Identifying the Barriers Affecting Quality in Maintenance within Libyan Manufacturing Organisations (Public Sector)

Obaid Ahmed Mohamed

School of Management
University of Salford, Salford, UK

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GLOSSARY OF TERMS AND ABBREVIATIONS

5-S	Seiri (organisation), Seiton (orderliness), Seiso (cleaning-the act of), Seiktsu (cleanliness-the state of) and Shitsuke (discipline-the practice of)
BSI	British Standards Institute
CBM	Condition-Based Maintenance
CM	Condition Monitoring
CMMS	Computerised Maintenance Management System
CPI	Consumer Price Index
CSFs	Critical Success Factors
CSO	Case Study organisation
EFQM	European Foundation for Quality Management
EU	European Union
GBT	Green Book Theory
GDP	Gross Domestic Product
GPC	General Planning Council
IMF	International Monetary Fund
IS	Information System
ISO	International Standards Organisation
IT	Information Technology
JIPM	Japanese Institute of Plant Maintenance
LCB	Libyan Central Bank
LCC	Life-Cycle Costs
LCP	Life-Cycle Profit
MD	Maintenance Department
MM	Middle Management
NAID	National Authority for Information & Documentation
OHSAS	Occupational Health and Safety Assessment Specification
OU	Open University
PD	Production Department
PDM	Predictive Maintenance
PM	Preventive Maintenance
PVC	Polyvinyl Chloride
QCC	Quality Control Circles
QM	Quality Management
QMPs	Quality Management Principles
QMS	Quality Management System
RCM	Reliability Centered Maintenance
SSA	Sub-Saharan African countries
TM	Top Management
TMM	Total Maintenance Management
TPM	Total Productive maintenance
TQM	Total Quality Management
TQMain	Total Quality maintenance
UK	United Kingdom
UN	United Nations
US	United States of America
VCM	Vinyl Chloride Monomer

ABSTRACT

This research is concerned with understanding a quality management system and its interaction with maintenance management activities within the organisation. The interaction between maintenance and quality, can lead to their integration with production. The second output of production is maintenance, whose output is increased production capacity. Both the production process and the quality of the maintenance work, which, in turn, affects equipment condition, affect the quality of final product. The thesis aims to identify the barriers and difficulties affecting quality in maintenance, within Libyan (public sector) manufacturing organisations. The specific objectives are derived to provide focus for the research activities, in order to fulfil the specific aim of the research in a structured and scientific manner.

In order to achieve the thesis objectives, an empirically-based systems analysis of two case study organisations in the Libyan public manufacturing sector was carried out. Substantial field work was carried out using predominantly a qualitative approach. Qualitative data was collected by semi structured interview (from different levels of management and supervisors) to explore the quality management phenomena, and to provide a more holistic understanding through triangulation techniques of required and suitable data.

This study has contributed to existing knowledge through getting an in-depth understanding of quality and maintenance issues. A specific definition of "quality in maintenance" was developed, common barriers of quality systems and the key factors of improving maintenance were summarised. Furthermore, by using the framework in figure 2.8 the enablers and inhibitors of quality in maintenance were demonstrated.

This study is the first one that identified the unique barriers affecting quality in maintenance within the Libyan manufacturing organisations. These barriers are divided into three main kinds: the technical, economic barriers, managerial, organisational barriers, and cultural environmental barriers. The key findings of the research indicate that the case study organisations do not actively promote quality in the maintenance area that takes into consideration the influence of organisational, social, economic and political factors (change culture) on the quality of operations and performance inside the organisations.

CHAPTER 1 INTRODUCTION TO THE RESEARCH

1.0 Overview

The world is now, without doubt, in the midst of the "Quality Revolution", a period of change affecting every type of business, organisation and person. In general, companies compete on three issues: quality, price, and delivery. This is true for all types of firms, whether manufacturing, services, or public sector. Quality is shaped at present as a fundamental strategy for the support and improvement of competitiveness in manufacturers and service industry.

In the middle of the eighties, there was growing interest in the study of maintenance models for systems with failure. These studies of maintenance are concerned with applying Total Quality Management techniques to the maintenance of both industrials and services processes where the main goal is to keep the firm in productive operation for as much of the time as possible (Al-Zubaidi, 1993).

In connection with, technical development, the influence of productivity and quality, move increasingly, from man to machine. The importance of maintenance is increased as high productivity and quality can be achieved by means of well developed and organised maintenance. Therefore the maintenance managers should be able to identify, evaluate, and manage the difficulties that are faced by their organisation.

It is vital that maintenance management becomes integrated with corporate strategy to ensure equipment availability, quality products, on-time deliveries and competitive pricing. The changing needs of modern manufacturing necessitate a re-examination of the role that improved maintenance management plays in achieving key cost and service advantages (Riis, et al., 1997).

Modern industrial firms are characterised by their dependence on technology to produce goods and services. All manufacturing and service businesses need equipment to deliver their output. Equipment is an asset that is essential for business success in the competitive global economy. Productivity and efficiency have increased rapidly due to the dramatic changes in equipment technology (Murthy, et al., 2002). However, the equipment is getting more complex and more expensive, which means this equipment should be in full operational mode to avoid any extra losses.

1.1 General background

During World War I, the production process became more complex demanding many operators work under the control of each foreman. Thus firms employed full time inspectors to remove the defects that were produced. Inspection was the basic way of quality control during the first half of the 20th century. After World War II, two quality gurus, Juran and Deming, introduced the statistical quality control approach to Japanese companies. These companies integrated quality into their management practices within 20 years. They made significant penetration into Western markets through the higher quality levels of their products (Evans & Lindsay, 1996).

Preventive maintenance (PM) was introduced in the 1950's, with productive maintenance becoming well-established during the 1960's. The development of total productive maintenance (TPM) began in the 1970's, when preventive maintenance was rapidly being replaced by predictive maintenance or condition-based maintenance (CBM). Predictive maintenance uses modern techniques to diagnose the condition of equipment during operation to predict the imminent failure. The period prior to 1950 can be referred to as the "breakdown maintenance" period (Willmot, 1997). Figure 1.1 describes the parallel evolution between quality and maintenance based on Feigenbaum's (1991) quality evolution and Willmot's (1997) maintenance evolution.

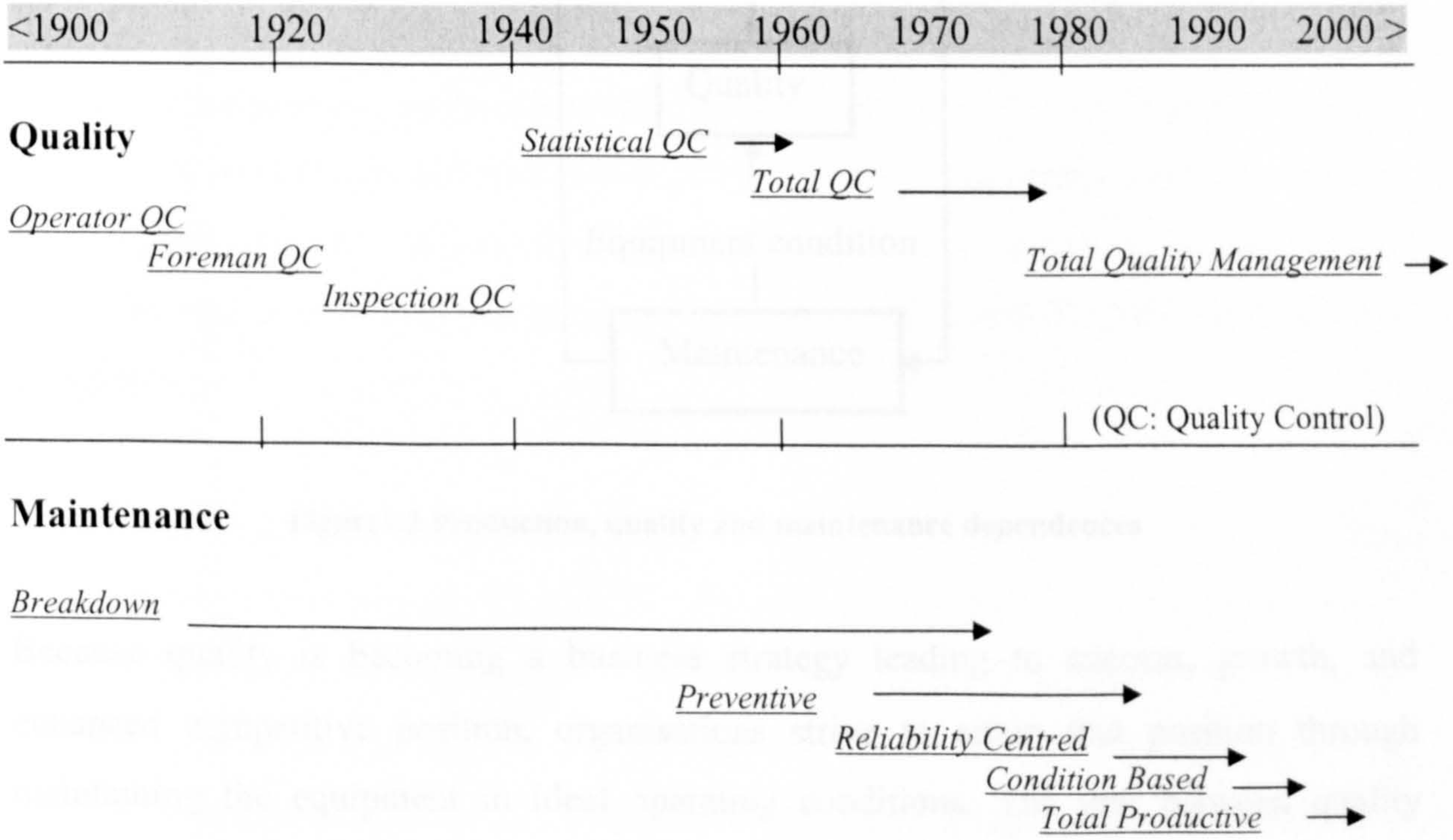


Figure 1.1 Evolution of quality and maintenance

During the past twenty years the advances in technology available to the maintenance department to manage its processes has delivered the situation where it is within the reach of all maintenance operations to achieve a world-class level of maintenance delivery. However, Maintenance still depends heavily on human input because only operations have been automated. Automated and technologically advanced equipment, however, requires skills beyond the competence of the average maintenance supervisor or worker, and to use it effectively requires an appropriate maintenance organisation (Nakajima, 1988).

Ben-Daya and Duffuaa (1995, p. 24) have proposed a broad framework for modelling the interaction between maintenance and quality, which can lead to their integration with production. The dependences between these three important components of any production system are shown in figure 1.2. The second output of production is maintenance, whose output is increased production capacity. Both the production process and the quality of the maintenance work, which, in turn, affects equipment condition, affect the quality of final product.

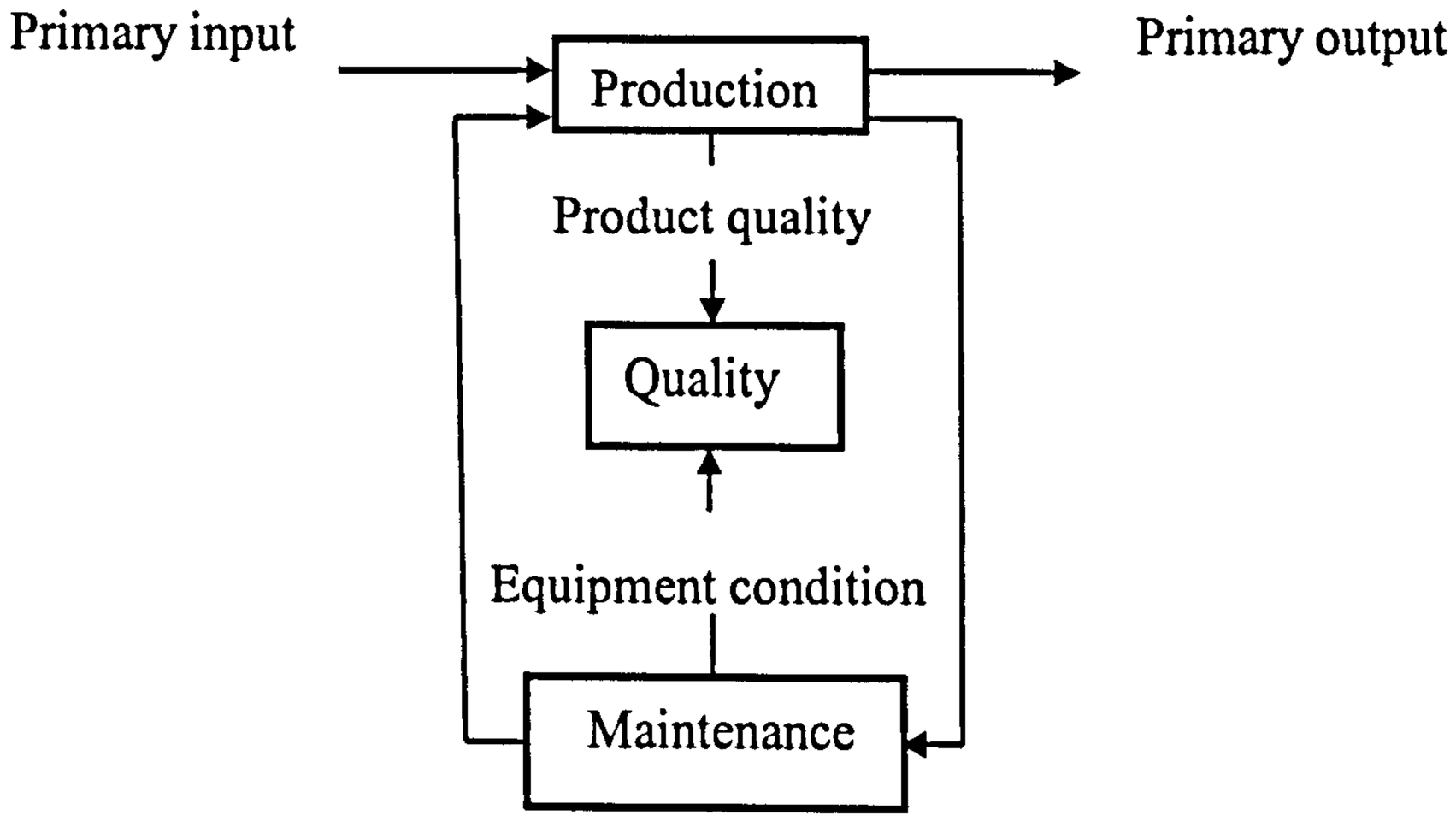


Figure1.2 Production, quality and maintenance dependences

Because quality is becoming a business strategy leading to success, growth, and enhanced competitive position, organisations strive to attain that position through maintaining the equipment in ideal operating conditions. The link between quality improvement and productivity is well established (Montgomery, 1985). Quality improvements mean, elimination of waste such as scrap and rework, which increase

productivity and often leads to cost reductions. Under the total quality management (TQM) philosophy, quality can no longer be inspected into the product, where final control inspection is being moved to the process level through adequate process control techniques (Ben-Daya & Duffuaa, 1995). The link between maintenance and quality, although not completely missing, is not adequately addressed in the literature.

1.2 The need for research

Many organisations view maintenance as the last controllable functions, in which they have an opportunity to reduce costs. However, arbitrarily reducing the maintenance budget can lead to lower levels of operating capacity and reliability. Therefore, many organisations are deeply relying on the maintenance function, to approach profitability. For that reason, they attempt to implement a variety of maintenance strategies, and tactics such as Total Productive Maintenance (TPM), Reliability Centred Maintenance (RCM), Total Quality Maintenance (TQMain), Condition Monitoring programs (CM), and Computerised Maintenance Management System (CMMS) (Lyonnet, 1991).

Maintenance costs are rising over time according to a number of studies conducted in the UK, EU and US. A report commissioned by the Department of Trade and Industry in the UK showed that manufacturing companies could make significant savings through very basic improvements in maintenance (Sharp & Kutucuoglu, 1997). Wireman (1991) found that 1/3rd of maintenance expenditure is unnecessary or wasted. He also revealed that a 10% reduction in maintenance costs could result in a 36% increase in the pre-tax profits, where maintenance costs are between 15 and 40% of the total cost of production. Willmott (1994, p. 10) revealed in the study based on a sample of 407 companies, in EU countries, that expenditure on maintenance is about 5% of total turnover; with a total annual spend of between 10% and 12% of EU industries' added value.

The annual cost of maintenance (corrective and predictive) as a fraction of the total budget varies across business sectors. Murthy et al. (2002) stated that the annual cost of maintenance in the mining industry could be as high as 40-50 per cent and in the transport industry it can vary from 20-30 per cent. These are the direct costs of actions to keep the equipment in a fully operational case. That means the maintenance is an important element of a modern business and must be managed effectively.

In order to be more independent and self-sufficient, developing countries have under taken several development plans, aimed to developing every aspect of life (economic, social and political). The objectives of the plans cannot be attained without appropriate attention being given to the management of all resources and development programs. Libya as one of the developing countries has undergone tremendous development over the past 30 years. The Government has utilised its oil wealth to change the face of the country. Factories, Schools, Universities, Hospitals, Highways and Airports have been built to international standards. Water, telephone and electrical networks have also been considerably expanded to cover almost every habitable spot in the country, (NAID, 2002). It is clear that the above infrastructure needs to be well maintained in order to keep it in a functional condition.

Over the past decade, due to the fluctuation of oil prices and considerable effect of a UN embargo on Libya, which started in 1992, the country's income has decreased considerably. Therefore, the budget allocated for maintenance is limited and the possibility of replacing broken-down or ageing facilities with new ones has been greatly reduced. Thus, the state will have to sustain the existing infrastructure as long as possible. Maintenance is therefore the name of the game at this stage of the country's development. Furthermore, maintenance expenditure is increasing due to the ageing of the infrastructure. The state therefore has to find ways of reducing the costs of performing maintenance while keeping the same quality of services delivered which means effective maintenance is actually needed. The fact that expenditure on maintenance is on the decrease, due to a shortage of funds, means that some maintenance work is not done as it should be, and therefore there will undoubtedly be some accumulation of unfulfilled maintenance work in the future. This unfulfilled maintenance work might also degrade performance, thus reducing the life span of some infrastructure (Al-Sultan, 1996).

According to NAID (2002), there is a large backlog of maintenance work in Libyan organisations, which is produced from:

- The maintenance work during the improvement plan stages was ignored as the country's infrastructure was built for the first time
- People (internal employees and external customers) have not been aware to deal well with facilities because they believe everything is the Government's responsibility.

Changes in Libyan economic policy have started at the beginning of the 21st century. Then the government commenced a gingerly open door policy to the overseas markets. The General Planning Council (GPC) was established in 1998, which undertakes the planning of the Libyan economy. Indeed that happened under the effect of the global market competition associated with the wishing of the state to adopt the quality standards to attain such improvement in different fields. Hence, the Libyan Economic Minister, in July 2002 said, "the public sector organisations have a chance to revise and prove their competence in front of the competition that has knocked on their doors. Producing just for a local market is gone, and those who have not the capability to compete on prices and in quality will be finished" (JANA, 2002).

This change has made the Libyan organisations gradually move out of the Government umbrella, which was to give them a monopoly of products and/or services. In this situation, Libyan organisations should strive to adopt quality management systems. Some have adopted, for example, the quality management systems standards- ISO 9000 (ISO Survey 9000, (2001)). Therefore, due to the financial, organisational, technical, and political difficulties, Libyan organisations should focus on the quality, as it is the crucial standard to measure the success level. It is vital to invest the current resources through the use of good improvement programs, such as; total quality management systems, particularly in maintenance operations, where the effectiveness of people and equipment can make success towards high productivity and low expenditure.

From the above, one can see that the costs of maintenance in Libyan organisations will continue to increase. The opportunities for new building projects and of replacing worn-out facilities are thus greatly diminished, as will be the amount of funds allocated to operation and maintenance, what is therefore actually required is effective maintenance management. Improving the effectiveness and quality of performing maintenance could be achieved by; better maintenance management, proper personnel training, and the introduction of proper legislation. Indeed, there are factors, barriers and difficulties affecting the improvement of maintenance in Libyan organisations, hence the researcher would like to focus on maintenance management and investigate these factors, barriers and difficulties. The findings of this research should help Libyan organisations identify the barriers that they encounter, and as a result, they can adopt suitable ways to overcome them. In addition, the research comes at an appropriate time to be the first one that brings quality management into the maintenance field in Libyan organisations.

1.3 The research question, aim and objectives

The general purpose of conducting this research is to generate new knowledge and understanding and hence build upon existing quality management theories (in maintenance area) based on the research findings. The purpose is to provide a deeper understanding of the barriers affect quality in maintenance in the environment of the case study organisations. Hence, the main aim of the research is "*to identify the barriers and difficulties affecting quality in maintenance within Libyan (public sector) manufacturing organisations*". And the specific objectives to achieve this aim are to:

- understanding quality management philosophies, maintenance management issue and models, and change management.
- investigate the factors that improve quality in maintenance activities, and develop a theoretical framework of driving and restraining forces of quality in maintenance.
- developing an appropriate research methodology to facilitate conducting case study organisations.
- investigate the barriers and difficulties affecting maintenance activities within Libyan case study organisations.

Thus, the purpose, aim and objectives help to guide the development of appropriate research questions. The overall research question to be asked in this study is: *how maintenance activities are managed, and what are the difficulties faced by Libyan manufacturing organisations (public sector) in establishing the quality system in maintenance area?* The results of the research, the discussion of the research, and the expected recommendations should assist the top management in the Libyan case study organisations to identify and determine the barriers and difficulties that they encounter to achieve effectiveness and quality in maintenance. Consequently, the findings of this study are intended to contribute to the knowledge of quality management systems in maintenance area, with particular reference and emphasis to Libyan manufacturing organisations (public sector). Similarly, it is expected that the research could be of benefit to other Libyan manufacturing organisations and might be of benefit to other organisations in developing countries that are seeking to improve maintenance.

1.4 The research contribution to the knowledge

The issue of quality in maintenance as discussed in sections (1.0 and 1.1) has to date been very general and hence studies of quality in maintenance practice have also been

very general and rare. Authors such as Coetzee (2000) and Ben-Daya & Duffuaa (1995) have mentioned to a gap in knowledge of understanding and addressing quality issue within the maintenance area, and thus the link between maintenance and quality. This research provides a genuine opportunity to advance existing knowledge and hence to understand quality in maintenance in general. It will contribute to the existing knowledge through providing in-depth understanding of quality in maintenance in the following issues:

- This study, in fact, is the first leading study in Libya which focuses on the quality in maintenance area and its obstacles. Expanding the existing knowledge of quality management literature in these countries is a contribution.
- A specific definition of "quality in maintenance" will be developed and introduced based on the literature survey.
- Common barriers and difficulties of implementing quality management systems in an organisation will be summarised and tabulated based on the many authors experience and studies from the literature survey.
- The key factors of improving maintenance activities will be summarised and tabulated based on many authors findings from literature survey.
- The demonstration of unique difficulties (barriers) affecting quality in maintenance within the two case study organisations.
- Deriving a theoretical framework of driving and restraining forces of quality in maintenance.

1.5 Research methodology

This study places an emphasis on a consistency between the purpose of research and its theoretical, methodological and methodical choices. A commitment to understanding quality and maintenance management in their historical, socio-economic and political contents requires reflexive and reflective processes of negotiated interaction between the researcher(s) and the researched (Laughlin, 1995). The approach is mainly qualitatively based, and as such, relates to the interpretive tradition. It seeks to collect data based on case studies, but also to maintain a strongly critical stance. This is in keeping with social science researchers who employ qualitative research methods and who espouse an approach in which theory and empirical investigation are interwoven (Silverman, 1985). The research methodology, described more in-depth in Chapter 3, has been applied in order to fulfil the aim and objectives of the study. However, this

research is conducted on two main bases, literature review and case studies. It is carried out in the following brief steps:

1.5.1 Literature review

Quality and maintenance are the main topics of the literature review. This literature review is conducted to enable the researcher to understand the concepts of quality in maintenance. They were intended to permit the researcher to recognise and cover the objectives and constitute a base for an overall understanding and identifying of the barriers affecting quality of maintenance in an organisation. The literature review also helps to choose the suitable methodology of research.

1.5.2 Adoption of research philosophy

There are two main traditional philosophical positions in research: epistemology-positivism and ontology-phenomenology (social constructionism). The Philosophers have argued about which one is best to conduct. Research Positivism, is described by Easterby-Smith, et al. (2002, p. 28), as: "The social world exists externally, and that its properties should be measured, through objective methods, rather than being inferred subjectively through sensation, reflection or intuition." While Social Constructionism, is the new paradigm, which has been developed by philosophers, during the last half century. Largely in reaction to the application of positivism to the sciences, stems from the view that 'reality' is not objective and exterior, but is socially constructed, and given meaning by people (Easterby-Smith, et al., 2002). Based on the nature of this research, the social constructionism (phenomenological) was chosen as the research philosophy. This is discussed in detail in chapter 3.

1.5.3 Adoption of research approach

A common theme in the literature is for authors to classify process or strategy of research under two main paradigms (Brannick and Roche, 1997, Collis and Hussey, 2003, Phillips & Pugh, 2000 and Bryman, 2001). These are - Qualitative research, which usually, emphasises words rather than quantification in the collection and analysis of data, and Quantitative research, which usually, emphasises quantification in the collection and analysis of data. The researcher has selected the qualitative as the main approach for this research. The qualitative approach enables the researcher to dive into the real life of a situational context to explore the included features and factors. It is

powerful for giving insights, findings, and recommendations within the boundaries of the context.

1.5.4 Case study approach

This study is exploratory and explanatory in perspective; it is interested in knowing that "what", "how" and "why" issues related to the investigating barriers and difficulties affecting maintenance in certain organisations. The case study method allows the researcher to concentrate on a specific instance or situation and to identify the various interactive processes at work within the boundary of academic study time limitation. Gummesson (2003) has summarised proper concerns of the case study approach such as: a free and wide choice of data generation and analysis techniques; access to reality and validity in focus and the purpose is understanding. This backs the researcher to select the case study approach.

1.5.5 Data collection and sources of data

Authors such as Easterby-Smith (2002), Collis and Hussey (2003), Bryman (1995) and others have mentioned some different data collection methods that include "Documents, Archival records, Interviews, Direct observation, Participant-observation, Diaries, Focus group, and Questionnaire". The term research technique is used here to illustrate the procedure to be followed to gathering data and data sources used within the research activities adopted in compiling this study. In this study, the researcher has used semi-structured interviews as the main data collection technique, he has also triangulated it with both archival documents and questionnaires survey techniques.

1.5.6 Visit organisations (case studies)

In this stage, the researcher has used all research techniques selected in section 1.5.5 to gather the required data from the identified organisations. He visited these organisations several times to investigate and identify the factors and barriers that have an impact on improving maintenance activities which the organisations experienced.

1.5.7 Data analysis and interpretation

In this step, data collected from case studies have been analysed and interpreted by suitable methods. And from the comparison of the practical barriers that organisations face to improve quality in maintenance and what has been researched in the literature review, a final discussion can be generated.

1.6 The thesis layout

The thesis is organised into seven chapters, which are briefly outlined below:

Chapter one; is devoted to explain the area of research interest. It provides an outline of the background and the need (motivational factors) of the study, as well as the main aim and objectives and contribution of the research.

Chapter two; covers the literature related to the study, includes; quality and maintenance management, change management and the research theoretical perspectives.

Chapter three; deals with the research methodology adopted for this study. Its purpose is thus to explore the methodological choice made to achieve the research aim and objectives. This chapter discusses the justifications for a qualitative approach adopted and the choice of research strategy (case study), meanwhile the methods and techniques that are adopted for gathering data required in this study.

Chapter four; is concerned with the case study organisations' environment. It provides a description of the Libyan environmental context (social, economic and political environment) within which the organisations under investigation operate.

Chapter five; is concerned with an analysis of the case studies data collected, this chapter identifies the major issues related to the barriers and difficulties affecting quality in maintenance system through the investigated organisations.

Chapter six; provides further discussion of the main findings of the research on the basis of theoretical perspectives. A further aim of this chapter is to explain the implications of these findings, the critique of methodology adopted, and the findings.

Chapter seven; provides a conclusion of the study in the light of the specific research aim and objectives. This chapter includes, meeting the aim and objectives of research, contribution to the knowledge, the recommendations for further researches and the limitations of research.

CHAPTER 2 LITERATURE REVIEW

2.0 Introduction

According to the importance of the literature review, in all academic studies, it is considered crucial sources of gathering data related to the subject of research. And regarding the nature of this study from which is an explanatory, exploratory in perspective, the literature review in this chapter has the following goals;

- to provide a basic understanding of quality management philosophy, principles, barriers and difficulties.
- to understand quality in maintenance context.
- to investigate the factors that improving maintenance activities, and existing maintenance management models.
- to understand the change management and culture effect on the management systems.

This chapter is divided into four main parts:

Part one; quality management discusses quality management principles and philosophy, barriers and difficulties affecting quality, quality benefits, quality in developing countries, a review of factors affecting quality management, and the summary.

Part two; quality and maintenance management argues elements of maintenance system, maintenance task profile, evaluation of maintenance management system, the link of maintenance and quality, maintenance and continuous improvement, integrating quality through maintenance activities, building maintenance strategy, overall maintenance management models, and the summary.

Part three; change management includes culture definition, culture difference and its effect on the management systems, the cultural transferability of management models, understanding change, maintenance improvement connected to organisational learning, resistance to change, managing the change, organising the maintenance structure, and the summary.

Part four; discusses the theoretical perspectives of the research related to quality in maintenance aspect, which includes: a definition of quality in maintenance, summarising of common barriers affecting quality management, summarising of key factors affecting maintenance improvement and the suggested steps to managing the change in an organisation. This part represents the theoretical framework of driving and restraining forces of quality in maintenance.

2.1 Quality management

2.1.1 Understanding quality

Quality is shaped at present as a fundamental strategy for the support and improvement of competitiveness in manufacturing and service industry. It is a philosophy, an attitude and a way of thinking that is an integral part of successful industries, businesses, health care, education, and personal growth. It means doing the right things right and effectively, and taking the suitable techniques to ensure excellence of the product or the service. The primary essence of any quality organisation is its personnel assets and the company culture. Eventually the concept manifests itself in the competitiveness of the company's products, whether it is a service product or material product, where the ability of all employees to join together in meeting the customer's requirement is one of the primary precepts of a superior organisation.

According to Dale (1999) quality is conformity to specification, which means that a quality product must comply with predetermined standards. This is a traditional view of quality, where the focus is on in-company processes. However, if quality is meeting or exceeding the expectations of customers, the focus is on the outside of the company. It is customers who evaluate the quality of product or service. These two recognitions of quality can advocate and assist each other in the same firm. ISO 9000, (2000) defines quality as the degree to which a set of inherent characteristics fulfils requirements. By combining the definitions of quality and requirements in ISO 9001, (2000) quality can be phrased as the degree to which a set of inherent characteristics fulfils a need, expectation that is stated, generally implied, or obligatory (Hoyle, 2001).

Total Quality Management (TQM) has been defined and its essential features described in different ways. There is no one, single, universally acceptable definition which managers can adopt; no individual author can claim a monopoly of the set of concepts or ideas which contribute to the overall philosophy and practice of TQM (Pheng, 1996).

Total Quality Management is defined in ISO 9000 (2000) as *"A management approach of an organisation, centred on quality, based on the participation of all its members and aiming at long-term success through customer satisfaction, and benefits to the members of the organisation and to the society"*. Ho and Fung (1994, p. 24) defined TQM, as "*TQM is a way of managing to improve the effectiveness, flexibility, and competitiveness of a business as a whole. It is also a method of removing waste, by involving every one in improving the way things are done"*.

In the case of commercial banking, Spitzer (1991) explained that TQM is a method of managing and operating a business that seeks to maximise firm value through a practice of maximising customer's satisfaction at the lowest possible cost, through a focus on continuous improvement of all processes existing within a company, where employees are empowered to improve these processes. Jostes and Helms (1994) defined TQM as the approach to continuous improvement that involves all levels of an organisation. TQM is defined by Oakland (1997, p. 22) as; *"an approach to improving the competitiveness, and flexibility of a whole organisation. It is essentially a way of planning, organising and understanding each activity, and depends on each individual at each level"*. TQM is a management philosophy that emphasise both the needs to meet external and internal customers' needs and expectations and the importance of doing things right first time. It is mainly concerned with continuous performance improvement.

Based on these definitions, and for purpose of facilities management, Pheng, (1996, p.8) defines TQM as *"A top down management philosophy focused on monitoring process variation, employee involvement, and continuous quality improvement in order to meet customer needs"*. On the whole, these definitions stresses that the TQM philosophy involves all people at all levels in all functions, and such definitions highlight deep the crucial need of continuous factors. Consequently, TQM is a long-term strategy and is concerned with cultural changes in a business as a whole and with creating missions, visions, and values.

The TQM philosophy provides the overall concept that fosters continuous improvement in an organisation. This philosophy emphasises a systematic, consistent and organisation-wide perspective, involving every one and every thing. It focuses primarily on total satisfaction for both internal and external customers within a management

environment that seeks continuous improvement of all systems and processes. The key elements of the philosophy are the prevention of defects and an emphasis on quality in design and basic. Apart from eliminating losses and reducing variability, TQM also supports the development of good relationships between employees, suppliers and customers. Its philosophy is based on extreme ambition to achieve victory.

In fact, quality has become an increasingly predominant feature of life. Today people are constantly involved in the search for quality products, quality services and even abstract notions such as quality time with which to share with their partners and families. The existence of this desire for quality has caused industries and organisations throughout the world to attempt to develop a philosophy that can deliver customers the quality they require. The growing demand of quality in most manufacturing organisations throughout the world, and based on what Wong (1998) has mentioned that many of the quality programs implemented in developing countries fail, due to a lack of real understanding of the quality principles. Therefore, it is very important for Libyan organisations to understand the philosophy and implications of quality, quality principles, implementing quality, factors affecting quality, barriers and difficulties, quality in developing countries, and total quality management (TQM). These concepts are discussed in the following sections.

2.1.2 Quality gurus

The quality Gurus introduced their ideas and the basic principles to develop the activities related to quality issues such as quality control, quality assurance, quality audit, quality management, and total quality management. Although they use different idioms, they are talking the same language and present many solutions to the needs of quality management. Joseph M. Juran, Edward Deming, Phillip Crosby, Armand Feigenbaum, Kaoru Ishikawa, and others are the quality gurus (Oakland, 1997). Their ideas are now being applied by many organisations world-wide. Many organisations have been looking for a number of years at different ways of motivating and involving employees in the quality of their work by applying approaches such as, Deming-14 points, Juran-breakthrough and control, Crosby-zero defect, Ishikawa-quality circles, Feingenbaum-total quality management, Taguchi-Taguchi technique (Vorley, 1998). These approaches have common ambitions, which are the attainments of quality, have been applied with varying degrees depending on a number of factors, for example, culture, systems, and structure of the organisation.

Oakland (1997) classified the similarities and the differences of the various approaches of the three gurus, Juran, Crosby, and Deming in tabular form, appendix 1 shows the similarities and the differences classified under 12 different factors. For more about quality gurus' philosophy and theories, the reader can see references: Juran (1988); Deming (1986), Feigenbaum, (1991), Crosby (1996), Oakland (1997), and Aguayo (1991).

