علامة(√) في المكان لمخصص.

اسم المؤسسة

Organisation name?

…….

عدد الموظفين بالمؤسسة

Size of organisation (number of employees)?

……..

ماهي وظيفتك

What is your occupation profession?

……..

ما هو اعلى مستوى تعليمي تحصلت عليه

What is the highest level of your formal education?

……

من المستفيد من خدمات المؤسسة

How would you classify the major users of your laboratory service?

Local companies ☐ الشركات المحلية

personal ☐ شخصي

Foreign companies ☐ شركات أجنبية

other… أخرى

ماهي طبيعة عمل المؤسسة

What is your organisation scope of work?

Chemical ☐ كيميائي

Petrochemical ☐ بتروكيماويات

Calibration ☐ معايرة

Testing ☐ الاختبارات

Pharmaceutical ☐ دوائية

standardisation ☐ التقييس

other please specify…… صناعات أخرى ، يرجى تحديدها

Part B: Investigating Dimensions of laboratory accreditation)

الجزءالثانى: البحث والتحقيق في العوامل التي من الممكن ان تؤثر على انشاء الاعتماد الوطني واعتماد المختبرات.

Scoring System

1	2	3	4	5
Highly Dissatisfied **غير راضي جدا**	Dissatisfied **غير راضي**	Neutral, Neither satisfied/ nor Dissatisfied **لا راضي ولا غير راضي**	Satisfied **راضي**	Highly Satisfied **راضي جدا**

Our aim in this section is to evaluate the readiness to develop a National Accreditation Body and evaluate laboratory knowledge. Please put "**x**" in the box that expresses your opinion based on the scoring system described above.

البيانات الموضحة تصف عدة ظواهر متعلقة بالمجلس الوطني واعتماد المختبرات

Section (1) Job and management						
Factor Elements		**5**	**4**	**3**	**2**	**1**
S1	Job specified well **طرق العمل واضحة**					
S2	Job supervision **الاشراف على العمل**					
S3	Respecting employees **ولاء واحترام ادارة المجلس او المختبر تجاه العاملين**					
S4	Awards and promotion are based on job performance. **الترقيات والمكافاءات تتم على اساس الاداء**					
S5	Employees' developing and creation are rewarded. **المؤسسة تقوم بمكافاة العاملين لابتكارهم وابداعهم**					
S6	Organisation' goals are clear **اهداف المؤسسة واضحة للجميع**					
S7	Employees are working to achieve long term goals. **الجميع يعمل على تحقيق الاهداف طويلة الاجل**					
S8	Employees are involved in decision making. **اتخاد القرار يتم بشكل جماعي**					
S9	The promotions scheme. **الرضاء بطرق الترقية**					
S10	The amount of monthly salary **المرتب الشهري الدي تتقاضاه**					
S11	Employees' Financial compensation. **التعويضات المالية**					
S12	Satisfied to work in this organisation. **تفتخر بالعمل في هده المؤسسة**					
S13	How many days do you work (1,2,3,4,5,6,7), are you happy with this **عدد الايام التي تشتغل في الاسبوع وهل انت راضي عنها**					

Section (2): Organisational culture						
Factor Elements		**5**	**4**	**3**	**2**	**1**
O14	The relations with staff leaders. **العلاقة بين الموظف ورئيسه المباشر**					
O15	The relationship of individuals within team works. **العلاقة بين العاملين داخل مجموعات العمل**					
O16	Attendance of periodic meeting. **حضور الاجتماعات الدورية**					
O17	People behaviours during meetings. **سلوك وتصرفات الموظفين خلال الاجتماعات**					
O18	Celebration of organisation' related events. **الاحتفال بالمناسبات التي لها علاقة بالمؤسسة**					
O19	Accreditation Body/Laboratory work to standardisation is working well. **العمل نحو مواكبة المواصفات الدولية داخل المؤسسة او المختبر**					
O20	Upgrading to new requirements taking immediate action by management. **مواكبة المواصفات الدولية الحديثة داخل المؤسسة او المختبر يتم بشكل سريع**					
O21	Effectiveness of team meetings. **جدوى وفاعلية الاجتماعات الدورية**					
O22	Effective communication between employees and management. **وجود ادوات اتصال فعالة بين العاملين والادارة**					
O23	Co-operation Between different departments **مستوى التعاون بين جميع الادارات**					
O24	All employees acknowledge the need to cope with the international requirements for Accreditation Body and Labs. **كل الموظفين يقرون بالحاجة لمواكبة التطورات العالمية داخل المؤسسة او المختبر**					
O25	Clear management mission. **اهداف الادارة المستقبلية واضحة**					

Section (3): Technical factor						
Factor Elements		**5**	**4**	**3**	**2**	**1**
Y26	Physical conditions at work. **الظروف الطبيعية للقيام بالعمل**					
Y27	Time and resources to do your job properly. **وجود الموارد اللازمة والوقت للقيام بالعمل**					
Y28	Availability of space for doing all the activities. **وجود المساحة الكافية للقيام بكافة الاختبارات داخل المؤسسة او المختبر**					
Y29	Protection from internal and external pressures. **عدم وجود ضغط داخلي اوخارجي**					
Y3	Confidentiality of customer's information and proprietary rights. **سرية المعلومات الخاصة بالزبائن**					
Y31	Availability of utilities to use, such as electricity, water, gases ... etc.). **وجود متكامل للمرافق العامة مثل الكهرباء وغيرها**					

Y32	Availability of a policy and procedure for corrective action. **وجود اجراءات تصحيحية موثقة في حالة وجود اخطاء**					
Y33	Procedures to determine root causes of problems.					
Y34	Procedures for preventive actions. **وجود اجراءات توصل الى الاسباب الحقيقية للمشكلة**					
Y35	Procedures for documentation. **وجود اجراءات للتوثيق**					
Y36	Security and confidentiality of records. **حماية وسرية المعلومات والملفات**					
Y37	Schedule and procedure of periodic internal audits. **وجود اجراءات للتدقيق الداخلي**					
Y38	Methods used in Accreditation Body/Lab are proven to be fit for intended use. **كفاءة الطرق المستخدمة لأداء العمل**					
Y39	Procedures to estimate uncertainty of measurements in testing and calibration (Accreditation Body and labs) **وجود إجراءات التأكد من القياسات في الاختبارات والمعايرة**					
Y40	Consideration given of all uncertainty. **الارتياب في القياسات يؤخذ بعين الاعتبار**					
Y41	Proper measurement and test equipment. **اختبارات الاجهزة والقياسات تتم بشكل مضبوط**					
Y42	Capability and accuracy of equipment and software to perform intended tasks. **دقة وكفاءة الاجهزة والبرامج لإنجاز العمل المطلوب**					
Y43	Identity and documentation of equipment. **توثيق لكل المعدات**					
Y44	Procedures for equipment calibration. **وجود اجراءات لمعايرة الاجهزة**					
Y45	Procedure for calibration of reference standards. **معايرة المعايير المرجعية**					
Y46	Procedure for handling, transport, storage and use of reference standards. **وجود اجراءات ءامنة لاستخدام ونقل وتخزين المراجع القياسية**					
Y47	Sampling procedures.**طرق واجراءات اخد العينات**					
Y48	Procedures for the transportation and protection of test and calibration items. **وجود اجراءات خاصة بتخزين او اتلاف مواد الاختبارات**					
Y49	Using of certified references.**استخدام مواد مرجعية معتمدة**					
Y50	Participation in inter-laboratory proficiency testing. **المشاركة في اختبارات الكفاءة بين عدة مختبرات**					
Y51	Results being accurately reported. **نتائج وتقارير الاختبارات تكون معدة بشكل دقيق**					
Y52	Reports including information requested by customer. **التقارير تشمل جميع البيانات المطلوبة من الزبائن**					

Section (4): Strategic planning and communication						
	Factor Element	**5**	**4**	**3**	**2**	**1**
P53	Deployment of policy and strategy. وجود سياسة واستراتيجية بالمؤسسة					
P54	Quality mission, vision and policy وجود سياسة و رؤية مستقبلية للجودة بالمؤسسة					
P55	Communications with other team in the organisation. طرق الاتصالات مع الادارات الاخرى					
P56	Strategy development التطويرالمستمرلاستراتجية المؤسسة					
P57	Information and instructions coming from formal way (in-house bulletin, email. المعلومات والتعليمات داخل المؤسسة تأتى بطرق رسمية مثل البريد الإلكتروني والنشرات الدورية					

Section (5): Training and knowledge						
	Factor Elements	**5**	**4**	**3**	**2**	**1**
T58	Employees being trained to use a wide range of problems solving tools. يتم تدريب الموظفين على كيفية حل المشاكل					
T59	Employees having opportunities to use their skills effectively in their job. اتاحة الامكانيات للموظفين لإبراز قدراتهم ومهاراتهم					
T60	Managers training employees to use their skills and talents. يقوم مدراء الإدارات بتدريب العاملين بالإدارات ودللك لإبراز مواهبهم وامكانياتهم					
T61	Staff involved in continuously reviewing and improving process. يخضع جميع الموظفين لبرنامج دائم لتقييم وتحسين الكفاءة					
T62	Training is used as revenue. يتم استخدام التدريب كمصدر للدخل					

Section (6): Quality program						
	Factor elements	**5**	**4**	**3**	**2**	**1**
Q63	Emphasis on meeting customer needs when planning. التأكيد على تحقيق رغبة العملاء عند التخطيط					
Q64	Continuous Quality improvement. التطوير المستمر لبرامج للجودة					
Q65	Customers' satisfaction is important for long-term success. رضاء العملاء هدف رئيسي للمدى الطويل					
Q66	Success in the market place depends on high Quality, products and services. نجاح التسويق يعتمد على الجودة العالية للمنتجات والخدمات					
Q67	Employees understand customers' requirements. يدرك العاملون متطلبات الزبائن					
Q68	Organisation meets customer needs. ادارة المختبر تعمل على تحقيق رغبة الزبائن					
Q69	Quality is more important than volume of sales.					

	الجودة لها اهمية اكبر من حجم المبيعات					
Q70	Staff have the knowledge and aware of ISO/IEC 17025 and 17011.**العاملين لهم دراية ب**					
Q71	Commitment to excellent customer service. **الهدف هو افضل خدمات للزبائن**					
Q72	Continuous company improvement. **المؤسسة تقوم بتطوير دائم**					
Q73	Awareness of cost consciousness of the company. **الكل على دراية بالتكاليف والمصاريف داخل المؤسسة**					
Q74	Established procedures are important. **الاجراءات المتبعة داخل المؤسسة لها اهمية كبيرة**					
Q75	Quality of equipment and resources do the work. **الاجهزة والمعدات دات جودة عالية**					

Part C: An investigation of the common barriers affecting accreditation

C	Critical factors (C) that you feel are critical and absolutely essential. **عامل مهم جدا**
I	Important factors (l) that you feel are important but not essential. **مهم**
L	Less important factors (L) that you feel are of minor importance. **اقل اهمية**

Our aim in this section is to investigate the difficulties to establish accreditation. Please put "**x**" in the box that expresses your opinion based on the scoring system described above. **الغرض من هدا الجزء هو معرفة المعوقات التي قد تحول دون انشاء برنامج الاعتماد**

No	**Critical Factors**	**C**	**I**	**L**
F76	Employee Training and education. **تدريب وتعليم الموظفين**			
F77	Top management commitment and involvement. **تعهد ومشاركة ادارة المؤسسة**			
F78	Rapid and effective communication. **اتصالات فعالة وسريعة**			
F79	Technical expertise on ISO 17025 and 17011 implementation. **وجود خبرات فعالة لتطبيق**			
F80	Time and resources. **الوقت والموارد**			
F81	Documentation process. **اجراءات توثيق المستندات**			
F82	Cooperation and commitment of work force. **التعاون والعمل للتحقيق الاهداف**			
F83	International competition. **المنافسة العالمية**			
F84	Pressure from customers. **الضغط من الزبائن**			
F85	Ready market and poor competitive environment. **وجود سوق للمنافسة**			
F86	Governmental support to accreditation programmes. **دعم الدولة لبرامج الاعتماد**			
F87	Effective information. **وجود معلومات فعالة**			
F88	People's attitudes towards accreditation. **انطباع الناس حول الاعتماد**			
F89	Experience amongst managers. **المدراء دو خبرة عالية**			
F90	Resistance to new responsibilities/job loss.			

	ردة الفعل نتيجة لمهام جديدة او فقد العمل			
F91	Role of middle managers as motivators and transmissions. **دور رؤساء الاقسام في تطور الادارة**			
F92	Financial capacity to meet the accreditation cost. **القدرة المالية لمواجهة تكاليف الاعتماد**			
F93	Appropriate technical knowledge amongst workers. **العاملين لديهم** **المعلومات الفنية الكافية**			
F94	Awareness of accreditation at the management level. **ادارة المؤسسة لديها الدراية الكافية بعملية الاعتماد**			

Part D: General questions

اسئلة عامة

Q 4.1-Does your laboratory have a Quality planning, control or improvement system?
هل المختبر لديه نظام لتخطيط, التحكم او تطوير الجودة

No ☐ Yes ☐

If yes describe the system.....

If No, why .....

Q4. 2-Do you have an official copy of **ISO/IEC 17011 or 17025?**
هل لديكم نسخة رسمية من

Yes ☐ No ☐

Q4. 3- Are you aware of the National Accreditation Body's role and benefits?
هل انت على دراية بمهام ومنافع الاعتماد الوطني

Yes ☐ No ☐

Q 4 .4-Do you think that national accreditation body and laboratory accreditation will improve economy and promoting access to international markets?
هل تعتقد ان اعتماد المختبرات والاعتماد الوطني سيساهم في تطوير الاقتصاد والدخول الى اسواق عالمية

Yes ☐ No ☐

Why? .....
.....

Q4. 5- Would your organisation be willing to cooperate with any government-driven approach for promoting and implementing ISO/IEC 17011and 17025?
هل تعتقد ان مؤسستكم ستتعاون وتشارك مع أي برنامج وطني يهدف الى تفعيل الاعتماد الوطني

Yes ☐ No ☐

Q4.6- Would organisations in developing countries benefit from National Accreditation Body and make them competent?
هل تعتقد ان برامج الاعتماد في الدول النامية ممكن ان تستفيد من الاعتماد الوطني ويؤهلهم للمنافسة

Yes ☐ No ☐

Q4.7- What would be the barriers to implementing National Accreditation Body in a developing county? **ماهى بنظرك العوائق التى ممكن ان تحيل دون استحداث الاعتماد الوطني**

Yes ☐ No ☐

Q4.9- who would be Prospective customer? **من هم الزبائن المتوقعين**

Q4.8- what do you think about doing service for free i.e. writing documentation for instance ISO standards?
ما هو اعتقادك حول تقديم بعض الاعمال بدون مقابل كالمساهمة فى اعداد المواصفات الوطنية

Please use the following space if you have any other comments you would like to add.
ادا كانت لديك أي اضافة او تعليق الرجاء اضافتها هنا

.....
.....
.....

Thank you very much for you time and cooperation
شكرا جزيلا لمساهمتك في هدا الاستبيان

Appendix 2: Interview

Semi –Structured Interview

Interview Guide

This guide lists a pre-determined set of questions or issues that are to be explored during an interview. This guide serves as a road map and checklist during the interview and ensures that basically the same information is obtained from the interviewees in Tunisian organisations.

Interview date ……..

Name of Organization……
Name of Participant:……..
Phone: ……
Email: .....
Position/Title:.....

Introduction:

Good Morning/Afternoon. My name is Tarek Elsmuai From Nottingham Trent University and I am conducting this interview as part of my PhD research: "Investigating the factors affecting the development of a sustainable National Accreditation Body for engineering and technology laboratories in North Africa"

This morning/afternoon I would like to talk to you about your perception of your organization's implementation of Accreditation / laboratory accreditation or any other Quality management system used in your organisation.

This interview is completely voluntary and confidential if at any time you would rather not answer a question please say so. The information will be used for a report but I will not include your name.

The interview should last about 30-45 minutes and with your permission will be taped. With your agreement I will proceed with the interview.

Part A ..... Easy Start

Q1. What does the word "Accreditation" means to you?

……

Q2. Has your organisation implemented a formal accreditation or Quality management system?

Not planned □	in preparation □	already implemented □

Q3. Which Quality methodologies has your organisation used to drive improvement?

TQM □ Six sigma □ Re-engineering □

ISO- series □ Benchmarking □ 5S's □

ISO/IEC 17025 □ ISO/IEC 17011 □

Other

(specify) …….

Q4. What are the reasons for implementing Accreditation?

	Rank
1……	□
2……	□
3……	□
4……	□
5……	□

Q5. What are the benefits that your organisation gains with implementing your Quality system?

Improve productivity □ Improve Image □

Reduce. Complaints □ Better Teamwork □

Reduce return	□	Improve product reliability	□
Reduce cost	□	Increase market share	□
Clear roles	□	Flatter organization	□
Lower staff turnover	□	Improve product Durability	□

Q6. Difficulties faced by your organisation in the introduction of accreditation?

1……

2……

3……

Lack of top management	□	Customer unawareness	□
Government Policies	□	Organisation culture	□
Government support	□	Technical constraints	□
Lack of infrastructure	□	Lack of resources	□
Lack of training	□	Bureaucratic organisation	□

Part B Accreditation Themes

Top Management Commitment

Q7. Does your organisation as a whole have agreed strategy for accreditation?

……..

Q8. Who is responsible for driving improvement in your organisation?

Government policy □

Senior management □

Quality Department □

Customers' feedback □

Staff □ Other .....

Q9. To what extent is the top management committed to accreditation and Quality issues? ……

Top management discuss accreditation and Quality issues in top management meeting

( )

Q10. Quality infrastructure

Does your organisation have a Quality steering and accreditation group to oversee the Quality policy and implementing it?

……

To what extent resources are available to support organisation strategies?

……

Strategic planning and Communication

Q11. To what extent does your organisation use teams in analysing processes for improvement?

.....

Q12. To what extent does your organisation use Quality Tools?

Flow charts	□	Cause and-effect diagrams	□
Histograms	□	PDCA cycle	□
Scatter diagrams	□	Control charts,	□
Pareto charts	□	Affinity diagrams,	□
Run Charts	□	None of these	□

Others (specify)……

Training And Development

Q14. What is the role of managers and supervisors in training activities in their departments?

.....

Q15. What percentage of staff has received awareness training in accreditation and laboratory accreditation?

100% □ 75% □ 50% □ 25% □ 0% □

How many days per year do the following personnel spend on formal training?

Top management □

Middle management □

Supervisor □

Operators □

Q16. How is training effectiveness evaluated?

.....

Technical Factors

Q17. Does management play an active role in ensuring data Quality?

.....

.

Q18. To what extent does your organisation uses information to make decisions and future predictions?

.....

.

Q19. To what extent is information is easily available from various sources to all those that require it?

Q20. Does your organisation's standards are revised on a regular basis by using data collected?

.....

.

Confirm Confidentiality!!

Thanks

Appendix 3:

Pilot Analysis and meaning x's in the last two columns

A-TUNC / Variables	Satisfied	Unsatisfied	B- LCAE	Satisfied	Unsatisfied	Similar	Different
S1	60%		S1	45%		×	
S2		30%	S2	45%			×
S3	45%		S3	50%		×	
S4		45%	S4		55%	×	
S5	45%		S5		50%		×
S6	50%		S6		40%		×
S7	40%		S7		35%		×
S8	35%		S8	50%		×	
S9		35%	S9		40%	×	
S10		45%	S10		55%	×	
S11		40%	S11		65%	×	
S12	30%		S12	35%		×	
S13	30%		S13	30%		×	
O14	30%		O14		35%		×
O15	55%		O15	65%		×	
O16	60%		O16	50%		×	
O17	45%		O17	75%		×	
O18		45%	O18		55%	×	
O19	55%		O19		40%		×
O20	45%		O20		35%		×
O21		45%	O21	40%			×
O22		45%	O22	40%			×
O23		35%	O23	35%			×
O24	75%		O24	50%		×	
O25		40%	O25		30%	×	
Y26		30%	Y26	40%			×
Y27	35%		Y27		40%		×
Y28	50%		Y28	40%		×	
Y29	35%		Y29	35%		×	
Y30		30%	Y30	25%			×
Y31		40%	Y31	40%			×
Y32	50%		Y32	50%		×	
Y33	35%		Y33	40%		×	
Y34		30%	Y34		35%	×	
Y35		35 N	Y35	55%		×	
Y36	45%		Y36	40%		×	
Y37	50%		Y37	45%		×	
Y38		40%	Y38	45%			×
Y39	40%		Y39	40%		×	
Y40	45%		Y40	65%		×	
Y41		40%	Y41		30%	×	
Y42	30%		Y42		40%		×
Y43	40%		Y43	35%		×	
Y44	35%		Y44	55%		×	
Y45		40%	Y45	45%			×
Y46		45%	Y46	35%			×
Y47	65%		Y47	70%		×	
Y48	45%		Y48	30%		×	

A-TUNC/ Variables	Satisfied	Unsatisfied	B-LCAE/ Variables	Satisfied	Unsatisfied	Similar	Different
Y49		35%	Y49		35%	×	
Y50		35%	Y50	45%			×
Y51	70%		Y51	55%		×	
Y52	45%		Y52	70%		×	
P53	65%		P53	45%		×	
P54		35%	P54		35%	×	
P55	50%		P55	70%		×	
P56		40%	P56	45%		×	
P57		45%	P57	55%		×	
T58		35%	T58	40%			×
T59		40%	T59	35%			×
T60		45%	T60	45%			×
T61	35%		T61	40%		×	
T62		45%	T62		45%	×	
Q63	35%		Q63		30%		×
Q64		40%	Q64	45%			×
Q65		30%	Q65	55%			×
Q66	30%		Q66	45%		×	
Q67		40%	Q67	40%			×
Q68	35%		Q68	35%		×	
Q69	40%		Q69		40%		×
Q70	60%		Q70	80%		×	
Q71	30%	30%	Q71	30%		×	
Q72		35%	Q72		35%	×	
Q73		45%	Q73		40%	×	
Q74	45%		Q74	35%		×	
Q75	35%		Q75	40%		×	
F76	85%		F76	75%		×	
F77	65%		F77	55%		×	
F78		50%	F78		50%	×	
F79	55%		F79	50%		×	
F80	45%		F80		45%		×
F81		55%	F81		50%	×	
F82		60%	F82		40% LESS	×	
F83		45%	F83		55%	×	
F84		55%	F84	50%			×
F85		40% LESS	F85		40%	×	
F86	65%		F86	65%		×	
F87		60%	F87		40% LESS	×	
F88		45%	F88		50% LESS	×	
F89		40% LESS	F89		50%	×	
F90		45%	F90	45%			×
F91	45%		F91		40%		×
F92	65%		F92		50%		×
F93		45%	F93	60%			×
F94	55%		F94	55%		×	