2.1.3 Quality management principles

Quality management principles are the main factors to insure the implementation of quality management a success. Quality management principles (QMPs) are a comprehensive and fundamental set of rules or beliefs for leading and operating an organisation aimed at continually improving performance over the long term by focusing on customers while addressing the needs of all stakeholders (Hoyle, 2001). The principles of quality management that have been emerged as fundamental to the management of quality are stated by the ISO 9000 (2000). Eight principles are derived from the collective experience and knowledge of the international experts (International Organisation for Standardisation, 2004), these principles are:

1-*Customer focus*: Costumers are the backbone of business in any organisations. Therefore every one in the organisation must focus on the customer not only the top management or particular departments in such organisation. Customer focus means achieving a customer's satisfaction through the conformance to its requirements. In ISO 9001(2000) standard, this principle is reflected through the requirements addressing the communication with the customer, management commitment, appointment of a management representative and the determination of customer needs and expectations (Hoyle, 2001).

2-*Leadership*: Top management establish unity and purpose for the internal environment of the organisation. Leaders must develop the following, for effective leadership: clear beliefs and objectives in the form of a mission statement; clear and effective strategies and supporting plans; the appropriate management structure; employee participation through empowerment (Oakland, 1997). Hoyle (2001) stated that the leadership must create and maintain the internal environment in the organisations to make people become fully involved in achieving the organisations' objectives. In the ISO 9000 (2000), the leadership principle is reflected through the

requirements addressing; internal communication, creating an effective work environment, planning and the setting of objectives and policies. Hence, communications, change, vision, respect for all individual are hallmarks of a good leader. As Al-Khalifa (2000) stated, the quality management process needs leadership throughout by top management who should understand and support its objectives and methodology. Management should actively listen to their employees and check progress. In general, without appropriate leadership, quality management will not succeed; only dynamic leadership can create the commitment to drive the QM strategy.

3-*Involvement of people*: When every one in the organisation from the top executives to the shop floor workers are involved, their productivity could be increased which means getting benefits. This principle is reflected in ISO 9000:2000 through the requirements addressing; participation in design reviews, defining objectives, responsibilities and authority, creating an environment in which people are motivated, internal communication and identifying complete needs. Therefore, people at all levels are the essence of the organisation and their full involvement enables their ability to be used for the organisation's benefits.

4-*Process approach*: A desired result is achieved more efficiently when related resources and activities are managed as a process; process management forces organisations to think in terms of processes rather than in terms of finished product. Hoyle (2001) refers that the process approach to management is not converting inputs to outputs that meet requirements. It is about managing process, with clearly defined purpose and objective, which is based on the needs of the interested parties. Those parties are designed to get the object and purpose, through tasks that capable human, physical, financial resource and information, and that measure, review and continually improve process efficiency and effectiveness.

5-*System approach to management*: This principle admits that there is an exchangeable effect between all parts of the system related to the behaviour in such an organisation. Identifying, understanding and managing a system of interrelated processes for a given objective contribute to the effectiveness and efficiency of the organisation (Ludwig-Becker, 1999)

6-*Continual improvement*: Usually moving to the best is coming from continuous improvement, which works as a refreshing source to development. It is vital to have a good continuous improvement program for any organisation to keep it on line of business. It is the assurance way to give the organisation a place in the current competitive work field. ISO 9000 version 2000 defines the continual improvement as; "A recurring activity to increase the ability to fulfil requirements.". It also addresses; improvement processes, identifying improvements, reviewing documents and processes for chances to achieve improvement.

7-*Factual approach to decision making*: This principle leads managers to approach the decision in different ways; decide what decisions need to be made, determine what facts to be needed to make the decision. And determine how much facts will be obtained and what methods to be used to get them. Ludwig-Becker (1999) stated that the effective decision and actions are based on the analysis of data and information. Scrap, rework, returns and customer information are all-important for decision making. The factual approach principle is reflected in ISO 9001 through the requirements (Hoyle, 2001) addressing; reviews, measurements and monitoring to obtain facts, control of measuring devices, analysis to obtain facts from information, records for documenting the facts and approvals based on facts.

8-*Mutually beneficial supplier relationships*: Nowadays organisations become more dependent upon their suppliers rather than ever before, as a mutually beneficial relationship between the organisation and its suppliers enhance the capability of the organisations to create value (Hoyle, 2001).

2.1.4 Implementing quality

Taking into consideration the variety of quality systems, attention should be drawn to the fact that although there are a variety of systems, the aims and objectives of all of them are pouring in one pot which is getting organisation's improvement and success. So that even sometimes there are different quality system names, they are very similar. For example, TQM is just a comprehensive meaning of QM; Sun (1999) reported that many quality methods are implemented simultaneously under the umbrella of TQM. The globalisation of the marketplace and the rapid improvement in high quality products and services has brought about a high level of market pressure worldwide. Therefore, the majority of companies are being forced not only to change their old

operational and management styles but also to develop better ways to ensure that customers are satisfied with products and services. Many programs of quality management are implemented in different organisations aiming to achieve the desired objectives in such organisations. These programs encompass the basic principles of quality management (QM), as outlined by quality gurus –Deming, Juran, Crosby and others. Firms in developed countries that have adopted a quality-oriented strategy have achieved improved productivity, greater customer satisfaction, increased employee moral, improved management-labour relations, and higher overall performance (Mersha, 2000).

To help companies implement a successful quality program, Cutler and Kleiner (1997) address four key areas. The first, planning, deals with setting the right quality course for success. The second, commitment, perhaps the broadest area, deals with effective practices for success. The third, opening the quality umbrella, tracks the failure of companies to implement quality company-wide and beyond. Finally, true customer satisfaction, asserts that a purely quality-based focus is not enough to ensure the survival and success of a quality program. Several methodologies for total quality management have been developed, including the ISO 9000 series, six sigma, and the European Foundation for Quality Management (EFQM) business excellence model (Klefsjo et al., 2001).

Motwani, et al. (1996) refer to the fact that implementing quality in the hospitality industry can lead to success through the following five stages: (1) awareness and commitment; (2) planning; (3) programming; (4) implementing; (5) evaluation. In the first stage, the top management must develop a complete understanding of what is QM and how they plan to achieve it, associated with its great commitment. In the second stage, management should identify strengths and weaknesses, provide education to key personnel, set visions and objectives, and take care to ensure that the organisation's culture is suitable to foster QM. The third stage, the management should name the process; state purpose through a new quality framework; provide training to all levels of personnel; conduct internal and external customer surveys to evaluate the current process; formulate a quality council to oversee and regulate the QM process; perform competitive benchmarking to compare its performance to other organisations; form quality improvement teams; and establish measures and quality indicators which truly measure the objectives and goals of the organisation. The fourth stage, should involve

providing ongoing education and training; forming new committees, new teams, new departments or hiring new specialists to help the process as and when required; and recognising and rewarding quality improvements. The fifth stage, evaluation should be involved to know whether the program of QM is successful or a failure; such a program may be redesigned or revised.

As Tannock and Krasachol (2000) note that ISO 9000 series have become important in developing countries, many countries in Asia such as Hong Kong, China, Malaysia, Singapore, Thailand, etc have adopted ISO 9000 series as well as some other countries in the Arabic world and Africa. Meanwhile others are looking foreword to adopting it as soon as possible. In developed countries, particularly in the United States of America and Western Europe, much research on ISO 9000 has consistently been carried out. The multi-national companies and large companies from Australia, New Zealand and Taiwan have implemented TQM (Bhanugopan, 2002), however, little work has been carried out in developing countries (Al-Khalifa and Aspinwall, 2000). This is actually true for the Arabic and African Countries, which means more focus on quality principles and standards are needed to starting implementation of quality systems within their organisations.

Research suggests that Irish firms prefer to implement an established quality standard such as ISO 9000 before embarking on a company-wide TQM initiative (Ismail and Hashmi, 1999). This agrees with the work of Dale (1994) who suggests that a quality system such as ISO 9000 is a prerequisite for successful TQM implementation. ISO 9000 series seem to be the most common quality program that have been adopted through firms in the world due to its requirements which make a firm able to compete and survive. Crumrine and Runnels (1991) offer a model for implementing TQM that identifies five categories for implementation and the tasks associated with each category. This model may help to get successfull implementation of quality systems in an organisation, as it addressed almost quality principles that have been mentioned in prior sections. Crumrine & Runnels's model consists of:

(1) *Commitment*. Investigate, evaluate, adopt, and obtain commitment to TQM
(2) *Organisational development*. Integrate TQM into key management processes; educate, train, and offer support to employees.
(3) *Customer focus*. Determine work teams; analyse customers, products/services.

(4) *Process orientation.* Identify, standardise, and improve process control.

(5) *Continuous improvement.* Develop method for identifying opportunities and integrating the improvement process into daily operations.

Since (TQM) is the theme for excellence for organisations to survive and grow. This section will try to explore the main two keys components of TQM and investigate best practices in achieving success in each of the key components. Authors such as Ho and Fung (1994), Senju (1992) and Osada (1991) have mentioned that the two main techniques (steps) for excellence for organisations in the way of implementing TQM are the five Ss (5-S) and Quality Control Circles (QCC). What 5-Ss stand for is described in table 2.1 (Ho & Fung, 1994, p. 24). However, the important points concerning 5-S are:

- The 5-Ss have been around a long time. People have not been that aware of them until now. So still, there is a space for improvement.
- The main reason why the 5-Ss are needed at work is because people do many things without thinking. The 5-Ss can help in every thing people do.
- The 5-Ss are same a mirror reflecting our attitudes and behavioural patterns. Even so, people often avert their eyes and prefer not to look at what they see there.
- Many of the frequent problems that people face would be cleared up if only they paid more attention to the 5-Ss. Observing the 5-Ss is not a mark of a lazy mind and a slothful attitude.
- Before management and supervisors tell other people they have to implement the 5-Ss. They need to take a good look at things and see if they really understand why themselves. Typical examples of 5-Ss are "to throw away rubbish", "daily cleaning", "one-is-best", and "30. Second retrieval".

Beskese and Cebeci (2001) mentioned that relationship were found between implementing TQM and having quality circles, external and internal customer satisfaction surveys, periodic determinations of quality costs, and suggestion systems. They advocated that the most widely used component of TQM is found to be a reward system for suggestions. Complete and correct implementation will be possible only by the help of education that well show what TQM really is. Ishikawa (1990, p. 1), defines quality control as "a system of methods for the cost-effective provision of goods or services whose quality is fit for the purchaser's requirements". A QCC is a small group, which voluntarily performs quality control activities within a single workshop. The

basic concepts behind QCC activities within the company-wide quality control effort (Ishikawa, 1990) are:

- To contribute to the improvement and development of enterprise.
- To respect humanity and to build worthwhile lives and cheerful workshops.
- To give fullest rein to human capabilities and to draw out each individual's infinite potential.

Japanese	English	Meaning
Seiri	Strucrturise	Organisation
Seiton	Systemise	Neatness
Seiso	Sanitise	Cleaning
Seiketsu	Standardise	Standardisation
Shitsuke	Scrutinise	Discipline

Table 2.1 Meaning of 5-Ss (Ho & Fung, 1994, p. 24)

Therefore, implementing quality in an organisation should begin with the drawing up of a quality policy statement and the establishment of an organisational framework for both managing and encouraging the involvement of all parties in attaining quality through teamwork, and whichever implementation model is employed, it should be appropriately linked to the: organisation's mission, its strengths and weaknesses, its culture, its opportunities and threats, and the number and location of change agents and would-be champions (Sutcliff and Pollock, 1992).

2.1.5 Barriers and difficulties affecting quality management

Most of the barriers and difficulties of implementing quality have strong links to the people affect directly or indirectly. Walsh, et al. (2002) identified the major barriers to QM implementation as being management behaviour, cultural change, making time, enhancing service and obtaining tangible benefits. Management behaviour and lack of management commitment appear to be the predominant cause of failure of QMS initiatives in organisations. Rohitratana and Boon-itt (2001) have mentioned that the obstacles in the ISO 9000 implementation process are lack of knowledgeable specialist in this subject matter; lack of understanding in the details of quality standards from the enterprises' point of view, which caused delay in implementation process; lack of support and co-operation from the staff, which invariably results in resistance.

Bhanugopan (2002) states that the most common problem for all the firms attempting to implement QM was the complication of implementation which include; the lack of knowledge, lack of management support, too complicated, lack of time for the line staff and the relatively high cost purported. Furthermore, Schein (1991) identified one of the common causes of failure of QM programs as being a lack of top management commitment.

According to cultural considerations, a study initiated by the World Bank (known as AM90s) indicated that a critical problem in economic management in Africa is the informal traditional institutions. They are rooted in the socio-cultural heritage of African societies, and they also are not connected with the formal institutions that have been transplanted into Africa (Dia, 1996). This was advocated by Walsh, et al. (2002) who mentioned that the most commonly quoted reasons for quality program failure were: resistance from employees, an unsuitable organisational culture and lack of top management commitment.

Tamimi and Sebastianelli (1998) have linked the barriers in the TQM implementation with the seven criteria: leadership, strategic planning, customer and market focus, information and analysis, human resources development and management, process management and business results. In their study, Tamimi and Sebastianelli (1998) found several factors working against TQM implementation. The major barriers cited by samples included not linking management's compensation to achieving quality goals and lack of training in areas such as group discussions, communication techniques, quality improvement skills, problem identification and problem-solving techniques, inadequate resources. In addition, Masters (1996) found the following factors leading to ineffective TQM implementation:

- lack of management commitment.
- weak comprehension of quality management.
- inability to change organisational cultures.
- lack of accuracy in quality planning.
- absence of continuous training and education.
- insufficient resources.

Adebanjo and Kehoe (1998), who studied TQM implementation in UK manufacturing organisations, identified quality problems as follows:

- upper management does not insist on systematic measuring of customer satisfaction level and training programs.
- lack of training programs to enhance workers' skills and involvement in quality improvement activities.
- organisations do not place enough importance on cases of goods returned nor relate such cases to customers.
- many organisations do not involve suppliers when making improvements to products and in general suppliers have difficulties in meeting the organisations' requirements.
- insufficient teamwork facilitators and team building techniques such as Belbin are not employed.
- worker evaluation lacks a systematic approach and hence salary adjustments are not commensurate with job functions.

In the United State, Salegna and Fazel (2000) surveyed the obstacles faced by TQM and non-TQM organisations, the results showed three main obstacles facing TQM organisations. These are insufficient time, poor communication and lack of real employee empowerment. For non-TQM organisations, the obstacles include lack of motivation, insufficient time and lack of strategic planning for change. Amar and Zain (2002) uncovered eleven factors seen to be barriers against the successful implementation of QM in Indonesian manufacturing organisations, the factors are: human resource, management, attitude towards quality, organisational culture, interdepartmental relations, materials, machines, equipment, information, method, and training.

Nagi & Cheng (1997) divided the barriers of quality management implementation into four main categories; *Cultural and employee,* which include; change of culture, fear/ resistance to change, lack of employee commitment and involvement, and lack of confidence by employees. *Infrastructure barriers*; which include; lack of customer feedback system, insufficient quality training and education, lack of recognition and rewards system, inadequate knowledge understanding in quality management system, underdeveloped measure of quality, and lack of expertise in QM. *Managerial barriers* which include; lack of manager's commitment, no proper vision and mission, high turnover/changes in key executives, and lack of leadership. *Organisational barriers*

which include; ineffective internal and external communication network, territorialism and organisational policy.

Despite the number of publications and the amount of research into QM, little empirical work has been carried out in developing, improving countries, particularly in the Arab world and Libya specifically. However, based on a study conducted in Qatar, Al-Khalifa and Aspinwall (2000) stated out the obstacles faced implementing quality management in Qatar were;

- the bureaucratic culture that was prevalent in their companies, particularly in the case of the services and government owned organisations.
- culture change.
- the rigid hierarchical and authoritative structure that exists in Qatar.
- top management commitment and support.
- employee resistance to change.
- current negative work climate and middle management resistance to change.
- lack of knowledge and skills of top management.
- limited resources to implement change.
- wrong people in the wrong position.
- promotions based on nationality rather than on qualifications.
- lack of empowerment at lower employee level.

Whalen and Rahim (1994) mentioned that the barriers affecting quality management implementation are; lack of management commitment, resistance of the workforce, lack of proper training, teamwork complacency, failure to change organisational philosophy, lack of resources provided, and lack of effective measurement of quality improvement. In addition, Sayle (1994) cites six causes of quality problems namely: lack of organisation, lack of training, lack of discipline, lack of resources, lack of time, and lack of top management support. MacDonald (1992) has mentioned nine key reasons for QM failure: lack of management commitment, lack of vision and planning, satisfaction with the quick fix, the process became tools bound, quality too constraining, culture change versus project approach, quality management became institutionalised, the people were not really involved, and lack of real business measurable.

Al-Zamani et al. (2002) identified three main categories of difficulties facing implementing quality management in Yemen. First, government takes control of the

selection and assessment of managers in the public organisation, which means lack of government-supported programs to quality. Second, lack of technical knowledge & training. Third, inappropriate managerial traditions. Finally, Oakland (1997) refers some of the obstacles to TQM implementation are that it can be seen as time-consuming, bureaucratic, rigid, impersonal, and/or the property of a specialist group. Frequently found is the so-called middle management resistance, particularly where there is a fear of openness.

2.1.6 Quality benefits

There is considerable research in the literature related to the benefits of companies who were certified ISO 9000 as a quality system throughout the world. Brown and Van der Wiele (1995) proposed the benefits obtained with the ISO 9000 certification as follows: increase in company quality awareness, increase in product quality awareness, improvement in company management, improvement in customer relations, improvement of the products and services offered, improvement of the relationship within the organisation, and increase in customer satisfaction.

The benefits of (QM) are summarised by Fox (1993), as helping organisations to:

- Focus clearly on the needs of their markets.
- Achieve a top quality performance in all areas, not just in product or service quality performance.
- Operate the simple procedures necessary for achievement of a quality performance.
- Critically and continually, examine all processes to remove non-productive activities and waste.
- See the improvements required and develop measures of performance.
- Understand fully and in details its competition and develop the effective competitive strategy.
- Develop the team approach to problem solving.
- Develop good procedures for communication and acknowledgement of good work.
- Continually review the processes to develop the strategy of never ending improvement.

Regarding the benefits that can be derived from implementing QM, firms should be encouraged to implement it. However, when all the responses to QM were combined together, the most admitted benefits derived from the implementation were increased efficiency in manufacturing industry and with service industry. Efficiency and customer satisfaction were mentioned as the most derived benefits from initiating QM (Bhanugopan, 2002). Walsh et al. (2002) stated that TQM offers many benefits to organisations that adopt it. The chief benefits attributable to TQM include: (1) the elimination of defects; (2) reduced scrap and rework; (3) reduced levels of cost; (4) increased levels of efficiency and productivity; (5) increased employee moral.

2.1.7 Quality in developing countries

With regards to the Libyan management system, in most developing countries, the state plays a dominant role in economic activity, and state-owned enterprises comprise the largest corporations. Moreover, to be taken seriously by other enterprises, the government's solid backing will be very helpful. Therefore, organisations should establish partnership with their respective governments. For such organisations, this might be the most important alliance they have to do, since restrictive regulations (such as strict foreign exchange controls, import controls, etc), enacted by the government and meandering through the bureaucratic system affect responsiveness to customer requirements (Nollet et al., 1994). Therefore, in addition to the firms' top managers, the active involvement and leadership of top government officials are even more critical for the success of quality improvement efforts in developing countries. Thus in view of rampant corruption and favouritism in most developing countries, workers should be convinced that the reward and recognition system is fair if the QM system is to be successfully implemented and sustained.

Increased liberalisation of international trade that resulted from negotiations at the Uruguay, roundtable of 1995 has brought pressure to bear on Sub-Saharan African (SSA) industries to be more competitive, both in price and quality, to succeed even in their domestic markets (Mersha, 2000). Because the ISO 9000 standards specify the quality systems necessary to meet stipulated requirements, for different situations and seek to ensure that customer requirements as stated in the technical specifications are met (Hayes, 1994). Quality improvement in general, and seeking ISO registration in particular, which could serve as a strong foundation for implementing more comprehensive quality improvement approaches, such as total quality management

(TQM), is immensely important for firms operating in Africa including Arabic countries. Mersha (2000) cites that QM implementation can have several benefits to manufacturing and service organisations in SSA: some of these benefits include the following:

Facilitate acceptance of positive change. Sub-Saharan African SSA societies tend to be less dynamic and more resistant to change compared with industrialised societies. QM in SSA can foster the culture of accepting positive change, and this can have far-reaching consequences for the region's development as a whole.

Adopt a more customer-oriented management approach. Compared with industrial countries, the treatment of customers in Africa both in private and in public sector has a lot to be desired. In SSA, customers do not receive the attention that they deserve.

Enable a more effective management and development of workers. Considering the shortage of capital investments in SSA countries, utilising human resources to improve quality, productivity and overall performance holds great promise. To utilise human resources effectively, however, appropriate training of the workforce both in technical and behavioural skills is essential. For example, a study based on the Kenyan industry showed that both workers and managers preferred a more democratic style of leadership to build consensus and trust (Dia, 1996).

Increase foreign exchange earnings. Most countries in the SSA region keep tight control of their limited foreign exchange earnings. To stretch the utilisation of the available foreign exchange, government regulations often require that companies purchase certain inputs from domestic suppliers. However, local suppliers in many SSA countries have difficulty meeting the quality and delivery requirements specified by their international customers (Nollet et al, 1994).

As Sanders and Scott (1997) observe: taking time out to develop, write, formalise, and implement processes in critical areas such as process control, purchasing, and contract review does improve the level of service provided to customers-even if it is not 'world class'. In view of the fact that adequate formal procedures may not be available in many SSA organisations, it could be more realistic to start out with ISO before launching the rather protracted TQM process that should be tailored to the prevailing social, cultural,

economic, and political conditions (Mersha, 2000). For example, it has been shown that Africans tend to place a higher value on interpersonal relations than on individual achievements compared with western societies (Dia, 1996).

Mersha (2000), mentions that there are case studies indicating that some of the basic requirements for successful implementation of TQM have already been effectively utilised in different parts of Africa. For example, in Zambia, listening to client suggestions helped minimise client dissatisfaction; in Ghana, taking stakeholders' views into account facilitated the development of a more client-oriented civil service system; and in the Gambia, the involvement of village-level groups on national policy issues influenced the final policy outcome. Moreover, other culturally sensitive incentive programs have been successfully utilised in Burkina Faso, Cote d'Ivoir and Togo. Therefore, taking in account the major change with its reflects and the specific conditions in each country and/or each organisation, as Mersha (2000) advocates, it is necessary to emphasise that there are indications, that the socio-cultural values prevailing in most African and all Islamic societies are suitable to the QM process. In the current competitive struggle for a large share of the global market, governments in improving countries should play an increasingly main role to facilitate the quality improvement effort through their firms as the commitment of government leaders in the quality improvement campaign is even more crucial, they should strive to create appropriate mechanisms for initiating, supporting and sustaining the quality improvement effort.

Regarding the political and social situation in most of the improving countries, many organisations have not operated as commercial companies because of various forms of government intervention, and in particular locally based companies that have been protected from international competition by government-imposed tariffs and trade barriers. This means the political impact is a very important factor. It works as a main barrier to operate or implement a quality system, which has to be taken into account when the researcher comes to identify the barriers and difficulties affecting quality in maintenance within Libyan organisations.

2.1.8 A review of factors affecting quality management implementation

It is assumed that in any situation there are both driving and restraining forces that influence any change that may occur, so implementing QM in both manufacturing and

service industry is surely affected by these forces. Driving forces, are the forces affecting a situation that are pushing in a particular direction; they tend to initiate change and keep it going, the two most significant driving forces of QM initiatives were the pursuit of competitive advantages and the need for improved quality (Walsh, et al., 2002). Restraining forces are the forces acting to restrain or decrease the driving forces. Bhanugopan (2002) mentions the enhancing force factors include employee outlook, customers' demand, the firms' edge over competition and its inclination to the international market, he also stated the following factors related to both driving and restraining forces: Driving forces; aspiration to succeed, employees' outlook, management acquiesce, customers' demand, edge over competitors and international market orientation. The quality initiatives in the majority of organisations originated with either the chief executive of the organisation or the quality department. Restraining forces; unclear directives, resistance to change, lack of training, fear of loss of control, lack of time for line staff, and high cost.

Walsh et al. (2002) recommend the following factors should be borne in mind when implementing and developing a TQM philosophy: (1) proper planning; (2) education and training. Employees should be comprehensively educated and trained; (3) motivation and commitment. Senior management should motivate employees and support QM programs; (4) information. Employees must be provided with all the required information; (5) time. Management must be patient; (6) cost. A QM program may require substantial investment; (7) change management. The quality improvement is the important goal for nearly all manufacturing organisations in the world. However, the methods to improve quality are numerous, they include, total quality management, statistical process control, zero defects program, quality function deployment, quality policy deployment, teams, benchmarking, kaizen, total productive maintenance as well as ISO 9000 series of standards (Gertsen et al., 1994).

It is believed that advocating of each of the change concept struggle when questioned about successful implementation. By experience, there is a critical matter between the theory and its implementation. For example, the researcher believes that it is easy to introduce a model in maintenance area, but it is so difficult to implement it successfully. Of course, the success highly depends on the understanding and commitment of whom they may be concerned with. Several authors have proposed general implementation frameworks, for instance, Davenport (1993) recommends the following five steps

framework: (1) Identify processes for innovation; (2) Identify change levers; (3) Develop process visions; (4) Understand existing processes; (5) Design and prototype the new process.

Quality management Gurus such as; Juran (1988), Deming (1986), Feigenbaum (1991) and Crosby (1996) are all advocates of continuous change and quality improvement. Many writers have discussed these guru's ideas such as McBride (1986) who concluded that, the golden thread running through the philosophies of all four gurus is the concept of adopting quality as a fundamental business strategy permeating the culture of the organisation. Similarly, Fine (1985) suggests that all four gurus have four essential points in common for successful implementation of a continuous change program: -

- The importance of top management support and participation.
- The need for workforce training and change.
- Careful planning and a philosophy of company-wide involvement.
- Quality improvement programs must present permanent ongoing activities.

In addition to these four categories, Oakland (1997) recognises that implementation of TQM requires effective leadership of the initiative through following five steps: Develop clear beliefs and objectives; Develop clear and effective strategies; Identify critical processes; Review management structure; Encourage effective employee participation. Further to the above categories, Dunn (1995) discusses factors affecting successful implementation of TQM through continuous improvement and change program, and he states out the following: -

- Time and resource requirements or constraints.
- A culture that results in reluctance to change.
- De-motivation experienced by management or workforce.
- Lack of communication by those who are implementing the strategy.
- The experience or knowledge of previous similar initiatives.
- A lack of confidence felt by employees on the organisation.
- Having a version of TQM imposed on the organisation by an external body who lacks knowledge.

2.1.9 Summary of part one

As a result of what was discussed in the previous sections, the researcher believes that the term quality means different things to different people. This is why defining quality is often the first step in most quality improvement journeys. A common understanding and vision of what is meant by quality helps the organisation focus its quality improvement efforts. Quality management stresses a systematic, integrated consistent, organisation-wide perspective involving everyone and everything. It focuses primarily on satisfaction for both the internal and external customers, within a management environment that seeks success and improvement of all processes. Furthermore, the QMS must be treated beyond going for certification; it must be build-in as part of the every day work. Full awareness on the benefits of the system is a necessity. Everyone needs to be trained sufficiently and management support and commitment.

As Sun (1999) has mentioned in section 2.1.4, many quality programs (systems) are implemented simultaneously under the umbrella of TQM. These systems encompass the basic principles of quality management, aim to getting organisations' improvement and success. Thus taking into consideration the distinction between quality management systems and broader quality management regimes incorporating continuous improvement culture such as TQM, quality improvement in general, and seeking ISO certification in particular, is immensely important for firms operating in developing countries including Libya. Therefore, the researcher has focused, in his empirical study, on quality management system; specifically to investigate the barriers that could face Libyan manufacturing organisations (public sector) in introducing quality management system.

According to the quality gurus' perspectives and authors such as Walsh et al. (2002), Dunn (1995), Oakland (1997), Davenport (1993), Fine (1985) and others, the critical factors for successful implementation of QMS can be summarised as follows:

- Careful planning and identifying processes for innovation; all proposed QM programs should be properly planned, monitored and reviewed.
- Unambiguous process vision and strategy, clear beliefs and aims.
- Top management support and commitment; top management must motivate employees and actively show commitment to proposed QM systems at all times.

- Smooth movement of information and effective communication system (internal/external); all related and required information must be communicated for all employees to successfully implement the QM programs.
- Proper training and education programs; employees should be comprehensively educated in QM principles and given the time to put this learning into practice. QM cannot be taught by instruction alone; it is through continuous practice and observation that the real learning process takes place.
- Sufficient time; a QM cannot put into practice overnight, but will take several years to develop and should be constantly evolving. Employees must be given the time to appreciate the usefulness of QM methods and to understand the benefits that these methods can bring about.
- Cultural considerations; the transition period involving the implementation of a QM strategy must be managed carefully. Enthusiasm for QM concepts and methods must be maintained until they are accepted as part of the organisation's culture and way of life.
- Employees' confidence, commitment and participation; employees should have full confidence and empowerment.
- Cost and resource requirements or constrains; a QM programs may need substantial investment. Management should view this investment as long-term and consider this against the benefits that are likely to accrue in years to come.
- Understanding existing process and review management structure; current situation of an organisation should be fully understood, its weakness and strengthens have to be determined.

2.2 Quality and maintenance management

2.2.0 Introduction

Quality is becoming a business strategy leading to success, growth and enhanced competitive position; so organisations strive to attain that position through maintaining the equipment in ideal operating conditions. Hence, one can see that quality, as a general concept is a demand for all sides of life; it has a strong link to the humanity improvement and style. It seems to be the golden thread, which motivates anyone to catch it. Quality can fit in anywhere and at anytime under certain conditions such as the availability of resources accompanied with full commitment of all interested people. Therefore, despite its difficulty to achieve, quality depends on the willingness and interest of the people in any place and at any time. Quality in general could be

expressed in the single words such as best, perfect, optimal and excellence. The link between maintenance and quality, although not completely missing, is not adequately addressed in the literature.

Although the importance of keeping all parts of any plant in proper working condition, so many organisations do not pay enough attention to maintenance as integrated activities. Increasing the capacity of products and providing goods and services can be gained by maintaining the physical assets with crucial care. It also can expand the ability to produce goods and services to the customer's satisfaction, consistently. Furthermore, it could predictably provide a safe and controlled work or service environment, with a minimum of risk. However, keeping a company working effectively is a complex job. There are several key concerns, in forms of questions, which impact the cost of asset maintenance; they are consistent with Campbell's (1995) perspective as follows;

- How does an organisation attract and keep capable people to maintain sophisticated equipment systems?
- What is the optimum level of inventory of maintenance parts, materials, and consumables? and what organisational arrangements are appropriate?
- Does an organisation need specialist maintenance engineering support?

Although these questions are not new, nowadays, global competitive stakes make it more important due to the concept of "maximise output of goods and services and minimise input of resources-financial, human, and physical". However, providing the best value is environmentally conscious and has to do with giving the best quality, at the suitable price. As Campbell (1995) stated the following equation of value;

$$Value = (Quality * Services) / (Cost * Time * Risk)$$

When the higher the quality and service for a given cost and response time, the more value to the customer. Therefore, the physical resources employed must be available when needed, and must produce at the required rate and quality, all at reasonable cost. Environmental and safety risks must be minimised. According to Campbell (1995) there are some innovative approaches in maintenance management; many organisations are working to gain competitive edge through implementing it such as; preventive maintenance PM, total productive maintenance TPM, reliability centred maintenance RCM, terotechnology, CMMS, and condition-based maintenance CBM.

2.2.1 Elements of a maintenance system

The maintenance system comprises both formal and informal elements. The formal elements include management systems and methods, organisational structures, information systems, and technology necessary to implement the generic maintenance tasks within an industrial enterprise. The management system essentially specifies when to deal with one or more of the maintenance tasks, what to do when the task is dealt with, and who should do it. The management system also includes the formal collective knowledge and know-how. Regarding the organisation, in some industrial firms, there is a distinct division of responsibility for maintenance tasks between operators of individual machining tools, set-up fitters and skilled workers from the maintenance department. An information system can range from manual data collection and reporting to sophisticated systems (Riis, et al., 1997).

Informal elements of a maintenance system include the actors of maintenance. These actors include the individuals performing maintenance functions (i.e. technicians, operators, managers) as well as the influence of the corporate culture. Individuals of a maintenance organisation act and decide using their knowledge, skills and know-how, their motivation and attitudes. In addition to being part of the formal management system, individuals act informally. Attention is given to how individuals from the maintenance department interact with other members of the organisation (Riis, et al., 1997). Riis, et al. (1997) state that, one of the design variables for improving maintenance with respect to individuals is to educate them by providing appropriate decision support in terms of information systems and decision rules. Although there are only a few possibilities to alter directly the culture in an industrial enterprise, it is suggested that corporate culture be included as an element in a maintenance system. It captures the collective, informal learning, which has occurred in the past. So the maintenance system is very much dependent on the structure and kind of firm, the external conditions internal constraints and specified corporate objectives. This analysis of the situation leads into the identification of the object system or focal areas for maintenance and the maintenance task profile.

2.2.2 Maintenance task profile

Typical maintenance tasks include fault isolation, fault detection, fault diagnosis, repair, replacement, overhaul, calibration and testing, lubrication of components, inventory control of spare parts, statistical analysis of failure and maintenance data, determination

of inspection schedules and methods (Niebel, 1994). Thorsteinsson and Hage (1991), develop a broader and richer definition of the maintenance task based in viewing the maintenance system as a production system where the 'products' are maintenance services. Thus, they identify twelve main maintenance tasks, or 'fields', that are grouped into three primary categories – technical, human, and economic. Definitions of these 12 maintenance fields are as follows:

The technical part;

- *The maintenance products.* Specification of the different types of services and products from the maintenance function. Specification in relation to each plant system.
- *Quality of the maintenance products.* Specification of quality of the maintenance jobs, quality reports, certification documents, decision about maintenance standards, etc.
- *Maintenance working methods.* Specification of working methods, time standards, relationship between maintenance jobs, etc.
- *Maintenance resources.* Equipment for maintenance, buying maintenance services, information about new equipment, capacity of equipment, usage control, etc.
- *Maintenance materials.* Inventory planning (spare parts, etc.), warehousing, relationship with vendors, etc.
- *Controlling maintenance activities.* Scheduling of maintenance jobs, progress in work, manpower planning, etc.

The human part:

- *Internal relations in maintenance function.* Relation to other department, corporation and co-ordination, especially to production.
- *External relation for maintenance function.* Relation to external parties especially related to environment and safety. Contact to local authorities, press, labour organisation, customer, vendors, neighbours, etc.
- *Organisation of the maintenance function.* Design of the organisation, selection of people, relationship between groups of skills, responsibility and authority.

The economic part:

- *Structure of maintenance.* Work breakdown of maintenance, responsibility for work packages, area structure, relation to accounting system, specification base (drawings, documentation), etc.
- *Production economy.* Production economy versus maintenance economy, cost benefit of maintenance.
- *Maintenance economy.* Economic control of maintenance: cost estimates, budgets, cash flow, accounting for the maintenance function. Plan investment and financing.

Thorsteinsson and Hage (1991), then link the five managerial functions of formulating goals and strategies, analysis, recording and controlling, specifying and planning, and conducting the work to the 12 maintenance fields by developing a "radar" diagram. This radar diagram, based on the graphical concept of a radar screen for tracking ships or airplanes, may then be used as a diagnostic tool to evaluate the level of managerial effort currently being expended by a company towards its maintenance activities. Using such radar diagram analysis leads to the development of maintenance profiles that clearly illustrate to management where their efforts have been allocated with respect to the maintenance task within their organisations. Moreover, the radar diagram may also be used to suggest changes to management efforts and to evaluate the possible organisational effects of new, improved maintenance management programs. The use of a radar diagram for identifying managerial efforts towards accomplishing maintenance tasks is viewed as a pragmatic tool for motivating changes to a maintenance system (Thorsteinssson & Hage, 1991).