Appendix 4: Principal Component Analysis

Kaiser- Meyer- Olkin Measure of Sample Adequacy. (KMO test) = .685		
	Component one Eigen value = 20.281	**Rotated component loading**
S9	The promotion opportunities	**.866**
S10	The amount of payment you earn	**.794**
S5	Employees rewarding for developing new ideas	**.750**
S8	Involvement of employees in decisions making	**.744**
S4	Advancements and promotion is on the basis of job performance only	**.729**
S11	Financial compensation	**.721**
S7	Clarity of long term goals to all employees	**.687**
	Component Two Eigen value = 7.887	
F89	Experience amongst managers.	**.843**
Y39	Existing of procedure to estimate uncertainty of measurements in testing and calibration.	**.832**
Y38	Method proven to be fit for intended use.	**.644**
F88	People's attitudes towards accreditation.	**.633**
F90	Resistance to new responsibilities/job loss.	**.545**
Y42	Capability and accuracy of equipment and software	**.505**
F92	Financial capacity to meet the accreditation cost.	**.499**
Y40	consideration given of all uncertainty components	**.493**
	Component Three Eigen value = 3.764	
F86	Governmental support programs to accreditation.	**.809**
Y36	Security and confidentiality of records	**.803**
Y37	Schedule and procedure of periodic internal audits.	**.696**
Y35	Procedures for Quality and technical records	**.616**
F87	Effective information.	**.532**
	Component Four Eigen value = 3.253	
T60	Managers training employees to use their skills and talents.	**.761**
T61	Staff involved in continuously reviewing and improving process.	**.680**
T59	Employees having opportunities to use their skills effectively in their job.	**.678**
T58	Employees being trained to use a wide range of problems solving tools.	**.614**
T57	Information and instructions coming from formal way (in-house bulletin, email.	**.527**
	Component five Eigen value = 3.058	
S2	The Quality of supervision	**.800**
S3	Loyalty and respect towards employees	**.779**
S1	Clearness of job description	**.772**
S6	knowing and understand goals	**.464**
	Component six Eigen value = 2.710	
F94	Awareness of accreditation at the management level.	**.838**
Y44	Establishment of procedures for equipment calibration	**.833**
Y41	Availability of the proper measurement and test equipment	**.549**
F91	Role of middle managers as motivators and transmissions.	**.529**
	Component seven Eigen value = 2.537	
O18	The events which are celebrated in this organizations	**.729**
O19	In this laboratory changing is faster and immediate	**.628**
O17	The people behaviours during meetings	**.567**
O21	Effectiveness of team meetings	**.556**
O22	Time of talking informally to senior managers	**.499**
O23	Co-operation Between different departments	**.437**
O20	Adjustment to new requirements	**.415**
O25	Management looking and seeking new ideas	**.403**
	Component Eight Eigen value = 2.319	
Q65	Customers' satisfaction is important for long-term success.	**.683**

Q66	Success in the market place depends on high Quality, products and services.	**.674**
Q64	Continuous Quality improvement.	**.549**
Q67	Employees understand customers' requirements.	**.504**
Q63	Emphasis on meeting customer needs when planning.	**.441**
F85	Ready market and poor competitive environment. F85	**.414**
	Component nine Eigen value = 2.289	
F82	Cooperation and commitment of work force.	**.742**
Y32	Availability of a policy and procedure for corrective action	**.740**
Y30	Protestation of client's information confidential and proprietary rights	**.470**
F80	Time and resources. F80	**.450**
	Component Ten Eigen value = 2.078	
P53	Deployment of policy and strategy.	**.733**
P54	Quality mission, vision and policy.	**.654**
Y52	Reports include information requested by client.	**.497**
	Component Elven Eigen value = 1.969	
F93	Appropriate technical knowledge amongst workers.	**.762**
Y43	Exiting identity of equipment such as, manufacture' s name, and other related documents.	**.742**
	Component Twelve Eigen value = 1.911	
F83	International competition.	**.823**
Y33	Investigation to determine root causes of problems.	**.791**
	Component thirteen Eigen value = 1.773	
Y34	Availability of procedures for preventive actions	**.814**
F84	Pressure from customers.	**.811**
	Component Fourteen Eigen value = 1.684	
F81	Documentation process.	**.886**
Y31	Availability and appropriates of utilities to use, such as electricity, water, air ... etc.).	**.885**
	Component Fifteen Eigen value = 1.540	
Q74	Established procedures are important.	**.722**
Q75	Quality of equipment and resources do the work.	**.599**
Q73	Awareness of cost consciousness of the company.	**.544**
Q72	Continuous company improvement.	**.520**
	Component Sixteen Eigen value = 1.517	
Q69	Quality is more important than volume of sales.	**.660**
Q70	Staff knowledge of ISO/IEC 17025 and 17011 is enough.	**.620**
Q68	Organization of laboratory meets customer needs.	**.480**
Q71	Commitment to excellent customer service.	**.453**
	Component Seventeen Eigen value = 1.457	
Y29	Protection from undue internal and external pressures.	**.766**
F79	Technical expertise on ISO 17025 and 17011 implementation.	**.740**
	Component Eighteen Eigen value = 1.410	
Y27	Availability of time and resources to do your job properly	**.666**
Y26	Physical conditions at work (noise, air condition ... etc.)	**.621**
F77	Top management commitment and involvement.	**.600**
F76	Employee Training and education.	**.509**
	Component Nineteen Eigen value = 1.311	
S13	Daily attendances	**.691**
S12	Happy and proud to work	**.554**
O15	The relationship of individuals and group	**.535**
O14	The relation with authority	**.490**
	Component Twenty Eigen value = 1.295	
Y46	Existing safe procedure for handling, transport, storage and use of reference standards and materials.	**.728**
Y47	Sampling plans and procedures.	**.551**

P56	Strategy development. P56	**.433**
	Component Twenty one Eigen value = 1.215	
Y48	Existing of procedures for the transportation and/or disposal of test / calibration items.	**.733**
Y50	Participation in inter-laboratory comparison or proficiency.	**.582**
Y49	regular using of certified reference materials/internal Quality control by using secondary reference materials.	**.515**
	Component Twenty two Eigen value = 1.154	
Y28	Availability of space for doing all the activaties such as space for sample storage ..etc.	**.829**
F78	Rapid and effective communication.	**.759**
	Component Twenty three Eigen value 1.134	
Y51	Accurately, clearly, unambiguously of reported results.	**.710**
	Component Twenty four Eigen value = 1.107	
O16	The periodic meeting you attend	**.770**
O24	All employees acknowledge the need to change	**.528**
	Component Twenty five Eigen value = 1.070	
T62	Training is used as revenue.	**.539**

Kaiser- Meyer- Olkin components loadings

Appendix 5 - Pairwise matrix comparison of PESTILE factors

Pairwise comparison matrix of the main criteria with respect to important External Factors

	Political	Economical	Social	Technological	International	Legal	Environmental	Priorities
Political	1	7	5	4	3	4	2	
Economical	1/7	1	9	7	6	3	3	
Social	1/5	1/9	1	1/5	1/6	1/7	3	
Technological	1/4	1/7	5	1	9	7	6	
International	1/3	1/6	6	1/9	1	1/5	5	
Legal	1/4	1/3	7	1/7	5	1	9	
Environmental	1/2	1/3	1/3	1/6	1/5	1/9	1	

Table 2 Pairwise comparison matrix for the sub criteria with respect to Political

	Political instability in North Africa	Changes in legislations	Corruption and bureaucracy	Priorities
P1- Political instability in North Africa.	1	5	3	
P2- Changes in legislations toward open market.	1/5	1	1/7	
P3- Corruption and bureaucracy.	1/2	7	1	

Table 3 Pairwise comparison matrix for the sub criteria with respect to Economic

	Inequality in wages	Limited sources of GDP	International investment	Priorities
E1- inequality in wages	1	5	9	
E2- Limited sources of GDP	1/5	1	7	
E3- International investment	1/9	1/7	1	

Table 4 Pairwise comparison matrix for the sub-criteria with respect to **Social**

	Raising in the education level	Local social development	Entrepreneurship spirit	Priorities
S1- Raising in the education level	1	7	5	
S2- Local social development and work behaviours	1/7	1	3	
S3- Entrepreneurship spirit	1/5	1/3	1	

Table 5 Pairwise comparison matrix for the sub criteria with respect to **Technology**

	Technology development	Infrastructure improvement	Linkage with international development	Priorities
T1- Technology development	1	1/5	7	
T2- Infrastructure improvement	5	1	9	
T3- Linkage with international development	1/7	1/9	1	

Table 6 Pairwise comparison matrix for the sub criteria with respect to **International**

	International politics	Cope with international treaties	Openness into INTL markets	Priority
I1- International politics	1	2	3	
I2- Cope with international treaties	1/2	1	1/5	
I3- Openness into international markets	1/3	5	1	

Table 7 Pairwise comparison matrix for the sub criteria with respect to **Legal**

	Separation between judiciary and executive power	Efficiency of the juridical system	Tax evasion	Priorities
L1- Separation between judiciary and executive power	1	1/3	5	
L2- Efficiency of the juridical system	3	1	9	
L3- Tax evasion	1/5	1/9	1	

Table 8 Pairwise comparison matrix for the sub criteria with respect to **Environment**

	Comply with environmental legislations	Pollution elimination	International treaties	Priorities
EN1- Comply with environmental legislations	1	1/2	3	
EN2- Pollution elimination	2	1	5	
EN3- International treaties	1/3	1/5	1	

Appendix 6 - Scripts used to plot Bayesian Networks

```
library(foreign, pos=4)

Dataset <- read.spss("C:/Users/n0140441/Desktop/all variables.sav",
use.value.labels=TRUE, max.value.labels=Inf, to.data.frame=TRUE)

head(Dataset)


#### network on components (NLPCA) ####
compBN<- Dataset [,95:101]
bn.hc.comp <- hc(compBN)
plot(bn.hc.comp, main = "Hill-Climbing - Components")
########################################

Dataset <- Dataset [,1:94]

library("bnlearn")
bn.gs <- gs(Dataset)
bn2 <- iamb(Dataset)
bn3 <- fast.iamb(Dataset)
bn4 <- inter.iamb(Dataset)
compare(bn.gs, bn2)
compare(bn.gs, bn3)
compare(bn.gs, bn4)
compare(bn2, bn3)
compare(bn4, bn3)
compare(bn2, bn4)
bn.hc <- hc(Dataset, score = "aic")
compare(bn3, bn.hc)
### par(mfrow = c(1, 2))

plot(bn.gs, main = "Constraint-based algorithms")
plot(bn.hc, main = "Hill-Climbing")

fit<-bn.fit(bn.hc, Dataset)
bn.fit.dotplot(fit)
bn.fit(net.hc1, datiBN)

#### Job, management and promotions #####
dataS<- Dataset [,1:13]
bn.hc.S <- hc(dataS, score = "aic")
plot(bn.hc.S, main = "Hill-Climbing - Job, management and promotions")

#### Culture Characteristics ####
dataO<- Dataset [,14:25]
bn.hc.O <- hc(dataO, score = "aic")
plot(bn.hc.O, main = "Hill-Climbing - Culture Characteristics")


#### Technical factor: Laboratory facilities, accommodation and
(Environmental Conditions) #####
dataY<- Dataset [,26:52]
bn.hc.Y <- hc(dataY, score = "aic")
plot(bn.hc.Y, main = "Hill-Climbing - Technical factors")


#### Strategic planning and communication ####
dataP<- Dataset [,53:57]
```

```
bn.hc.P <- hc(dataP, score = "aic")
plot(bn.hc.P, main = "Hill-Climbing - Strategic planning and
communication")


###### Training and knowledge #######
dataT<- Dataset [,58:62]
bn.hc.T <- hc(dataT, score = "aic")
plot(bn.hc.T, main = "Hill-Climbing - Training and knowledge")


##### Quality program #####
dataQ<- Dataset [,63:75]
bn.hc.Q <- hc(dataQ, score = "aic")
plot(bn.hc.Q, main = "Hill-Climbing - Quality program")


####  Factors ####
dataF<- Dataset [,76:94]
bn.hc.F <- hc(dataF, score = "aic")
plot(bn.hc.F, main = "Hill-Climbing - Factors")
```