According to Reason and Hobbs (2003), the major types of unsafe act that occur in maintenance are: (1) recognition failures; (2) memory lapses; (3) slips of action; (4) errors of habit; (5) mistaken assumptions; (6) knowledge-based errors; (7) violations. Some of the main factors contributing to non-detection errors are summarised below;

- Inspection was interrupted before reaching defect.
- Inspection was completed, but the person was distracted, preoccupied, tired or in a hurry.
- The person did not expect to find a problem in that location.
- One defect spotted, but next one close to it missed.
- Inadequate lighting, dirt, or grease.

- Inadequate rest breaks.
- Access to job was unsatisfactory.

Reason and Hobbs (2003) mentioned that the key factors that are known to increase the frequency of maintenance errors are documentation problems, time pressure, poor housekeeping and tool control, inadequate coordination and communication, fatigue, inadequate knowledge and problems with procedures. Reason and Hobbs (2003) summarised the maintenance errors in the context of local error-producing factors in figure2.1.

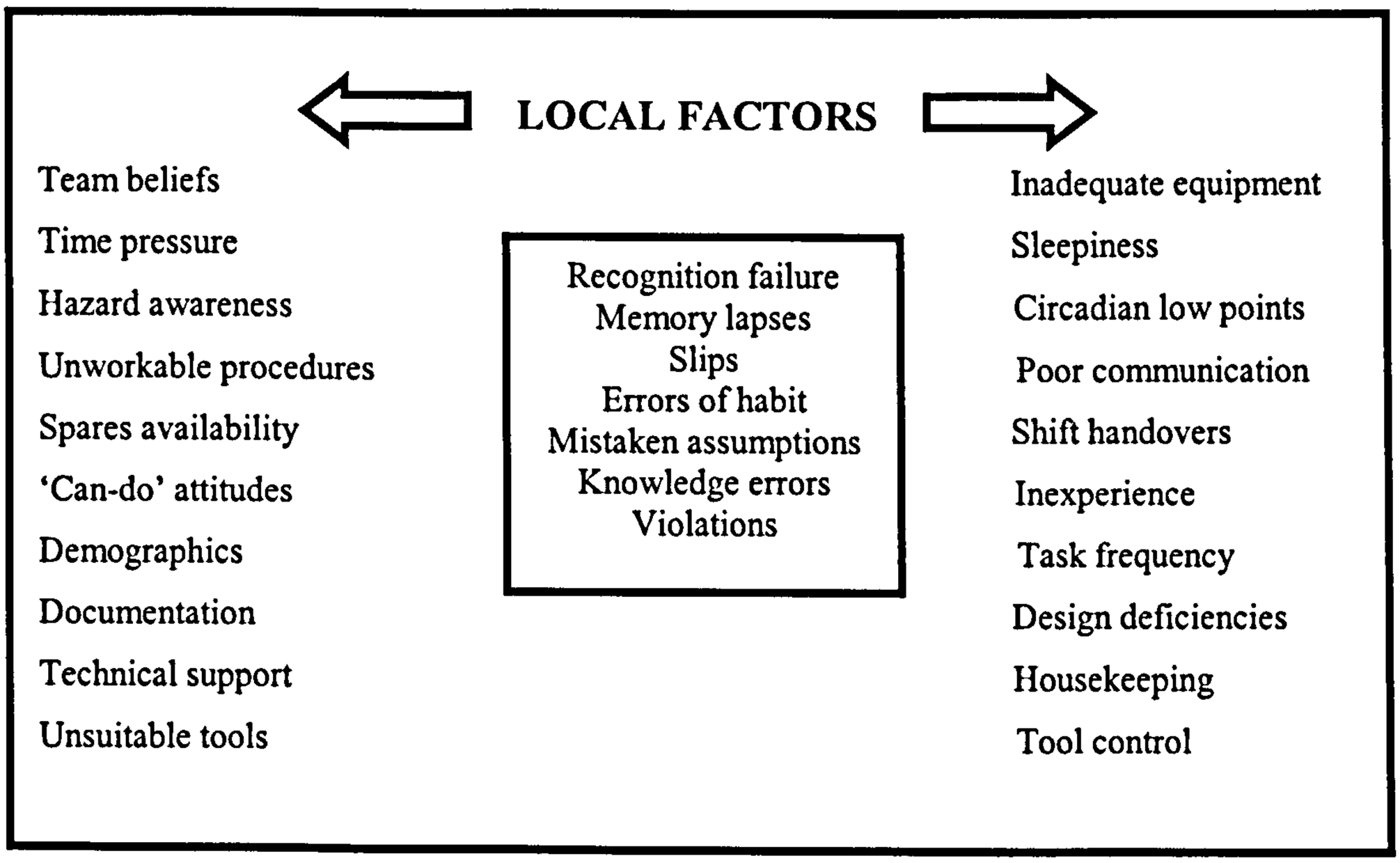


Figure 2.1 maintenance errors (central box) in the context of local error-producing factors (outer box); (Reason and Hobbs, 2003, p. 36)

2.2.3 Maintenance management in context

The job that maintenance is meant to do in fact is to keep an asset performing to the standard that is required. Maintenance management deals with the planning, organising, and controlling it takes to accomplish that. Clearly, maintenance is an important part of the asset life cycle. Campbell (1995) mentioned that there are nine steps of an asset management process which are: 1-*Asset strategy, 2-plan, 3-evaluate, 4-design, 5-create/procure, 6-operate, 7-maintain, 8-modify, 9-dispose.* However, these steps should be reduced to eight steps without the ninth one 'dispose' and work as one cycle to

keep the dependency going on. Maintenance is one step in an eight-step asset management process. The relation between the eight-step asset management processes is described in figure 2.2. Asset management begins by asking why the asset is required and how it relates to the business plan. After that, a closer look sets the purpose, function, and standards of performance. It is then justified; comparing costs to benefits, and ranked as an investment option by the company. After approval, detailed design and specifications are completed. The asset is constructed, or procured, and maintained (and after modified as time goes on).

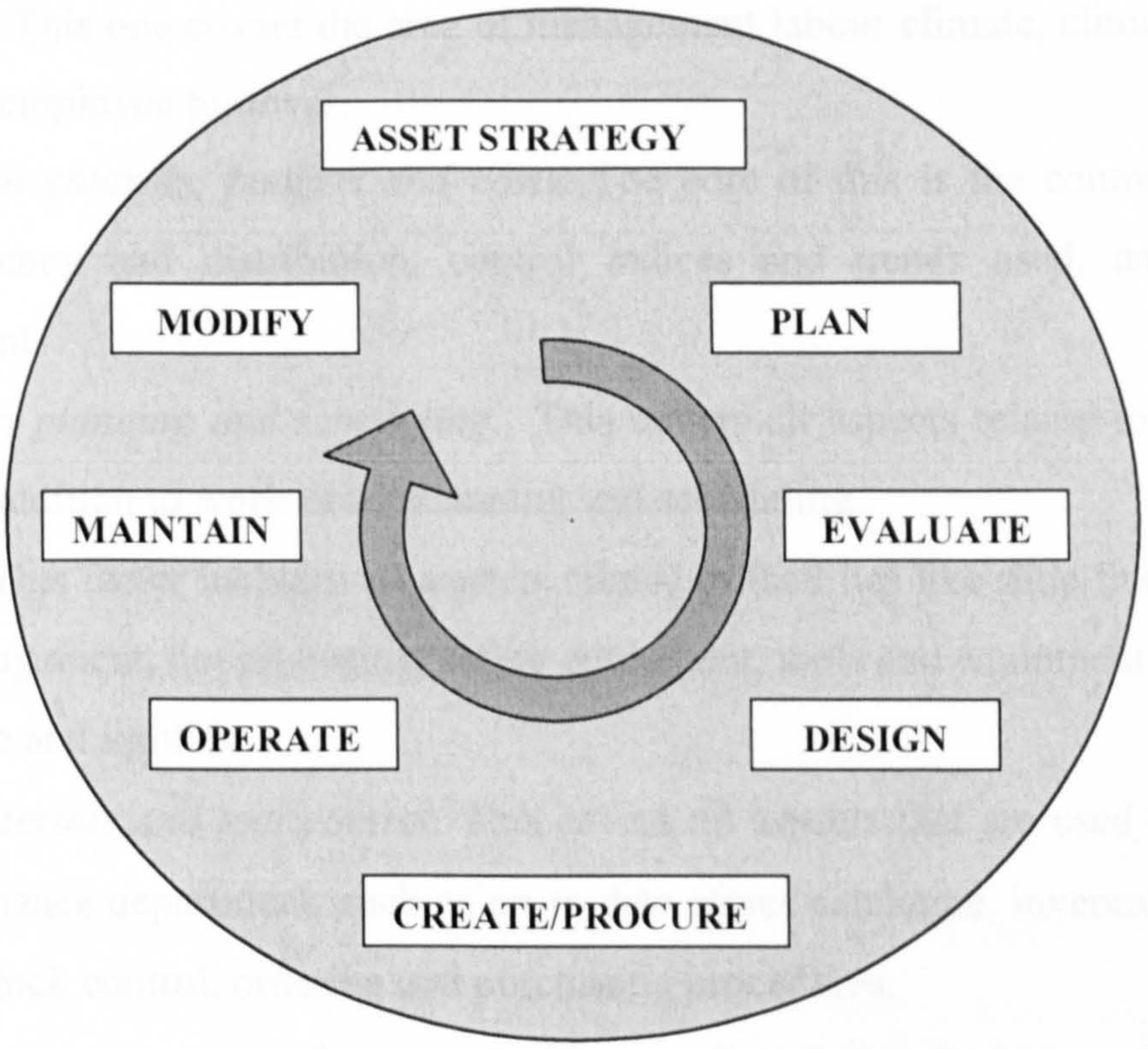


Figure 2.2 A cycle of asset management process (Adapted from Campbell, 1995)

2.2.4 Evaluation of a maintenance management system

In order to examine the state of maintenance practice, two main issues should be considered, the management side of maintenance and the technology used. The key factors in maintenance, which were introduced by Westerkamp (1985) could highlight weak points in an organisation of maintenance system and used to measure and evaluate the present maintenance function. These factors are presented by Al-Muhaisen and Santarisi (2002) as follow:

1- *Productivity audit.* This assesses the current and potential productivity and summarises the results of all other key factors.

2- *Organisation, staffing and policy.* This factor covers the organisation chart, job description of employees and the support function that exists in the maintenance organisation, as well as whether a written controlled policy and management goals exist or not.

3- *Management training.* This factor concentrates on all management training activities including the master training plan and on/off-site training.

4- *Planners' training.* This factor concentrates on all planner-training activities.

5- *Personnel planning.* This factor concentrates on all personnel 'skills' training activities.

6- *Motivation.* This one covers the area of management labour climate, climate survey and annual employee turnover.

7- *Management controls, budgets and costs.* The core of this is the control reports, their frequency and distribution, control indices and trends used, and budget measurement.

8- *Work order, planning and scheduling.* This covers all aspects related to the-order system, in addition to work-order planning and scheduling.

9- *Facilities.* This factor includes all aspects related to facilities like shop floor control, layout arrangement, housekeeping, safety equipment, tools and equipment available, office space and lighting.

10- *Stores, materials and tool control.* This covers all aspects that are used to support the maintenance department, such as up-to-date stores catalogue, inventory system, tools list, stock control, ordering and purchasing procedures.

11- *Preventive maintenance and equipment history.* It includes the history file system and its records, equipment covered by preventive maintenance programs and all reports related to them.

12- *Reliability engineering.* This one questions the percentage reliability engineering used in the plant in order to analyse all down time and major repairs.

13- *Work measurements and incentives.* This factor questions all the main maintenance standards used in the maintenance system.

14- *Data processing.* This factor concentrates on all aspects relevant to data processing, starting from computer support and capabilities, and data storing, and ending with retrieving data from the computer.

Raouf (1994) proposed a framework for evaluating a maintenance management system. This framework consists of two stages: stage 1 is concerned with the evaluation of the maintenance management system and its implementation. At this stage global organisation structure, procedure compliance, resources availability, adequacy of information system and impact of deviations from standards is evaluated. Stage 2 deals with the evaluation of maintenance management standards, procedures and programs. This includes quality control procedures, planning and scheduling procedures, materials control and supply procedures and training programs. The following factors should evaluate to improving maintenance productivity through structural audits (Raouf, 1994), the factors are: labour productivity; organisation staffing and policy; management training; planner training; craft training; motivation; management control and budget; work order planning and scheduling; facilities; stores, material and tool control; preventive maintenance and equipment history; engineering and condition monitoring and information systems.

A growing number of industrial plants are expending considerable effort reviewing their relative competence in maintaining reliable equipment at a competitive cost. Some are using the traditional approach of consultant provided surveys or audits; some use a benchmarking approach to help quantify capabilities and compare with other plant data; others are quite comfortable to use their own cost and equipment availability measurements. Al-Muhaisen and Santarisi (2002) mention that, the auditing or benchmarking is the practice of measuring performance against a standard. The measured performance can be production, maintenance or another type. The standard can be set by an individual company based on competitor's performance or on comparable industry data, every company wishes for continuous improvement every year, and by performing benchmarking or auditing surveys could determine whether or not the company's business practices are all they should be. There are three types of benchmarking exercises (McQueen, 1999):

(1) Internal benchmarking, where multiple-plant organisations set company-wide standards for each of the sites to follow, then charts how standards are met.
(2) Industry benchmarking, where company performance is measured against other organisations in the same industry.
(3) Best-practice benchmarking, where performance is measured against other companies considered to be industry leaders, regardless of business.

The assessment processes will deliver an enhanced (and often quantified) view of the maintenance practices most in need of improvement. The best strategies are usually the ones developed most promptly after completion of the assessment. First, audit provides an initial assessment that is more subjective, but provides an in-depth look at a site's practices. Second, the process is more quantitative, scoring the site against a more rigorous excellence model (Jones and Rosenthal, 1997). An audit of the maintenance system will determine the efficiency and effectiveness of existing operations, will highlight the strengths and weaknesses in the system, and will help in the proper planning and control of its activities. In addition, it provides a methodology or framework for improving maintenance effectiveness continuously by auditing the main subsystems such as maintenance management, maintenance operation and equipment management (Duffuaa et al., 1999)

2.2.5 Discussion of quality and maintenance implications

2.2.5.0 Introduction

The question that arises is how could quality be achieved in an organisation? It might be through applying a certain procedure or approach under direct supervision and control of effective management, where the effective management can be defined as; *"The ability for coordination and fulfilment of all activities in an organisation that lead to attaining the desired objectives in a climate of satisfaction through people within all organisation's departments during the shortest possible time and with minimum costs"* Although, there is no specific definition for quality of maintenance yet, there are some considerable meanings and discussions relevant to such a concept from some authors who have written in particular about three main issues: the link of maintenance and quality; continuous improvement and integrating quality through maintenance activities in the organisations. This is discussed in the following sections.

2.2.5.1 The link of maintenance and quality

Because quality is becoming a business strategy leading to success, growth, and enhanced competitive position, organisations strive to attain that position through maintaining the equipment in ideal operating conditions. The link between quality improvement and productivity is well established (Montgomery, 1985). Quality improvements mean elimination of waste such as scrap and rework, which increase productivity and often lead to cost reductions. Quality can no longer be inspected into the product, where final control inspection is being moved to the process level through

adequate process control techniques (Ben-Daya & Duffuaa, 1995). The link between maintenance and quality, although not completely missing, is not adequately addressed in the literature. The focus of total productive maintenance (TPM) is on reducing equipment losses. It means equipment management. Nakajima (1988) identifies the following equipment losses: (1) equipment failure; (2) set-up and adjustment; (3) idling and minor stoppages; (4) reduced speed; (5) process defects; (6) reduced yield. One of the six big losses of any equipment is directly related to quality. Although the link has been identified by TPM, there are no adequate models relating quality and maintenance. Possible reasons, according to Ben-Daya & Duffuaa (1995) include:

- The outputs of the maintenance department are difficult to define. Hence, it is much harder to develop an explicit input/output relationship. Also to measure and quantify maintenance output and its effect on quality is difficult compared with production.
- Traditionally maintenance has been regarded as a necessary evil and at best a secondary subsystem driven by production. Not until recently has its importance to profitability been recognised.
- Maintenance as a function in an organisation has complex relationships with other functions.

The effect of maintenance on quality has been discussed by Taguchi *et al* (1989), some models based on the Taguchi online quality control approach have been presented. The basic idea is to perform preventive maintenance PM, when the amount of deviation in the product characteristic, used to measure quality, reaches a given threshold. Therefore, it is possible to reduce the deviation from the target, and consequently enhance quality by performing PM. Models that determine the PM schedule which minimises the quality loss function, can also be developed as extensions and alternatives to the idea proposed in Taguchi *et al.* (1989).

Lillrak (1990) cited in (Ollila and Malmipuro, 1999, p.17) has noticed, in explaining the TQM concept, that maintenance has a role in quality. He says that, "Maintenance activities should be executed according to total productive maintenance (TPM) philosophy". In addition, Bergman and Klefsjo (1993) have emphasised the role of maintenance in their book 'Quality'. They also realised that life cycle profit is an essential part of modern maintenance thinking. Oakland (1997) mentioned that, the best equipment would not work satisfactorily unless it is cared for. This statement implies

that utilising production machinery carries out modern production, and if the machinery is not in good condition, quality will thus deteriorate. Products have three properties in the eyes of a buyer: quality, price/costs, and delivery time, maintenance affects all of them. In the popular ISO 9000 quality standards maintenance has been recognised in two different ways. One of the positive features of ISO 9000 from the very beginning has been the demand of calibration of measurement equipment in the way that traceability of the accuracy is maintained. This is typical maintenance operation. The ISO 9000 also clearly states that maintenance functions of process equipment should be carried out in a planned manner guaranteeing the continuous process performance (Ollila and Malmipuro, 1999).

Bamber, et al. (2002) mention that the relatively new management systems standards ISO 14001 (Environmental) and OHSAS 18001 (Health and Safety), coupled with the standard ISO 9000 (Quality series), could signify for the modern maintenance organisation an emphasis toward the quality if a total productive maintenance (TPM) program coupled with the practical application of manufacturing management techniques cements ISO 14001, ISO 9000 and OHSAS 18001 together. This system emphasises the role of maintenance in the firms that communicates a great value-adding status to the maintenance activities. Bamber et al. (2002, p. 24) conclude, "Environmental or health and safety management means a new direction for the modern maintenance organisation. This new emphasis directs the maintenance function to take an approach to maintenance management that is more integrated and holistic than previously taken. This integrated and holistic approach communicates a higher value-adding role for the modern maintenance engineer that ultimately is stakeholder led".

Based on a study, carried out by Ollila and Malmipuro (1999), to find the actual quality impacts in five Finnish industries; food, mechanical wood processing, paper machine, chemical batch processing, and power production, the researchers concluded that the main causes of quality deficiencies in some industrial processes are as following: in the food industry there was only one quality deficiency and it was caused by maintenance defects; in mechanical wood processing, maintenance was the third most important reason, and in power production it was the most important reason while in paper machine operation, maintenance was the second most important reason. Hence, in all of these four cases, this study revealed that maintenance has a much bigger role with regard to quality than production and quality managers expected.

Therefore, maintenance should be notified as a potential source of improvement. Maintenance managers should encourage quality people to take maintenance with consideration as a main category. Showing maintenance impacts on quality can be the way for maintenance managers to get more resources for maintenance and then simply they can show their capabilities in improving quality, efficiency and availability of processes (Ollila and Malmipuro, 1999).

2.2.5.2 Maintenance and continuous improvement

Bamber et al. (2002), quote that for the maintenance organisation such controls may be integrated into a planned maintenance system that involves routine monitoring, calibration, repairing, and replacement of plant and components to ensure continued capability. This method of maintenance engineering management is similar to the Juran (1988) quality management trilogy of planning, control and improvement. In the future, manufacturing will become as intensive as continuous process production is nowadays, and will therefore need a maintenance system that works to get this. It has to stop the battle between production and maintenance, by broadening the perspective of maintenance and integrating the two systems into a complete market-oriented system. The needs of such an integrated system include; feedback system, management information system, and improved preventive maintenance (PM). Sherwin (2000) emphasises that the systems should include provision for the improvement of life-cycle cost and life-cycle profit through the adjustment of schedules and the modification and replacement of equipment, which requires full integration of maintenance with the other major company functions.

Coetzee (2000) mentions that the implementation of proper maintenance management in many organisations is lagging far behind the development in the technical systems being maintained and even the maintenance management techniques and philosophies that are available. This is mainly due to a large gap between maintenance management on the one side and the maintenance operational staff on the other side. To close this gap, managers should apply some maintenance management techniques in their firms such as, total quality management, total productive maintenance, maintenance information systems, reliability centred maintenance, etc. These certainly can play a role in the solution of the problem. Furthermore, Riis, et al. (1997) stated that two major trends in the development of maintenance management research identified by the benchmarking studies as:

- emerging developments and advances in maintenance technology, information and decision technology, and maintenance methods; and
- the linking of maintenance to quality improvement strategies and the use of maintenance as a competitive strategy (e.g. the development of total productive maintenance (TPM).

In the concept of improvement, Ben-Daya and Duffuaa (1995, p. 20) state, "Quality improvement means elimination of waste such as scrap and rework, which increases productivity and often leads to cost reductions. Under the total quality management (TQM) philosophy, quality can no longer be inspected into the product". Because quality is a key factor in measuring equipment effectiveness, quality of maintenance activities themselves is an important issue, since they affect equipment performance and consequently the quality of the final product.

Kelly (1997) regards maintenance as the control of reliability. He recognises the major maintenance policies and ranks them as follows:

- Design out if economically possible
- Condition-based (condition judged with machine running)
- Condition-based (condition determined by inspection while stopped)
- Age/block preventive maintenance, which he calls "fixed time"
- Operate to failure

Therefore, maintenance should be notified as a potential source of improvement. Maintenance managers should encourage quality people to take maintenance with consideration as a main category. Maintenance impacts on quality can be the way for maintenance managers to get more resources for maintenance and then simply they can show their capabilities in improving quality, efficiency and availability of processes (Ollila and Malmipuro, 1999).

2.2.5.3 Integrating quality through maintenance activities

It is vital that maintenance management becomes integrated with corporate strategy to ensure equipment availability, quality products, on-time deliveries and competitive pricing. The changing needs of modern manufacturing necessitate a re-examination of the role that improved maintenance management plays in achieving key cost and service

advantages (Riis, et al., 1997). In maintenance, the most known approach relevant to quality is total productive maintenance (TPM). TPM is based on two complementary concepts; quality and people who actually use the equipment through total involvement of all within an organisation (Nakajima, 1988). TPM is similar to TQM as they both seek participation by all and no divisional barriers. It serves to promote quality into the maintenance function by translating the language of TQM into maintenance (Sharp, *et al.*, 2000).

Coetzee (1999) refers to the increased use of various methodologies/techniques /philosophies to improve the effectiveness and efficiency of the maintenance function in the organisation being a very important step to enable it to cope with the increased importance of the function. However, this will only be successful if combined with a total (holistic) approach that develops a solution based on a top down requirements analysis. Raouf (1994) cites that the objective of quality maintenance is to build quality through equipment ensuring that no product defects are due to inadequate equipment capability or its malfunctioning. Another aim of quality maintenance is to aim for zero production equipment failures.

Al-Najjar (1996) argues that more maintenance should in future be done 'on condition', and the other principal strand of total quality maintenance is that maintenance should be integrated with production and scheduled with it. Al-Najjar mentions that TQMain is a result of establishing a common database through integrating the maintenance program with other plant programs to form an overall plant information technology system. Identifying and "eliminating" quality deviations and failure causes at early stages and extensive uses of data feedback are the suggested tools to accomplish continuous improvements and to assure high quality products. He sees that the quality and reliability of products and processes may be improved through detecting and eliminating common and special causes of problems at early stages. Therefore, TQMain provides a basis, to find true optima or best approximations, in more realistic situations for, continuous reduction, in the cost per unit of quality product (Al-Najjar, 1996). Raouf and Ben-Daya (1995, p. 7) have defined total maintenance management (TMM) as; "a systematic approach to maintenance", and the main objective of TMM is to provide a methodology or framework for improving maintenance effectiveness continuously. They have said that quality in maintenance is based on the following:

1. An assessment of the current state of maintenance through a well-designed and comprehensive audit of the maintenance department.
2. Developing the necessary tools for analysing the audit results. This helps reveal the current maintenance state and identify potential areas for improvement.
3. Benchmarking, this gives the improvement effort another dimension. Striving for excellence is greatly enhanced by having higher goals based on the best maintenance practices.

It is said that maintenance system comprises three subsystems; maintenance management, maintenance operations and equipment management. The researcher agrees with Sharp, et al. (1997) who have mentioned that if it is to provide a quality and cost effective service to the maintenance area in an organisation, it must address the following: a reduction in breakdowns; improved effectiveness of maintenance team; an improved procedure for work order handling; accountability of work undertaken; objective data required, performance, statistics; greater control of purchases and stores requisitions; improved communications with the rest of the company; and identification of key plant items and product routes. In their quest towards world-class manufacturing, industries firms should appreciate the need for efficient maintenance systems that could be effectively integrated with their corporate strategy.

2.2.5.4 Building a maintenance strategy and developing the vision

It has to know the current situation of maintenance and how well they are doing, and where they are going. According to Campbell (1995), a typical business strategy has the following elements:

1- a description of the current products and services, and of the key customers and their degree of satisfaction.
2- an analysis of the financial performance.
3- a review of the competitive environment and state of the market place.
4- the strength ,weaknesses, and key competitive dimensions of the business.
5- a description of the business vision in, say five years.
6- a statement of the mission, guiding principles plan to achieve them.

One problem, which was found to have a great impact on maintenance practices, is the gap in communication which exists between the people controlling the financial side and those controlling the technical side of maintenance (Mostafa, 2004). Once the company defines and communicates its business strategy, the suitable approach can be applied to maintenance. Foremost in any business plan are the needs and wants of the customers, shareholders, and other stakeholders. The key objectives for each function and element in the business strategy are drafted with them in mind. According to Muhlemann, et al. (1993) and Campbell (1995), the objectives of maintenance are:

1. To enable product or service quality and customer satisfaction to be achieved through correctly adjusted, serviced and operated equipment.
2. To maximise the useful life of the equipment.
3. To keep equipment safe and prevent the development of safety hazards.
4. To minimise the total production or operating costs directly attributable to equipment service and repair.
5. To minimise the frequency and severity of interruptions to operating processes.
6. To maximise production/operation capacity from the given equipment resources.

Furthermore maintenance is likely to have the following targets according to Campbell (1995) as; maximise the production rate of a particular product; phase out the operation of a plant or product line; add productive capability (assets) for another plant and eliminate stores inventories through vendor partnering. Like any other tool of business, maintenance strategy should not hammer away in only one direction. If the company's situation changes so must the maintenance model. As Campbell (1995) mentioned, in the following some objectives can be considered as the foundation of the maintenance vision:

1- to re-engineer the entire maintenance management process, with particular emphasis on preventive and planned corrective work.

2- to set the terms for, select, and implement a computerised maintenance and inventory management system.

3- to augment the short, medium, and long-range maintenance planning capabilities they would ultimately shape the annual plans and budgets of the department. The first step in realising these goals was to take stock of the current situation.

Once understanding where maintenance management stands, a shared vision must be developed. Taking in account that the maintenance improvement plan is the difference between the current reality and such vision, this vision will emerge when the strategic model is followed, and the main goals must be based on the overall business plan. Ensuring "best practice" is a realistic vision for industry sector, and setting priorities for the various factors assessed. With the maintenance review and vision determined, the improvement plan to achieve the vision should include (Campbell, 1995) the following considerations:

- The task and its key activities. For instance, planning and scheduling includes identification, prioritisation, materials, labour/skills, work steps, safety considerations, justification, approval, production scheduling, capacity planning, execution, reporting, follow-up, and customer satisfaction.
- The priority of the initiative, relative to others. If there are several improvement projects, how much senior management time will each receive?
- Estimated resources and level of effort required.
- The "champion", or person responsible for ensuring successful completion, and the "sponsor" to provide the resources.
- The start date, completion date, and milestones along the way.
- The goal to be achieved on successful completion, and what it is going to measure to determine if it is on the right track.

From the above discussion, the vision should be to do the maintenance without loss, where the mission of maintenance in an organisation is as follows:

- To provide cost-effective, efficient, high quality maintenance functions by taking action to increase the reliability and performance of assets through a program of continuous improvement (Hoffman, 2002).
- To plan, organise, develop, and manage human resources in such a way as to maximise the contribution of all maintenance activities.

2.2.5.5 Maintenance: new focus for improving quality

Maintenance operates in parallel to production, where production produces the primary product and maintenance produces the capacity of production. Moreover, the role of maintenance in accomplishing production objectives in terms of quality is well

established (Nakajima, 1988). Regarding to Kelly (1989) and Duffuaa & Ben-Daya (1993, 1995), improving maintenance productivity mainly focused on using audit schemes. These schemes focus on the major maintenance factors and evaluate their performance. These factors include labour productivity, organisation, staff and policy, training, motivation, maintenance control, preventive, condition based maintenance and information systems. From the audit result, the factors needing improvement are outlined and some recommendations to improve each factor are prescribed.

Duffuaa et al. (2001) indicated that maintenance system plays a key role in the long-term profitability of an organisation in the private and public sectors. And because maintenance is responsible for keeping equipment fit, safe to operate and well configured to perform its task, it has a major impact on delivery, quality and cost. Looking for good maintenance management methodologies and practises in order to reduce cost while improving equipment reliability and plant availability, Richard et al., (2000) mentioned that benchmarking approach has attracted more attention in services and manufacturing industries, benchmarking can be used as a management tool to:

- identify strengths and weaknesses of their operations and maintenance.
- learn from leading organisations.
- search for the world's best practises.
- work for superior business process performance.

An empirical study conducted by Mjema and Mweta (2003) in Tanzania has shown that there has been an increase in productivity, reduction of downtime and reduction of overall maintenance cost by introducing IT in the maintenance department. According to Mjema and Mweta (2003), sound benefits were achieved from introducing CMMS in the maintenance department in one of Tanzanian orgainsation. The results show that there has been a decrease in downtime of the equipment by 9%, the overall maintenance cost has decreased from the highest of US $2.7 million per annum in 1996 to about US $ 1.2 million in 1999. The productivity has increased by 50% and the availability of the equipment has increased by an average of 15%. This means introducing of CMMS has helped to improve the performance of the company in terms of productivity and reduction of the overall operational unit cost.

2.2.5.6 Key factors to improve maintenance activities

Further to what has been discussed in previous sections about the main factors of maintenance activities. For maintenance technique, many authors such as Cholasuke, et al. (2004), Jonsson (1997), Coetzee (1999), Ingalls (2000), have mentioned that maintenance success factors used as key measures in maintenance practices. It is agreed among many authors such as Kelly (1997), Wilson (1999), and Ingalls (2000) that the success of maintenance management relies mainly on leadership providing direction, focus and support. Many works verified that the lack of linkage between policy and the overall corporate strategy of manufacturing organisation leads to poor maintenance performance (Jonsson, 1997). How efficiently the maintenance function operates depends highly on the maintenance of organisational structure (Ingalls, 2000), since organsational structure controls the manpower, the hierarchy of communications and maintenance resource allocation with the right capabilities in the right maintenance areas is essential (Kelly, 1997).

Maintenance technique used can very highly affect maintenance performance, Jonsson (1997) mentioned that the cost of repairing in reactive mode is higher than the cost of repairing in preventive mode and also has less performance than preventive mode. This is because the reactive maintenance does not tackle the root level of problem and always results in repetitive failure. Many organisations tend to adopt the proactive maintenance philosophies such as TPM and RCM, since these approaches are committed to long-term improvement of maintenance management. One other factor that can bring about the efficient maintenance management is the operational involvement since one of the main causes of breakdown comes from abusing operation and a lack of primary care from the operators.

Maintenance plans help in scheduling maintenance work and allocating the resources for each task. The lack of planning can significantly restrict a maintenance operation from meeting its objectives in the organisation. Consequently proper planning can lead to high responsiveness, less unplanned work (Cholasuke, et al. 2004). Management information system, related to all maintenance data, e.g. collecting, analysing, and transforming is very important. Cholasuke, et al. (2004) and Ingalls (2000) stated that computerised maintenance management system can bring about an effective and efficient management of maintenance information. Computerising data of spare parts facilitate the inventory control and the possibility of reducing the overall maintenance

cost. Because people are the most important resource of maintenance, it is agreed that effective maintenance of human resource management is one of the factors of a successful maintenance management program (Nakajima, 1988; Kelly, 1997; Jonsson, 1997; Ingalls, 2000).

2.2.6 Overall maintenance management models

The function of maintenance can be defined as the proper use of resources to ensure plant is repaired, replaced, adjusted or modified to enable it to operate at a specified availability and performance. Armstrong (1987) mentioned that the function of maintenance might be extended to include such aspects as: (1) Establishing maintenance standards and the effects of any deviations from those standards on the users; (2) Deciding relative merits of alternative maintenance policies; (3) Clarifying constraints such as available financial resources and acceptable delay times; (4) Estimating expenditure and phasing backlog work; (5) Providing technical support; (6) Advising on the maintenance implications of design. In this section, some models for maintenance management are described from the viewpoint of one who believes that improvements can be regarding maintenance as a "contributor to profits" rather than "a necessary evil". The reasons why maintenance is such a "Cinderella function" are largely historical and can mostly be overcome by new information technology IT and its falling cost, (Sherwin, 2000).

2.2.6.1 Basic terotechnology model

This is taken from the original UK government work and is contextually significant because, borrowing from the quality gurus, it called for feedback of information at several points in the maintained system's life cycle. Sherwin (2000) stated that this model omits costs but includes all the reliability engineering management and feedback loops necessary and desirable also in the development of machinery for manufacturing. One firm's product is often part of its customer's manufacturing plant. This model is considered by Nakajima (1989) as one of the important theories of maintenance contribution to the evolution of TPM. According to the definition outlined by the British Standards Institute (BS 3811: 1984) Terotechnology is, "A combination of management, financial, engineering, and other practices applied to physical assets in pursuit of economic life-cycle costs (LCC). Its practice is concerned with the specification and design for reliability and maintainability of plant and machinery, equipment, buildings, and structures, with their installation, commissioning, maintenance, modifications, and replacement and with feedback of information on

design, performances and costs". Therefore, Terotechnology involves the equipment user and supplier, and engineering organisations in the pursuit of economical LCC.

2.2.6.2 Advanced terotechnological model – need for integrated IT system

The development in terotechnology from life cycle cost LCC-based to life cycle profit LCP-based may seem minor, but is in fact profound because it allows the maintenance function to be seen as contributing to profits rather than just spending money (Sherwin, 2000). To accommodate the profit aspect it becomes necessary to acknowledge dependencies and connections that were always there but were not previously specifically brought into policy calculations and company planning. In this state, Sherwin (2000, p. 149) stated, "LCP will remain just a worthy objective unless the company's IT system is sufficiently integrated to cope with the demands for instant, detailed and unambiguous information with which to feed the mathematical models and other decision-guiding procedures, predictions, simulations and calculations". Conversely, an integrated IT system obviously has its own waste-cutting advantages if it can be made good enough for every one to want to use it; but for that to occur it must be based upon an agreed overall model of the way the factors of production and management interact. Possibly, TQM/Terotechnology/LCP is the best available (Sherwin, 2000).