Appendix 7 - Conditional probability tables

> fit

Bayesian network parameters

Parameters of node S1 (multinomial distribution)					
Conditional probability table:					
S8					
S1	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.05882353	0.20000000	0.08333333	0.13333333	0.00000000
Dissatisfied	0.00000000	0.15000000	0.00000000	0.66666667	0.00000000
Neutral	0.29411765	0.10000000	0.08333333	0.00000000	0.00000000
Satisfied	0.52941176	0.50000000	0.58333333	0.00000000	1.00000000
Highly Satisfied	0.11764706	0.05000000	0.25000000	0.20000000	0.00000000
Parameters of node S2 (multinomial distribution)					
Conditional probability table:					
S1					
S2	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.62500000	0.07692308	0.00000000	0.10714286	0.11111111
Dissatisfied	0.37500000	0.69230769	0.00000000	0.28571429	0.11111111
Neutral	0.00000000	0.00000000	0.87500000	0.14285714	0.00000000
Satisfied	0.00000000	0.23076923	0.12500000	0.39285714	0.33333333
Highly Satisfied	0.00000000	0.00000000	0.00000000	0.07142857	0.44444444
Parameters of node S3 (multinomial distribution)					
Conditional probability table:					
S2					
S3	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.20000000	0.04761905	0.18181818	0.00000000	0.00000000
Dissatisfied	0.70000000	0.66666667	0.27272727	0.16666667	0.00000000
Neutral	0.10000000	0.23809524	0.45454545	0.11111111	0.00000000
Satisfied	0.00000000	0.04761905	0.09090909	0.66666667	0.66666667
Highly Satisfied	0.00000000	0.00000000	0.00000000	0.05555556	0.33333333

Parameters of node S4 (multinomial distribution)					
Conditional probability table:					
	S13				
S4	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.00000000	0.25000000	0.00000000	0.16666667	0.00000000
Dissatisfied	0.66666667	0.66666667	0.00000000	0.13333333	0.13333333
Neutral	0.00000000	0.08333333	0.16666667	0.30000000	0.26666667
Satisfied	0.00000000	0.00000000	0.50000000	0.33333333	0.46666667
Highly Satisfied	0.33333333	0.00000000	0.33333333	0.06666667	0.13333333
Parameters of node S5 (multinomial distribution)					
Conditional probability table:					
	S4				
S5	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.8750000	0.1875000	0.0000000	0.0500000	0.0000000
Dissatisfied	0.1250000	0.6875000	0.2666667	0.0000000	0.0000000
Neutral	0.0000000	0.1250000	0.6000000	0.2000000	0.1428571
Satisfied	0.0000000	0.0000000	0.1333333	0.6500000	0.2857143
Highly Satisfied	0.0000000	0.0000000	0.0000000	0.1000000	0.5714286
Parameters of node S6 (multinomial distribution)					
Conditional probability table:					
	S3				
S6	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.20000000	0.07407407	0.07692308	0.00000000	0.00000000
Dissatisfied	0.40000000	0.66666667	0.23076923	0.16666667	0.00000000
Neutral	0.40000000	0.18518519	0.46153846	0.33333333	0.00000000
Satisfied	0.00000000	0.03703704	0.15384615	0.50000000	0.33333333
Highly Satisfied	0.00000000	0.03703704	0.07692308	0.00000000	0.66666667
Parameters of node S7 (multinomial distribution)					
Conditional probability table:					

S4					
S7 Satisfied	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly
Highly Dissatisfied 0.00000000	0.50000000	0.12500000	0.06666667	0.10000000	
Dissatisfied 0.14285714	0.00000000	0.56250000	0.20000000	0.05000000	
Neutral 0.00000000	0.50000000	0.31250000	0.60000000	0.15000000	
Satisfied 0.71428571	0.00000000	0.00000000	0.06666667	0.65000000	
Highly Satisfied 0.14285714	0.00000000	0.00000000	0.06666667	0.05000000	
Parameters of node S8 (multinomial distribution)					
Conditional probability table:					
S7					
S8 Satisfied	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly
Highly Dissatisfied 0.00000000	0.77777778	0.21428571	0.33333333	0.00000000	
Dissatisfied 0.00000000	0.22222222	0.71428571	0.23809524	0.15789474	
Neutral 0.00000000	0.00000000	0.00000000	0.38095238	0.21052632	
Satisfied 1.00000000	0.00000000	0.07142857	0.04761905	0.52631579	
Highly Satisfied 0.00000000	0.00000000	0.00000000	0.00000000	0.10526316	
Parameters of node S9 (multinomial distribution)					
Conditional probability table:					
S8					
S9 Satisfied	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly
Highly Dissatisfied 0.00000000	0.58823529	0.15000000	0.00000000	0.00000000	
Dissatisfied 0.00000000	0.35294118	0.45000000	0.16666667	0.06666667	
Neutral 1.00000000	0.00000000	0.25000000	0.66666667	0.13333333	
Satisfied 0.00000000	0.00000000	0.10000000	0.16666667	0.66666667	
Highly Satisfied 0.00000000	0.05882353	0.05000000	0.00000000	0.13333333	
Parameters of node S10 (multinomial distribution)					
Conditional probability table:					
S9					

S10	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.84615385	0.11111111	0.05882353	0.00000000	0.00000000
Dissatisfied	0.07692308	0.72222222	0.35294118	0.14285714	0.00000000
Neutral	0.07692308	0.11111111	0.58823529	0.00000000	0.00000000
Satisfied	0.00000000	0.05555556	0.00000000	0.71428571	0.50000000
Highly Satisfied	0.00000000	0.00000000	0.00000000	0.14285714	0.50000000

Parameters of node S11 (multinomial distribution)

Conditional probability table:

S10

S11	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.71428571	0.13636364	0.07692308	0.00000000	0.00000000
Dissatisfied	0.00000000	0.50000000	0.15384615	0.00000000	0.00000000
Neutral	0.00000000	0.27272727	0.61538462	0.07692308	0.00000000
Satisfied	0.21428571	0.09090909	0.15384615	0.92307692	0.25000000
Highly Satisfied	0.07142857	0.00000000	0.00000000	0.00000000	0.75000000

Parameters of node S12 (multinomial distribution)

Conditional probability table:

O21

S12	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.20000000	0.08823529	0.00000000	0.00000000	0.00000000
Dissatisfied	0.00000000	0.29411765	0.00000000	0.09090909	1.00000000
Neutral	0.40000000	0.00000000	0.00000000	0.36363636	0.00000000
Satisfied	0.00000000	0.52941176	0.50000000	0.36363636	0.00000000
Highly Satisfied	0.40000000	0.08823529	0.50000000	0.18181818	0.00000000

Parameters of node S13 (multinomial distribution)

Conditional probability table:

O24

S13	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied

Highly Dissatisfied	0.14285714	0.07142857	0.00000000	0.00000000	0.00000000
Dissatisfied	0.14285714	0.25000000	0.00000000	0.12500000	0.40000000
Neutral	0.14285714	0.00000000	0.40000000	0.00000000	0.20000000
Satisfied	0.00000000	0.57142857	0.50000000	0.43750000	0.40000000
Highly Satisfied	0.57142857	0.10714286	0.10000000	0.43750000	0.00000000

Parameters of node O14 (multinomial distribution)

Conditional probability table:

	S2				
O14	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.20000000	0.00000000	0.18181818	0.00000000	0.00000000
Dissatisfied	0.60000000	0.42857143	0.18181818	0.27777778	0.16666667
Neutral	0.20000000	0.14285714	0.54545455	0.00000000	0.00000000
Satisfied	0.00000000	0.33333333	0.09090909	0.55555556	0.83333333
Highly Satisfied	0.00000000	0.09523810	0.00000000	0.16666667	0.00000000

Parameters of node O15 (multinomial distribution)

Conditional probability table:

	Q70				
O15	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.00000000	0.00000000	0.00000000	0.09523810	0.00000000
Dissatisfied	0.71428571	0.68181818	0.75000000	0.23809524	0.25000000
Neutral	0.00000000	0.27272727	0.00000000	0.19047619	0.12500000
Satisfied	0.28571429	0.04545455	0.25000000	0.33333333	0.62500000
Highly Satisfied	0.00000000	0.00000000	0.00000000	0.14285714	0.00000000

Parameters of node O16 (multinomial distribution)

Conditional probability table:

	F84		
O16	Critical	Important	Less Important
Highly Dissatisfied	0.00000000	0.00000000	0.22222222
Dissatisfied	0.59090909	0.46153846	0.44444444
Neutral	0.09090909	0.26923077	0.11111111
Satisfied	0.31818182	0.26923077	0.11111111
Highly Satisfied	0.00000000	0.00000000	0.11111111

Parameters of node O17 (multinomial distribution)

Conditional probability table:

	O16				
O17	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.75000000	0.00000000	0.09090909	0.06250000	0.00000000
Dissatisfied	0.25000000	0.72727273	0.36363636	0.25000000	0.00000000
Neutral	0.00000000	0.15151515	0.09090909	0.25000000	0.00000000
Satisfied	0.00000000	0.12121212	0.45454545	0.43750000	0.50000000
Highly Satisfied	0.00000000	0.00000000	0.00000000	0.00000000	0.50000000
Parameters of node O18 (multinomial distribution)					
Conditional probability table:					
	O17				
O18	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.60000000	0.00000000	0.10000000	0.17647059	0.00000000
Dissatisfied	0.00000000	0.45454545	0.10000000	0.17647059	0.00000000
Neutral	0.20000000	0.00000000	0.60000000	0.05882353	0.00000000
Satisfied	0.20000000	0.48484848	0.20000000	0.58823529	0.00000000
Highly Satisfied	0.00000000	0.06060606	0.00000000	0.00000000	1.00000000
Parameters of node O19 (multinomial distribution)					
Conditional probability table:					
	O18				
O19	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.57142857	0.00000000	0.12500000	0.00000000	0.00000000
Dissatisfied	0.00000000	0.73684211	0.50000000	0.44827586	0.33333333
Neutral	0.14285714	0.05263158	0.25000000	0.27586207	0.00000000
Satisfied	0.00000000	0.21052632	0.12500000	0.24137931	0.33333333
Highly Satisfied	0.28571429	0.00000000	0.00000000	0.03448276	0.33333333
Parameters of node O20 (multinomial distribution)					
Conditional probability table:					
	O19				
O20	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.80000000	0.06250000	0.00000000	0.15384615	0.00000000
Dissatisfied	0.20000000	0.65625000	0.33333333	0.15384615	0.00000000
Neutral	0.00000000	0.06250000	0.25000000	0.23076923	0.50000000
Satisfied	0.00000000	0.21875000	0.33333333	0.46153846	0.00000000
Highly Satisfied	0.00000000	0.00000000	0.08333333	0.00000000	0.50000000
Parameters of node O21 (multinomial distribution)					
Conditional probability table:					
	O22				
O21	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.60000000	0.00000000	0.00000000	0.04761905	0.33333333
Dissatisfied	0.40000000	0.70588235	0.33333333	0.33333333	0.00000000