2.2.6.3 Preventive maintenance

Experience shows that preventive maintenance (PM) reduces maintenance costs, and the comprehensive PM system requires well-trained PM inspectors who are dedicated to PM work and well-maintained equipment history. Ben-Daya and Duffuaa (1995) mention that PM system consists of:

- PM checklist specifying lists of PM work for each piece of equipment;
- PM routes showing the sequence of equipment to be worked on in a given period;
- PM schedule specifying the PM frequency;
- PM reports covering the PM work actually done on a daily basis.

2.2.6.4 Condition based monitoring and predictive maintenance

Hartmann (1987) defines predictive maintenance (PDM) as the extrapolation of graphic trends of measured physical readings against known engineering limits for the purpose of detecting, analysing, and correcting equipment problems before failure. It involves

the taking of periodic measurements, such as vibration velocity, tension, pressure, alignment, water, heat, resistance, capacitance, etc. Although, condition based monitoring (CBM) is considered a form of predictive maintenance, CBM rests primarily on several basic approaches to predicting equipment condition and aims at predicting failure before it occurs, with enough time to replace faulty part(s) prior to failure and without seriously effecting operations. At the most basic level the senses of look, listen, feel and smell are used to detect a worsening condition of plant (Bamber, 1998).

2.2.6.5 Total quality maintenance (TQMain)

AL-Najjar (1996) has developed TQMain model, another complementary branch of which includes the development from LCC to LCP. It is soundly based on the Deming cycle (plan-do-check-act-plan, etc.), which is the foundation of TQM, and can be used for the improvement of any technical or managerial system, (Sherwin 2000). Al-Najjar focuses on condition monitoring (CM) by vibration analysis. And it is therefore natural that his managerial model for maintenance should specifically include inspection and monitoring maintenance policies in its structure. He starts by reviewing the increasing cost of maintenance, pointing to evidence that it has recently been going up faster than inflation and increasing as a proportion of company costs.

Al-Najjar (1996, p. 5) defines TQMain as "A strategy which enables the user to maintain and improve continuously the technical and economic effectiveness of process elements". Thus, he defined TQMain's role as: a means for monitoring and controlling deviations in a process condition and product quality, and for detecting failure causes and potential failures in order to interfere when it is possible to arrest or reduce machine deterioration rate before the product characteristics are intolerably affected and to perform the required action to restore the machine/process or a particular part of it to good as new. According to this strategy, e.g. vibration-based, age-based maintenance would be integrated with the essential activities in the plant, such as production/operation, quality control, and environmental condition.

2.2.6.6 Reliability-centred maintenance (RCM)

RCM is another newly-popular concept. It is a method for determining of maintenance needs developed within the aircraft industry and later adapted to several other industries and military branches. The availability of reliability data and operating experience is of vital importance for RCM; it aims at determining the maintenance requirement of each

item of plant and equipment in its operating context and aims to ensure that these requirements are fulfilled. It is often the maintenance approach used when parts failure may lead to catastrophic events (Geraghty, 1996; Al-Najjar, 1996). RCM does not recognise that maintenance is an economic problem at the machine or plant level. It concentrates on improving existing plan rather than getting future plan right from the beginning, which can be achieved only data feedback to designers, (Sherwin, 1994). One more shortcoming of RCM is that it does not make full provision for the use of condition-based techniques, so that the potential failure developments are not followed until just before failure (see for example Hollick and Nelson, 1995).

Sherwin (2000) mentions that, the popularity of RCM probably depends mainly upon its not requiring any significant input or investment from higher management. In fact its proponents tell them that savings are to be expected in the maintenance budget. RCM tries to deal with reliability and maintenance in relative isolation from costs and profits. It contains many good ideas, most of which appear in other methods also.

2.2.6.7 Total productive maintenance (TPM)

Looking from management view some authors in TPM has given a sign to the link between total quality management and TPM. Naylor (1996) suggests that TPM is an approach involving all employees from the shop floor to top managers and is based on the notion of teamwork where those who carry out the operation are also encouraged to control quality, change tools, and do some equipment maintenance. Bamber (1998) presents a comprehensive review of TPM literature from which he has identified two main approaches to defining TPM described as the Japanese approach and the Western approach. The Japanese approach is promoted by the Japanese Institute of Plant Maintenance (JIPM) which is advocated by its vice chairman Nakajima who attempts to summarise an entire philosophy in succinctly defining TPM as: production maintenance involving total participation, in addition to maximising equipment effectiveness and establishing a thorough system of PM, where PM is a comprehensive planned maintenance system.

The western approach is depended on the ideas of some famous authors such as Willmott (1997, p. 2) the managing director of Willmott Consulting Group in UK, who provided a definition that is more suited to Western manufacturing as; "TPM seeks to engender a company-wide approach towards achieving a standard of performance in

manufacturing, in terms of the overall effectiveness of equipment, machines and processes, which is truly world class". Similarly, Hartmann, president of the International TPM Institute Inc., in USA, provides a definition that is suggested as being more readily adopted by Western companies. Hartmann (1992) mentioned that, TPM permanently improves the overall effectiveness of equipment with the active involvement of operators. He also proposes some stages for implementing TPM:

1- Improving equipment to its highest required level of performance and availability;
2- Maintaining equipment at its highest required level of performance and availability;
3- Procuring new equipment with a defined level of high performance and low life cycle cost.

Tajiri and Gotoh (1992) and Shirose (1992) regard Nakajima as the father of TPM and they recognise that a full definition contains the following five points:

1. It requires the participation of all activities, (maintenance department workers, equipment operators, and equipment designers).
2. It aims at getting the most efficient use of equipment.
3. Establish a total (company-wide) planned maintenance system, (preventive maintenance, and improvement related maintenance).
4. Involve every one from top management down.
5. It promotes and implements planned maintenance based on autonomous, small group activities.

Considering TPM as a suitable quality technique can be applied in maintenance activities. And as any business functions there are some encounters barriers and difficulties affecting TPM implementation. Bakerjan (1994) has attributed the relatively failure on implementing TPM program to the following three major barriers: (1) Lack of management support and understanding; (2) Lack of sufficient training programs; (3) Failure to allow sufficient time for the evolution. The term TPM is sometimes known as total productive management, it must be seen as along-term commitment to strive for zero losses and not a way of obtaining short-term fixes. Windle, (1993) considers that

limited applications of TPM from companies, which have taken the short-term perspective, have led to regressive steps, including:

- Converting skilled maintenance personnel into routine operators;
- Shifting line authority for maintenance crews to production managers;
- Pushing TPM as a means to reduce the apparent overhead of the maintenance department;
- Applying TPM principally to reduce maintenance costs.

In the same direction, Davis (1997) outlines ten main reasons for TPM failure within UK manufacturing organisations as:

1- The program is not serious about change.
2- Inexperienced consultants/trainers used.
3- The program is too high level, run by managers for managers.
4- There is a lack of structure and relationship to strategic needs.
5- The program does not implement, change on the shop floor, and is not managed.
6- A lack of education and training for those expected to take it on board and provide support.
7- Programs are initiated and run exclusively by engineering and seen by production as a project that does not involve them.
8- Attempts to apply TPM in the same way it is implemented in Japan, using the standard approach found in Japanese publications.
9- TPM teams lack the necessary mix of skills and experience.
10- Poor structure to support the TPM teams and their activities.

2.2.6.8 Maintenance organisational maturity grid

Fernandez, et al. (2003, p. 967) carried out a model of maintenance maturity grid; the model is based on the quality management maturity grid originally proposed by Crosby (1979), figure 2.3. This model includes five stages that reflect the culture of the maintenance function, the stages are: stage1- Uncertainty, stage2- Awakening, stage3- Enlightenment, stage4- Wisdom and stage5- Certainty. Maintenance evolves from a predominantly reactive state in the first stages to a preventive and eventually into a predictive state in the last stages. Fernandez, et al. (2003) mention that to be possible to transfer through the stages, it is essential that senior managers understand the role

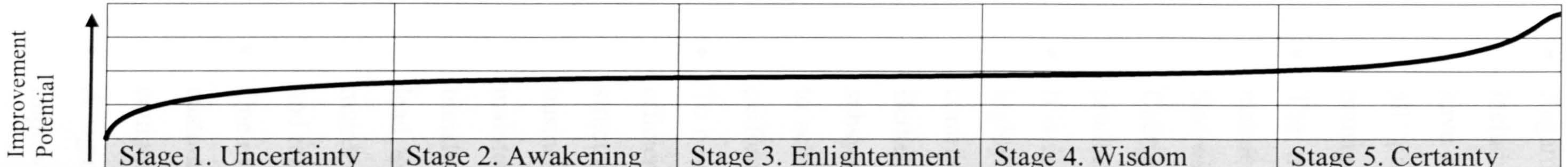
maintenance plays in the business as a key tool not only for saving money by reducing the frequency of failures but also for improving the availability of the plant due to increasing equipment reliability. In this model Fernandez, et al. (2003) tend only to use and select a computerised maintenance management system CMMS as an appropriate model can suit maintenance needs, however due to the flexibility of this model it can be used to suit some other maintenance management systems. Regarding the situations of each organisation in which a model can suit maintenance needs is dictated by the features of the system and by the objectives of maintenance department as well. As a result, selected models should be versatile enough to integrate new systems/techniques as the maintenance function improves.

According to the stages of this model, senior managers in a maintenance department can follow up the performance measures of three main issues, which are management understanding & attitude, problem handling and company maintenance posture. If these issues go systematically in parallel it can help to make sure that the performance of an organisation is gradually improving.

2.2.7 Summary of part two

Some authors discuss that maintenance activities should be regarded as an essential factor can contribute in improving the productivity of business, when continuous and enough co-operation and co-ordination are fitted between all maintenance staff and all other employees (in related departments through organisation) as well. This means maintenance activities should be considered as a main business processes rather than just subordinates. Therefore, quality could be considered as a pathway to the total process of managing maintenance.

Dwight (1994) and Geraerds (2000) consider the important contribution of maintenance that maintenance makes in promoting the business goals, and challenges the prevalent view that maintenance is a subordinate activity. Furthermore, Dwight (1994) suggests the efficient application of resources to control and reconcile actual system behaviour to the effective attainment of business requirements that focuses on the links between maintenance activities, driven by the efforts of individuals, and the business goals. From the above discussions, one can conclude the following comments:



	Stage 1. Uncertainty	Stage 2. Awakening	Stage 3. Enlightenment	Stage 4. Wisdom	Stage 5. Certainty
Management Understanding & Attitude	No comprehension of maintenance as a management tool	Recognition that maintenance management may be of value	Learn more about maintenance management; becomes supportive	Participative and recognises its role	Maintenance is an essential part of the company system
Problem Handling	Problems are fought as they occur	Still reactive but with spare parts available when failures occur	Problems solved by input from maintenance, operations, engineering and quality control	Predictive using monitoring techniques	Problems are prevented increasing availability and therefore productivity
Company maintenance posture	"We do not know why we have problems in maintenance"	"It is necessary to have problems with maintenance"	"We identify and solve problems"	"Quality products cannot be made with poorly maintained equipment, therefore quality maintenance is a routine"	"We don't expect breakdowns, on the contrary, we are surprised when they occur"
CMMS	No CMMS used	System contains asset and materials management modules	A condition monitoring event module is integrated into the system	Capable to generate PM schedules. A DSS is used to support the decision making process	Fully automated, from the detection of failure to the generating of work orders based on meaningful and reliable information

Performance Measures

Figure 2.3 Maintenance Organisational Maturity Grid; Source: Adopted from Antil (1991) in Fernandez, et al.(2003, p. 967)

- Regarding the principles of quality management, maintenance activities have to include; an effective leadership, involving all people, managing processes which have a clearly defined purpose and objective, the exchangeable effect between all parties of the system, continuous improvement program, and how management make the decisions.
- The majority of authors who have written about the quality concept in maintenance are focused on the manufacturing side, such as; Kelly (1989, 1997), Sherwin (2000), Al-Najjar (1996), Ben-Daya and Duffuaa (1995), Raouf (1995), Coetzee (1999, 2000), etc. They connect the maintenance directly with production operations.
- It is clear that the performance of the human part of the maintenance system is highly contributing to the performance of the maintenance system, which contributes to the total organisational performance. Performance was defined by Berkel, et al. (1995, p. 163) as "the efficient and effective use by the human subsystem of its resources to achieve the maintenance goal" where the aims are to achieving conditions under which people will be prepared and motivated to perform well, to evaluating total system performance and improving quality.
- To be competitive, organisations must continually improve; they are embracing efficiency methods such as just-in-time and total quality management. These structured systems can identify and help implement ways to enhance the business. The competitive pressures in the marketplace are changing maintenance. It also has much to learn from the new techniques that are transforming business practice. However, using such techniques properly can lead to better maintenance, which means cost-effective. Hence, an effective maintenance activity can contribute to production efficiency, plant availability and reliability and consequently to company profitability.
- One of the objectives of maintenance is to enable product or service quality and customer satisfaction to be achieved through properly maintained and operated equipment.
- A significant contribution could be occurred from the increased output due to improved maintenance. Implementing QM into the maintenance function could successfully contribute to the organisation's performance, which means QM is not restricted to just manufacturing and service functions (Sharp et al, 1997).

- In spite of all maintenance management models, which are discussed in prior sections, there are three main maintenance strategies commonly used by manufacturing industries; breakdown maintenance, preventive maintenance (PM) and condition based maintenance (CBM). Of course, there are some attempts to apply other strategies but still narrow such as TPM, CMMS, and RCM.

Therefore, solving maintenance problems requires a total approach, with many changes on the corporate levels as well as the sub-unit levels. Maintenance system can be seen responsible for frequent production and quality loss, consequently, the link of maintenance to quality is clear and quality system therefore has to play a significant role in all maintenance activities improvement. Culture effect, transferability and understanding change in context of its driving and restraining forces, in addition to how change management can be managed in an organisation and particular in maintenance area, all these aspects will be discussed in the next part.

2.3 Change management

2.3.1 Culture definition

In management literature, culture is seen as an important effect on practice. The degree of influence of culture in general and more specifically in the subdivisions of national, organisational, and occupational culture, has been, however, the subject of much discussion over the last few decades. Many authors cited that there are several definitions of culture itself in current use. Adler and Jelinek (1986, p. 74), seeing culture as "a set of taken-for-granted assumptions, expectations, or rules for being in the world. It is a paradigm, map, frame of reference, interpretive schema, or shared understanding". Hofstede (1991, p. 180) suggests that culture is "the collective programming of the mind which distinguishes the members of one group or category of people from another". Where 'group' indicates to a number of people in contact with each other and 'category' indicates to consist of people who, without necessarily having contact, have something in common.

Schein (1985, p. 3) produced a definition for organisational culture as "the pattern of basic assumptions that a given group has invented, discovered or developed in learning to cope with its problems of external adaptation and internal integration. Which have worked well enough to be considered valid, and therefore to be taught to new members

as the correct way to perceive, think, and feel in relation to those problems". Schine (1985, p. 3) proposed a model, containing three levels of organisational culture, shown in figure 2.4 those three levels are; (1) artifacts (surface), (2) values, and (3) assumptions. He mentioned that within organisations, culture exists simultaneously on each of these three related levels and that in order to describe a culture all of them need to be considered. This makes a qualitative approach essential. Williams, et al. (1993) have seen culture as the commonly held and relatively stable beliefs, attitudes and values that exist within the organisation. Brown (1998) mentioned that, the organisational culture refers to the pattern of beliefs, values and learned ways of coping with experience that have developed during the course of an organisation's history, and which tend to be manifested in its material arrangements and in the behaviours of its members. Therefore, the culture could be; "the existing pattern of beliefs, attitudes, values and procedures in an organisation". It is the ways of thinking, feeling and reacting.

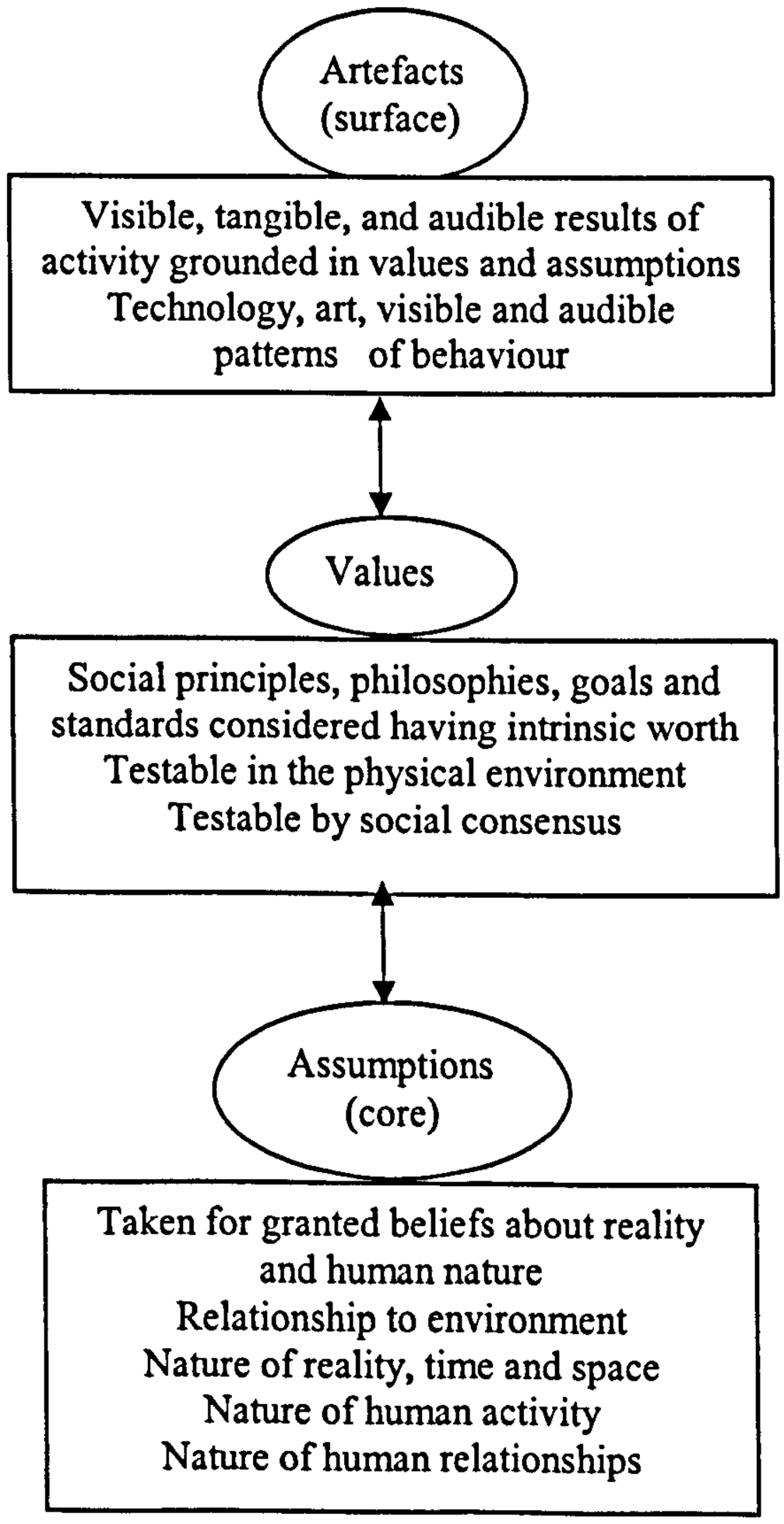


Figure 2.4 The three levels of organisational culture, (source: adapted from Schine, 1985, p.3)

2.3.2 Culture difference and its effect on the management systems

A survey was conducted to examine and compare the values and behaviour of senior managers in technical education in the United Kingdom and Egypt by Humphreys (1996) who showed that culture difference is a significant factor and that for example, western management models and concepts are not necessarily completely transferable to other cultures. Egyptian and Libyan culture are very close as both countries are from the Arabic world (North Africa), they have had the same culture's elements such as religion, language, habits and norms. This survey studied the nature of culture and cultures difference and found it to be a complex issue dependent on factors such as the predominant religious beliefs of the country. Such a survey concludes that Western management tools need to be adapted and refined to fit the cultural context of recipient countries, and argues that the central factor in the success or failure of intercultural encounters in management is inter-personal communication. Al-Khalifa (2000), mentioned that the national culture represented by the shared values of a society/country influences organisational culture and, thus influences quality implementations. Work by Elashmawi and Harris cited in Al-Khalifa (2000), compares the most important cultural values of the US, Japan and Arab countries (see table 2.2). This table shows a great deal of difference between these three cultures, the priority of cultural values has been changed from one culture to another. This can affect technology transfer, managerial attitudes and employees' performance etc.

United States	**Japan**	**Arab countries**
1. Freedom	1. Belonging	1. Family security
2. Independence	2. Group harmony	2. Family harmony
3. Self-reliance	3. Collectiveness	3. Parental guidance
4. Equality	4. Age/seniority	4. Age
5. Individualism	5. Group consensus	5. Authority
6. Competition	6. Cooperation	6. Compromise
7. Efficiency	7. Quality	7. Devotion
8. Time	8. Patience	8. Patience
9. Directness	9. Indirectness	9. Indirectness
10. Openness	10. Go-between	10. Hospitality
Notes: "1" represents the most important cultural value, "10" the least		

Table 2.2 Priorities of Cultural Values. (Source: Al-Khalifa (2000, p.54))

Hofstede (1980,1991), has suggested four dimensions of culture difference between nations, and clustered cultures according to whether they were high or low on each of these dimensions which he labeled as: "Power-distance", "Uncertainty avoidance", "Individualism-collectivism" and "Masculinity-Femininity".

1- Power-distance is described as the extent to which the less powerful person in a society accepts inequality in power and considers it normal.
2- Uncertainty avoidance which indicates the extent to which people in a culture are made nervous by situations which they consider as unstructured, unclear, and the extent to which they try to avoid such situations by adopting strict codes of behaviour and a belief in absolute truths.
3- Individualist cultures, it is assumed that a person looks after his/her immediate family whereas in collectivist cultures it is accepted that any person through birth and later events belongs to one or more cohesive collectives (in-group) from which they cannot detach themselves.
4- Masculine cultures are seen by Hofstede as having vastly different social roles for the sexes, whereas in feminine cultures social roles overlap significantly.

The main factors which were included in Hofstede (1980) survey are; good physical working conditions, security of employment working in a co-operative environment, having a well defined job, preferred type of managerial style, actual behaviour of superior, the best way to get ahead, attitude to conflict, the reason for a hierarchical structure, and attitude to rules. These dimensions that compared by Humphreys (1996), based on Hofstede (1980), for Egyptian and British respondents, are in table 2.3. Further, Hofstede's study (1991) of national culture differences indicates that African societies tend to be collectivist and have high power distance. Such values and behavioural traits should be taken into account in designing effective reward and recognition programs in SSA.

Dimension	UK	Egypt
Power-distance index	Very low	Moderate
Uncertainty avoidance index	Low	High
Individualism-collectivism index	High individualism	Extremely low individualism
Masculinity-feminity index	Extremely low masculinity	Moderate masculinity

Table 2.3 Culture dimensions responses, (Source: Humphreys 1996, p.36)

2.3.3 Religion as a source of culture difference

Hofstede (1991) minimises the cultural relevance of religion. He sees religious affiliation by itself as less culturally relevant than is often assumed. On the other side

Humphreys (1996) sees the religion as the major source of cultural perspective, however, Ahmed (1992) cited that with Islam encompassing such a large area of the world with significant populations, western society can no longer survive in its own interest by being ill-informed or misinformed about the Islamic world. Ahmed (1992) suggests that the materialist civilisation of the west has become the dominant universal expression of humanity. This would seem to support the "culturally imperialist" flavour attributed by some to management training in the developing world. But Ruthven (1992, p. 29) disagrees with this perspective, and seeing a synergistic force generated by the interactions between cultures as; "for what was true of modernism has ceased to be the case in the post-modern era which, significantly, coincides with the emergence of the Pacific nations as the world's leading economic powers. The revolution in communications, which has thrown so much of traditional Islamic society into disarray, has less to do with cultural imperialism than with the synergy created by the simultaneous interactions of cultures all over the world". Because religion is an element of culture, one can say that state and religion cannot be separated either from a social and cultural point of view.

2.3.4 The cultural transferability of management models

There is a considerable debate about the management theory from which it is transferable across cultures. Humphreys (1996) argues that there are significantly different values held by UK and Egyptian educational managers in areas of management theory and practice, such as motivation, resistance to change, attitude to appraisal, the use of delegation, preferred leadership style, risk-taking behaviour and expected career structure. It is also apparent that the differences in values may not necessarily be a function solely of national culture, but also other factors, including occupation. Oxtoby (1993) mentioned that the national ideologies, historical antecedents, and social, economic and cultural factors as the source of complexity of the issue. However, most of the comparative work is based on experience in Europe, USA and Japan.

In designing and delivering management training programs for use in overseas countries, particularly developing states, as Humphreys (1996) sees, there is no doubt that culture must be taken into consideration. This means that values and culture must be taken into account. When for example, knowledge and practice of management, which have been developed in the Western world, transfer to other countries, some

modifications may be needed in order to fit the values, culture of particularly developing countries.

Hofstede (1991) suggested that nations could be regarded as the source of a considerable amount of common mental programming of their citizens, when there are strong forces for integration within a nation such as a dominant language, common mass media, national education system, and national political system. It has already been suggested by Hofstede that there are a variety of factors, which contribute to culture differences between nationalities such as a dominant language, common mass media, national education system, national political system, and national armed forces. Perhaps, though, in this case one of the major sources is difference in predominant religion. The idea of an occupational culture, which transcends national boundaries is attractive, and was confirmed superficially in a study of teachers' perceptions of educational management conducted by Smith (1994).

As discussed earlier, every society has its own work ethics that are usually influenced by people's environment and attitudes over the years, which in turn influences their view. Roney (1997) pointed out several different issues that exist between national cultures, they are: (1) the way people view the world; (2) how they deal with uncertainty; (3) the degree to which individuals are integrated into groups; (4) how information is processed; (5) concept of time; (6) how individuals establish relationships with others.

2.3.5 Understanding change

Change can be described as a transfer from one case to another through transitional stages. It is useful to know something about what psychologists refer to as the "Cycle of Loss" when introducing significant change in people's lives. The cycle of loss was developed to counsel people when they have experienced a major setback such as the death of a loved one, divorce, or bankruptcy. It also applies when a major change occurs in the working lives. At first people deny that there is a need for change, then come anger that this should happen, followed by bargaining to cure the symptom, not the root cause. Depression follows with full realisation. Finally, there is acceptance of the new reality (Campbell, 1995). Therefore, understanding this cycle of loss can help cope with change and manage the way it is introduced. Change is impacting on organisations as never before, due to worldwide competition.

Changes relating to total quality management, acquisitions, mergers and divestitures, downsizing and workplace industrial relations have been established. Global organisations adopt international best practices to secure a competitive advantage. Organisations that do not change and adapt to the new competitive environment will be defeated in the marketplace and will disappear or be taken over by those that do (Raymond, 2002).

The consistent demands for improved performance caused by intense competition, demanding customers, cost pressures and rapid change have made continuous productivity improvement a necessity for survival. TQM makes an organisation committed by continuous improvement and totally meeting customer needs. It means inserting quality in all business activities; design, production, maintenance, purchasing, marketing and human resources. Change occurs when there is an imbalance between the sum of the restraining and driving forces. Driving forces could be; customer satisfaction, resource availability, worldwide competition, technology awareness, high demand for such service or product, etc. Restraining forces may be culture effect, unclear vision, lack of confidence, lack of sufficient resources, job design, etc (Senior, 2002; Paton & McCalman, 2000). The driving and restraining forces of change are described in figure 2.5.

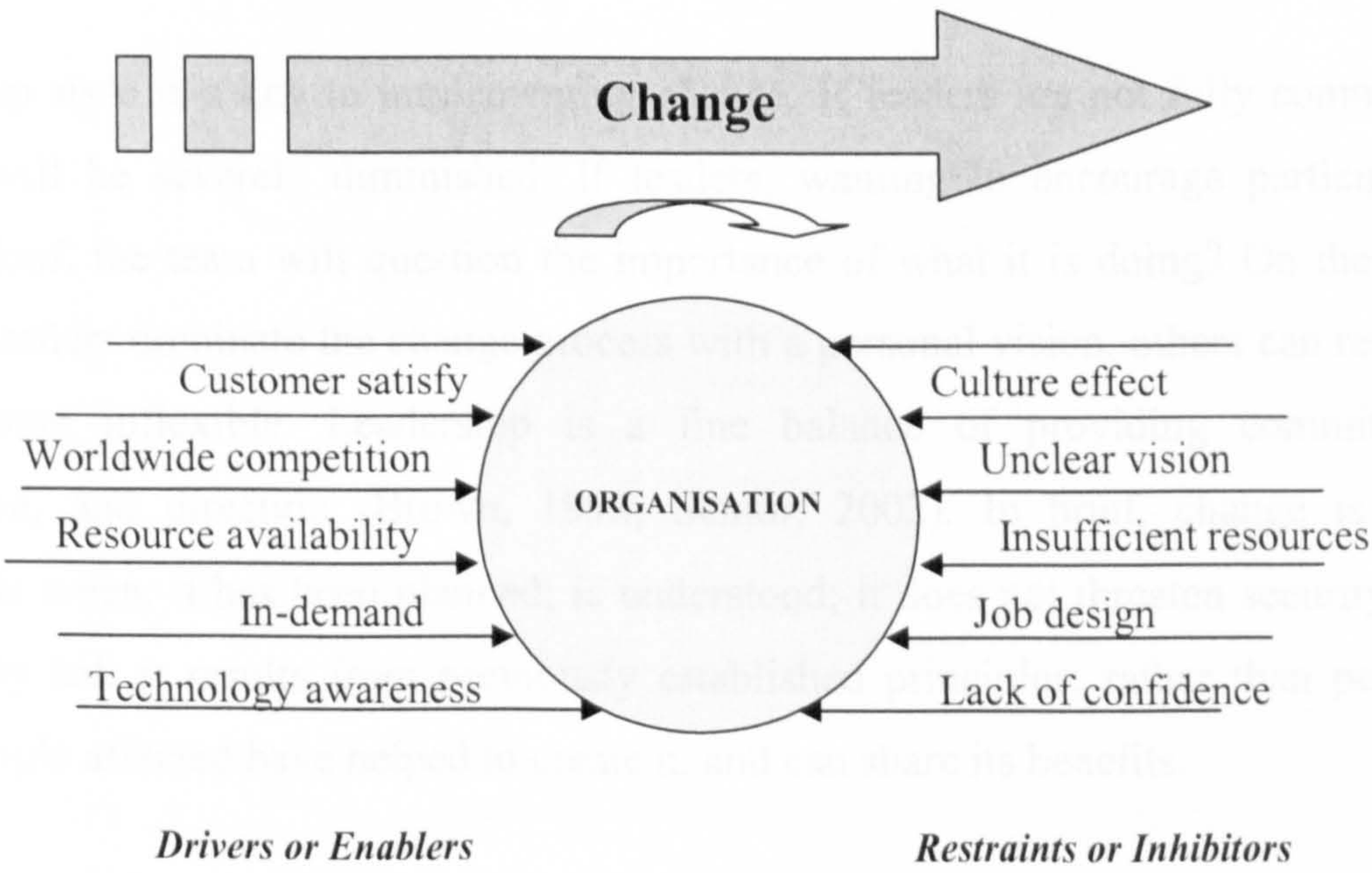


Figure 2.5 Driving and restraining forces of change

Regarding those driving and restraining forces, there are three basic strategies that should be conducted for achieving change: (1) increase the driving forces, (2) decrease the restraining forces, and (3) a combination of both driving and restraining forces.

2.3.6 What provokes organisational change?

The concept of organisational change is in regard to organisational-wide change, as an example of organisation-wide change might include a change in mission, restructuring operations, new technologies, mergers, major collaborations, "rightsizing", new programs such as TQM, re-engineering, etc (Paton & McCalman, 2000). Change should not be done for the sake of change- it is a strategy to accomplish some overall goal. Usually change is provoked by some major driving forces, these forces 'factors' have discussed in 2.3.5. Providing information through education and training to all employees will improve the odds for success within an organisation because they will participate in the makeover and have time to get used to it. The benchmarking of indicators, processes, and organisation structures can also help determine both the direction and rate of change. Authors such as Senior (2002), Sullivan & Lytton (2000) and Campbell (1995) mentioned that some noteworthy attributes of change in successful western companies are that: it was directed strategically, it was participatory, the team approach was used, it was balanced in functions, it was flexible, it was integrated (not simply interfaced) and there was excellent communication.

Leadership style is a key to implementing change. If leaders are not fully committed, success will be severely diminished. If leaders, wanting to encourage participation appear aloof, the team will question the importance of what it is doing? On the other hand, if leaders dominate the change process with a personal vision, others can resent it and become inflexible. Leadership is a fine balance of providing commitment, motivation, and direction (Brown, 1998; Senior, 2002). In brief, change is more acceptable when: it has been planned; is understood; it does not threaten security; it is effectively led; it results from previously established principles; rather than personal edict; people affected have helped to create it, and can share its benefits.

Successful change must involve top management, including the board and chief executive in addition to all organisation's levels. A change agent role is usually responsible to translate the vision to a realistic plan and carry out the plan. Change is usually best carried out as a team-wide effect. Communications about the change should

be frequent and with all an organisation's members. To sustain change, the structures of the organisation itself should be modified, including strategic plans, policies and procedures, communication and education.

2.3.7 Maintenance improvement connected to organisational learning

Riis and Neergaard (1994) cited in (Riis, et al., 1997), argue that there is a need to link manufacturing planning to the perspectives of individual behaviour, decision support, management systems and organisational structure, and corporate culture. These authors develop a multi-factor organisational learning model as a new manufacturing paradigm. The model illustrated in figure 2.6 includes both formal and informal dimensions in a company. As new methods and technology evolve for maintenance planning, such as expert systems, constraint-based reasoning, belief networks and artificial neural networks, there is an important need to develop a broader framework to ensure that these methods become integrated into the *modus operandi* of an organisation.

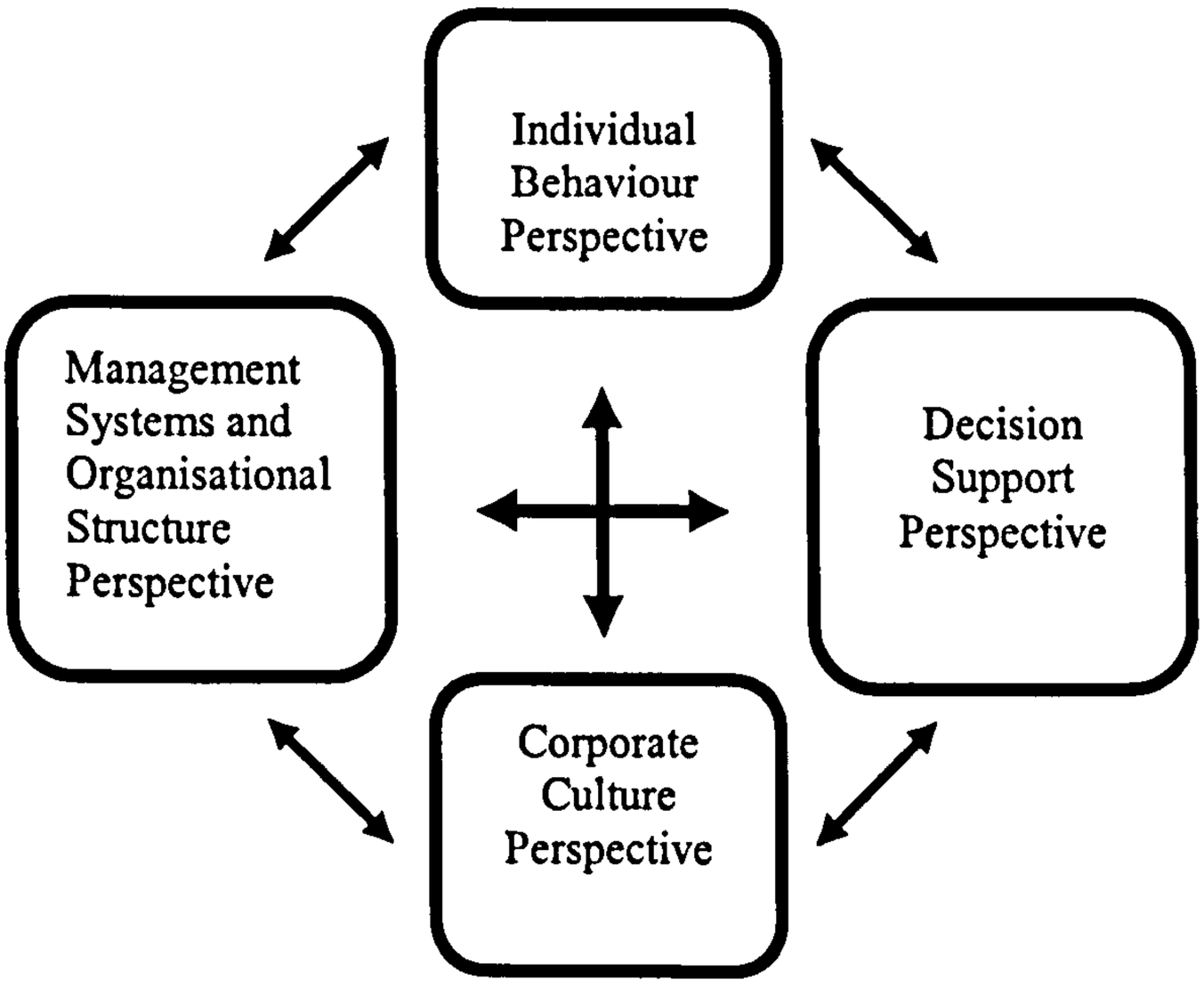


Figure 2.6 The Riis Neergaard model of organisational learning

(Source: Riis, et al. (1997, p.351)

A Danish-Norwegian survey reported by Frick, et al. (1992) shows that most companies tended to introduce technological means first and afterwards adjust the imbalance by applying organisational means. To better insure that technology, organisational development and corporate strategy are coupled; the Riis-Neergaard model can be used to ask key questions during the maintenance system development process, such as:

- What will be the consequences for the four types of learning of introducing the new maintenance system for a company?
- Which changes are required in a company's management systems, information technology, organisational structure and culture, as well as individual behaviour in order to utilise the new maintenance system fully?

2.3.8 Resistance to change

Typically, there is a resistance to change. People are afraid of the unknown, of losing skills and status, and of not being able to cope. Some employees may see change as implied criticism; others may criticise those introducing the change or the need for change itself. Others may not agree with the targeted end result, especially if they have had little or no input or if the new plan appears to be foisted on them from outside. Actually, there are some reasons that make managers and employees resist change because they perceive the change as a threat, due to uncertainty of vision and mission of that change. Some of the common reasons why people resist change are summarised by Raymond (2002) as follows:

- *Fear of the unknown* – not understanding what is happening or why.
- *Disrupted habits*- feeling upset when old ways of doing things can not be followed.
- *Loss of confidence*- feeling incapable of performing well under the new way of doing things
- *Loss of control*- feeling that things are being done 'to' them rather than 'by' them or 'with' them.
- *Poor timing*- feeling overwhelmed or those things are moving too fast.
- *Work overload*- not having the physical or mental stamina to handle the change.
- *Loss of face*- feeling inadequate or humiliated because the 'old' ways are not longer perceived as 'good' ways.
- *Lack of purpose*- not seeing a reason for the change or not understanding its benefits.
- *Economic loss*- feeling that their pay and benefits may be reduced or that they may lose their job.

Resistance to change usually comes from both management and employees. Therefore, managers should treat any resistance as an opportunity to re-evaluate a proposed change and to identify and deal with the real barriers to the change. According to Raymond (2002), Paton & McCalman (2000), Angeli, et al. (1998), Campbell (1995), a resistance to change can be overcome by the following ways:

- Communication- communication is the first strategy required for any organisational change. If management provided enough information in advance, to employees regarding the need and nature of the change. Also information about the planned timing of the change and its possible impact on the employees and organisation. This action can reduce fear of the unknown and change team behaviours that are in conflict with the proposed changes.
- Participation- employees who participate in developing and implementing change are more likely to be supportive than those who have it imposed on them from above. Participation can reduce fear of the unknown and lead to commitment.
- Guarantee- it is desirable that management guarantees that employees will not be disadvantaged, even while they engaged with any change activities such as training.
- Certainty- it is better to let people know exactly where they stand and to detail what is going to happen and when.
- Counselling- non threatening discussions and counselling can help defuse rebellious and angry feelings and facilitate voluntary employee acceptance of the change.
- Negotiation- people will naturally seek to ensure that any change is consistent with their own values and needs. Negotiation gives a margin of flexibility between all parts within the organisation.
- Reward- managers and employees who contribute to the successful introduction of change should be motivated. Those who accept new work assignments and do extra effort deserve reward.
- Coercion- this may be necessary when speed is essential and other alternative approaches prove ineffective. Usually coercion involves the use of threat or punishment against those resisting changes, such as loss of promotion, transfers, poor performance rating, pay cuts, and termination.

Consequently, the resistance effect to change should be assessed and managed as a part of the implementation strategy. Resistance behaviour reflects emotion that expresses people's feelings about how they personally experience the impact of the change.

Looking to culture compatibility, the inverse relationships in the new approach (change) conflict with bureaucratic structures that have been traditional monopolies.

2.3.9 Managing the change

According to the above discussions, the main basic principles of continuous improvement are: planning and operating processes, providing inputs, evaluating outputs, testing performance, and making suitable modifications, focusing on the customer, understanding the process, and seeing that all employees are committed to quality. Consequently, it is so important to understand how new changes could address quality systems in the maintenance area. The following sections describe the related topics.

2.3.9.1 Managing quality into organisations

Management commitment and leadership, continued improvement, and culture change are considered the foundation stone for a successful quality management (QM) implementation. An organisation can reach excellent customer service only if senior management is convinced or forced to understand, adopt and commit to implementing total quality in the entire organisation (Angeli, et al., 1998). It is a case of changing the culture, the attitudes and the way of thinking of levels of an organisation's structure. Keeping in mind that changing culture takes time, the importance is how can this change be accomplished in the best and the most suitable way in an organisation? The concept of culture change in relation to quality improvement is well established. The world has entered a new economic era where companies will survive only if they pay attention to quality. In order to bring an organisation into the quality revolution the organisational leader must have, as his primary personal job responsibility, quality and culture.

There is no single or "best" way of beginning the process of quality improvement. There are, however, common elements and principles, which apply to all organisations. Every organisation is different in terms of its people, culture, history, customs, prejudices, structure, products and/or services, technology and processes. Recognising and adopting the following as Raymond (2002), Sharp, et al. (1997) and Paton & McCalman (2000) have suggested could be used to manage quality into organisations:

- Improving the quality of work life- putting the emphasis on people development and providing them with the opportunity to develop to their full potential.

- Creating a quality culture- quality is reflected in the organisation's strategic objectives and is communicated throughout the organisation.
- Appreciating the customers- the products or services should meet or exceed the customer's expectations.
- Championing of QM by top managers commitment is essential to the success of any QM program.
- Measuring quality- measurement should do for its practical value.
- Starting with quality- quality assurance is built into every product or service, policy or practice. Quality is part of the corporate culture.
- Striving for high standards.
- Rewarding employees for teamwork and quality- QM requires management to encourage employees to share ideas and to act to them. Reward systems must recognise and reinforce such behaviour.
- Recognising that QM is a strategy that depends for success on the effective management of human resources- attracting and selecting people who are motivated by the idea of teamwork, quality and customer service necessitates the introduction of new recruitment and selection processes.
- Involving people- the assumption is made that people involved in the process have the best knowledge of how the process works.
- Training management and employees in leadership and team building- exercises and workshops focused on practical skills for working in teams, such as problem solving, communication, negotiation, conflict management and coaching, are common ways of doing this.
- Recognising that there is no one best way of introducing QM- successful companies tailor (QM) to meet their own organisational requirements.
- Eliminating waste and non-value added activities

As a result of implementing quality management into maintenance, a UK company had seen significant improvements. Sharp, et al. (1997) referred that, Thomas Bolton Limited, a Company in UK has realised savings in excess of £ 200,000 with opportunity costs in excess of £1,000,000 and manufacturing output has risen by over 50% which has improved the competitiveness of the company and therefore improved their ability to meet customer demand. Sharp et al. (1997) advocated that a significant contribution was from the increased output due to improved maintenance. They concluded that

implementing QM into the maintenance function could successfully contribute to the organisation's performance, which means QM is not restricted to just manufacturing and service functions.

2.3.9.2 Categories important for managing commitment

Hansson et al. (2003) have identified several categories of activities common to TQM, TPM and RCM that affect commitment during the change process. The identified categories are as follows:

- Support and leadership, which implies making employees feel recognised and visibly showing that significance of the change to motivate employees. Management should also consider the work environment.
- Strategic planning, which implies activities which link TQM, TPM and RCM to the organisation mission, vision and defined business strategy, and strategic priorities and goals. This gives a clear picture of how the improvement will benefit the organisation and promote desired achievements such as management and employees understanding.
- Planning the implementation (change), which implies developing a clear scope in order to identify obstacles and driving forces? This facilitates monitoring and follow-up. It also implies activities, which promote the participation of all concerned parties.
- Buying-in and empowerment, which implies activities such as identifying what each group or level of employees and management want, empowerment activities, such as sharing responsibility, promote involvement, job satisfaction, independence and ownership among employees.
- Training education, which implies activities that develop employee competence, skills and knowledge. Training promotes employees belief that the company is investing in them; it also supports understanding and awareness.
- Communication and information; which implies open and meaningful communication about aims and goals, and about the concept and how it will affect employees personally. Information and communication promote desired achievements such as understanding and involvement.
- Monitoring and evaluation, which implies activities such as obtaining measurable and quantified results and objectives, so as to have a clear scope and

focus, and continually monitoring and following through the process. Employees have to see how they can personally benefit from the change, while management must see how it benefits the company. Monitoring and evaluation yields feedback on results that promote creation of a motivated management, which continuously provides resources and support for the implementation.

2.3.9.3 Managing change in maintenance

Nowadays, change is faster than ever, and it is unpredictable. In the past, an outside expert was often brought into an organisation to research and design changes. This was followed by an edict from executive management to put these ideas into practice. An organisation must manage the change course in an organised and controlled form toward a predetermined goal or vision. Change as mentioned before simply can be described as a movement from one state to another, through some transitional forms, to a final condition. For plant engineering and maintenance, the main aim is to boost equipment or/and facility productivity, which can involve many areas in continuous change. Campbell (1995) stated out those areas as follows:

- increasingly complex technology in every aspect of work.
- integrated information and data management for employees, fixed assets, costs, performance, and activities.
- Advancing process automation and robotics requiring less operators and more highly trained technicians.
- Tighter design tolerances for higher quality products and less maintenance intervention.
- Shorter obsolescence cycles as time-to-market for new products decreases.
- Large scale of plant with increasing flexibility.
- Higher investment targets and profit margins in the new global economy.
- More rigorous health and safety standards in all jurisdictions.
- Raised environmental expectations by both regulators and consumers.
- Increased degree of contracting as business stick with their core competencies and contract out the rest.
- Product liability law changes.
- Workers' expectations for self-realisation in their jobs.

In order to improve the reliability and maintenance of production machines in a company local to Salford University, Sharp & Marsh (1991) found that there are some management factors must be considered prior to implementing a CBM system. These factors were; full senior management commitment; reluctance of production supervision to release machines that are still operating, because they think it is developing a problem to maintenance due to no guarantee when the machine would be available to production again; production supervision were reluctant to release operators for CBM activities such as inspections and even machine cleaning; clearing the jams of machine's components, together with the lack of training of the operators. They often caused "knock-on" effects, which resulted in future, stoppages at a later time; both the maintenance tradesmen and production operators were financially "better-off" working to a breakdown maintenance policy. The researcher believes that these management factors are crucial and more important than the technical issues when an organisation wants to adopt a new program or technique in both maintenance and production by way of getting improvement. This was a real example of how any project of change within this area to be successful.

The most difficult aspect of change is usually convincing those concerned of the need to change. That is not easy especially when it means destabilising the entire organisation. There are several approaches to try. Campbell (1995) advocated that an independent review of maintenance management could be an appropriate starting point. A customer satisfaction survey can provide information on how the organisation is perceived by its clients (maintenance staff listen to production staff and repair shops listen to maintenance staff, etc.). This destabilising basically means shaking up the status quo- in turn, freeing up employees to think of better alternatives and thereby allowing the organisation to move. Ideally, change should make the organisation more effective, and, at the same time, make the work more interesting and satisfying. Employees must not only endorse the new methods, they must play a large part in designing them. If they are not involved, the situation will not improve and the organisation could be harmed.

Therefore, regarding to the discussions in the previous sections and relying on some authors such as Raymond (2002), Oakland (1997), Sharp, et al. (1997) and Campbell (1995), to be successful in applying TQM system, a vision for maintenance must be embraced by every employee at all levels. They must understand, accept, and, particularly, internalize the need for change. Only the individuals involved can alter an

organisation, because change requires a shared vision, and commitment. An overall approach to organisational and job change can be summarised as Raymond (2002), refers in the following seven critical success factors (CSFs):

1- Establish the need to change and set the objectives.
2- Get all employees involved and committed.
3- Define the approach and clarify the boundaries.
4- Collect all the facts and analyse.
5- Prepare options and select the solution.
6- Develop the plan and carry out it.
7- Evaluate and communicate the results.

2.3.9.4 Organising the maintenance structure

In the large factories and industrial sites, maintenance management became an important issue. Consumer demand pushed these firms to increase products or services. In the past, maintenance organisations were centralised through the maintenance manager, who was responsible typically for all aspects of plant and facility support; mechanical and electrical trades, electric power, steam, compressed air and water services, maintenance engineering and planning, repair shops and custodial work, and ground and civil maintenance. Almost all services were dispatched centrally, and all spares and materials were regulated from the main or central stores (Giles & Cambpell, 2003). This system has the strength from two sides, first; it ensured control over policy, procedures, systems, quality, and training. Second; efficient leveling of the workload across the operation was guaranteed. However, the major disadvantage was inflexibility. Campbell (1995) mentioned that such inflexibility was felt in many ways:

- Sluggish response time to production requests.
- Trades peoples' ignorance of specific equipment in the plant.
- Customer unawareness of the trades.
- Rigidity in approach, procedures and policy.
- High charge-out rates to the local areas and bureaucratic process.
- Customer dissatisfaction over allocation of resources.
- Strict demarcation among the trades, and between maintenance and production, creating "turf wars".

- Focus on efficiency, not effectiveness.

Global competition and the push for long-term profits transformed centralised management theory. Production became the responsibility of area or product managers, who had to react quickly as economic conditions changed. Also, management participation and job enrichment for front line workers began to improve productivity and effectiveness (Giles & Cambpell, 2003). This has fueled decentralisation and moved maintenance into the mainstream of operations. But attention should be drawn to some questions such as: does centralisation always lead to inflexibility? And how are risk management and maintenance engineering handled consistently from department to other, under full decentralisation? Usually the dogmatic approach does little to balance unique technical, systems and behavioural complexities. However, it is essential to revise the maintenance strategy- its mandate, policies, key objectives, and structure. It is also important to keep sight of the enterprise business plan and the environment in which the maintenance function must perform. Keeping in mind the eventual goal of the maintenance function- providing effective equipment at a reasonable cost, and considering the debate among maintenance and production managers, it was agreed by Campbell (1995) to have the following structure for maintenance:

- Central maintenance for facility maintenance, stores inventory warehousing and control, fabrication and machine shops, tooling, information database control, and specialised trades training.
- Focused factory maintenance for workshops, planning and scheduling, operator training in maintenance, and maintenance engineering.
- Cell maintenance for multi-skilled teams, urgent maintenance, preventive maintenance, and consumable and free issue parts and supplies.

Introducing any new programs or systems usually needs to accurately understand how they will work into the organisations. Structure of organisation is very affected by such new systems, because the existing structure could not be effectively managed or the communication system between the departments or units is not well organised. The department structure is recognised to improve communication and to introduce the concept of multi-trade team working. Sharp, et al. (1997) have introduced a new structure when they were conducting a study at Thomas Bolton Company, figure 2.7 shows the structure of engineering department in an organisation. This structure seems

to be more effective, as the communication between the engineering manager, maintenance development engineer, project engineer and supervisors has improved as well as it allows employees to work as a team.

Hence, it is important to recognise that there are many influences on the way an organisation might structure for successful performance and to cope with change. There is no one best way to design organisational structures, which will guarantee successful performance. And as Senior (2002) advocates, depending on factors such as strategy, technology, size, the degree of predictability of the environment and lifestyle of employees, an organisation could be successful and respond to the need for change.

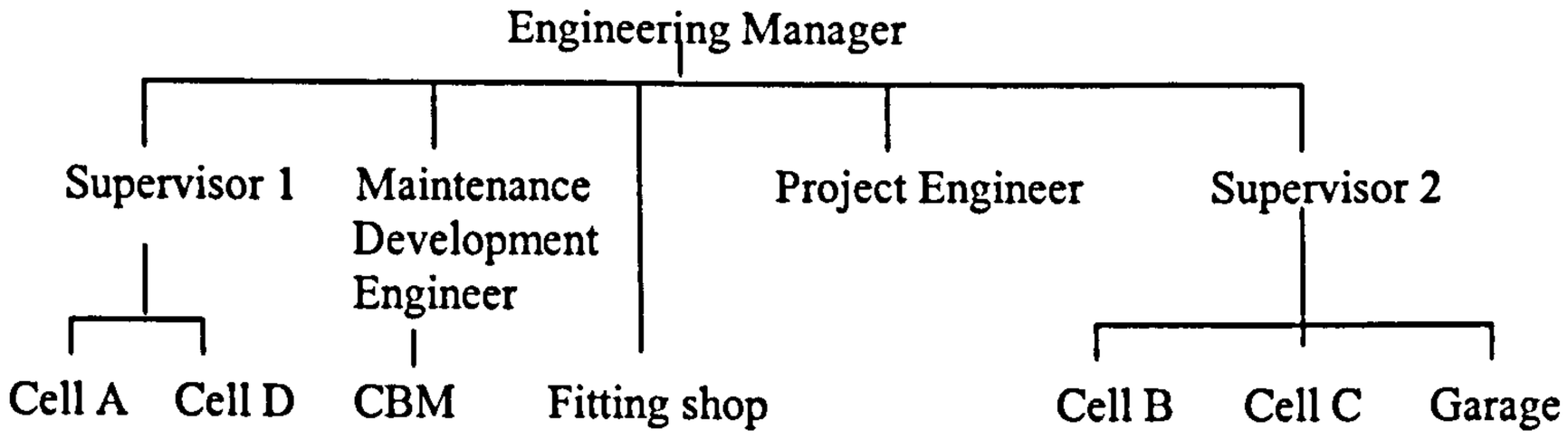


Figure 2.7 Structure of engineering department in an organisation

2.3.10 Summary of part three

In general, one can deduce that the change has two dimensions; business dimension and people dimension. The business dimension of change includes the typical project elements, which are the standard elements of a business change that managers feel most comfortable. These elements are; the business need; the scope and objectives; new processes, systems and organisational structure should be developed; the implementation and post implementation of new plan into the organisation. Whereas the people dimension of change requires an effective management able to manage the following elements: awareness of the need of change; desire to participate and support the change; knowledge of how to change; ability to implement the change on a day-to-day basis; reinforcement to keep the change in place.

According to the change management and QM, the researcher believes that senior managers in an organisation should recognise and establish the need for change, to deal with increasing competitiveness. They also must have good understanding of how to implement the changes. Successful change is achieved by establishing process

management teams, which begin with clear mission statement, analysis of the critical success factors (CSFs), understanding the key processes and developing organisational structure. Integrating QM into the activities of the business can be done through seven steps to a self-reinforcing cycle of commitment, communication, and culture change. The seven steps are: gain commitment to change, develop a shared mission or vision of the desired change, define the measurable objectives, comprise developing the mission into its CSFs, understanding the key processes, breaking down the key processes into sub-processes, and monitoring and adjusting the processes (Oakland, 1997).

With respect of Al-Khalifa (2000), who indicated that by obtaining cultural information relative to successful QM processes, an organisation could identify problem areas in advance, based on culture gaps with desired values and congruence with undesired values. And as has been mentioned in previous sections, it is believed that an organisation cannot pursue quality management successfully in the long run if its environment, organisational culture and climate are not supportive of quality practises. Thus, due to the similar culture in all Arab countries, it is belived that the approach, which was presented by Al-Khalifa (2000), can similarally be used in Libya. That approach suggested four main phases to transfer from state to other relating to quality programs, these phases are: Phase one- commitment to cultural change; Phase two- understanding the existing and desired cultures; Phase three- modify or prepare the existing culture to help implement quality management; Phase four- organisation readiness for change-address and resolve quality issues.

2.4 The research theoretical perspectives

In this part it may be helpful to remind the reader that the aim of this study is to identify the barriers and difficulties affecting quality in maintenance within Libyan manufacturing organisations (Public sector). In order to achieve the research aim and objectives, and from the arguments and discussions of literature surveys, the researcher has generated some aspects related to the research's purposes. Thus the purpose of this part is to summaries the concepts and that emerged from the literature review in parts 1, 2 and 3 and set them into a theoretical framework. It divided into five sections; section one argues about the definition of quality in maintenance, this is followed by the summarising of the common barriers affecting quality management in the organisations, the third section includes a summarising of the key factors affecting maintenance improvement. Fourth, a suggestion of how to manage change programs into an

organisation based on the elements of the framework will be presented in section five. Finally, the theoretical framework will be developed and presented in figure 2.8.

2.4.1 Definitions of quality and maintenance

It seemed to be that most definitions of quality maintenance are concerned on the equipment side (improving the effectiveness and efficiency of equipment), it is valuable to illuminate quality issue in maintenance from processes, procedures point of view, in how can people manage processes successfully. It is essential to bring up the definition of "Quality" in general, before identifying quality in maintenance. The Oxford dictionary (2001) has defined quality as "a feature of something, especially one that makes it different from something else." It comes as a word from the Latin word '*qualitas*' from quails 'of what kind, of such a kind'. Quality is often used to signify "excellence" of a product or service. It is very close to what Edmond Burke said in 1791, "Good order is the foundation of all good things".

Quality has been defined from many viewpoints by several authors. Some examples of common quality definitions are as follows:

Juran and Gryna (1993, p. 3) defines quality as it is customer satisfaction, "*Fitness for purpose or use*"; Deming (1986, p. 5) defines quality, as *"Quality should be aimed at the needs of the consumer, present and future"*. Crosby (1996, p. 24) defines quality as "*Conformance to requirements and it is conforming to specification*"; Feigenbaum (1991, p. 7) defines quality as "*the total composite product and service characteristics of marketing, engineering, manufacture and maintenance through which the product and service in use will meet the expectation by the customer*"; and Oakland (1997, p. 5) defines quality as *"...is simply meeting the customer requirement"*.

Maintenance as a word comes from the verb 'maintain', which has been defined by the Oxford dictionary (2001) as; keep (a building, machine, etc.) in good condition by checking or repairing it regularly. It comes from the Latin word '*manu tenere*', 'hold in the hand'. Narayan (1998, p. 39) defined maintenance as *"Maintenance may be defined most effectively by what it does, namely, the preservation or restoration of the desired function of a given process, at the lowest total cost"*. It can be argued that a well accepted definition of maintenance is; "*All activities intended to keep technical systems in or restore them to the condition considered necessary to fulfil their intended function" (Geraerds, 2000, p. 1)*. Niebel (1994) sees maintenance as it is the work

undertaken to keep or restore every facility to an acceptable standard at an acceptable cost. Furthermore, the following definitions for different types of maintenance are all given in British Standards Institute BS 3811 (1984): *Planned maintenance*: this is maintenance organised and carried out with forethought, control and the use of records to a predetermined plan. *Scheduled maintenance*: Preventive maintenance carried out to a pre-determined interval of time, number of operations, mileage, etc. *Unplanned maintenance*: *ad hoc* maintenance carried out to no predetermined plan. *Preventive maintenance*: Maintenance carried out at predetermined intervals, or corresponding to prescribed criteria, and intended to reduce the probability of failure, or the performance degradation of an item. *Corrective maintenance*: Maintenance carried out after a failure has occurred, and intended to restore an item to a state in which it can perform its required function. *Emergency maintenance*: Maintenance, which it is necessary to put in hand immediately to avoid serious consequences. *Condition-based maintenance*: Preventive maintenance initiated as a result of knowledge of the condition of an item from routine or continuous monitoring.

2.4.1.1 A specific definition of quality in maintenance

Quality has to be considered from the point of view of the user. One definition of quality from Aguayo (1991, p. 46) is "anything that enhances the product from the view point of the customer". He added; some aspects of quality are easily identified, such as how well something works, its dependability, and the length of time before failure, but other aspects of quality are not easily identified or measured. Therefore, quality could be considered as a pathway to the total process of managing maintenance. Dwight (1994) and Geraerds (2000) consider the important contribution of maintenance that maintenance makes in promoting the business goals, and challenges the prevalent view that maintenance is a subordinate activity. Furthermore, Dwight (1994) suggests the efficient application of resources to control and reconcile actual system behaviour to the effective attainment of business requirements that focuses on the links between maintenance activities, driven by the efforts of individuals, and the business goals.

Hence, according to the traditional definition of quality of the conformance to specifications, the maintenance department has a target of keeping the equipment in good condition to maintain the standard of workmanship which, in turn, conform to specifications which, as a result improves quality of the product. Moreover, the modern concept of TQM emphasise that quality is a responsibility to be shared by all people in

an organisation. This advocates that the maintenance function acts in a supporting role to keep equipment operating effectively to maintain quality standards as well as to maintain the quantitative and cost standards of the output. Therefore, by combining the definitions of quality and maintenance that have been mentioned through section 2.4.1, and whereas the maintenance function aimed at keeping a plant in serviceable condition, quality in maintenance could be phrased by the researcher as:

"A set of activities fulfilling internal stakeholder expectations to achieve the organisation's aims based on customer requirements by keeping or restoring plant to an effective condition".

Regarding this definition, the included terms can be described as: *Internal stakeholders:* every one with concern in the organisation from top to bottom particularly top management, maintainers, and operators. *Customers:* the persons, departments or firms of a specified kind that the maintenance department, organisation has to supply them services of maintenance. *Expectation:* belief that all objectives of the organisation which related to maintenance activities will be achieved and get success. *Effective:* producing the desired or intended results by keeping all equipment in the best condition and *Plant:* the equipment and facilities used to make products/services.

Maintenance therefore, is a dynamic activity comprised of a great number of variables interacting with one another. And according to Nieble (1994), the maintenance organisation in any industry or business is faced with the same problems confronting manufacturing management in the production of a competitively priced product. The maintenance department can be thought of as a structured activity that is integrated with other departments of the enterprise and whose product is service.

2.4.2 Summarising of common barriers affecting quality management

From the previous discussions in the literature survey, and in particular in sections 2.1.5 and 2.1.8, the researcher has generated the most common barriers of quality management that have been mentioned by many authors. Those barriers were concluded and summarised by the researcher in table 2.4, the researcher tabulated those barriers according to the authors' name and the year of its publishing (issuing).

Table 2.4 Barriers and difficulties of quality management systems

Barrier and difficulty	Authors' names and year
-Bureaucratic and formalistic	Oakland (1997), Al-Khalifa & Aspinwall (2000), Amar& Mohd Zain (2002), Al-Zamani et al., (2002), MacDonald (1992)
-Typical resistance to any change, (culture change)	Oakland (1997), Nagi & Cheng (1997), Al-Khalifa & Aspinwall (2000), Walsh et al (2002), Masters (1996), Salegna & Fazel (2000), Amer & Mohd Zain (2002), Dale (1994), MacDonald (1992), Whalen&Rahim (1994),
- Middle management resistance	Oakland (1997), Al-Khalifa & Aspinwall (2000), Amar & Mohd Zain (2002)
- Lack of employees participation, involvement, and commitment (coordination)	Oakland (1997), Nagi & Cheng (1997), Al-Khalifa & Aspinwall (2000), Rohitratana & Boon-itt (2001), Walsh et al. (2002), Amar & Mohd zain (1998), Sayle (1994), MacDonald (1992)
- Lack of customer requirements and feedback system	Tamimi & Sebastianelli (1998), Nagi & Cheng (1997), Adebanjo & Kehoe (1998)
- Lack of sufficient quality training and education	Nagi & Cheng (1997), Oakland (1997), Tamimi & Sebastianelli (1998), Masters (1996), Adebanjo & Kehoe (1998), Amar & Mohd Zain (2002), Al-Zamani et al. (2002), Sayle (1994), Whalen&Rahim (1994)
-Lack of confidence by employees and lack of teamwork complacency (cooperation)	Oakland (1997), Nagi & Cheng (1997), Amar & Mohd Zain (2002), Whalen&Rahim (1994)
-Ineffective internal and external communication network	Oakland (1997), Nagi & Cheng (1997), Salegna & Fazel (2000), Amar & Mohd Zain (2002), Al-Zamani et al (2002), Tamimi & Sebastianelli (1998)
-Lack of knowledge and skills of top management	Al-khalifa & Aspinwall (2000), Adebanjo & Kehoe (1998), Amar & Mohd Zain (2002)
-Organisational policy	Oakland (1997), Nagi & Cheng (1997), Al-Khalifa & Aspinwall (2000), Tamimi & Sebastianelli (1998), Amer & Mohd Zain (2002), Al-Zamani et al. (2002), Dale (1994), (2002),Whalen&Rahim (1994),Sayle (1994)
- Insufficient time	Oakland (1997), Nagi & Cheng (1997), Walsh, et al. (2002), Bhanugopan (2002), Salegna & Fazel (2000), Sayle (1994)
- Lack of employee empowerment	Al-Khalifa & Aspinwall (2000), Salegna & Fazel (2002)
- Limited resources	Al-Khalifa & Aspinwall (2000), Oakland (1997), Masters (1996), Amar & Mohd Zain (2002), Whalen & Rahim (1994),Sayle (1994) Tamimi & Sebastianelli (1998), MacDonald (1992)

The table is continued……..

Barrier and difficulty	Authors' names and year
-Lack of recognition and rewards system	Nagi & Cheng (1997), Tamimi & Sebastianelli (1998)
-Lack of expertise in quality management	Oakland (1997), Nagi & Cheng (1997), Dale (1994), Amar & Mohd Zain (2002)
- Inadequate knowledge understanding in quality management system	Nagi & Cheng (1997), Rohitratana & Boon-itt (2001), Bhanugopan (2002), Masters (1996), Amar & Mohd Zain (2002), MacDonald (1992)
-Underdeveloped measure of quality	Adebanjo and Kehoe (1998), Nagi & Cheng (1997), MacDonald (1992), Whalen & Rahim (1994)
-Lack of top management commitment and support	Nagi & Cheng (1997), Oakland (1997), Al-Khalifa & Aspinwall (2000), Rohitratana & Boon-itt (2001), Masters (1996), Bhanugopan (2002), Schein (1991), Walsh, et al. (2002), Amar & Mohd Zain (2002), Al-Zamani et al. (2002), Dale (1994), Whalen & Rahim (1994), Sayle (1994), MacDonald (1992)
-No proper vision and mission	Tamimi & Sebastianelli (1998), Nagi & Cheng (1997), Masters (1996), MacDonald (1992), Dale (1994)
- Lack of leadership, (wrong people in the wrong position)	Nagi & Cheng (1997), Al-Khalifa & Aspinwall (2000), Tamimi & Sebastianelli (1998), Amar & Mohd Zain (2002), Dale (1994)
-Lack of awareness and misunderstanding the benefits	Walsh, et al. (2002), Al-Khalifa & Aspinwall (2000), Salegna & Fazel (2000), Amer & Mohd Zain (2002),

Table 2.4 Barriers and difficulties of quality management systems

2.4.3 Summarising of key factors affecting maintenance improvement

From the previous discussions in the literature survey, and in particular in sections 2.2.4, 2.2.5.2, 2.2.5.5 and 2.2.5.6, the researcher has generated the key factors of maintenance improvement that have been mentioned by many authors. Those factors were concluded and summarised by the researcher in table 2.5, the researcher tabulated those factors according to the authors' names and the year of its publishing (issuing).

Table 2.5 Factors improving maintenance activities

Factor	Authors' names and year
Optimum level of inventory of spare parts	Campbell, (1995); Niebel, (1994); Reason & Hobbs, (2003); Thorsteinsson &Hage, (1991); Al-Muhaisan & Santarisi, (2002); Raouf, (1994); Sharp et al., (1997), Mostafa, (2004); Cholasuke, et al. (2004); Ingalls, (2000);
Maintenance working methods (techniques)	Campbell, (1995); Thorsteinsson &Hage, (1991); Niebel, (1994); Raouf, (1994); Coetzee, (2000); Davis, (1997); Fernands, et al., (2003); Mostafa, (2004)
Maintenance management and information technology system	Sherwin, (2000); Riis, et al., (1997); Raouf, (1994); Coetzee, (2000); Duffuaa & Ben-daya, (1993); Mjema & Mweta, (2003); Kelly, (1989); Fernands, et al., (2003); Mostafa, (2004); Wilson, (1999); Ingalls, (2000); Cholasuke, et al. (2004).
Corporate culture (beliefs)	Reason & Hobbs, (2003); Riis, et al., (1997); Davis, (1997); Mostafa, (2004)
Policy deployment and organisation	Riis, et al., (1997); Davis, (1997); Mostafa, (2004); Raouf, (1994); Thorsteinsson &Hage, (1991); Kelly, (1997); Wilson, (1999); Ingalls, (2000); Campbell, (1995); Al-Muhaisan & Santarisi, (2002); Sharp et al., (1997),
Co-operation and co-ordination and communicate to other departments	Thorsteinsson &Hage, (1991); Reason & Hobbs, (2003); Campbell, (1995); Mostafa, (2004); Sharp et al., (1997),
Auditing and benchmarking	Thorsteinsson &Hage, (1991); Al-Muhaisan & Santarisi, (2002); Raouf, (1994); Richard, et al., (2000)
Maintenance strategy (vision and mission)	Thorsteinsson &Hage, (1991); Campbell, (1995); Mostafa, (2004); Davis, (1997); Hoffman, (2002); Sharp et al., (1997),
Planning and scheduling	Sharp et al., (1997); Thorsteinsson &Hage, (1991); Campbell, (1995); Mostafa, (2004); Cholasuke, et al. (2004); Al-Muhaisan & Santarisi, (2002); Raouf, (1994)
Documentation and recording	Sharp et al., (1997); Thorsteinsson &Hage, (1991); Campbell, (1995); Mostafa, (2004); Al-Muhaisan & Santarisi, (2002); Raouf, (1994); Reason & Hobbs, (2003)
Time pressure	Bakerjan, (1994); Reason & Hobbs, (2003)
Housekeeping and layout arrangement	Reason & Hobbs, (2003); Al-Muhaisan & Santarisi, (2002); Mostafa, (2004); Ho & Fung, (1994); Osada, (1991); Senju, (1992)
Knowledge and experience	Reason & Hobbs, (2003); Bakerjan, (1994); Kelly, (1997); Davis, (1997); Nakajima, (1988); Cholasuke, et al. (2004); Ingalls, (2000);

The table is continued……..