Neutral	0.00000000	0.08823529	0.33333333	0.00000000	0.00000000
Satisfied	0.00000000	0.20588235	0.33333333	0.61904762	0.33333333
Highly Satisfied	0.00000000	0.00000000	0.00000000	0.00000000	0.33333333

Parameters of node O22 (multinomial distribution)

Conditional probability table:

	O24				
O22	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied Highly	Satisfied
Highly Dissatisfied	0.28571429	0.00000000	0.00000000	0.00000000	0.60000000
Dissatisfied	0.71428571	0.67857143	0.20000000	0.43750000	0.20000000
Neutral	0.00000000	0.03571429	0.20000000	0.00000000	0.00000000
Satisfied	0.00000000	0.28571429	0.40000000	0.56250000	0.00000000
Highly Satisfied	0.00000000	0.00000000	0.20000000	0.00000000	0.20000000

Parameters of node O23 (multinomial distribution)

Conditional probability table:

	O24				
O23	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.42857143	0.03571429	0.20000000	0.00000000	0.00000000
Dissatisfied	0.57142857	0.78571429	0.30000000	0.18750000	0.80000000
Neutral	0.00000000	0.00000000	0.30000000	0.06250000	0.00000000
Satisfied	0.00000000	0.17857143	0.10000000	0.75000000	0.20000000
Highly Satisfied	0.00000000	0.00000000	0.10000000	0.00000000	0.00000000

Parameters of node O24 (multinomial distribution)

Conditional probability table:

	O18				
O24	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.28571429	0.00000000	0.37500000	0.06896552	0.00000000
Dissatisfied	0.00000000	0.63157895	0.25000000	0.44827586	0.33333333
Neutral	0.00000000	0.21052632	0.37500000	0.10344828	0.00000000
Satisfied	0.14285714	0.15789474	0.00000000	0.37931034	0.33333333
Highly Satisfied	0.57142857	0.00000000	0.00000000	0.00000000	0.33333333

Parameters of node O25 (multinomial distribution)

Conditional probability table:

	Y34				
O25	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.33333333	0.00000000	0.25000000	0.13793103	0.00000000
Dissatisfied	0.00000000	0.69565217	0.25000000	0.24137931	0.00000000
Neutral	0.00000000	0.26086957	0.12500000	0.06896552	0.00000000
Satisfied	0.33333333	0.04347826	0.25000000	0.51724138	1.00000000
Highly Satisfied	0.33333333	0.00000000	0.12500000	0.03448276	0.00000000

Parameters of node Y26 (multinomial distribution)

Conditional probability table:

	Y30				
Y26	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.50000000	0.00000000	0.18181818	0.00000000	0.00000000
Dissatisfied	0.50000000	0.52941176	0.27272727	0.57692308	0.00000000
Neutral	0.00000000	0.00000000	0.09090909	0.07692308	0.37500000
Satisfied	0.00000000	0.47058824	0.45454545	0.30769231	0.50000000
Highly Satisfied	0.00000000	0.00000000	0.00000000	0.03846154	0.12500000

Parameters of node Y27 (multinomial distribution)

Conditional probability table:

	S1				
Y27	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.00000000	0.00000000	0.50000000	0.10714286	0.11111111
Dissatisfied	0.87500000	0.53846154	0.00000000	0.50000000	0.22222222
Neutral	0.12500000	0.00000000	0.37500000	0.03571429	0.22222222
Satisfied	0.00000000	0.38461538	0.12500000	0.35714286	0.22222222
Highly Satisfied	0.00000000	0.07692308	0.00000000	0.00000000	0.22222222

Parameters of node Y28 (multinomial distribution)

Conditional probability table:

	Y27				
Y28	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.62500000	0.13333333	0.00000000	0.00000000	0.00000000
Dissatisfied	0.12500000	0.60000000	0.42857143	0.27777778	0.00000000
Neutral	0.00000000	0.00000000	0.42857143	0.05555556	0.33333333
Satisfied	0.12500000	0.26666667	0.14285714	0.61111111	0.33333333
Highly Satisfied	0.12500000	0.00000000	0.00000000	0.05555556	0.33333333

Parameters of node Y29 (multinomial distribution)

Conditional probability table:

	F87		
Y29	Critical	Important	Less Important
Highly Dissatisfied	0.13888889	0.23809524	0.00000000
Dissatisfied	0.30555556	0.14285714	0.00000000
Neutral	0.22222222	0.14285714	0.00000000
Satisfied	0.27777778	0.47619048	0.66666667

Highly Satisfied	0.05555556	0.00000000	0.33333333		
Parameters of node Y30 (multinomial distribution)					
Conditional probability table:					
	Y38				
Y30	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.2500000	0.0000000	0.1111111	0.1052632	0.0000000
Dissatisfied	0.2500000	0.3571429	0.0000000	0.3157895	0.0000000
Neutral	0.0000000	0.2142857	0.5555556	0.0000000	0.0000000
Satisfied	0.5000000	0.4285714	0.3333333	0.3684211	0.3333333
Highly Satisfied	0.0000000	0.0000000	0.0000000	0.2105263	0.6666667
Parameters of node Y31 (multinomial distribution)					
Conditional probability table:					
	Y33				
Y31	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	1.00000000	0.04000000	0.25000000	0.06896552	0.00000000
Dissatisfied	0.00000000	0.28000000	0.50000000	0.37931034	0.00000000
Neutral	0.00000000	0.16000000	0.00000000	0.06896552	0.25000000
Satisfied	0.00000000	0.52000000	0.25000000	0.48275862	0.25000000
Highly Satisfied	0.00000000	0.00000000	0.00000000	0.00000000	0.50000000
Parameters of node Y32 (multinomial distribution)					
Conditional probability table:					
	Y40				
Y32	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.66666667	0.03333333	0.00000000	0.00000000	0.20000000
Dissatisfied	0.00000000	0.43333333	0.71428571	0.42857143	0.00000000
Neutral	0.00000000	0.16666667	0.00000000	0.09523810	0.00000000
Satisfied	0.33333333	0.36666667	0.28571429	0.47619048	0.00000000
Highly Satisfied	0.00000000	0.00000000	0.00000000	0.00000000	0.80000000
Parameters of node Y33 (multinomial distribution)					
Conditional probability table:					
	Y32				
Y33	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.75000000	0.00000000	0.14285714	0.00000000	0.00000000
Dissatisfied	0.00000000	0.66666667	0.28571429	0.16666667	0.25000000
Neutral	0.25000000	0.03703704	0.14285714	0.04166667	0.00000000

Satisfied	0.00000000	0.29629630	0.42857143	0.75000000	0.00000000
Highly Satisfied	0.00000000	0.00000000	0.00000000	0.04166667	0.75000000

Parameters of node Y34 (multinomial distribution)

Conditional probability table:

	Y33				
Y34	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.50000000	0.04000000	0.00000000	0.00000000	0.00000000
Dissatisfied	0.25000000	0.60000000	0.00000000	0.24137931	0.00000000
Neutral	0.00000000	0.04000000	1.00000000	0.03448276	0.50000000
Satisfied	0.25000000	0.28000000	0.00000000	0.68965517	0.25000000
Highly Satisfied	0.00000000	0.04000000	0.00000000	0.03448276	0.25000000

Parameters of node Y35 (multinomial distribution)

Conditional probability table:

	F83		
Y35	Critical	Important	Less Important
Highly Dissatisfied	0.00000000	0.00000000	0.05555556
Dissatisfied	0.28571429	0.40000000	0.11111111
Neutral	0.28571429	0.05000000	0.00000000
Satisfied	0.32142857	0.55000000	0.50000000
Highly Satisfied	0.10714286	0.00000000	0.33333333

Parameters of node Y36 (multinomial distribution)

Conditional probability table:

	Y35				
Y36	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.00000000	0.00000000	0.00000000	0.03448276	0.00000000
Dissatisfied	1.00000000	0.50000000	0.44444444	0.06896552	0.00000000
Neutral	0.00000000	0.22222222	0.33333333	0.00000000	0.00000000
Satisfied	0.00000000	0.27777778	0.11111111	0.82758621	0.22222222
Highly Satisfied	0.00000000	0.00000000	0.11111111	0.06896552	0.77777778

Parameters of node Y37 (multinomial distribution)

Conditional probability table:

	Y36

Y37	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	1.0000000	0.1250000	0.0000000	0.0312500	0.0000000
Dissatisfied	0.0000000	0.6250000	0.4285714	0.2500000	0.0000000
Neutral	0.0000000	0.1250000	0.2857143	0.0312500	0.0000000
Satisfied	0.0000000	0.1250000	0.1428571	0.6875000	0.6000000
Highly Satisfied	0.0000000	0.0000000	0.1428571	0.0000000	0.4000000

Parameters of node Y38 (multinomial distribution)

Conditional probability table:

	Y37				
Y38	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.75000000	0.00000000	0.20000000	0.00000000	0.00000000
Dissatisfied	0.00000000	0.71428571	0.40000000	0.35483871	0.00000000
Neutral	0.25000000	0.14285714	0.20000000	0.12903226	0.00000000
Satisfied	0.00000000	0.14285714	0.20000000	0.48387097	0.00000000
Highly Satisfied	0.00000000	0.00000000	0.00000000	0.03225806	1.00000000

Parameters of node Y39 (multinomial distribution)

Conditional probability table:

	Y38				
Y39	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.50000000	0.03571429	0.00000000	0.00000000	0.00000000
Dissatisfied	0.25000000	0.92857143	0.22222222	0.36842105	0.00000000
Neutral	0.00000000	0.03571429	0.33333333	0.05263158	0.00000000
Satisfied	0.25000000	0.00000000	0.44444444	0.52631579	0.50000000
Highly Satisfied	0.00000000	0.00000000	0.00000000	0.05263158	0.50000000

Parameters of node Y40 (multinomial distribution)

Conditional probability table:

	Y39				
Y40	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.66666667	0.00000000	0.00000000	0.05555556	0.00000000
Dissatisfied	0.00000000	0.69444444	0.20000000	0.22222222	0.00000000
Neutral	0.33333333	0.05555556	0.60000000	0.05555556	0.00000000
Satisfied	0.00000000	0.25000000	0.20000000	0.61111111	0.00000000
Highly Satisfied	0.00000000	0.00000000	0.00000000	0.05555556	1.00000000

Parameters of node Y41 (multinomial distribution)