Factor	Authors' names and year
Resources availability (tools, equipment, facilities) and data processing	Sharp et al., (1997); Reason & Hobbs, (2003); Al-Muhaisan & Santarisi, (2002); Mostafa, (2004); Thorsteinsson &Hage, (1991); Campbell, (1995); Raouf, (1994); Cholasuke, et al. (2004);
Training programs	Al-Muhaisan & Santarisi, (2002); Mostafa, (2004); Kelly, (1989); Raouf, (1994); Duffuaa & Ben-daya, (1993); Bakerjan, (1994); Davis, (1997)
Motivation and rewards	Al-Muhaisan & Santarisi, (2002); Mostafa, (2004); Kelly, (1989); Raouf, (1994); Duffuaa & Ben-daya, (1993); Cholasuke, et al. (2004); Ingalls, (2000); Nakajima, (1988);
Preventive maintenance and equipment history	Al-Muhaisan & Santarisi, (2002); Kelly, (1989); Duffuaa & Ben-daya, (1993); Mostafa, (2004); Ben-daya & Duffuaa, (1995);
Continuous improvement	Al-Muhaisan & Santarisi, (2002); Mostafa, (2004); Kelly, (1989); Duffuaa & Ben-daya, (1993); Cholasuke, et al. (2004); Ingalls, (2000); Nakajima, (1988); Ollila and Malmipuro, (1999); Juran, (1988); Bamber, et al., (2002); Sherwin, (2000); Riis, et al., (1997); Al-Najjar, (1996);
Accountability of work undertaken	Sharp et al., (1997); Mostafa, (2004); Campbell, (1995)
Financial aspects	Al-Muhaisan & Santarisi, (2002); Mostafa, (2004); Kelly, (1997); Cholasuke, et al. (2004); Ingalls, (2000); Thorsteinsson &Hage, (1991)

Table 2.5 Factors improving maintenance activities

2.4.4 Managing change programs into an organisation

Regarding the importance of understanding the ways that change should be addressed, and according to many authors such as Raymond, (2002), Senior, (2002), Brown, (1998), Campbell, (1995), and Humphreys, (1996), the researcher believes that to make sure, the change processes in an organisation are implemented successfully, managing change should involve some main steps, which are described below;

Step one*-Determining the need for change;* typically, the need for change becomes apparent when there is a gap between organisational performance objectives and actual performance. Managers should analyse situations and determine what it is that is preventing the organisation from achieving a desired performance. As change is a

human and technical issue, managers must therefore be alert to the cultural barriers and support for change and the modifications to the organisational culture required.

Step two-Determining obstacles to change; managers in an organisation need to identify all the potential barriers to change, and determining what is actually generating resistance to change at different levels of such organisation. Raymond (2002) mentions that employee acceptance of change is increased by harmonious industrial relations. Typically, where changes in power or status are involved, politicking and conflict will surface as individuals fight to retain or overthrow the status quo. An existing culture, strategies, and structure of organisation are powerful barriers to change.

Step three- Introducing a change; the introduction of change can be done by internal managers or external consultants. An organisation's own managers, while more knowledgeable about people and business operations, often are too narrow in outlook and too saturated with the existing culture to introduce change successfully. Consultants, on the other hand, while politically neutral and possessing broader and more knowledgeable viewpoints generally do not know the organisation and its people (Paton & McCalman, 2000). Consequently, consultants can face considerable obstacles in trying to introduce change. As a result, organisations often combine teams of consultants and managers in an attempt to benefit from both insider know-how and external independence and expertise.

Step four-Evaluating change; to measure the effectiveness of change, an organisation must compare the before and after situations. Indicators such as employee productivity, job satisfaction, sales and the like can be used to evaluate the effects of the change. If the change proves ineffective, however, a need for even further change is created.

2.4.5 Developing the theoretical framework

This research is concerned with understanding a quality management system and its interaction with maintenance management activities within the organisation. Change management is also considered as an important issue that needs addressing by the manufacturing organisations. The interaction between maintenance and quality, can lead to their integration with production, as the maintenance is the second output of production process. Therefore, considering a quality in maintenance as a change technique in an organisation, the elements of the framework, mainly are: driving and

restraining forces of quality in maintenance. The driving forces 'enablers' of quality in maintenance include; the principles of quality management (see 2.1.3) such as customer focus, leadership, involvement of people, process approach, system approach to management, continual improvement, factual approach to decision making and mutual beneficial supplier relationships. These principles are associated with the key factors affecting maintenance improvement (see table 2.5) such as maintenance working method, corporate culture, policy deployment and organisation, auditing and benchmarking, planning and scheduling, documentation and recording knowledge and experience, resource availability, training programs, continues improvement, etc.

Hence, the restraining forces 'inhibitors' of quality in maintenance include; the barriers and difficulties face an organisation (see table 2.4) such as typical resistance to change, lack of understanding quality systems, lack of top management commitment, underdeveloped measure of quality, lack of recognition and rewards systems, lack of expertise in quality, limited resources, lack of employee empowerment, lack of customer focus, lack of quality training, etc. These barriers have been classified by many authors into several categories, for instance, Al-Zamani et al. (2002) classified them into three groups; governmental, technical and organisational barriers, and Nagi & Cheng (1997) classified them into four groups; employee & cultural, infrastructure, manager and organisational barriers. These elements are interacting together through a change process and formalising the initial framework. Therefore, using a construction of this theoretical framework will contribute to the achievement of the aim and objectives of research through an in-depth investigation of its elements within the case study organisations. Figure 2.8 shows the initial developed framework of enablers and inhibitors of quality in maintenance.

2.4.6 Summary of part four

In this part, the issues which emerged from the literature review have been considered along with literature on the development of the theoretical framework for this study. Those aspects have together formalised the theoretical basis (framework) of this study, in which they will guide the researcher to select the suitable approach, design, techniques and methods of the research methodology to achieve the research aim and objectives. The research methodology adopted of this study will be discussed and justified in the following chapter.

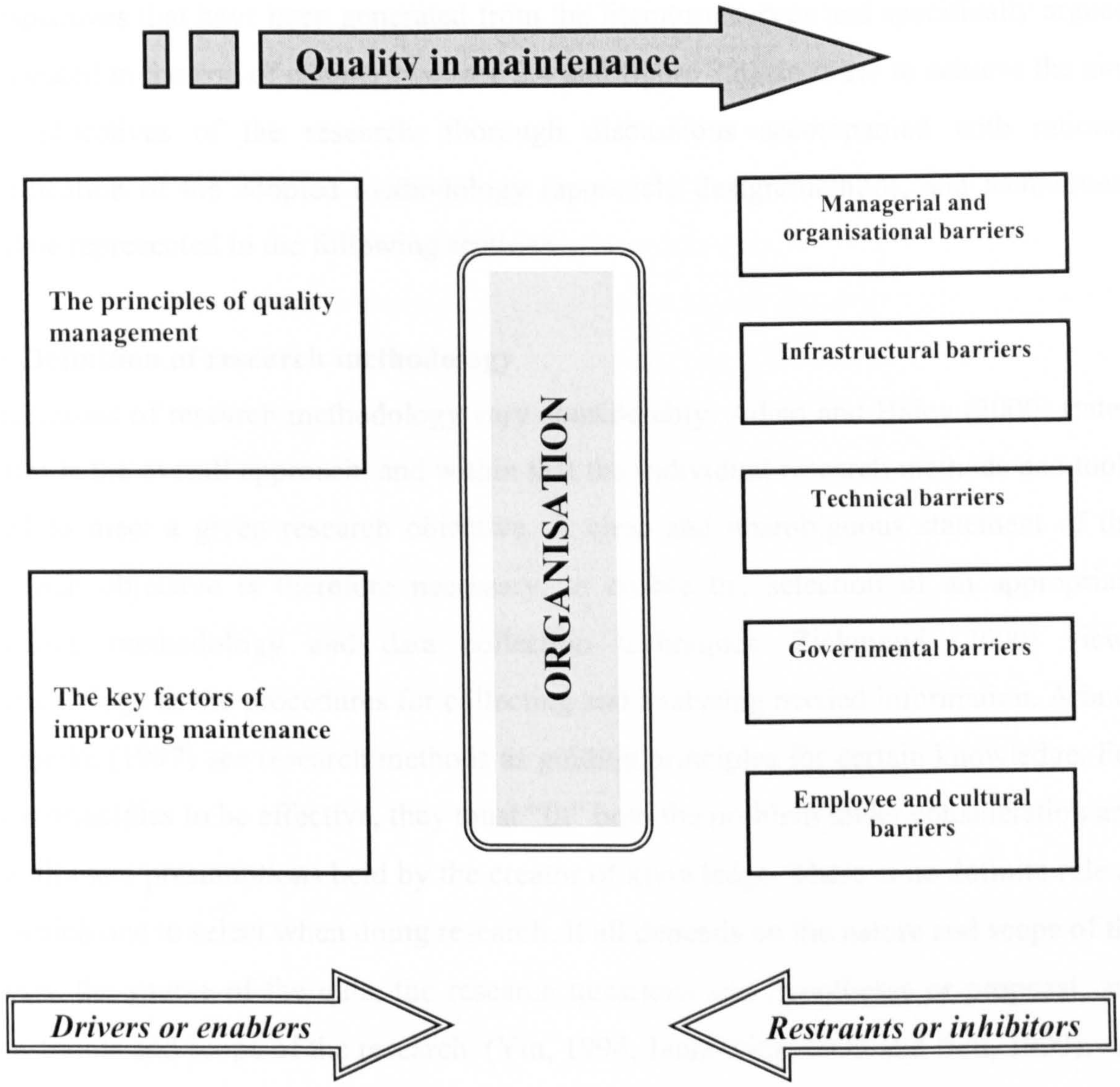


Figure 2.8 The initial framework of driving and restraining forces of quality in maintenance

CHAPTER 3 THE RESEARCH METHODOLOGY

3.0 Introduction

In this chapter, the research methodology will be addressed in the light of the theoretical perspectives that have been generated from the literature survey and specifically argued and stated in the end of chapter two (see 2.4 and figure 2.8). In order to achieve the aim and objectives of the research, thorough discussions accompanied with rational justification of the adopted methodology (approach, design/methods, and techniques) will be represented in the following sections.

3.1 Definition of research methodology

Definitions of research methodology vary considerably. Adam and Haley (2000) stated that it is the overall approach, and within that the individual research methods and tools used to meet a given research objective. A clear and unambiguous statement of the research objective is therefore necessary, to enable the selection of an appropriate research methodology and data collection techniques. Zickmund (2000) views methodology as the procedures for collecting and analysing needed information. Arbnor & Bjerke (1997) see research methods as guiding principles for certain knowledge. For such principles to be effective, they must "fit" both the problem under consideration and the ultimate presumptions held by the creator of knowledge. There is no definite rule as to which one to select when doing research. It all depends on the nature and scope of the thesis, the source of the data, the research questions and hypotheses or proposal, and constraints and scope of the research, (Yin, 1994, Jankowicz, 1993 and Bell, 1999), and the overall research aim. Therefore, research methodology is a way of how one goes around or about doing research. This commences with identifying a problem and the nature of phenomenon to be studied. With the objectives of the study, this section outlines the associated research methodology. It first should present that the framework within the research has been conducted and the kind of tools the methodology uses to collect and analyse data and how, the data will be interpreted.

3.2 Adoption of research philosophy

There are two main traditional philosophical positions in research: epistemology-positivism and ontology-phenomenology (social constructionism). The Philosophers have argued about which one of the two main philosophies is best to conduct. Research Positivism, is described by Easterby-Smith, et al. (2002, p. 28) as "The social world

exists externally, and that its properties should be measured through objective methods, rather than being inferred subjectively through sensation, reflection or intuition." Social Constructionism is the new paradigm, which has been developed by philosophers during the last half century, largely in reaction to the application of positivism to the sciences. It stems from the view that 'reality' is not objective and exterior but is socially constructed and given meaning by people (Easterby-Smith, et al., 2002). Easterby-Smith, et al. (2002, p.28) describe social constructionism as: "focuses on the ways that people make sense of the world, especially through sharing their experiences with others via the medium of language. Social constructionism is one of a group of approaches as interpretative methods in other words; people construct their own words and give meaning to their own realities." The contrasting implications of positivism and social constructionism are shown in table 3.1.

Positivism		Social Constructionism
The observer	must be independent	is part of what is being observed
Human interests	should be irrelevant	are the main drivers of science
Explanation	must demonstrate causality	aim to increase general understanding of the situation
Research progresses through	hypotheses and deductions	gathering rich data from which ideas are induced
Concepts	need to be operationalised so that they can be measured	should incorporate stakeholder perspectives
Units of analysis	should be reduced to simplest terms	may include the complexity of 'whole' situations
Generalisation through	statistical probability	theoretical abstraction
Sampling requires	large numbers selected randomly	small numbers of cases chosen for specific reasons

Table 3.1 Contrasting implications of positivism and social constructionism (Easterby-Smith, et al. 2002, p. 30)

Based on the contrasting implications of positivism and social constructionism paradigms in table 3.1, and to what Remenyi, et al. (1998) mentioned that, if the research strategy is employed successfully, it may deliver an opportunity to produce a high-quality contribution to the body of knowledge and thus it is certainly worthwhile

for the masters or doctoral student to employ the phenomenological approach to research. Furthermore, Leonard and McAdam (2001) suggest that a methodology, which inquires more deeply into QM-related events within the organisation, is needed to enable a coherent and firmly founded set of QM theories to be elucidated. In this situation, a phenomenological perspective is considered to be more appropriate: "appreciate the different constructions and meanings that people place upon their experience...explain why people have different experiences, rather than search for external causes" (Easterby-Smith et al. 2002, p. 30). Based on the above discussions and the group of the implications of these two main philosophies summarised in tables 3.1 and also the nature of this research, the social constructionism (phenomenological) was chosen as the research philosophy.

3.3 A critique of the two research approach (qualitative & quantitative)

Different types of research are based in differing conceptions of the nature of science. The connection between theory and research, epistemological considerations and ontological considerations – quantitative and qualitative research can be taken to form two distinctive clusters of research strategy or paradigm (Bryman, 2001). The common theme in the literature is for authors to classify process or strategy of research under two main paradigms (Brannick and Roche, 1997, Collis and Hussey, 2003, Phillips and Pugh, 2000 and Bryman, 2001). In research the word "paradigm" refers to the progress of scientific practice based in people's philosophies and assumptions about the world and the nature of knowledge; in this context, how the research is conducted? Hence, the two main paradigms are: -

* *Qualitative (Phenomenological) Research,* which is based on methods of data generation, which are flexible and sensitive to the social context in which data are produced (Phillips and Pugh, 2000, Collis and Hussey, 2003). The nature of reality is defined by the interaction of the researcher with the phenomenon under study. Qualitative research usually emphasises words rather than quantification in the collection and analysis of data.

* *Quantitative (Positivistic) Research,* which assumes that there is a single objective reality. According to this assumption, two independent researchers can use standard research methods to study a phenomenon, and both will arrive at the same conclusion. In such research, researchers emphasise careful control and measurement by assigning numbers to measurements (Bryman, 2001). Quantitative research usually emphasises quantification in the collection and analysis of data.

Based on Hussey and Hussey (1997), table 3.2 lists the key features of the two main paradigms that indicate to the process or strategy of research. Some researchers prefer an approach to the relationship between theory and research that is primarily inductive. With an inductive stance, theory is the outcome of research. In other words, the process of induction involves drawing generalisable inferences out of observations (Bryman, 2001). It is clear that, whereas deduction entails a process in which: Theory leads to observations/findings. Induction entails a reversed process where; Observations/ findings lead to theory development.

The emergence of the social science in the 20th century, led social science researchers to be wary of the deductive approach. They were critical of an approach, which enabled a cause-effect link to be made between particular variables, without an understanding of the way in which, humans interpreted their social world (Saunders, et al., 2000). Of course, developing such an understanding is a strength of inductive research. Research using the inductive approach would be particularly concerned with the context in which such events were taking place. Therefore, the study of a small sample of subjects may be more appropriate than a large number, as with the deductive approach (Easterby-Smith, et al., 2002).

Qualitative (Phenomenological)	Quantitative (Positivistic)
Uses small samples	*Uses large samples*
Concerned with generating theories	*Concerned with hypothesis testing*
Data is rich and subjective	*Data is highly specific*
The location is natural	*The location is artificial*
Reliability is low	*Reliability is high*
Validity is high	*Validity is low*
Generalises from one setting to another	*Generalise from sample to population*

Table3.2 Features of the Two Main Paradigms (from Hussey &Hussey 1997, p. 54)

3.4 Justification of the research approach adopted

There remains some discussion amongst the current literature concerning research methods, as to which approach is the most valid. However, as Jankowicz (2000) notes the decision regarding which research method to employ should always be taken in consideration of the research objectives. Therefore, if the research objectives demand a thorough understanding of a certain phenomenon, in this case a qualitative approach is more appropriate: "Qualitative methods are therefore more suitable when the objectives of the study demand in-depth insight into a phenomenon" (Ghauri et al. (1995, p. 86)). Since the two approaches, quantitative and qualitative, are largely complimentary and

cannot be easily separated they could be used together. The use of both quantitative and qualitative methods in the same study is known as *triangulation*. Denzin (1989, p. 297) defines triangulation as "the combination of methodologies in the study of the same phenomenon" while Easterby-Smith, et al. (2002, p. 146) identify four types of triangulation: Theoretical triangulation, where a theory is taken from one discipline and used to explain a situation in another discipline. Data triangulation, when data is collected, at different times or from different sources in the study of a phenomenon. Triangulation by investigators, where different researchers independently collect data on the same phenomenon and compare the results. Methodological triangulation, when both quantitative and qualitative methods, of data collection, are used. However, as expressed in this section, the main restrictions posed by the triangulation method are the time and resource factors; therefore, the extent of data-collection is influenced by the amount of time available to help collect meaningful data.

In the answering of the question, what is important about well-collected qualitative data? Amaratunga, et al. (2002, p. 21) say, "One major feature is that they focus on naturally occurring, ordinary events in natural settings, so that there is a view on what 'real life' is like". Another feature of qualitative data is their richness and holism, with strong potential for revealing complexity. Such data provide 'rich descriptions' that are vivid, nested in a real life context, and have a ring of truth. Furthermore, the fact that such qualitative data are typically collected over a sustained period makes it powerful for studying any process. Qualitative data are useful when one needs to discover or explore a new area, and to supplement, validate, explain, illuminate, or reinterpret quantitative data collected from the same setting (Amaratunga et al.2002).

Gummeson (1999) cites that while quantitative research is concerned with issues such as how much, how often, how many, qualitative research on the other hand is concerned with identifying certain phenomena based on an in-depth exhaustive investigation and analysis. Bell (1999) mentioned that, research adopting a qualitative perspective is more concerned to understand an individual's perceptions of the world. They seek insight rather than statistical analysis.

From the above discussion, the researcher has selected the qualitative philosophy as the main approach of this research because it enables the researcher to dive in the real life of context to explore the included features and factors. It is powerful for giving insights,

findings, and recommendations. This approach is advocated by many authors such as, Amaratunga et al. (2002), Gummeson (1999), Jankowicz (1993), Bell (1999), Leonard & McAdam (2001) and Easterby-Smith et al. (2002).

3.5 A critique of the case study research design (method)

A definition of the case study as a research strategy was stated by Yin (2003, p. 14) in two ways, first, the technical definition begins with the scope of a case study: "as an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident." Second, "the case study as a research strategy comprises an all-encompassing method; covering the logic of design, data collection techniques, and specific approaches to data analysis".

Yin (2003) appears to operate from a realist ontology when he defends case method against attacks, especially in relation to the three forms of validity: construct validity, internal validity, and external validity. A key suggestion for dealing with construct validity is to use multiple sources of evidence and to establish a chain of evidence. For internal validity, Yin (2003) stresses the importance of building cases over time in order to eliminate alternative explanations. Internal validity is only a concern for causal case studies, in which an investigator wants to know whether event x led to event y; and for external validity he points out that case studies rely on analytic rather than statistical generalisations. There has been some reluctance to apply ideas of validity and reliability to interpretative and constructionist research, because they might imply acceptance of one absolute (positivist) reality. However, as qualitative methods become increasingly mainstream, there is a growing realisation of their importance – because constructionist research must develop the power to convince examiners, professionals and the wider public that their results should be taken seriously (Easterby-Smith, et al. 2002)

Reliability, also, is one test commonly used to establish the quality of any empirical social research, where the operations of a study such as data collection procedures can be repeated, with the same findings. Since the goal of reliability is to reduce the errors and biases in a study, Yin (2003, p. 38) refers that "the general way of approaching the reliability problem is to make as many steps as operational as possible and to conduct research". This means that case study research procedures and techniques should be properly documented.

The great strength of the case study method is that it allows the researcher to focus on a specific instance or circumstance and to attempt to identify the various interactive processes at work and also the case study approach is appropriate for individual researchers since it gives a chance to one view of a problem to be studied in depth within a limited time scale (Bell, 1999). In addition, case study has the strength from its ability to deal with a full variety of evidence – documents, artefacts, interviews, and observations – beyond what might be available in the conventional historic study. The case study researcher aims to identify the common organisation stages, and to explain how they affect the implementation of systems and influence the way an organisation functions. According to Yin (2003), case study research is concerned with the interaction of factors and events and, as Nisbett and Watt (1980) pointed out that, sometimes it is only by taking a practical instance that can obtain a full picture of case elements' interaction. Though observation and interview are most frequently used in case study, no technique should be excluded.

3.6 Single case study or multiple cases

A further contention surrounding the case study methodology involves the selection of either a single case study or multiple cases, and numerous levels of analysis (see Eisenhardt (1991) and Yin (1994, 2003). The question arises, whether or not to pursue a single-case or multiple cases strategy. In designing case research a key question is the number of respondents. The single case can be used to determine whether a theory's proposition is correct or whether some alternative set of explanations may be more relevant. It is also appropriate to use this strategy when the case represents an extreme or unique case (Yin, 2003).

Multiple case studies looking at several sites aim to reach more generalisable conclusions than those provided in a single case. In consideration of these points of view and in particular to enhance the generalisability of the research findings, Perry and Coote (1994) state that the literature on the issue of case study sample size varies significantly from the view that the number selected is at the discretion of the researcher, to saturation and to the point of redundancy. Therefore, as there is no rule for the selection of a sample size in qualitative research, each scenario needs to be considered in context.

Yin (2003) suggests the following criteria for selecting cases:

- Every case had to demonstrate – prior to final case selection – the occurrence of exemplary outcomes the basic replication question would then be whether similar events within each arrangement could account for these outcomes.
- The study's policy concern – some of the arrangements would have a federally supported type of organisation at its centre, but other arrangements would have it in a more peripheral relationship
- The cases would cover different regions of the country.

In fact, scientific facts are rarely based on single experiments; they are usually based on a multiple set of experiments, which have replicated the same phenomenon under different conditions. So, the same approach can be used with multiple-case studies, but requires a different concept of the appropriate research designs. The short answer as advocated by Yin (1994, 2003) is that case studies, like experiments, are generalisable to theoretical propositions and not to populations or universes. In this situation, the case study, like the experiment, does represent a "sample", and the investigator's goal is to expand and generalise theories (analytical generalisation) and not to enumerate frequencies (statistical generalisation) where the goal is to do a " generalising" and not a "particularising" analysis.

Although all designs can lead to successful case studies, when the researcher has a choice and resources, multiple case designs as Yin (2003, p. 53) has referred may be preferred over a single case. Even for "two-case" case studies, he advocated "to begin with, even two cases, the researcher has the possibility of direct replication. As with two experiments, analytic conclusions independently arising from two cases will be more powerful than those coming from a single one". Multiple case studies are becoming more prevalent despite being more expensive and time-consuming to conduct, hence, any use of multiple-case designs should follow a replication, not a sampling, logic, and an investigator must chose each case carefully (Yin, 2003). The cases should serve in a manner similar to multiple experiments, with similar results (a literal replication) or contrasting results (a theoretical replication) predicted explicitly at the outset of the investigation.

3.7 Justification of the case study method adopted

Jankowicz (1993) mentions, that the advantage of case study research is that it will enable comprehensive and informative data to be generated. The case study method is particularly appropriate for individual researchers as it gives the opportunity for one aspect of a problem to be studied in depth within a limited time scale (Bell, 1999). In other words, the case study method allows the researcher to concentrate on a specific instance or situation and to identify the various interactive processes at work within the boundary of academic study time limitation. Gummesson (2003) has summarised proper concerns of case study approach such as: a free and wide choice of data generation and analysis techniques; access to reality and validity in focus; and the purpose is the understanding. This backs the researcher to select the case study approach.

This study is exploratory and explanatory in perspective; it is interested in knowing that "what", "how" and "why" issues related to the identifying barriers and difficulties affecting maintenance in certain organisations. Yin (1994), recommends that for research projects that are of this nature and that focus on the "what, why, and how questions, then the case study approach would be ideal. Case study is a useful strategy for converting tacit knowledge into explicit knowledge so practitioners can learn more about the performance of their business systems. Considering the definition of case study by Yin (2003), which is discussed in section 3.5, it could be determined what and why that phenomenon happened? Ghauri et al. (1995, p. 86) mention, "Historical review, group discussions and case studies are mostly qualitative research methods. These qualitative methods use relatively more qualitative techniques, such as conversation and in-depth semi-structured interviews". From the critique of the case study, given in section 3.5 and 3.6, its great strength is to allow the researchers to focus on a limited situation and to attempt to classify the various interactive processes at work. It is expected that generalisability be enhanced not only through using a number of case study organisations, but also through a literature survey and analysis of other case study reports on companies or organisations with experience of implementing a Quality Management technique (QM) in maintenance activities. The results and conclusions drawn from the research are strongly based on objective evidence obtained from literature, other case study information, and data analysis from the cases study.

Since a case study is an extensive examination of a single instance of a phenomenon of interest and is an example of a phenomenological methodology (Collis and Hussey,

2003), in which this research is involved, the case study approach is adopted because it is considered, in the previous sections, to be the most suitable method of research for organisational research due to time and resource constraints. In addition, because case studies are very effective when they are used to study organisations and institutions, as they are more "forgiving" in their design which allows the space for modifications and change of focus at every stage (Yin, 2003). Generally, case study design is adopted regarding all previous discussions that could conform with;

- This research attempts to illustrate new and possibly innovative practices in maintenance in Libyan organisations – answering the 'what' question.
- This research explores the barriers and factors within areas of overlap – answering the 'how' and 'why' questions
- This research focuses on contemporary events in Libyan organisations – answering the 'what' question
- The case study is excellent as a recorder of decisions, reasons, motivations, and structural relationships (Leavy, 1994).

Consequently, the case study, like any research strategies, is a way of investigating an empirical topic by following a set of pre-specified procedures. The researcher who decided to use even one, two or more case studies should take into consideration the ability to verify a proper saturation through getting appropriate information. Therefore the case study is an important design (method) when conducting research, as it allows the researcher to focus on a specific instance or circumstance, and to attempt to identify the various interactive processes at work, and also the case study method is appropriate for individual researchers since it gives a chance to view a problem to be studied in depth. In addition, the case study has the strength from its ability to deal with a full variety of evidence – documents, artefacts, interviews, and observations – beyond what might be available in the conventional historic study.

3.8 Selection of research techniques (data collection and sources of data)

Bryman (1995) makes a distinction between research designs and research methods (or techniques of data collection). Accordingly, research design 'method' is the overall structure and orientation of investigation, which provides a framework within which data is collected and analysed. While particular designs tend to be associated with particular techniques of data collection. Despite the general agreement with Bryman (1995) on what he called (Chief research design and method in organisational research)

the difference is, it is more appropriate to call the ways of gathering data by "technique" rather than by method. Moreover, to avoid the confusion may be occurred in the research methodology terms, it is better to classify them; approach, design, and technique respectively. The term "approach" is used here to inferring the two main paradigms; positivistic (quantitative) and phenomenological (qualitative), whereas, the term "design" is referring to the way of how the research will be generated. Likewise, the term "technique" is used here to illustrate the procedure to be followed to gathering data and data sources used within research activities. As Ghauri et al. (1995) note, research techniques are primarily concerned with how one collects data than why one does this since this issue is determined by the research method employed within the framework of the case study methodology. The so called, (Chief research design and method in organisational research) is modified and becomes the "chief research methodology" which is presented in table 3.3, the letter 'T' refers to data collection techniques, the letter 'D' refers to research design (methods).

Research approaches	**Research designs**	**Research techniques**
Phenomenological (qualitative)	**D1** Action research **D2** Ethnographic **D3** In-depth surveys **D4** Participant observer **D5** Focus group **D6** Scenario research **D7** Case studies **D8** Field experiments **D9** Futures research	**T1** Documents, archival record **T2** Self-administrated questionnaire **T3** Structured interview **T4** Unstructured interview **T5** Direct observation **T6** Participant observation **T7** Simulation **T8** Focus group **T9** Diaries
Positivistic (quantitative)	**D10** Forecasting research **D11** Laboratory experiments **D12** Large-scale surveys	

Table 3.3 Chief research methodology in organisational research (analogous to Bryman (1995))

According to Remenyi et al. (1998) and Bryman (1995), research design includes; action research, ethnographic, case studies, field experiments, focus group, forecasting research, future research, in-depth surveys, laboratory experiment, large- scale surveys, participant observer, and scenario research. Authors such as Bryman (1995), Easterby-Smith, et al. (2002), Collis and Hussey (2003) have mentioned some different data collection techniques. Those data collection techniques could be summarised as: "Documents, Archival records, Interviews, Direct observation, Participant-observation, Diaries, Focus group, simulation, and Questionnaire". An in-depth structured and

unstructured interview is important technique for gathering information, from individuals. It has been used extensively in the research, where collections of specific formulated questions are asked of a respondent by the interviewer. An in-depth or semi-structured interview and unstructured interviews are carried out in an informal way, allowing respondents considerable latitude in what they say both types of interview techniques contribute to the discussion in the case study organisation sections.

Easterby-Smith, et al. (2002), mentioned that, the interview bias on quantitative research is regarded as crucial, however, with in-depth interviewing the issue is slightly different. Easterby-Smith, et al. (2002, p. 93), say "since depth interviews derive from a social constructionist perspective, it follows that there is no one 'objective' view to be discovered which the process of interviewing may bias". In order to avoid bias, according to these authors, there is often the tendency for researchers to want to focus on discovering responses to specific alternatives, and in this case 'probe' can be useful as an intervention technique to improve, the interviewee's response. Consideration should be taken that, probes should never lead.

Interviews are one method of obtaining data particularly in the case of qualitative and case study approach. Unstructured interviews are usually conducted to obtain definite ideas about what is and is not important and relevant to a particular problem situation. However, structured interviews give more in-depth information about specific variables of interest (Sekaran, 2003). Jankowicz (2000), states that semi-structured interviews are a powerful data collection technique when used within the context of a case study research method. In organisations, managers tend to be powerful and busy people, they are unlikely to allow research access to their organisations unless they can see some commercial or personal advantage to be derived from it. This means, that access for fieldwork could be very difficult and may be hedged with many conditions. That is why Easterby-smith, et al. (2002, p. 8), say "Nowadays, managers have to count very carefully the cost of their time and therefore short interviews, fitted into busy schedules, are likely to be much more feasible than unstructured observations and discussion which can take a lot of time". Therefore, the researchers should take this issue into their considerations when they select an interview technique.

Sekaran (2003) mentions that questionnaires also are an efficient data collection mechanism when the researcher knows exactly what is required and how to measure the

variables of interest, self-administered questionnaires are collections of questions that the respondent completes on his or her own. Additionally, a major source of data available is archival information from the notes, minutes of meetings, project plans, and presentation materials, records of process measurement and procedure documentation, this information accrued within the other relevant activities that provide historical documents, contemporary records and existing statistics. Hence, based on what was discussed in previous sections, (3.2, 3.3, 3.5 and 3.8) the researcher concluded that the relation between the different elements of research methodology (approaches, designs, and research techniques) can be clearly shown in figure 3.1, the *italic* writing indicates to the elements of research methodology adopted in this study.

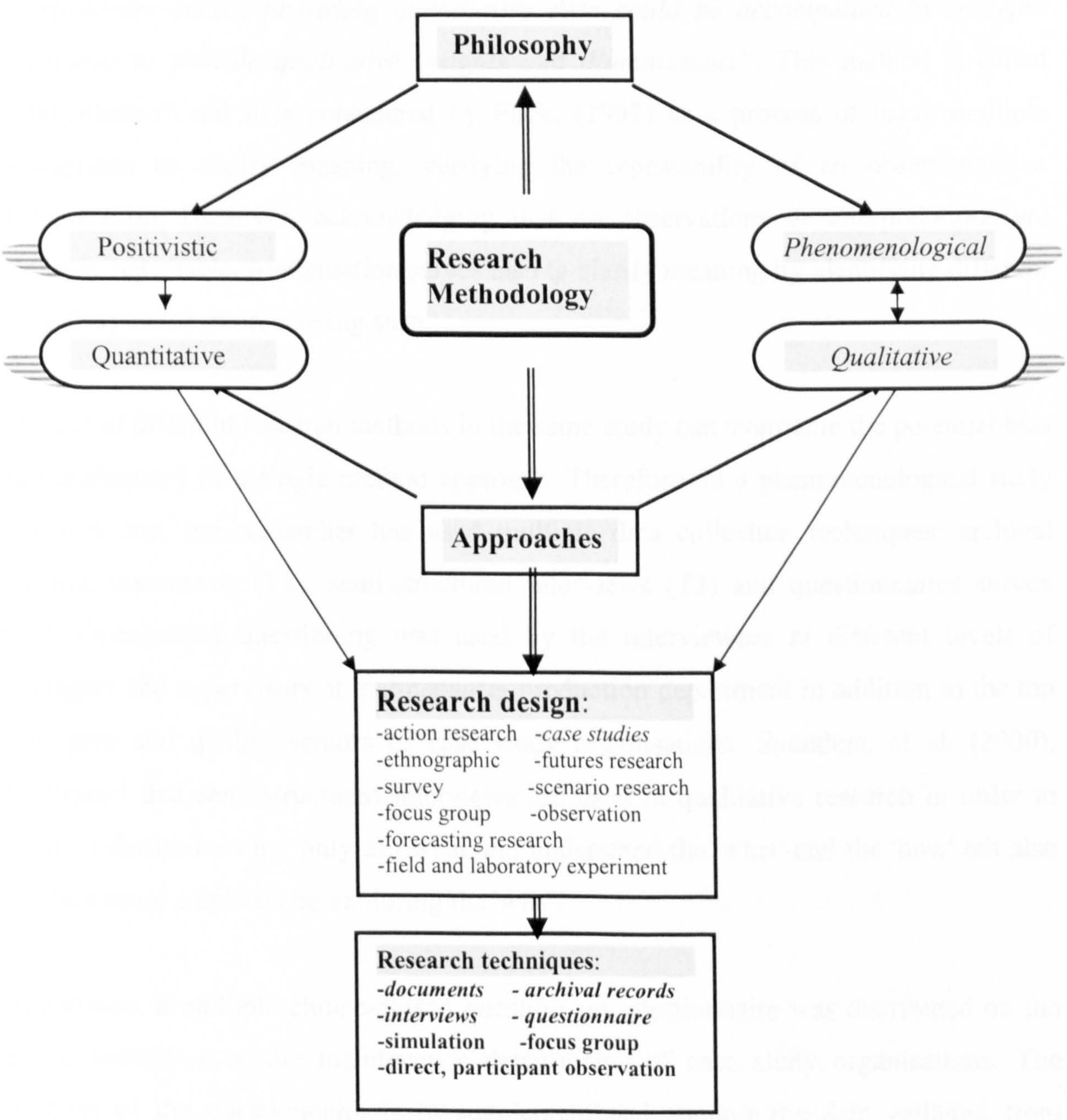


Figure 3.1 The relations between philosophy, approaches, methods, and techniques of research methodology

3.9 Research techniques adopted

The literature reviews have highlighted the barriers, difficulties, critical factors and variables that affect the quality in maintenance within an organisation. Based on the literature review the researcher has developed the questions that have been conducted in both interviews and questionnaires, and because some qualitative data collection methods are so closely intertwined with the analysis of the data, that it is impossible to separate the two processes such as questionnaires and structured interviews as a research instrument (Collis and Hussey, 2003). Although the main approach used in this research was qualitative, the researcher used a quantitative approach as an assistant by triangulating data within the organisations of case study research based on what Hussey and Hussey (1997, p. 74), have mentioned as: "*it is perfectly possible, and even advantageous, to use both qualitative and quantitative methods for collecting data. A questionnaire survey providing quantitative data could be accompanied by in-depth interviews to provide qualitative insights and illuminations*". This method is called "triangulation" and it is considered by Flick, (1992) as a process of using multiple perceptions to clarify meaning, verifying the repeatability of an observation or interpretation. However, acknowledging that no observations or interpretations are perfectly repeatable, triangulation serves also to clarify meaning by identifying different ways the phenomenon is being seen.