Conditional probability table:					
Y40					
Y41	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.3333333	0.0000000	0.0000000	0.0000000	0.0000000
Dissatisfied	0.0000000	0.8000000	0.1428571	0.2380952	0.0000000
Neutral	0.0000000	0.0000000	0.7142857	0.0952381	0.0000000
Satisfied	0.6666667	0.2000000	0.1428571	0.5714286	0.2000000
Highly Satisfied	0.0000000	0.0000000	0.0000000	0.0952381	0.8000000
Parameters of node Y42 (multinomial distribution)					
Conditional probability table:					
Y41					
Y42	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	1.00000000	0.00000000	0.00000000	0.09090909	0.00000000
Dissatisfied	0.00000000	0.66666667	0.14285714	0.40909091	0.00000000
Neutral	0.00000000	0.06666667	0.71428571	0.00000000	0.16666667
Satisfied	0.00000000	0.26666667	0.14285714	0.40909091	0.00000000
Highly Satisfied	0.00000000	0.00000000	0.00000000	0.09090909	0.83333333
Parameters of node Y43 (multinomial distribution)					
Conditional probability table:					
Y40					
Y43	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	1.00000000	0.00000000	0.00000000	0.00000000	0.00000000
Dissatisfied	0.00000000	0.70000000	0.28571429	0.19047619	0.00000000
Neutral	0.00000000	0.06666667	0.28571429	0.09523810	0.00000000
Satisfied	0.00000000	0.20000000	0.28571429	0.66666667	0.00000000
Highly Satisfied	0.00000000	0.03333333	0.14285714	0.04761905	1.00000000
Parameters of node Y44 (multinomial distribution)					
Conditional probability table:					
Y41					
Y44	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	1.00000000	0.06666667	0.00000000	0.04545455	0.00000000
Dissatisfied	0.00000000	0.66666667	0.28571429	0.27272727	0.00000000
Neutral	0.00000000	0.06666667	0.71428571	0.22727273	0.00000000
Satisfied	0.00000000	0.20000000	0.00000000	0.36363636	0.00000000
Highly Satisfied	0.00000000	0.00000000	0.00000000	0.09090909	1.00000000
Parameters of node Y45 (multinomial distribution)					
Conditional probability table:					
Y44					

Y45	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.75000000	0.17857143	0.00000000	0.14285714	0.00000000
Dissatisfied	0.00000000	0.42857143	0.08333333	0.21428571	0.00000000
Neutral	0.00000000	0.07142857	0.58333333	0.14285714	0.12500000
Satisfied	0.00000000	0.32142857	0.33333333	0.50000000	0.12500000
Highly Satisfied	0.25000000	0.00000000	0.00000000	0.00000000	0.75000000

Parameters of node Y46 (multinomial distribution)

Conditional probability table:

	Y45				
Y46	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.8000000	0.0000000	0.0000000	0.0000000	0.0000000
Dissatisfied	0.0000000	0.3750000	0.1666667	0.3333333	0.0000000
Neutral	0.2000000	0.3750000	0.5833333	0.2857143	0.2857143
Satisfied	0.0000000	0.2500000	0.2500000	0.3809524	0.5714286
Highly Satisfied	0.0000000	0.0000000	0.0000000	0.0000000	0.1428571

Parameters of node Y47 (multinomial distribution)

Conditional probability table:

	Y46				
Y47	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.75000000	0.06666667	0.00000000	0.00000000	0.00000000
Dissatisfied	0.00000000	0.66666667	0.26086957	0.31578947	0.00000000
Neutral	0.25000000	0.06666667	0.43478261	0.15789474	1.00000000
Satisfied	0.00000000	0.20000000	0.26086957	0.47368421	0.00000000
Highly Satisfied	0.00000000	0.00000000	0.04347826	0.05263158	0.00000000

Parameters of node Y48 (multinomial distribution)

Conditional probability table:

	Y47				
Y48	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.85714286	0.00000000	0.00000000	0.00000000	0.00000000
Dissatisfied	0.00000000	0.40909091	0.05882353	0.16666667	0.00000000
Neutral	0.00000000	0.22727273	0.70588235	0.16666667	0.00000000
Satisfied	0.00000000	0.27272727	0.23529412	0.66666667	0.50000000
Highly Satisfied	0.14285714	0.09090909	0.00000000	0.00000000	0.50000000

Parameters of node Y49 (multinomial distribution)

Conditional probability table:					
	Y47				
Y49	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.57142857	0.00000000	0.00000000	0.05555556	0.00000000
Dissatisfied	0.00000000	0.27272727	0.17647059	0.11111111	0.50000000
Neutral	0.00000000	0.54545455	0.64705882	0.16666667	0.00000000
Satisfied	0.42857143	0.18181818	0.11764706	0.66666667	0.00000000
Highly Satisfied	0.00000000	0.00000000	0.05882353	0.00000000	0.50000000
Parameters of node Y50 (multinomial distribution)					
Conditional probability table:					
	Y30				
Y50	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.00000000	0.11764706	0.00000000	0.03846154	0.00000000
Dissatisfied	0.00000000	0.29411765	0.45454545	0.23076923	0.00000000
Neutral	1.00000000	0.23529412	0.18181818	0.11538462	0.00000000
Satisfied	0.00000000	0.29411765	0.36363636	0.61538462	0.50000000
Highly Satisfied	0.00000000	0.05882353	0.00000000	0.00000000	0.50000000
Parameters of node Y51 (multinomial distribution)					
Conditional probability table:					
	Y50				
Y51	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.33333333	0.06250000	0.15384615	0.00000000	0.20000000
Dissatisfied	0.66666667	0.37500000	0.07692308	0.10344828	0.00000000
Neutral	0.00000000	0.25000000	0.53846154	0.13793103	0.00000000
Satisfied	0.00000000	0.25000000	0.23076923	0.65517241	0.40000000
Highly Satisfied	0.00000000	0.06250000	0.00000000	0.10344828	0.40000000
Parameters of node Y52 (multinomial distribution)					
Conditional probability table:					
	Y51				
Y52	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.80000000	0.00000000	0.00000000	0.07142857	0.16666667
Dissatisfied	0.20000000	0.66666667	0.20000000	0.10714286	0.16666667
Neutral	0.00000000	0.00000000	0.53333333	0.07142857	0.00000000
Satisfied	0.00000000	0.25000000	0.26666667	0.71428571	0.16666667
Highly Satisfied	0.00000000	0.08333333	0.00000000	0.03571429	0.50000000

Parameters of node P53 (multinomial distribution)				
Conditional probability table:				
Highly Dissatisfied	**Dissatisfied**	**Neutral**	**Satisfied**	**Highly Satisfied**
0.13636364	0.19696970	0.04545455	0.51515152	0.10606061

Parameters of node P54 (multinomial distribution)					
Conditional probability table:					
	P53				
P54	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.66666667	0.15384615	0.00000000	0.05882353	0.14285714
Dissatisfied	0.33333333	0.46153846	0.00000000	0.35294118	0.14285714
Neutral	0.00000000	0.00000000	1.00000000	0.11764706	0.00000000
Satisfied	0.00000000	0.38461538	0.00000000	0.44117647	0.00000000
Highly Satisfied	0.00000000	0.00000000	0.00000000	0.02941176	0.71428571

Parameters of node P55 (multinomial distribution)					
Conditional probability table:					
	P56				
P55	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.45454545	0.06896552	0.00000000	0.00000000	0.00000000
Dissatisfied	0.36363636	0.72413793	0.50000000	0.16666667	0.00000000
Neutral	0.09090909	0.00000000	0.00000000	0.00000000	0.00000000
Satisfied	0.09090909	0.20689655	0.50000000	0.83333333	1.00000000
Highly Satisfied	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000

Parameters of node P56 (multinomial distribution)					
Conditional probability table:					
	P57				
P56	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.71428571	0.18518519	0.00000000	0.05000000	0.00000000
Dissatisfied	0.28571429	0.59259259	0.30000000	0.35000000	0.50000000
Neutral	0.00000000	0.07407407	0.40000000	0.00000000	0.00000000
Satisfied	0.00000000	0.14814815	0.30000000	0.55000000	0.00000000
Highly Satisfied	0.00000000	0.00000000	0.00000000	0.05000000	0.50000000

Parameters of node P57 (multinomial distribution)					
Conditional probability table:					
	Y38				
P57	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied

Highly Dissatisfied	0.50000000	0.07142857	0.00000000	0.05263158	0.33333333
Dissatisfied	0.00000000	0.60714286	0.55555556	0.21052632	0.16666667
Neutral	0.00000000	0.14285714	0.33333333	0.05263158	0.33333333
Satisfied	0.50000000	0.17857143	0.00000000	0.68421053	0.00000000
Highly Satisfied	0.00000000	0.00000000	0.11111111	0.00000000	0.16666667

Parameters of node T58 (multinomial distribution)

Conditional probability table:

	P57				
T58	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.42857143	0.18518519	0.00000000	0.10000000	0.50000000
Dissatisfied	0.14285714	0.51851852	0.20000000	0.20000000	0.00000000
Neutral	0.14285714	0.03703704	0.80000000	0.10000000	0.00000000
Satisfied	0.14285714	0.18518519	0.00000000	0.55000000	0.00000000
Highly Satisfied	0.14285714	0.07407407	0.00000000	0.05000000	0.50000000

Parameters of node T59 (multinomial distribution)

Conditional probability table:

	T58				
T59	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.54545455	0.04761905	0.16666667	0.00000000	0.00000000
Dissatisfied	0.18181818	0.61904762	0.08333333	0.11764706	0.00000000
Neutral	0.09090909	0.14285714	0.66666667	0.23529412	0.00000000
Satisfied	0.18181818	0.14285714	0.08333333	0.52941176	0.80000000
Highly Satisfied	0.00000000	0.04761905	0.00000000	0.11764706	0.20000000

Parameters of node T60 (multinomial distribution)

Conditional probability table:

	T59				
T60	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.55555556	0.11111111	0.12500000	0.00000000	0.25000000
Dissatisfied	0.33333333	0.55555556	0.06250000	0.15789474	0.00000000
Neutral	0.11111111	0.27777778	0.62500000	0.21052632	0.00000000
Satisfied	0.00000000	0.00000000	0.18750000	0.52631579	0.25000000
Highly Satisfied	0.00000000	0.05555556	0.00000000	0.10526316	0.50000000

Parameters of node T61 (multinomial distribution)

Conditional probability table:

	T60				
T61	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.50000000	0.17647059	0.00000000	0.00000000	0.00000000
Dissatisfied	0.20000000	0.70588235	0.20000000	0.14285714	0.00000000

Neutral	0.20000000	0.00000000	0.35000000	0.07142857	0.20000000
Satisfied	0.00000000	0.00000000	0.40000000	0.71428571	0.60000000
Highly Satisfied	0.10000000	0.11764706	0.05000000	0.07142857	0.20000000
Parameters of node T62 (multinomial distribution)					
Conditional probability table:					
T61					
T62	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.50000000	0.15000000	0.18181818	0.04761905	0.33333333
Dissatisfied	0.25000000	0.50000000	0.09090909	0.19047619	0.00000000
Neutral	0.25000000	0.20000000	0.63636364	0.04761905	0.00000000
Satisfied	0.00000000	0.05000000	0.09090909	0.66666667	0.33333333
Highly Satisfied	0.00000000	0.10000000	0.00000000	0.04761905	0.33333333
Parameters of node Q63 (multinomial distribution)					
Conditional probability table:					
Q64					
Q63	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.75000000	0.04000000	0.18181818	0.16666667	0.00000000
Dissatisfied	0.00000000	0.64000000	0.18181818	0.08333333	0.00000000
Neutral	0.00000000	0.20000000	0.27272727	0.25000000	0.00000000
Satisfied	0.00000000	0.08000000	0.27272727	0.50000000	0.50000000
Highly Satisfied	0.25000000	0.04000000	0.09090909	0.00000000	0.50000000
Parameters of node Q64 (multinomial distribution)					
Conditional probability table:					
O19					
Q64	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.20000000	0.00000000	0.16666667	0.07692308	0.00000000
Dissatisfied	0.60000000	0.62500000	0.08333333	0.07692308	0.00000000
Neutral	0.00000000	0.03125000	0.33333333	0.30769231	0.50000000
Satisfied	0.00000000	0.34375000	0.41666667	0.53846154	0.25000000
Highly Satisfied	0.20000000	0.00000000	0.00000000	0.00000000	0.25000000
Parameters of node Q65 (multinomial distribution)					
Conditional probability table:					
Y45					
Q65	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.20000000	0.00000000	0.08333333	0.09523810	0.00000000
Dissatisfied	0.60000000	0.43750000	0.58333333	0.04761905	0.00000000
Neutral	0.20000000	0.25000000	0.08333333	0.42857143	0.57142857
Satisfied	0.00000000	0.25000000	0.16666667	0.38095238	0.00000000