The use of different research methods in the same study can overcome the potential bias and inadequacy of a single-method approach. Therefore, in a phenomenological study like this one, the researcher has used multiple data collection techniques; archival records, documents (T1), semi-structured interviews (T3) and questionnaires survey (T2). Open-ended questioning was used by the interviewees at different levels of managers and supervisors at maintenance, production department in addition to the top managers and quality seniors of case study organisations. Saunders, et al. (2000), mentioned that semi-structured interviews are used in qualitative research in order to conduct discussions not only to reveal and understand the 'what' and the 'how' but also to place more emphasis on exploring the 'why'.

In addition, a multiple choice-closed question set questionnaire was distributed on the entire workforce in the maintenance departments of case study organisations. The purpose of the questionnaire is to supplement and support the data gathered from interviews. Furthermore, documents such as minutes of meetings, reports and other

related papers and archives were also used to substantiate the interviews. Based on the literature review information, the questions used in the interviews and questionnaires were designed to collect the required data related to the aim, objectives of this research. Therefore, the results will be introduced in relation to the aim, objectives of this study that were set forth in chapter 1.

3.10 Generating and developing the questions of interview and questionnaire

The main function of the questions, used in both interviews and questionnaire, is to gather enough required data to achieve the aim and objectives of the research. The literature review is the main source of forming the questions, thus, the researcher has generated and developed the questions of the interviews and questionnaire in the light of related topics such as; barriers, difficulties, critical factors and variables that affect the quality in maintenance within an organisation found in the literature review. The questions of both, interviews and questionnaires were specifically devised from the elements of the theoretical framework (see 2.4) which includes, the common barriers affecting quality (table 2.4) and key factors affecting maintenance improvement (table 2.5). The questionnaire was mainly transcribed from the statements of tables 2.4 and 2.5.The developed questions were appropriate to get the required data from the case study organisations, and all relevant issues covered. To enhance validity and reliability issues, the researcher's supervisor who has quality and maintenance expertise reviewed the questions of both interviews and questionnaires. His comments were taken into consideration. Furthermore, to support the validity and reliability issues, feedback from the pilot study (see 3.11.1) resulted in some of the questions being modified and changed. Forms of interview questions and questionnaire are attached in appendices 2.1 and 2.2 respectively.

3.11 Sampling strategy of research

This research is a case study based strategy. In the following sections, in addition to the pilot study was conducted, the justification of choosing a certain number and kind of real case study organisations, furthermore, the samples of interviewed people.

3.11.1 Conducting the pilot study

Many authors have mentioned the importance of a pilot study, in the case of conducting research. For instance, Yin (2003, p. 79) has said "the pilot case study helps investigators to refine their data collection plans with respect to both the content of the

data and the procedures to be followed". Ghauri et al. (1995) say that a pilot study is the test that checks the understanding of the interviewee regarding the research problem and interview questions, and such pilot research also provides first-hand insight into what might be called the "cultural endowment" of the informants. In addition, Oppenheim (1992) mentioned that the function of a pilot study is not the collection of findings but the testing out of questions and procedures. Gill and Johnson (1991) also have said that a pilot study can provide good feedback to the researcher for more accurate and clear questions that will be used in the real case studies. Furthermore, Gill and Johnson (1991) stated that conducting a pilot study before the main survey allows any potential problems in the pro forma of the interview and questionnaire to be identified and corrected.

A pilot study gives an investigation of whether the questions asked are sufficient to generate the required information, furthermore, it enhances the validity of such questions in both interviews and questionnaire, as the researcher has a chance to reword and reconstruct the questions. Hence, the researcher believes that a pilot study is very important to make sure that the questions of interviews make sense to the respondents, and to guess the suitable time for each interview. Furthermore, the researcher believes that, a pilot study can help, to get more accurate questions related to the research problem that can be used when conducting the real case studies. Therefore, the researcher contacted three Libyan manufacturing organisations as a pilot study for his research, these organisations are: Arab Company for Engineering Industries, Assamaka Company for Paints & Chemical materials, and Mechanical Centre for Producing Spare Parts and Dies. The purpose of conducting 3 cases was for getting feedback from different respondents' background in different organisations by the criteria of size, activity and site. This helped the researcher to ensure the validity of questions of interviews, furthermore, he got good experience on how he can access the Libyan organisations. The pilot study interviews involved three levels of management and supervisors; top management, maintenance department, and production department. All the questions for the interviews were deduced and designed according to the quality and maintenance literature review in chapter 2. According to the pilot study activities, the researcher got some relevant comments that are summarised as follows:

- The questions of interviews were modified due to; some questions were found to have the same meaning (repeated questions). Some of them were in the form of

combined questions, and there are other sources into an organisation to getting information such as documents, reports, etc.

- The modified questions were covering all the research topics, related to the difficulties affecting quality in maintenance. They were quite enough for getting the required data. The questions were translated to an Arabic language to facilitate them for the respondents, as it their first language.

3.11.2 Conducting the real case study organsations

Based on the early discussions in sections (3.5, 3.6 and 3.7), and what Leavy (1994) advocates, multiple case studies looking at several sites aim to reach more generalisable conclusions than those provided in a single case. Multiple cases augment external validity and help guard against observer biases. Moreover, what Yin (2003, p. 54) stated, "The criticisms may turn into scepticism about the ability to do empirical work in a single case study. Having two cases can begin to blunt such criticisms and scepticism". Therefore, the researcher decided to use two case studies as a sampling strategy of this research for the following reasons:

- can verify a proper saturation through getting appropriate information (Gummesson, 2003).
- less cases give more opportunity to go deep.
- may enhance the generalisability of the research due to the similarity of all Libyan manufacturing firms, particularly in the management procedure and control system. And comparisons allow the special features of cases to be identified much more readily (Bryman, 2001).
- the constraint of limited time (PhD study).

In summary, the reason for choosing two case study organisations is a balancing act between the needs to obtain rich informative data through rigorous investigation and the need to enhance generalisability of the research findings while understanding and recognising the differences apparent in each case.

The researcher conducted his two cases in the manufacturing sector based on the following:

- Because of the economic, social and political importance of this sector for Libyan society. It is a sector where a relatively large investment has been made about $12000 million over the period of 1970 to 1995 (Bait Al-Mal, 2000).
- Most Libyan manufacturing firms have faced problems such as the reduction of productivity and the increase in production cost (Ejigu & Sherif, 1994; Bengharbia, 1994).
- Manufacturing industry may be considered as a theoretical (purposeful) sampling.
- The demand of a comprehensive understanding of the various issues in the organisations relating to the quality management and quality in maintenance.
- The possibility of getting access to real world data which could help to reflect the real situation of what will be studied (Gummesson, 2003).

The subject of this study is the two Libyan manufacturing organisations (public sector); case study ogranisation (X1) and case study ogranisation (X2). The main reasons of choosing these two cases were that:

- they are the first two organisations in Libya that have been certified to ISO 9000 which make them as the pioneers of adopting quality systems in the country.
- they play a significant role in the country; Company X1 is the only company produces TVs sets in Libya, and company X2 is the only one in the North West of Libya which produces and sells, in addition to some petrochemical products, the table salt, company X2, can be seen it is responsible for essentially providing table salt for all Libyan people.
- the researcher has had good relationships with many people in top and middle management positions, which means they ease accessibility into the organisations. This relationship is particularly important factor and it was thought that this would help in a number of ways, such as assisting communication with interviewees and other employees, and collecting particular documents appropriate for research.

The main source of gathering data for these two case studies is the semi-structured interviews, (Appendix, 2.1) which were conducted with all the targeted respondents in both cases. According to the organisational structure of each surveyed organisation the targeted interviewees were;

For the organisation X1:

- Top management; managing director, manager of technical training office, manager of research & development office, and seniors of quality.
- Production department; production manager, and heads of units.
- Maintenance department; maintenance manager, heads of units, and supervisors.

For the organisation X2:

- Top management; director general, technical manager, and seniors of quality.
- General production department; General production manager, and managers of departments.
- Maintenance department; maintenance manager, heads of divisions, and supervisors.

The researcher believes that the chosen sample for interviews is sufficient to represent the data required for this study. Consideration was made that those selected to be interviewed would represent the main departments, which are very close to maintenance activities, and their positions allowed them to have a good knowledge and information related to this study topic. To obtain a general perspective on quality management and maintenance issues; selected managers from the top management level were interviewed. To obtain a specific perspective on quality management; seniors of quality were interviewed. And to obtain a general and specific perspective on difficulties and barriers encountering improvement and quality maintenance; managers and supervisors in production and maintenance departments were respectively interviewed.

The total staff of management at the organisation X1 were 32, and 53 in the organisation X2. The numbers of interviewees in each two case study organisations were 19 and 30 respectively, they distributed through three management levels: level one (L1), includes top management and seniors of quality. Level two (L2), includes maintenance managers and supervisors, and level three (L3), includes production managers. Covering these three levels can enhance the validity and reliability by getting responses from different points of view, which means triangulating peoples' opinions. The distribution of numbers of all respondents at different levels in both organisations is shown in table 3.4

Management levels	Total numbers of interviewees	
	Organisation X1	Organisation X2
Top management and seniors of quality L1	7	7
Maintenance department L2	9	16
Production department L3	3	7
Total	19	30

Table 3.4 Distribution of total numbers of all respondents

The total number of maintenance staff was 40 and 130 people in CSOX1 and CSOX2 respectively. The questionnaires (Appendix 2.2) were distributed to all the maintenance staff in both organisations by the rate of 40 forms in the organisation X1 and 130 forms in the organisation X2. The responses were high from the organisation X1, they were 32/40, which equals 80%, and the responses from organisation X2 were good, by the rate of 76/130, which equals 59%. Therefore, the total numbers of responses from both cases were 108 from 170 giving a return rate of nearly 64%.

3.12 Gathering and analysing data

The interviews and questionnaire were conducted during the period from August to November 2003 however; the total responses of the questionnaires were completed by March 2004. The questionnaire helped the researcher to get a feed back from most of the maintenance staff (engineers, technicians and workers) in both case studies as it was distributed to all of them; this feed back was used to supplement and support the findings of interviews and to triangulate the collected data. To reduce the problems that accompany the interview protocol, such as "bias, poor recall, and poor inaccurate articulation", based on Yin, (1994), the researcher strengthened (triangulated) the information from each interview with that from other sources (questionnaire and archives/documents).

To ease, the understanding of questions, making respondents more comfortable and familiar the researcher provided question forms to the interviewees in advance, this provision allowed the interviewed people to make comments about the questions before conducting the interview. This provision should also promote validity and reliability by enabling the interviewee to consider the information being requested and allowing them

the opportunity to assemble supporting organisational documentation from their files. Saunders, et al. (2000, p. 252) said "credibility may also be promoted through the supply of relevant information to participants before the interview". The researcher also was given a good chance to explain the questionnaires' questions to most of the maintenance staff.

The researcher took notes during each interview, so that as far as possible vital points were not missed, and copies of any documentary evidence which seemed relevant were usually obtained at the same time. Each interview was later converted into some forms of written record, usually on the same day. This discipline is supported by many researchers such as Stake, (1995) and Yin, (1994). Despite its importance, a tape recorder was not used because most of the respondents did not like recording of their interviews. It may be due to the cultural and political considerations. In this case, as far as reasonable, copious notes were taken during the interview itself. In addition, interviewees were very generous as they gave the researcher sufficient time for the interview; furthermore they gave him a chance to come back at any time to enquire about their answers or about any other information. This gave the researcher confidence in the accuracy of the interview process and increased the reliability of the research process. Although it is difficult to evaluate the honesty and accuracy of the responses of interviewees, the overall impression gained was that the respondents were generally intelligent, friendly, open, and gave generously of their time and cooperation, and most seemed interested in the research. It may be interesting to note that the reception and assistance given by some managers were beyond expectation. Some of key managers in both organisations spent many hours with the researcher explaining the main aspects of their operation. Some managers also offered the researcher extra informal meetings out of the companies.

Many authors have written about the analysis of data in research context, for example, Saunders, et al. (2000), mentioned that, there is not a standardised approach to the analysis of qualitative data, phenomenologists, for instance, resist categorising or coding their data, preferring to work from the transcripts of interviews. Saunders, et al. (2000), indicated, using the transcripts or notes of qualitative interviews or observations by thoroughly reading and re-reading them is one approach to analysing this type of data, the approach adopted in this study involves classing the mass of qualitative data collected into meaningful and related categories. This allows the researcher to rearrange

and analyse the data systematically and rigorously (Saunders, et al. 2000). Flick (2003, p. 176), says "we can distinguish two basic strategies in handling texts: on the one hand the coding of the material with the aim of categorising and/or theory development; and on the other the more or less strictly sequential analysis of the text aiming at reconstructing the structure of the text of the case". Yin (2003) advocated that, the overall goal in data analysis is to treat the evidence fairly, produce compelling analytic conclusions and rule out alternative interpretations. Yin (2003, p. 109) states "data analysis consists of examining, categorising, tabulating, or otherwise recombining the evidence to address the initial propositions of a study"

Therefore, regarding the above discussions, and what Collis and Hussey (2003, p. 264) state, the responses were analysed and then categorised into distinct groupings. Keeping the aim and objectives of this study at the front of the mind, the researcher converted the interviews' responses into some form of written record, after that the data collected were grouped into categories according to patterns or themes which emerge. Then the researcher wrote summarises of his findings and used them to construct generalisations with which he can confront existing theories and intended theories. It was not necessary to produce word-for-word transcriptions of the interviews as the data analysis techniques selected did not require this. The researcher was satisfied that the generalisations arising from data collected were sufficiently robust to stand the analysis of existing theories.

Data from the questionnaire were coded and frequency counts were calculated and then converted into percentages and tables (see appendix 4). In order to provide some context for the phenomenon under study, the researcher collected background information from the case study organisations. The most important use of documents in case study according to Yin (2003), is to support and augment evidence from other resources, thus, some documents available in both case studies were used such as: letters, memoranda, agendas and minutes of meetings, reports, project plans, progress reports, strategic or business plans, improvement planning, action and review documents, etc.

3.13 Chapter summary

Regarding the research question, aim and objectives outlined in chapter 1.3, and as described in previous sections for using the case study method, the research design is broadly analogous to an approach that is advocated by the view of some authors such

as, Yin (1994), Bryman (1995), Ghauri et al. (1995) and Easterby-Smith, et al. (2002). The research design also takes into consideration the time scale limited to a PhD study. Although this method is considered a qualitative approach to organisational research, the essentials of this research process resemble a scientific approach to the conduct of research and are appropriate for organisational study. Thus, this provides the framework for a systematic approach and the methodology adopted in the research design is shown in figure 3.2

In this chapter, thorough discussion about the research methodology; philosophy, approach 'qualitative & quantitative' and critique and justification of the research approach adopted have been carried out. A critique and justification of the case study research design adopted; single or multiple cases, research technique 'data collection and sources of data' were discussed. Finally, the researcher discussed the generation of questions used in both interview and questionnaire when conducting the pilot and real case studies. In the next chapter the case study organisations, in context of Libyan environment 'economic, social and political' will be discussed.

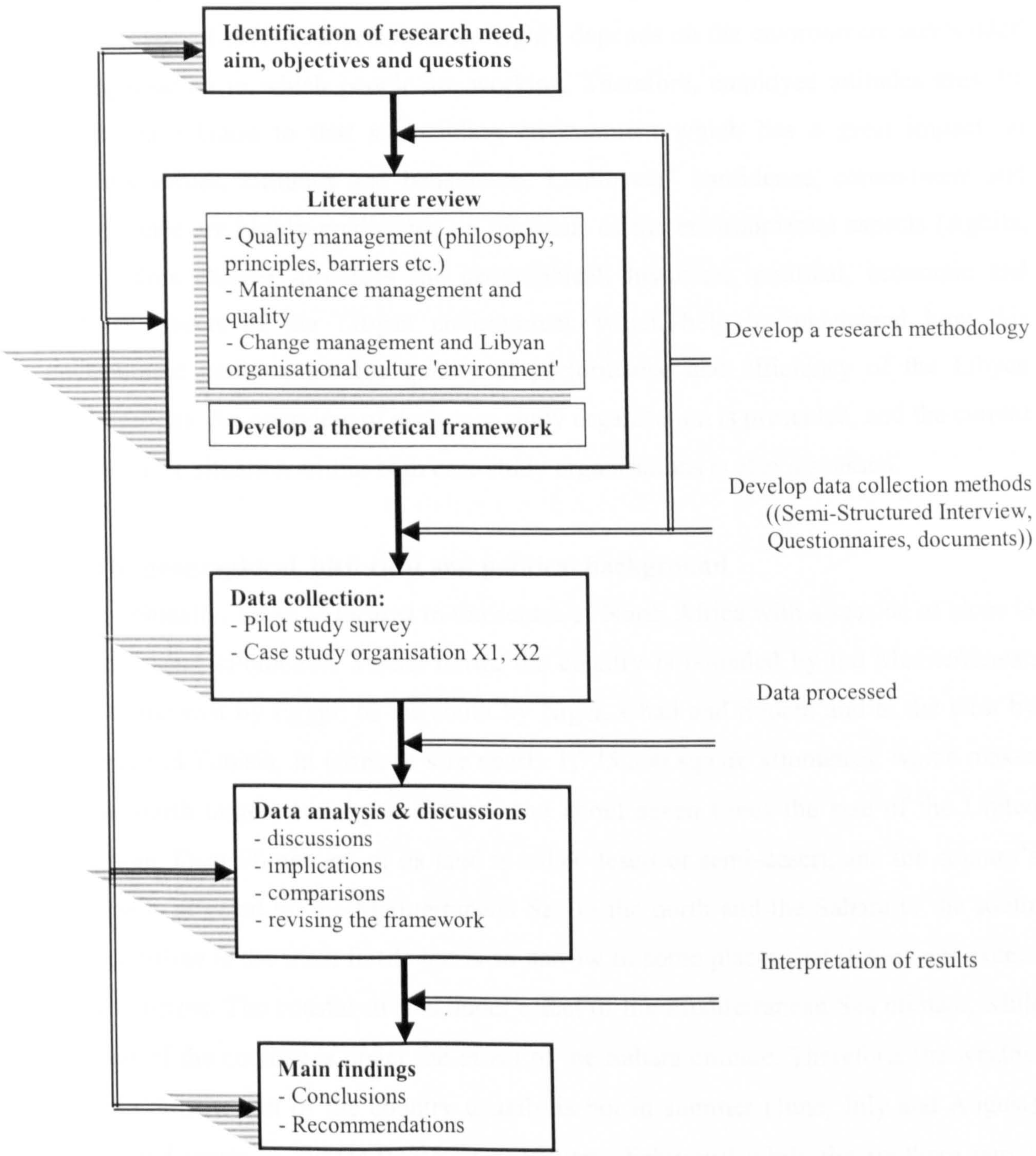


Figure 3.2 Research design

CHAPTER 4 LIBYAN ENVIRONMENT AND THE CASE STUDY ORGANISATIONS

4.0 Introduction

As the environment naturally signifies the current situations and circumstances under which people carry out their activities, understanding of an organisation's climate such as employee attitudes and performance highly depends on the environment surrounded an organisation in which people are working. Therefore, employee attitudes must be studied in relation to that surrounding environment which has a great impact on people's values, attitudes and behaviours. Employees' confidence, commitment and performance are highly predictable on the basis of the environmental aspects (Aghila, 2000). This chapter discusses the geographical, historical, political, economic and cultural aspects of the Libyan environment, which help to understand how this environment could affect the quality of performance and efficiency of the Libyan organisations. An overview of each case study organisation is presented, and the current maintenance situation within both case study organisations is also discussed.

4.1 The geographical, historical and political background

Geographically, Libya is located in the centre of North Africa with a seaside of close to two thousand kilometres. To the north, the country is bounded by the Mediterranean Sea; to the east by Egypt; to the south by Niger, Chad and Sudan; and to the west by Algeria and Tunisia. In terms of size nearly 1,775,500 square kilometres, which makes it the fourth largest country in Africa, and about seven times the size of the United Kingdom. Over 90 percent of its land is either desert or semi-desert, and the country's climate is affected by the Mediterranean Sea to the north and the Sahara to the south. The coastline is the most fertile but is so narrow in some places that it does not exceed 50 kilometres. The coastal strip is under effect of the Mediterranean Sea climate, while the rest of the country is under the effect of the Sahara climate. Therefore, the weather in the northern part of the country usually is hot in summer (June, July and August), rainy, and warm in winter (December, January, February) while the southern part is very hot and dry in summer and cold and dry in winter (NAID, 2002).

According to the Human Development Report (2000), Libya's population is approximately 5 million, and urban population grew on average by 4.2 per cent annually. Health care and education have improved under the impact of oil wealth. Throughout history, several nations, political systems and leaders have left their mark

on the country and its history. The Phoenicians arrived from the shores of Lebanon and built a few coastal trading centres, with three of them, the western shores, eventually becoming the major cities of Tripoli, Leptis Magna and Sabrata. The Greeks settled on the eastern shores, where they developed an elaborate system of irrigation, which helped develop agriculture, and built five major cities including Benghazi and Cerene. Most of these became thriving trade and cultural centres, and their ruins still bear testament to their previous glory. Next came the Romans. They ruled Libya until their empire finally declined and the Byzantines took over from the 5th century AD to the 7th century AD, at which time Libya became part of the Arab Islamic Empire. Libya has stayed true to her Arabic Islamic identity, despite several attempts from Christian Europe to change this, namely, the Spanish and the Knights of St John from Malta who ruled the north western shores for half a century during the 16th century, and the Italians who invaded the country in the early years of the 20th century (NAID, 2002).

Libya was granted independence by a UN resolution. Independence was proclaimed on 24 December 1951 and it became a kingdom following the British model. On September 1, 1969, Libya was transformed to a republic regime. The country underwent a number of far-reaching social, political and economic changes, the most important being the declaration of the Libyan "JAMAHIRIYA" in March 1977(NAID, 2002). The Jamahiriya according to the green book by Gaddafi (1981), is a state of the masses involving the transfer of both legislative and executive powers, to the people. Libya was divided into several small communities, each with its own legislative group called (Basic People's Congress) and an executive team called (People's committee). The basic congresses and at the later stage the people's congress at the municipal level, were expected to debate issues ranging from the maintenance of local roads to international issues such as the reconstruction of the UN. The various issues debated at both these levels were later grouped together in the melting pot of the General People's Congress, where they became national policy.

Throughout its history, Libya played an essential role in international relations, especially in relation to countries with shores on the Mediterranean Sea, which through out the history has been the cradle of various civilizations. The country was invaded by almost every major international power. Each has attempted to include Libya within its boundary. Libya has always played a major and important role in world trade, especially between central Africa and Europe. The process of modernising the society has its roots

in different time periods. It is possible to trace the early roots of modernisation in Libya to the second half of the 19th century, when Libya was under the rule of the Ottoman Empire. The country experienced for the first time, modern schools, hospitals, municipal facilities, a publishing house, newspapers and a number of new regulations. However, the major cultural change came when Italy invaded the country during the 1920s. This change was many-sided: Libyan saw modern war equipment for the first time and this was their first contact with modern forms of technology (Attir, 1995).

4.2 Libyan society: social and cultural aspects

Islam is the religion of Libya and Arabic is its official language. Libya differs from many other Arab countries that have more than one religion and more than one rite. All Libyans are Sunni Muslims and are fundamentally attached to their Islamic faith. Religion permeates all sides of Libyans' life. Like any Arabic culture, Libyans are known for their hospitality, sociability, adaptability and flexibility. They communicate easily and pay much attention to communication and verbal agreement. The family is of great importance to the individual. The importance of belonging to a social group is reflected in all sides of social and professional life. Libya's work culture is different from the western world. Because of the Libyans' propensity to act within groups, business does depend on friendship, and indeed is geared at generating new friends' relations among people. In such an environment, trust and reliability are important factors. Because of the traditional unity of the family and of groups, Libyans are equipped with a high degree of social competence and the ability to think collectively. This makes the establishment of teamwork in firms and the public administration easier. Findings of a study carried out by Aghila (2000, p. 43) revealed that members of Libyan organisations seek tight social relationships; he says "this type of organisational culture has been carried through the society in which there are tight relationships of individuals in the family and tribe and these relationships are reflected in the organisations".

Traditional Libyan society consists of families, clans and tribes, the family is extended, consisting of a man and his wife, their unmarried children, married sons with their wives and children, sometimes three or four generations can be included in one huge house. However, in modern Libya the situation has begun to change, each family has its own separate house and can move to another city regarding the work place or for any other reasons. In addition to the social Libyan structure (family, clans and tribes), the religious factor is very important. Islam as a religion of Libyan people has been played a

very significant role affects the values and attitudes of Libyans. Furthermore, as Bait-Elmal (2000, p. 31) mentioned, "Islam for the Libyan people, is a code that directs social relations from the home to the marketplace to the workplace. It is a philosophy that people in Libya live every day". Therefore, the religious institution has had an intense effect on Libyan society throughout its history.

Women in modern Libya enjoy an important social status. Fifty years ago, women were confined to their homes. Basic women's rights were provided for in the constitution and the laws of the newly independent state. Thus, women were granted equal rights to men in terms of education, equal pay for similar jobs, and equal rights to engage in different activities. This does not mean that all such rights are exercised in real life. Many traditional customs are still stronger than the law. The government made the emancipation of women among its topmost priorities, and a plan was developed to fulfil such a priority. The first step was to implement the Law of Compulsory Education, which made it compulsory for all children, male and female, to attend nine years of schooling. The next step was to facilitate the entry of women into the job market, allowing them to work next to males, and to open all fields of work to women, including the police force and the army with all its specialisations (Attir, 1985).

The individuals in Libyan society identify themselves strongly with their family and tribe and consider themselves to be members of a group whose importance outweighs their own. The family has educational, economic, and security functions or roles-providing organisation for its member. In return, the individual has to obey, respect, and preserve the rules and traditions of those social units. From the total of families, a clan is formed and then from the total of clans the tribe is formed. In Libya, as in most Arab societies, loyalties are usually based on family and region, as well as on tribal groupings. None of the political changes in the country; from Italian to the kingdom to the Jamahiriya could change the strong relationships between the individuals in Libyan society with their families and tribes.

4.2.1 The cultural transferability

Because of the importance of the culture differences effect on management issues, various comparative cross-cultural studies aimed to develop a general theory of organisations, which would avoid cultural particularities. Aghila, (2000) refers that the direct transfer of Western theory to developing countries like Libya, without

understanding cultural differences, may face difficulties in implications of the organisational and managerial practices in these countries. Hence, the differences in cultures between nations and particularly between developed and developing countries should be recognised furthermore understood due to the effect of globalised economies in the world. Consequently, to avoid problems might be occurred in organisations during transferring management techniques and ideas such as quality management systems from a country to another, consideration of cultural conditions should be highly appreciated and taken. Therefore, developing countries should not directly transfer ideas from capitalist, free economy and individualist societies to traditional, socialist and collectivist societies such as Libya, as they need to orient their own models.

With regards to economic activities, Islam permits trade; encourages thrift, competition, induces hard work and supports innovation however it prohibits usury. The Quran and the prophetic prescriptions contained in the deeds and practices of the prophet Mohammed as guides in business conducts and social affairs. Aghila, (2000, p. 47) says, "Islam has provided a set of general guidelines that could be applied to management. These guidelines can be easily detected in the Quran and the prophetic prescriptions like consultation, which is an important Islamic principle governing the administration and management of public interests". Honesty also is a principle that Islam urges Muslims to carry out tasks that are entrusted to them efficiently and completely. Islam tempts for a good supervision, manager, leader must think of himself as an ideal model, he/she should be gung ho, pragmatic and the first to take up responsibilities. To complete a description of the Libyan environment, a brief review of the economic situation in Libya will be useful. This will be the subject of the next section.

4.3 Libyan economy

Having outlined the geographical, historical, political and social aspects of Libya, it is useful to review the economic situation in the country since 1951 (year of independence) to the beginning of the 2000s. The development of modern societies in the developing countries (Third World) is due to an increase in the scope of government activity. Libya is no exception. Therefore, the Libyan government made the search for economic as resources its major priority.

According to the International Monetary Fund IMF (2003), the Libyan economy depends heavily on the oil sector and remains largely state controlled and regulated. The authorities initiated in 2002 steps to liberalise the economy. On January 1, 2002, the dual exchange rate system was unified at a fixed rate of one Libyan Dinar (LD) equal to 0.608 American dollar ($) and the foreign exchange rationing and import licensing requirements were eliminated. Economic developments in 2002 were impacted by these developments and by the accommodating fiscal and credit policies, in an environment of continuing high oil prices. Real non-oil Gross Domestic Product (GDP) grew by about 3 percent and deflation continued with a 9.8 percent decline in the Consumer Price Index (CPI). The external current account shifted to a deficit for the first time since 1998, and gross official reserves decreased slightly to about US$13.7 billion (18.7 months of imports).

The fiscal stance remained expansionary in 2002, with the non-oil overall fiscal deficit widening to 32 percent in 2002 from about 29 percent of GDP in 2001. Expenditure growth in 2002 was driven by budgeted capital expenditure growth of 3.2 percent of GDP, mainly on development projects in communications, construction, health, housing, and education. On the revenue side, oil revenue in Libyan Dinar terms was boosted by the large devaluation of the official exchange rate at the beginning of 2002. However, tax revenue decreased and customs revenue stagnated despite a surge in imports, mainly as a result of widespread exemptions granted to public enterprises. The overall consolidated budget position registered a surplus of 4 percent of GDP. Table 4.1 shows the basic economic and financial indicators during the period 1999-2003 in Libya. The Real GDP has changed by percentage of (– 0.2 to + 5.6), and the Real non-oil GDP changed by 2.5% to 3.1%, meanwhile the CPI changed by rate of -9.8% to 2.8%. Also the financial variables in percent of GDP were fluctuated in both the overall government position and the non-hydrocarbon balance.

There was some progress in the banking sector reform agenda with a number of measures adopted to strengthen banking supervision. Two new private commercial banks and one private regional bank were licensed in 2002 and preparations are under way for the privatisation of a public bank. Another commercial bank is being considered for privatisation. A committee to examine the restructuring of banks was established in 2002. In June 2003, Libya accepted its obligations under Article VIII of the IMF's Articles of Agreement (IMF, 2003). According to the IMF, the key challenge

facing the Libyan authorities in the medium and long term is to achieve sustainable high rates of economic growth to generate employment opportunities for a rapidly growing labour force. The authorities agreed that this goal would not be achievable without a drastic reduction in the dominant role of the public sector.

	1999	2000	2001	2002	2003
National income and prices	(Percentage change)				
Real GDP	0.7	2.3	0.5	-0.2	5.6
Real non-oil GDP	2.6	3.1	2.5	2.9	2.7
CPI	2.6	-2.9	-8.8	-9.8	2.8
External sector	(In billions of U.S. dollars; unless otherwise indicated)				
Exports, f.o.b.	7.2	12.1	9.0	8.3	9.6
Of which: hydrocarbons	6.7	11.6	8.5	8.1	9.4
Imports, f.o.b.	4.7	4.1	5.3	7.4	6.3
Current account balance	1.6	7.0	2.4	-0.2	1.6
(In percent of GDP)	5.4	20.5	8.6	-1.2	7.6
Overall balance (deficit -)	0.4	5.8	1.0	0.2	1.5
Financial variables	(In percent of GDP)				
Overall government position (deficit -)	5.5	9.5	-0.3	3.9	11.8
Nonhydrocarbon balance (deficit -)	-11.9	-17.7	-29.3	-31.8	-27.4
	(Changes as a percent of beginning broad money stock)				
Money and quasi-money	5.8	1.9	20.5	5.3	…
Net credit to the government	-7.3	-29.7	-1.9	-10.7	…
Deposit rate (1-year deposits, in percent)	5.5	5.5	5.5	5.5	…

Table 4.1 Libya: Basic Economic and Financial Indicators, 1999-2003 Source: IMF Report, Libya-2003

There is a close relationship between the quantity and quality of economic actors and the chance for success in international economic cooperation. Libya's educational system has been upgraded by means of a broad expansion of school and university education, as well as the creation of other institutes. Moreover, this large educational campaign includes sending many Libyan students and postgraduates abroad. The aim is

to increase the number of highly qualified professionals in all sectors. According to the General Secretariat for Education and Scientific Research GSESR, (1999), in comparison to the rest of North Africa, Libya has the highest number of academically trained and highly qualified citizens. Many Libyans have completed study programmes at well-known foreign universities across the world. They are well educated, but not sufficiently well trained, in particular with regard to management and leadership techniques.

The events including US government sanctions, EU sanctions and in a series of Security Council resolutions, UN sanctions have negatively affected in the country economy. The main impact was felt in defence goods, civil aviation and the expansion and development of Libyan oil and gas field. Libyans wishing to travel abroad-for example, for medical treatment or to make a pilgrimage to the holy Land (Mecca) had to go by land or sea. This also acted as a serious discouragement to foreign businessmen who wished to visit Libya. However, since the UN sanctions were lifted in 1999, the government of Libya has tried to make the country attractive to foreign investors.

4.3.1 Oil as a base line of Libyan economy

Exploitation of major oil and gas reserves has formed the backbone of the Libyan economy for the last 40 years. This has led to significant underdevelopment in other sectors of the economy. Oil was discovered in large quantities, and since 1960, the petroleum industry has increasingly dominated the whole economy. The development of the oil industry was remarkable, both in terms of its rapidity and its proliferation. In about 40 years since oil was discovered, Libya has made very considerable progress, developing from one of the poorest countries in the world into one whose physical and human infrastructure compares favourably with that of its neighbours. The Libyan economy is dominated by the hydrocarbon sector, which now accounts for one-third of national output and generates more than 95% per cent of total foreign earnings. However, this sector provides employment for only about 2% of the country's workforce of some 1.2 million (Bait-Elmal, 2000).