Highly Satisfied	0.00000000	0.06250000	0.08333333	0.04761905	0.42857143
Parameters of node Q66 (multinomial distribution)					
Conditional probability table:					
Q65					
Q66	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.20000000	0.00000000	0.00000000	0.07142857	0.00000000
Dissatisfied	0.00000000	0.66666667	0.25000000	0.14285714	0.00000000
Neutral	0.20000000	0.19047619	0.40000000	0.21428571	0.00000000
Satisfied	0.60000000	0.09523810	0.25000000	0.50000000	0.33333333
Highly Satisfied	0.00000000	0.04761905	0.10000000	0.07142857	0.66666667
Parameters of node Q67 (multinomial distribution)					
Conditional probability table:					
Q66					
Q67	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.00000000	0.00000000	0.00000000	0.05263158	0.00000000
Dissatisfied	0.50000000	0.71428571	0.12500000	0.15789474	0.12500000
Neutral	0.00000000	0.14285714	0.43750000	0.21052632	0.00000000
Satisfied	0.00000000	0.14285714	0.43750000	0.47368421	0.37500000
Highly Satisfied	0.50000000	0.00000000	0.00000000	0.10526316	0.50000000
Parameters of node Q68 (multinomial distribution)					
Conditional probability table:					
Q67					
Q68	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	1.00000000	0.04545455	0.07142857	0.04545455	0.00000000
Dissatisfied	0.00000000	0.63636364	0.21428571	0.13636364	0.00000000
Neutral	0.00000000	0.13636364	0.50000000	0.13636364	0.14285714
Satisfied	0.00000000	0.09090909	0.14285714	0.63636364	0.00000000
Highly Satisfied	0.00000000	0.09090909	0.07142857	0.04545455	0.85714286

Parameters of node Q69 (multinomial distribution)					
Conditional probability table:					
	Y37				
Q69	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.00000000	0.04761905	0.00000000	0.00000000	0.20000000
Dissatisfied	0.75000000	0.61904762	0.60000000	0.29032258	0.00000000
Neutral	0.00000000	0.28571429	0.00000000	0.16129032	0.00000000
Satisfied	0.25000000	0.04761905	0.40000000	0.45161290	0.00000000
Highly Satisfied	0.00000000	0.00000000	0.00000000	0.09677419	0.80000000
Parameters of node Q70 (multinomial distribution)					
Conditional probability table:					
	Y33				
Q70	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.00000000	0.24000000	0.25000000	0.00000000	0.00000000
Dissatisfied	1.00000000	0.36000000	0.00000000	0.31034483	0.00000000
Neutral	0.00000000	0.12000000	0.00000000	0.13793103	0.25000000
Satisfied	0.00000000	0.20000000	0.50000000	0.48275862	0.00000000
Highly Satisfied	0.00000000	0.08000000	0.25000000	0.06896552	0.75000000
Parameters of node Q71 (multinomial distribution)					
Conditional probability table:					
	Q68				
Q71	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.25000000	0.10000000	0.07142857	0.05555556	0.50000000
Dissatisfied	0.00000000	0.65000000	0.42857143	0.11111111	0.10000000
Neutral	0.25000000	0.05000000	0.28571429	0.22222222	0.00000000
Satisfied	0.00000000	0.20000000	0.21428571	0.38888889	0.20000000
Highly Satisfied	0.25000000	0.00000000	0.00000000	0.22222222	0.20000000
Parameters of node Q72 (multinomial distribution)					
Conditional probability table:					
Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied	

0.12121212	0.39393939	0.22727273	0.22727273	0.01515152

Parameters of node Q73 (multinomial distribution)

Conditional probability table:

	F91		
Q73	Critical	Important Less	Important
Highly Dissatisfied	0.33333333	0.04166667	0.50000000
Dissatisfied	0.33333333	0.33333333	0.33333333
Neutral	0.25000000	0.16666667	0.16666667
Satisfied	0.02777778	0.45833333	0.00000000
Highly Satisfied	0.02777778	0.00000000	0.00000000

Parameters of node Q74 (multinomial distribution)

Conditional probability table:

	Q75				
Q74	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.50000000	0.12000000	0.00000000	0.11764706	0.25000000
Dissatisfied	0.50000000	0.60000000	0.41176471	0.17647059	0.00000000
Neutral	0.00000000	0.20000000	0.52941176	0.11764706	0.00000000
Satisfied	0.00000000	0.04000000	0.05882353	0.52941176	0.25000000
Highly Satisfied	0.00000000	0.04000000	0.00000000	0.05882353	0.50000000

Parameters of node Q75 (multinomial distribution)

Conditional probability table:

	T62				
Q75	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Highly Dissatisfied	0.08333333	0.00000000	0.07142857	0.00000000	0.00000000
Dissatisfied	0.33333333	0.64705882	0.42857143	0.22222222	0.00000000
Neutral	0.16666667	0.23529412	0.50000000	0.22222222	0.00000000
Satisfied	0.25000000	0.11764706	0.00000000	0.50000000	0.60000000
Highly Satisfied	0.16666667	0.00000000	0.00000000	0.00000000	0.40000000

Parameters of node F76 (multinomial distribution)

Conditional probability table:

	F78		
F76	Critical	Important	Less Important
Critical	0.8235294	0.8846154	0.1666667
Important	0.1764706	0.1153846	0.8333333
Less Important	0.0000000	0.0000000	0.0000000

Parameters of node F77 (multinomial distribution)

Conditional probability table:

	F76		
F77	Critical	Important	Less Important
Critical	0.92307692	0.21428571	
Important	0.07692308	0.50000000	
Less Important	0.00000000	0.28571429	

Parameters of node F78 (multinomial distribution)

Conditional probability table:

	S12				
F78	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Critical	0.75000000	0.23076923	0.90000000	0.39285714	0.72727273
Important	0.00000000	0.61538462	0.10000000	0.53571429	0.18181818
Less Important	0.25000000	0.15384615	0.00000000	0.07142857	0.09090909

Parameters of node F79 (multinomial distribution)

Conditional probability table:

	F76		
F79	Critical	Important	Less Important
Critical	0.71153846	0.28571429	
Important	0.26923077	0.28571429	
Less Important	0.01923077	0.42857143	

Parameters of node F80 (multinomial distribution)

Conditional probability table:

	T61				
F80	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Critical	1.0000000	0.5000000	0.4545455	0.8571429	0.8333333
Important	0.0000000	0.2500000	0.5454545	0.1428571	0.1666667
Less Important	0.0000000	0.2500000	0.0000000	0.0000000	0.0000000

Parameters of node F81 (multinomial distribution)

Conditional probability table:

	F80		
F81	Critical	Important	Less Important
Critical	0.60869565	0.33333333	0.20000000
Important	0.32608696	0.66666667	0.20000000
Less Important	0.06521739	0.00000000	0.60000000

Parameters of node F82 (multinomial distribution)

Conditional probability table:

	Y26				
F82	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Critical	0.00000000	0.41379310	0.83333333	0.36000000	0.50000000
Important	1.00000000	0.51724138	0.00000000	0.48000000	0.00000000
Less Important	0.00000000	0.06896552	0.16666667	0.16000000	0.50000000

Parameters of node F83 (multinomial distribution)

Conditional probability table:

	O16				
F83	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Critical	0.7500000	0.5454545	0.2727273	0.2500000	0.0000000
Important	0.0000000	0.3030303	0.7272727	0.1250000	0.0000000
Less Important	0.2500000	0.1515152	0.0000000	0.6250000	1.0000000

Parameters of node F84 (multinomial distribution)

Conditional probability table:

	P53				
F84	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Critical	0.1111111	0.3076923	1.0000000	0.4117647	0.0000000
Important	0.4444444	0.3076923	0.0000000	0.3235294	1.0000000
Less Important	0.4444444	0.3846154	0.0000000	0.2647059	0.0000000

Parameters of node F85 (multinomial distribution)

Conditional probability table:

	Y31				
F85	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Critical	0.3750000	0.6000000	0.0000000	0.3793103	0.0000000
Important	0.3750000	0.3500000	0.4285714	0.4137931	0.0000000
Less Important	0.2500000	0.0500000	0.5714286	0.2068966	1.0000000

Parameters of node F86 (multinomial distribution)

Conditional probability table:

	S5				
F86	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Critical	1.00000000	0.43750000	0.50000000	0.76470588	0.66666667
Important	0.00000000	0.43750000	0.43750000	0.17647059	0.00000000
Less Important	0.00000000	0.12500000	0.06250000	0.05882353	0.33333333

Parameters of node F87 (multinomial distribution)

Conditional probability table:

	F82		
F87	Critical	Important	Less Important
Critical	0.44444444	0.74193548	0.12500000
Important	0.40740741	0.09677419	0.87500000
Less Important	0.14814815	0.16129032	0.00000000

Parameters of node F88 (multinomial distribution)

Conditional probability table:

	F82		
F88	Critical	Important	Less Important
Critical	0.37037037	0.32258065	0.62500000
Important	0.55555556	0.51612903	0.00000000
Less Important	0.07407407	0.16129032	0.37500000

Parameters of node F89 (multinomial distribution)

Conditional probability table:

	Y40				
F89	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Critical	0.0000000	0.5000000	0.0000000	0.6666667	0.2000000
Important	0.3333333	0.4000000	0.7142857	0.2380952	0.8000000
Less Important	0.6666667	0.1000000	0.2857143	0.0952381	0.0000000

Parameters of node F90 (multinomial distribution)

Conditional probability table:

	F78		
F90	Critical	Important	Less Important
Critical	0.3571429	0.7142857	0.0000000
Important	0.6428571	0.1428571	0.0000000
Less Important	0.0000000	0.1428571	1.0000000

Parameters of node F91 (multinomial distribution)

Conditional probability table:

	Y31				
F91	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Critical	0.1250000	0.7000000	1.0000000	0.4137931	1.0000000
Important	0.6250000	0.3000000	0.0000000	0.4482759	0.0000000
Less Important	0.2500000	0.0000000	0.0000000	0.1379310	0.0000000

Parameters of node F92 (multinomial distribution)

Conditional probability table:

	Y43				
F92	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Critical	0.6666667	0.2592593	1.0000000	0.5000000	1.0000000
Important	0.0000000	0.5555556	0.0000000	0.3636364	0.0000000
Less Important	0.3333333	0.1851852	0.0000000	0.1363636	0.0000000

Parameters of node F93 (multinomial distribution)

Conditional probability table:

	F85		
F93	Critical	Important	Less Important
Critical	0.42307692	0.52000000	0.80000000
Important	0.38461538	0.48000000	0.13333333
Less Important	0.19230769	0.00000000	0.06666667

Parameters of node F94 (multinomial distribution)

Conditional probability table:

	Y38				
F94	Highly Dissatisfied	Dissatisfied	Neutral	Satisfied	Highly Satisfied
Critical	0.2500000	0.6428571	0.3333333	0.5789474	1.0000000
Important	0.5000000	0.2142857	0.6666667	0.4210526	0.0000000
Less Important	0.2500000	0.1428571	0.0000000	0.0000000	0.0000000

Appendix 8 - Analytical Hierarchy Process Ranking

AHP Analytic Hierarchy Process

n= 3 Input 1

Objective Pairwise Political

Only input data in the light green fields!

Please compare the importance of the elements in relation to the above objective and fill in the table: Which element in each pair is more important, **A or B**, and **how much** more important is it. (Use the scale 1-9 as given below)

	Element	Comment
1	Political instability in NA	0
2	Changes in legislations	0
3	Corruption and bureaucracy	0
4		
5		
6		
7		
8		

Name: Participant 1
Date: 07/04/2012

	Element A		Element B	More Important	Intensity (1-9)
1	Political instability in NA	compared with	Changes in legislations	A	5
2			Corruption and bureaucr	A	3
3					
4					
5					
6					
7					
1	Changes in legislations	compared with	Corruption and bureaucr	B	7
2					
3					
4					
5					
6					

A
B

AHP Analytic Hierarchy Process (8x8 Matrix)

Power Method (Dominant Eigenvalue)

	1	2	3	4	5	6	7	8	Iteration	Normalisation
1	1.00	5.00	3.00	-	-	-	-	-	3.23	0.601
2	0.20	1.00	0.14	-	-	-	-	-	0.4	0.074
3	0.33	7.00	1.00	-	-	-	-	-	1.7	0.323
4	-	-	-	1.00	-	-	-	-		
5	-	-	-	-	1.00	-	-	-		
6	-	-	-	-	-	1.00	-	-		
7	-	-	-	-	-	-	1.00	-		
8	-	-	-	-	-	-	-	1.00		
Sum (col)	1.533333	13	4.142857	0	0	0	0	0		

Economic

AHP Analytic Hierarchy Process

n= 3 Input 1

Objective AHP Economic

Only input data in the light green fields!

Please compare the importance of the elements in relation to the above objective and fill in the table: Which element in each pair is more important, **A or B**, and **how much** more important is it. (Use the scale 1-9 as given below)

	Element	Comment
1	inequality in wages	0
2	Limited sources of GDP	0
3	International investment	0
4		
5		
6		
7		
8		

	Element A		Element B	More Important	Intensity (1-9)
1	inequality in wages	compared with	Limited sources of GDP	B	5
2			International investment	B	9
3					
4					
5					
6					
7					
1	Limited sources of GDP	compared with	International investment	A	7
2					
3					
4					
5					
6					

Name: Participant 1

Date: 07/04/2012

A

B

AHP Analytic Hierarchy Process (8x8 Matrix)

Power Method (Dominant Eigenvalue)

	1	2	3	4	5	6	7	8	Iteration	Normalization
1	1.00	0.20	0.11	-	-	-	-	-	0.32	0.06
2	5.00	1.00	7.00	-	-	-	-	-	3.75	0.7
3	9.00	0.14	1.00	-	-	-	-	-	1.24	0.2
4	-	-	-	1.00	-	-	-	-		
5	-	-	-	-	1.00	-	-	-		
6	-	-	-	-	-	1.00	-	-		
7	-	-	-	-	-	-	1.00	-		
8	-	-	-	-	-	-	-	1.00		
Sum (col)	15	1.342857	8.111111	0	0	0	0	0		

Social

AHP Analytic Hierarchy Process n= 3 Input 1

Objective AHP Social

Only input data in the light green fields!

Please compare the importance of the elements in relation to the above objective and fill in the table: Which element in each pair is more important, **A or B**, and **how much** more important is it. (Use the scale 1-9 as given below)

	Element	Comment
1	Raising in the education	
2	Local social development ar	
3	Entrepreneurship spirit	
4		
5		
6		
7		
8		

	Element A		Element B	More Important	Intensity (1-9)
1	Raising in the education	compared with	Local social developmer	A	7
2			Entrepreneurship spirit	A	5
3					
4					
5					
6					
7					
1	Local social development and work behaviours	compared with	Entrepreneurship spirit	A	3
2					
3					
4					
5					
6					

Name: Participant 1

Date: 07/04/2012

A

B

AHP Analytic Hierarchy Process (8x8 Matrix)

Power Method (Dominant Eigenvalue)

	1	2	3	4	5	6	7	8	Iteration	Normalization
1	1.00	7.00	5.00	-	-	-	-	-	3.233	0.738
2	0.14	1.00	3.00	-	-	-	-	-	0.745	0.17
3	0.20	0.33	1.00	-	-	-	-	-	0.4	0.091
4	-	-	-	1.00	-	-	-	-		
5	-	-	-	-	1.00	-	-	-		
6	-	-	-	-	-	1.00	-	-		
7	-	-	-	-	-	-	1.00	-		
8	-	-	-	-	-	-	-	1.00		
Sum (col)	1.342857	8.333333	9	0	0	0	0	0		

Technology

AHP Analytic Hierarchy Process n= 3 Input 1

Objective AHP Technology

Only input data in the light green fields!

Please compare the importance of the elements in relation to the above objective and fill in the table: Which element in each pair is more important, **A or B**, and **how much** more important is it. (Use the scale 1-9 as given below)

	Element	Comment
1	Technology development	0
2	Infrastructure improvement	0
3	Linkage with international de	0
4		
5		
6		
7		
8		

Name: Participant 1

Date: 07/04/2012

	Element A		Element B	More Important	Intensity (1-9)
1	Technology development	compared with	Infrastructure improveme	B	5
2			Linkage with internationa	A	7
3					
4					
5					
6					
7					
1	Infrastructure improvement	compared with	Linkage with internationa	A	9
2					
3					
4					
5					
6					

A
B

AHP Analytic Hierarchy Process (8x8 Matrix)

Power Method (Dominant Eigenvalue)

	1	2	3	4	5	6	7	8	Iteration	Normalisation
1	1.00	0.20	7.00	-	-	-	-	-	1.009	0.227
2	5.00	1.00	9.00	-	-	-	-	-	3.208	0.721
3	0.14	0.11	1.00	-	-	-	-	-	0.226	0.051
4	-	-	-	1.00	-	-	-	-		
5	-	-	-	-	1.00	-	-	-		
6	-	-	-	-	-	1.00	-	-		
7	-	-	-	-	-	-	1.00	-		
8	-	-	-	-	-	-	-	1.00		
Sum (col)	6.1428571	1.3111111	17	0	0	0	0	0		

International

AHP Analytic Hierarchy Process n= 3 Input 1

Objective AHP International

Only input data in the light green fields!

Please compare the importance of the elements in relation to the above objective and fill in the table: Which element in each pair is more important, **A or B**, and **how much** more important is it. (Use the scale 1-9 as given below)

	Element	Comment
1	international politics	
2	Cope with international treat	
3	openness into international	
4		
5		
6		
7		
8		

	Element A		Element B	More Important	Intensity (1-9)
1	international politics	compared with	Cope with international t	A	2
2			openness into internatio	A	3
3					
4					
5					
6					
7					
1	Cope with international treaties	compared with	openness into internatio	B	5
2					
3					
4					
5					
6					

Name: Participant 1

Date: 07/04/2012

A

B

AHP Analytic Hierarchy Process (8x8 Matrix)

Power Method (Dominant Eigenvalue)

	1	2	3	4	5	6	7	8	Iteration	Normalisation
1	1.00	2.00	3.00	-	-	-	-	-	3.468	0.5241
2	0.50	1.00	0.20	-	-	-	-	-	0.885	0.1338
3	0.33	5.00	1.00	-	-	-	-	-	2.262	0.3419
4	-	-	-	1.00	-	-	-	-		
5	-	-	-	-	1.00	-	-	-		
6	-	-	-	-	-	1.00	-	-		
7	-	-	-	-	-	-	1.00	-		
8	-	-	-	-	-	-	-	1.00		
Sum (col)	1.833333	8	4.2	0	0	0	0	0		

Legal

AHP Analytic Hierarchy Process n= 3 Input 1

Objective AHP Legal

Only input data in the light green fields!

Please compare the importance of the elements in relation to the above objective and fill in the table: Which element in each pair is more important, **A or B**, and **how much** more important is it. (Use the scale 1-9 as given below)

	Element	Comment
1	Separation between judiciary	
2	Efficiency of the juridical sys	
3	Tax evasion	
4		
5		
6		
7		
8		

	Element A		Element B	More Important	Intensity (1-9)
1	Separation between judiciary and executive power	compared with	Efficiency of the juridica	B	3
2			Tax evasion	A	5
3					
4					
5					
6					
7					
1	Efficiency of the juridical system	compared with	Tax evasion	A	9
2					
3					
4					
5					
6					

Name: Participant 1

Date: 07/04/2012

A

B

AHP Analytic Hierarchy Process (8x8 Matrix)

Power Method (Dominant Eigenvalue)

	1	2	3	4	5	6	7	8	Iteration	Normalisation
1	1.00	0.33	5.00	-	-	-	-	-	1.197	0.265
2	3.00	1.00	9.00	-	-	-	-	-	3.029	0.67
3	0.20	0.11	1.00	-	-	-	-	-	0.283	0.0629
4	-	-	-	1.00	-	-	-	-		
5	-	-	-	-	1.00	-	-	-		
6	-	-	-	-	-	1.00	-	-		
7	-	-	-	-	-	-	1.00	-		
8	-	-	-	-	-	-	-	1.00		
Sum (col)	4.2	1.444444	15	0	0	0	0	0		

Environment

AHP Analytic Hierarchy Process n= 3 Input 1

Objective AHP Environment

Only input data in the light green fields!

Please compare the importance of the elements in relation to the above objective and fill in the table: Which element in each pair is more important, **A or B**, and **how much** more important is it. (Use the scale 1-9 as given below)

	Element	Comment
1	Comply with environmental l	
2	Pollution elimination	
3	International treaties	
4		
5		
6		
7		
8		

	Element A		Element B	More Important	Intensity (1-9)
1	Comply with environmental legislations	compared with	Pollution elimination	B	2
2			International treaties	A	3
3					
4					
5					
6					
7					
1	Pollution elimination	compared with	International treaties	A	5
2					
3					
4					
5					
6					

Name: Participant 1

Date: 07/04/2012

A

B

AHP Analytic Hierarchy Process (8x8 Matrix)

Power Method (Dominant Eigenvalue)

	1	2	3	4	5	6	7	8	Iteration	Normalisation
1	1.00	0.50	3.00	-	-	-	-	-	1.595	0.308
2	2.00	1.00	5.00	-	-	-	-	-	3.0036	0.58
3	0.33	0.20	1.00	-	-	-	-	-	0.565	0.109
4	-	-	-	1.00	-	-	-	-		
5	-	-	-	-	1.00	-	-	-		
6	-	-	-	-	-	1.00	-	-		
7	-	-	-	-	-	-	1.00	-		
8	-	-	-	-	-	-	-	1.00		
Sum (col)	3.333333	1.7	9	0	0	0	0	0		