According to the IMF report, the Libyan economy still depends heavily on the oil sector and remains largely state controlled and regulated. An exceptional combination of circumstances contributed to the development of the petroleum sector. Lack of investment outside the hydrocarbons sector was further undermined by years of UN

sanctions (1992-1999), which led to periodic shortages of basic goods and food inside the country (IMF, 2003).

4.3.2 Economy and industrial sector

Before the discovery of oil, the Libyan economy was basically dependant on agriculture and pasturage. Associated with oil discoveries some factories were established. The industry was controlled by the private sector until the last quarter of the 1970s, when public sector firms replaced this. The transformation from the private sector to the public sector was carried in accordance with a new socialist economic perspective in Libya. The industrial sector was established to reduce the country's dependence on the crude oil exports.

The government pressed ahead in building industrial bases such as those which processed crude oil and natural gas for petrochemicals and related industries. The non-oil industries also received considerable attention. The non-oil industrial sector consists of light and heavy industries. Light industry comprises: food, light chemical, engineering and minerals, textile, furniture and paper products industries. State gave priority to heavy industries in the budgets of the various development plans (1970-1990). For example, the total allocations to the heavy industries were about 2043 million LDs, (Secretariat of Industry and Minerals, 1995). This allocation reflects the insisted desire of the country to develop this sector so that it may achieve the aims of developing the national economy and replacing the oil sector in the future. Examples of heavy industries are: the iron and steel complex, chemical industries, trucks and buses, tractors and trailers, etc.

The industrial sector forms an important part of the Libyan economy by creating capital investment, creating new jobs, freeing the economy from dependence on oil, contributing to the gross national income and providing a better life for existing and future generations, as well as creating an educated and resourceful workforce. Consequently, the industrial sector contributed to the Libyan GDP by 3800 million LDs on the period of 1970-2000, and the total number of workforce at the year 2000 was 124900 people (General Secretariat of the production's affairs, 2002). The UN and USA sanctions and reduction of oil prices and other problems forced the industrial sector to perform below their designed capacities, that action reflected on the output values of industrial sector, for example, the output value in 1992 was 86.324 million LDs,

1141.614 million LDs in 1993 and declined to 952.122 million LDs in 1994 (Secretariat of Industry and Minerals, 1997).

Aghila, (2000) mentioned that other problems have appeared in recent years in the Libyan economy such as mismanagement, centralisation, lack of cooperation among sectors and a poor pay system. The contribution of the non-oil sectors in the GDP has remained low or limited, despite the effort to build valuable projects to develop the economy and to take the place of oil in the future. The low performance of the industrial sector could be returned to the absence of positive management, especially in the areas of planning, organising, controlling and marketing. Moreover, the Secretariat of Industry and minerals reports for example, indicate other internal factors such as frequent machinery breakdowns and underestimated levels of maintenance. Shortages and delays in receiving raw materials (except oil), semi-finished goods and spare parts, shortage of water supplies, inadequate operating and maintaining systems, shortage of skilled and trained personnel (The Secretariat Annual Report, 1997-2002). These circumstances consequently adversely affect the performance of Libyan employees as well as their organisations and the overall economy.

4.4 Administrative system in manufacturing sector in Libya

According to Willmott, (1996), the design and operation of systems of accountability tend to reflect and reproduce the relations of power in which they are embedded. In Libya, as a developing country, manufacturing public sector is highly centralised as instruments of public policy, as it is meant to achieve certain social and economic objectives. Thus, social obligations are explicit objectives for the Libyan public organisations, which were established by the state for the fulfilment of social and economic objectives. This is advocated by some authors such as Achary (1996) who mentioned that, societal context is very often significant in the prioritising of particular development projects, and the way accountability practices are exercised.

As a part of national development, planning and public policy, the society through the governmental bodies, should call the organisations to account and have the right to be fully informed about them and to scrutinise and criticise their performance. Consequently, there are many governmental bodies that have been given the right to influence policy and ask for specific information from organisations. Governmental bodies such as the Ministry of Industry, Ministry of Finance, Ministry of Control,

Ministry of Economy and Libyan Central Bank have been given mandates by the General People's Congress (Parliament- the highest authority in the country) to manage and control operations in all public organisations.

4.5 Case study organisations

In this section, the researcher would like to shed light on the two chosen organisations in the context of Libyan environment; structure of Public accountability and administrative system in manufacturing public organisations in Libya (both cases from the Libyan manufacturing sector). As was discussed above, the absence of positive management, especially in the areas of planning, frequent machinery breakdowns and underestimated levels of maintenance are the important factors affecting the efficiency of Libyan organisations.

4.5.1 The organisation management

Regarding the political system in the Libyan state which is discussed early in this chapter, most Libyan manufacturing organisations are managed by people's committees consisting of five to seven members appointed by the government. One of the members is chosen as the General Secretary (Director General or Managing Director) of the committee. Specific or academic qualifications are not important for anyone to serve as a member of that committee. The government through the Ministry of Industry has the right to remove and dismiss the whole committee or any one of its members without giving any reason for such removal or dismissal (Bait-Elmal, 2000). As a result, the organisational structure of both cases has been modified many times through the history of each one. In case X2 that consists of six plants (factories), the management committee and the top manager appoint the plant managers. The top manager and his committee have the right to remove or dismiss any one of them without giving any reason. In both cases, X1 and X2 the heads of departments are appointed by a decision from the top manager, but the heads of divisions/units are appointed according to suggestions from the heads of departments. However, the top managers have the right to suggest any one, or change any one in the divisions and units.

4.5.2 An overview of the organisation X1

Case study organisation X1 was established in 1987. It is located in the eastern suburb of Tripoli, the capital of Libya. The main activity of this organisation is producing several kinds of electronic/electric materials. At the beginning, all products are provided

to the local markets, no possibility to export the products out of the country due to the main reason, the demand was greater than the supply. However, when the country has opened the doors to international markets, the organisation then started thinking to sell its products to more than local markets. This change has pushed it to seek the level of quality to make the organisation has the ability of competitiveness. International markets take into consideration standard requirements for the quality products. Therefore, such an organisation strives to get the stable situation in the markets, and it adapted the ISO 9000 system. At 1999, this organisation was certified to ISO 9000 version 1994 and then transferred to the 2000 version, which made it the first Libyan organisation that was certified to ISO 9000 system. From that time, it was considered as a leading company in quality. The total number of employees in the organisation X1 is 566 people, including engineers, technicians, tradesmen, and others. About 40 persons are working in the maintenance department.

The procedures of maintenance in this organisation rely on two common maintenance (types) systems; corrective maintenance and preventive maintenance. Corrective (emergency) maintenance is the maintenance operations that are carried out when breakdowns occur in such plant, machines or/and instruments. Preventive (planned) maintenance is the maintenance operations that are carried out periodically at specific intervals (weekly, monthly, yearly, etc.). The maintenance department of organisation X1 consists of two main units; mechanical and electrical maintenance unit. For the organisational structure of case study organisation X1 see appendix 3.1.

4.5.3 An overview of the organisation X2

Case study organisation X2 is located on the seacoast west of Tripoli. This organisation was opened on 30 of August 1980. It is one of biggest industrial complexes in Libya (1450 employees, with nearly 130 maintenance staff). It produces, in addition to petrochemical materials, some other chemical materials. Part of their production is sold locally, and the other part is exported to neighbouring countries like Tunisia and Egypt. This organisation consists of six plants:

- Salt Plant (Sodium Chloride); to produce the salt in which part of it is used for making table salt and the rest is delivered to the electrolysis plants for chloride and caustic soda production
- Polyvinyl Chloride Plant (PVC); this plant produces six types of PVC powder: (S80- S70- S68- S65- S60- S58). The plant's production is used in

manufacturing electric appliances, means of transportation, furniture synthetic floor carpet, office and engineering equipment, and household utensils as well as in the other industrial products.

- Electrolysis Plant; the wet salt from the plant is utilized as raw material in electrolysis plant to produce caustic soda solid – flakes – liquid and chloride, Sodium hypochlorite and Hydrochloric acid of 30% concentration.
- Vinyl Chloride Monomer (VCM) Plant; in this plant, the chlorine produced by the Electrolysis plant reacts with the ethylene gas where the former is thermally cracked into vinyl chloride which is distilled and refined. Later, it is stored in spherical tanks ready to be transferred to the vinyl chloride plant.
- Polyvinyl Chloride Plant (PVC) Granulating Plant; in this one the PVC powder is granulated to be used in the manufacturing bottles, rigid pipes, irrigation pipes, footwear, solid panels, doors, windows etc.
- Gases' Plants; the organisation includes plants for producing industrial and medical gases. These produce the following gases: oxygen, nitrogen, argon, nitrous oxide and acetylene. In addition, there is a unit to produce welding electrodes.

Organisation X2 was certified to ISO 9000 in 2002. The maintenance work has been carried centrally except some light activities which have been done by a few tradesmen attached to each plant. The organisation case study X2 is relying on two main maintenance procedures: corrective maintenance and planned (preventive) maintenance. Planned maintenance is scheduled monthly and yearly in addition to overhaul maintenance for plants. The maintenance department in this organisation was divided into four main divisions: mechanical, electrical, welding, and civil maintenance, which can be seen clearly in appendix 3.2.

4.6 Discussion of the current maintenance situation within CSOs

So far, the maintenance approaches adopted by case X1 and X2 are mainly planned and reactive maintenance that incorporate planned preventive maintenance and breakdown services. Therefore, at the moment, planned preventive maintenance and breakdown services are the main methods of maintenance for both CSOs. However, according to top managers and the heads of maintenance departments at both CSOs, the goal is to move away from high levels of reactive maintenance of assets and implement planned maintenance regimes, which will result in process reliability and performance to

business needs. The maintenance departments in these organsations aim to achieve a high percent of preventive maintenance with zero backlogs on reactive work.

In case X1 the maintenance philosophy adopted is mainly that preventive maintenance and breakdowns. The resulting workload is managed and prioritised on a very informal basis. Some managers pointed out that accountability of maintenance strategy was not clear at works level; there was no formal betterment policy with improvement targets. Some job history data were logged but mean time between failures and cost of failure are not determined. The real cost of maintenance and how it is related to type of job, type of asset or cause is unknown. Nevertheless, this "lack of planning" does not mean that shop floor activities are unorganised but is more of a problem of "lack of documentation" of what is going on. Most of the maintenance activities are "planned" in the mind by the maintenance supervisors and craftsmen, based on years of site experience. Some maintenance staff see themselves as a highly committed and qualified team and they expressed that commitment to improving plant by strong criticism of the inadequacy of the current maintenance approach. According to the internal documents and reports, there was some accumulated work to be done in maintenance area and some other problems as well. The assets were reasonably maintained by criteria of continue production, but still there was scope to get better in cost reduction and improvement.

The maintenance techniques of case X2 represent a mixture of breakdown services, planned preventive maintenance and condition monitoring practice in a somewhat fragmented manner. Historically, the maintenance system has been predominantly preventive maintenance plus a large quantity of breakdown services due to continuous production and the ageing profile of the equipment. The reason for this may be shortage of qualified staff and the perceived lower cost of breakdown maintenance compared with preventive maintenance, most of the interviewees indicated that the maintenance techniques used at work were mostly, or often, breakdown maintenance, while some others felt that preventive maintenance was carried out.

According to the maintenance managers, more than 75% of the maintenance staff's time was spent on breakdowns. Condition-monitoring techniques are only used on the critical equipment for which there is no standby system and which they cannot afford to lose. A manual system is used to record, daily, all maintenance activities by the supervisors.

Although most of the maintenance staff interviewed considered that the maintenance function was managed as effectively as it could be only a small minority of maintenance surveyors thought that the maintenance techniques currently used by the organisation were appropriate. The reason is mainly the lack of designed time for maintenance activities, as the presses are being used most of the time for production work. As a result maintenance work has to be fitted in between gaps of production activities, quite often one hour here and one hour there.

The pitfall of the current maintenance system is well recognised by case X2, but limited work has been done to reverse the situation. As a result of this mode of operation, the maintenance staff tends to work in a fire-fighting style to tackle breakdowns, and they are very experienced in doing so. What is lacking in the maintenance system is to develop a far more rigorous maintenance strategy to look into improving the long-term reliability of the equipment by reducing the level of breakdowns in the first place. The challenge for the senior management team is to move away from a mainly breakdown oriented maintenance regime to one with a greater emphasis on predictive and preventive methods. This of course, represents a marked cultural shift and significant change process.

4.7 Summary

The objective of this overview of Libyan environment has been to understand the surrounding environment of case study organisations, because environmental aspects are found to influence organisation efficiency and people's attitudes and employees' satisfaction, commitment and performance are most highly to be predictable on the basis of these environmental aspects (Aghila, 2000). Furthermore, it is to be considered as a background for later discussions in subsequent chapters. This chapter has discussed major aspects of Libyan environment in relation to: geographical, historical and political background; population and the workforce; cultural and economic aspects.

This chapter also focused on Libyan culture where the Libyan society still consists of extended families and tribes, where a strong social hierarchical structure prevails strong ties and very closes relationships. The Libyan families and tribes are influenced by Islamic rules in relation to the regulation of life. Arabic culture and Islamic rules are the most dominant elements to individual and group behaviour, social values, beliefs,

attitudes, state laws, political system and economy. Libyan economy can be considered as one of the important factors in shaping people's attitudes and behaviour.

Despite the efforts towards the diversification of the Libyan economy, the oil sector still represents the main contributor to this economy. Nevertheless, the government has spent so much on the industrial sector, as well as on other sectors unfortunately the performance of the economy has been low as a result of various problems which the Libyan public sector faced. It can be said that economic systems in Libya have been influenced by changes in ideology, the socialist ideology that has been adopted from the Green Book.

The existence of external political and administrative mechanisms for implementing plans can be expected to affect the process and structure of decision-making in Libyan public organisations. This makes the organisations part of governmental machinery, which increases the likelihood of exposure to rules and procedures, and results in them becoming more structured and centralised. The evidence (internal documents and archives) shows that neither of the two organisations has adopted the third generation of the maintenance philosophy (a philosophy based on reliability and availability issues such as TQM, TPM, CBM and RCM) in its true sense yet, preventive maintenance (PM) appears to be the major technique deployed, although a large proportion of the maintenance activities are breakdowns.

In the following chapter, the research findings (related to the barriers affecting quality in maintenance) from the two case study organisations will be highlighted and presented in the relation of the Libyan environment context.

CHAPTER 5 RESEARCH FINDINGS

5.0 Introduction

Semi-structured interviews were the main source of data for this study in addition to the questionnaires, documents such as minutes of meetings, newsletters and reports were also used to substantiate the interviews. The findings will be presented in relation to the aim and objectives of research to answer the research question as set forth in chapter 1. Appendix 2.1 shows the list of questions used as a guide in the interviews (interview protocol) and appendix 2.2 shows the questionnaire's form. The main part of this chapter presents the interviews results, followed by the questionnaire and documents results, which used mainly to supplement and triangulate the data of the in-depth interview. Finally, the possible novel contribution to knowledge from these CSOs' findings is presented in section 5.4.

5.1 Interview results

The interviews were conducted during the period of August to November 2003. The time allocated for each interview fluctuated from case to case, and in general, the average time was about one hour and a half. In order to present the data from interviews, the following terminology is used in this study: Case Study Organisation (CSO), Quality Management System (QMS), Top Management (TM), Maintenance Department (MD), Production Department (PD) and Middle Managers- managers from both MD and PD (MM). The researcher used Interview Protocol as the researcher instrument (Appendix 2.1). The responses of all interviewees in CSOX1 and CSOX2 are analysed and presented in the sections 5.1.1 to 5.1.9.

Thus, as has been described in chapter 3, the total interviewees in each case study organisations X1 and X2 were 19 and 30 respectively, the interviews were conducted with all the targeted respondents. The respondents were targeted in order to represent three levels: top management, maintenance department and production department. (This approach was justified in section 3.11.2).

5.1.1 Understanding quality management systems and benefits

The researcher believes that understanding and knowing any issues first, is the main key of how to deal with it after, thus to gain an understanding of quality management systems and benefits from all CSO employees, the researcher used an open question:

what is the importance of understanding QMS? As it regards; "understanding quality management systems and benefits from the managers' point of view" respondents revealed that some educational/training programs were delivered to managers, though the scope, was quite limited. TM in both CSOs do not get involved strongly in such programs, they were very busy and thinking that it is enough to encourage the middle managers. Consequently, TM thought that there was no insisted need to attend and participate in education/training programs related to quality management, as these programs should be concerned by quality members who are working in the quality office or a department. It was found that managers at different levels in both CSOs have had just a general understanding of QMS. This limited understanding leads to unawareness of quality and to the lack of recognition of its benefits too.

To investigate the level of QMS understanding, the interviewees were asked what major difference has QMS brought to the organisations as compared to prior state with a particular reference to the maintenance department. Only two respondents out of 19 from CSOX1 and three respondents out of 30 from CSOX2 did not see any difference, they believe that work was running by the same as before! However, most of the respondents at both cases have mentioned that quality management (ISO 9000) has made the staff more disciplined and more consistent. Quality management provides the staff with a clear understanding of their work and allows them to review what they were doing in which that quality management processes open the door to conduct self-monitoring from the staff. Quality management in general, was believed from most mangers to be a very useful way to improve all business activities because of its integrated organisational system.

To explore further into the extent of managers' views on QMS benefits, respondents were asked whether CSOX1 and CSOX2 have achieved a better performance after the certification to ISO 9000, most of the respondents from both organisations have agreed that the effect was positive, they indicated to such improvement in the organisations' performance happened in general. For instance, the employees' performance became more disciplinal and quite better than before.

It was revealed that the level of managers' awareness and understanding of quality management was fairly low, the awareness of quality also was low at the employee level, due to the very limited chances for education and training programs in quality

matters. Only a few employees were actually involved in training and education programs related to quality management systems due to two reasons; unclear organisational strategy, and a shortage in resources such as funds, expertise, and facilities. Hence, according to the majority of respondents at both CSOs, the employees have had just a general understanding of quality issues. Furthermore, no introduction plan was introduced to them prior to adoption of such quality programs. The implications of this finding will be discussed in the next chapter.

5.1.2 Leadership, management support and commitment

In CSOX1, in relation to the question if there is "an effective leadership in the organisation or not", (effective leadership according to Oakland (1997), means that the managers have had the ability to lead an organisation to achieve its objectives), most respondents from MM and supervisors have said that there is no effective leadership. The common expression they usually used was "wrong people in the wrong position due to qualification and experience". Some managers of top level have not a suitable qualification and enough experience, reasons of that will discuss in the next chapter. In CSOX2, similar to what was found in CSOX1, the majority of responses confirmed that, actually the wrong people are in the wrong positions (this was triangulated by checking some relevant documents and questionnaires' feed back as well). This means there is no effective leadership in the organisation. Reasons after that according to the respondents were; TM members' appointment was controlled by the government bodies such as Ministry of Industry. Such an appointment was subjected to social and political considerations rather than skills and qualification.

In both CSOs: in reply to the question "to what extent do top management support and commit to quality programs", despite some concern from TM by quality issues in general, the majority of respondents agreed that there is a lack of continuous top management support and commitment. Only a few respondents expressed contrary opinion, they assert that there is a considerable top management support to quality programs, for example, TM was very committed and supported getting certified to ISO 9000 in these organisations. However, according to responses from managers (both in production and maintenance departments), top management support after ISO certification gradually decreased and became more words than action. While asking top managers about their commitment and support for quality, they answered that despite the fact they were recognising the importance of issue they have encountered some

problems such as unavailability of resources in the forms of funds, relevant skills, qualifications and external interventions. Nevertheless, some top managers showed considerable enthusiasm to support quality in their organisations.

The respondents who are seniors of quality in the two CSOs have insisted that TM does not pay the required attention to the recommendations of management review reports. They were doing that despite the crucial importance of continuous improvement in all quality programs, as it is one of its main principles. Those respondents advocated that some managers feel very sensitive when they were asked to comply with the recommendations and notes of a monthly management review report. This was for the current organisational culture that makes the managers not accept an evaluation or/and a critique from others, especially those are in the same level or lower.

According to the Statement *"Top management does/does not pay enough attention to continuous improvement in maintenance area"*, in CSOX1, the majority of respondents strongly agreed that top management does not pay the required attention to improving maintenance, the respondents mentioned that top management are looking to the maintenance from only the cost side, more than any others, they still consider maintenance as a "necessary evil" they did not appreciate the indirect costs of maintenance, e.g. the cost of loss of asset availability. So, with respect of that, maintenance locates in the end of their priorities, and they do not recognise the role that many continuous improvements of maintenance activities can play on improving productivity and then business in an organisation. In CSOX2, despite the slight difference in the size of majority of responses, the findings are similar to what has been found in CSOX1. Most of the respondents agreed that top management does not give the desired attention to improving maintenance for the same reasons. They said maintenance improvement needs money, and they could not procure that in the current situation, the implications of this matter will be discussed later (see 6.1.11).

5.1.3 Managing maintenance activities; mission, needs, and link to quality

The question, *"Has the organisation a strategy vision and clear understanding of the scope of maintenance mission, needs, and costs?"* was asked to investigate the linkage between maintenance and strategic direction of CSOs. In CSOX1, the majority of responses indicated that, there was, no clear vision in the organisation, and maintenance's mission, needs, costs were not fully understood. The respondents pointed

out that the unstable situation at the governmental level is one of the main reasons, in addition to the lack of effective leadership through government administrational bodies that usually have been involved in controlling these case study organisations. In CSOX2, a few respondents mentioned that maintenance (mission, needs, etc.) are overlooked by top managers, as TM looks to maintenance, only from a costs view, which means a very narrow understanding. Hence, top management doesn't pay enough attention to maintenance mission and needs. Two respondents from the maintenance department have said that even though there is no proper vision in the organisation, the mission of maintenance is very clear, at least for the maintenance staff. By this saying, they meant that maintenance staff have well understood the maintenance mission (function) which is keeping the plant in good condition, to avoid breakdowns and continue production. As mentioned earlier in section 5.1.2, TM is still looking to the maintenance from only the cost side, more than any others, for instance its need and possibility to contribute in the profitability, for that TM did not appreciate the basic needs of maintenance operations such as the availability of resources and effective management to avoid any cost of loss of asset availability.

According to the question *"were the organisation's strategies and methods for preparation of a program for preventive maintenance, inspections, testing, etc. clearly expressed and communicated to the relevant units?"* which was asked only to maintenance department (MD is more concerned and involved with these specific activities than other departments). In CSOX1, most respondents mentioned that, strategies and methods were not clearly expressed and communicated to the relevant units. Actually, no integrated programs have been planned to apply such methods or procedures along all maintenance areas and in addition, those methods often were not communicated on time to the relevant sections and units. Maintenance staff are still working under the effect of the old prevailing routine before adopting the quality program (ISO 9000), this was because the staff awareness is still under the level that should be addressed for quality issues, and also staff were still influenced by the previous organisational culture. In CSOX2: a similar pattern was revealed, the majority of respondents referred that, despite some strategies and methods were expressed, most of them have not been communicated easily between the relevant units.

According to the question, *does the maintenance function have available resources in the forms of skills, methods, analysis tools, etc. to conduct analysis of the desired*

quality? in CSOX1: some respondents said that in general, there is a shortage of skills, methods, analysis tools, etc. When they were asked what the reason for that shortage is, they answered that this is due to the lack of TM care for maintenance and the unclear vision of the organisation as a whole. The other respondents have identified that the shortage is only in the form of methods and analysis tools, which means the organisation lacks the suitable methods and the tools of analysis that ease conducting analysis of the desired quality. Similarity, in CSOX2, most respondents have seen that maintenance functions have not the available resources in the forms of planning, skills, methods, analysis tools, etc. for almost the same reasons as CSOX1. Some respondents from three levels TM, MD and PD mentioned that the main resource, which they have missed, was the sufficient budgets, because most resources depend on it.

Some of the maintenance managers were not sure how to apply quality in the maintenance department, and in their opinion, improvement may not be achieved by just being certified to a certain quality program like ISO9000, the attention should draw to the real TM commitment and furthermore to the continuity of that support through all programs stages. Others, in TM and in MD from CSOX1 were agreeing that the certified department to ISO 9000 could be better than none certified through all the organisation's departments and activities, they said at least in this case there was some standards' requirement need to be achieved which give a chance to evaluate and test the work being done and have to be practiced. It is useful to refer here that the people from CSOX1 were still affected by the ISO 9000, (version 1994) which is procedure based despite the organisation has transferred to the revised version 2000 which is process based. Three respondents from CSOX1 and seven from CSOX2, at three different levels, have seen that it is difficult to recognise the improvement made by the quality system at any department in just a short term, any such programs need a long period of time for thorough assessment. A few respondents in MD pointed out a big cultural change is required by the QMS, whereas in the past tasks were done informally, the quality system for example; ISO 9000 includes certain procedures (discipline) and disclose information that has not been available in the past. As a consequence, those respondents felt that the QMS created more constriction and more commitment required from the managers and employees. Thus, resistance from some people who do not like change from their previous position might appear. These findings and others related to maintenance activities will be discussed in details at the next chapter, their concepts and implications will be discussed and demonstrated.

According to the question, *has the organisation had a backlog of maintenance work?* The respondents replied mainly "yes" in both CSOs, but with some differences. The difference was about the amount of delayed work. According to the respondents the reasons after that were; the inadequacy of maintenance staff performance, lack of effective maintenance management and planning, and the lack of resources in the maintenance department e.g. fund, equipment, skills etc. Most of the respondents in the CSOs, particularly in the maintenance department, have mentioned that it is so difficult to get spare parts on time on several occasions. The reason, according to them, was that spare parts availability depends on some external and internal factors such as the allocated budget, stock control and the system of storing, which they found difficult to manage. In reply to a question that asked what improvement could be made in maintenance activities, the respondents pointed out that, there was a need to have a quality system that includes continuous improvement, benchmarking and measurement of performance.

Respondents from MD were asked, *"How are urgent jobs in maintenance carried out?"* In CSOX1, the majority of respondents have seen that urgent jobs were carried out collectively by all people who were involved in the maintenance functions and operations despite the current administrative routine. Some respondents from MD mentioned that, "by experience, carrying out the urgent job directly is better than relying on the current procedure...in these cases people who are responsible or by other words working in such area, can deal directly and fast with the urgent jobs than any others". Following the current procedure, according to respondents, take a long time, because the journey of paperwork, sometimes, does a significant delay. This delay made some maintenance supervisors ignore the steps of such procedure and directly contact the skilled people, even from different units, to finish the work. Regarding the Libyan culture, especially in an emergency case, all people are satisfied to participate and contribute doing urgent jobs collectively. Moreover, they are proud to introduce help to others in the critical times. However, in CSOX2, more respondents than in CSOX1 mentioned, the urgent jobs were carried out relying on the current procedure, following the relevant (administrative) procedure. All respondents from the two CSOs preferred to do urgent jobs away from the routine, which they called "routine constrictions", they believed a current procedure (routine) usually slows the work and make it difficult.

In CSOX2, the respondents (such as, general production manager, maintenance manager, heads of mechanical and electrical division in maintenance department, in addition to some maintenance supervisors) have recognised that when some breakdowns happened at the same time at different plants, the work was highly chaotic. This meant that the central maintenance system failed to address breakdowns at different plants at the same time, and this was also one reason of accumulated maintenance work.

5.1.4 Quality and maintenance system performance in the organisation

In the interview with the managers in MDs in both CSOX1 and CSOX2, a question *how they managed or cope with the current management system practiced,* was asked. In the following paragraphs some extra questions were asked, such as *is there a clear set of procedures or practices available for all the tasks that are in the maintenance department?* A head of a unit said, "actually, there is no clear set of processes relevant to maintenance operations, it is not accurately as what should be as a quality system". It meant that the current procedures were much relied on the corrective ways than preventive or proactive/predictive ways. Corrective actions, according to the respondents, usually focus on the end of task rather than processes that are followed to finish it, hence, recording the processes, sometimes, could be ignored. However, most of the respondents from both CSOs indicated that, due to the very importance of data and information accompanied with all maintenance tasks they prefer things kept and recorded in a documented manner as in a quality management system.

In reply to the question *who writes or produces these procedures?* typical responses were that, no full procedures have taken place, whatever ways MDs in two CSOs often do work, this is normally passed verbally (on memory) or on some form of checklists, usually by the person who performs the tasks plus a relevant supervisor. *Are these procedures documented in your department/unit or division?* The answer was, "yes, but not full formal documentation". It was just some simple instructions for future reference or records. *How are changes to work processes recorded?* The response from a supervisor was, "...describe in the files, not recorded, just go on with the new approach usually it is recorded in the work file". *How are these procedures kept?* a supervisor also answered, "...the person who performs it, kept by the person concerned". *Do the different staff do similar work subjected to any standard procedure?* Another head of unit/division said, "None, staff are free to practice their own way, no standardisation but

the principles I believe are the same". It was noticed that, sometimes the allocated time of doing tasks were subjected to the maintainers' mood and options, they can freely control when the work will be finished even if it took more than the usual expectations. Because of lacking knowledge and experience related to the maintenance function from TM, they can not force the maintenance staff to finish on time. It was so easy that maintainers convinced TM by the reasons of delay even when they were not true. *Is there any audit conducted to ensure that work is done according to some standard?* The respondents answered by saying, they do have some irregular internal audits and externals that basically are done by external party (an auditing program was run in CSOX1 during the research interviews). Respondents in both CSOs mentioned that there are no formal (proper) audits conducted in the maintenance department; there are only some simple checks on the status of their task regarding the progress made and discussion on problems faced. The reasons after that according to the respondents were; no official commitment to do that previously, as a consequence, procedures tended to be on its simple check form, managers still are not aware and do not recognise that benefits can be gained from audit programs in the maintenance area. Audits could help in identifying the weakness and strength of system, and as a result advocate the continuous improvement in such an organisation.

When asked whether the procedures that they had were fully documented, most managers answered that they have a basic system in the form of checklists on how work was to be performed. Recording the work steps is relying on the staff of work individually; some people do not comply/follow the rules and ignore recording activities. Importantly, some instruction procedures in maintenance (particular what are related to the machines) were in English, a consideration that people could not understand the English language has to affect the maintainers' ability and performance. Moreover, some employees were illiterate hence were not able to fill in any paperwork, even in their native language. Generally, changes were recorded by writing some notes in the work file or by sharing these changes during an informal discussion. From the interviews, it was revealed that there was no standard procedure for tasks even that were similar, as each one of the maintenance staff had the freedom to perform their task in the way they like. Therefore, in both CSOs the work procedures at maintenance departments were not fully documented, and sometimes tasks were done based on memory, it depended on the person who conducted that work. Even though this was

considered a poor maintenance work it also affected the quality of maintenance operations.

It was found that there was no full commitment to the performance measurement system in the maintenance department in both CSOs. Regarding what departments want to report, each department was asked to use a set of performance measures, which include performance indicators such as the percentage of planned maintenance, craft productivity, backlog, critical equipment availability, overall equipment effectiveness, etc. required by the audit commission. It was also up to these departments (and their divisions, sections, and units) to set the targets to be achieved. The departments were then required to submit a monthly, quarterly and annual report to the maintenance manager in both CSOs. In case CSOX1 the reports were presented directly during the periodical top management meeting, while in CSOX2, the reports are presented firstly at the meeting of technical affairs general department and then are submitted to the technical general manager who presents them in a monthly top management meeting.

Respondents such as managers and supervisors at MD in both CSOs were asked their opinion in regards to various aspects of performance measurement in their organisations. The managers mentioned that the tools used to measure performance in the organisation were basically job sheets, time sheets and reports. The current performance measurement practices were criticised for being just reports of the department activities rather than an indicator of target achievement. According to the respondents, the current system failed to measure the department's effectiveness and efficiency. The measurement indicators were also seen as just a series of inconsistent measures that people have to fulfill and which did not add value to the organisation. Moreover, the measurement was perceived to be very subjective without measuring 'real' quality in which efficiency and effectiveness of maintenance can be measured.

Almost all of the respondents in the maintenance departments were considering the job sheet as the basic tool that their management used to measure their individual performance. Most of the respondents at different levels (TM, MD, and PD) believe that the organisation needs to have a suitable performance measurement system to assess or evaluate the employees individually. To make that system active, the respondents think it should be out of the social and relationships considerations which are very deep-

rooted in the Libyan organisational culture, it, therefore, should be rigorous and business based.

5.1.5 Training programs and experience in quality

Due to the increasing importance of training and experience in organisations, participants from the two CSOs were asked questions to reveal their opinions about the issues in this section from different sides of perspectives, however, in the next chapter, these findings will be discussed in details and their potential implications will be highlighted.

The opening question asked, "*Has the organisation introduced sufficient quality training programs and education for employees?*" In both CSOs, all respondents agreed that there was not sufficient quality training and education for employees. Moreover, those respondents, who were strongly agreeing about this issue, even mentioned that the organisation has not applied any real quality training and education for employees except a few for just ISO 9000, furthermore they advocated that no introduction of the quality systems had been introduced to employees in the organisations before adopting the ISO 9000 system. The reason for that, according to the respondents was the unawareness and poor understanding of QMS from top managers. Most respondents at MD in both CSOs strongly agreed that the selection of trainees is subjected to special considerations and was very political. In other words, they mentioned that, the selection was subject to social relationships, self benefits and power relations rather than based on experience, work needs and suitability for the job.

Most of the respondents from MD mentioned that their organisations have lacked a specific training program to focus on the maintenance area. Some training programs were actually without prior planning and with a rather cloudy mission. There was no analysis of training needs. The respondents also pointed out that the distribution of numbers of trainees between departments was also not subjected to the real needs of each department, the reason of that will be discussed in section 6.1.1.1.

When asked about the experience/expertise in quality management, the majority of respondents from both CSOs were admitting that their organisations were lacking the experience/expertise in quality management. They of course referred to the relative immaturity of QMS in their organisations and in their country as well. In addition, they

indicated to the nearest situation when their organisations were faced with a lot of difficulties and problems related to the state policy such as several sanctions that were imposed on the country from both USA and UN for a long time. That position banned Libyan organisations from making contact to other advanced countries to get benefit from their experiences and practices in QMS.

5.1.6 The organisational policy and socio-culture impact

It was noticed that the organisational policy of both CSOs was very similar because of the one nature of all Libyan firms, which are controlled directly by the state under unified law and regulations, for example the system of wages and salaries is the same, the accountability and responsibility of/between all departments and divisions or units is also the same, the structure of organisations is similar etc. On the question, *has the company an effective 'proper' organisational policy,* the answer was mostly 'no', the respondents mentioned that, organisational policy is very rigid and depends on old management implications and philosophies. No new improvement was made in the organisations' policy for a long time and no real changes on law and regulations happened as well. Respondents thought that the existence of bureaucracy in their organisations made all business activities very difficult, since the bureaucracy slows down the level of performance and puts many obstacles in the way of improvement.

For instance, when managers were asked about whether there is a recognition and rewards system in their organisations, the respondents asserted there was no recognition and rewards system in place. The respondents indicated that, despite the existence of some rules and regulations relevant to the recognition and rewards, no real system for recognition and rewards were actually practicised in both CSOs. Respondents also mentioned that only some attempts were done to some workers from some managers individually by chance, or due to some special relations, from those managers to the TM or even to some relevant government leadership. This means no real commitment to this issue from the top management in both CSOs. A possible reason is not enough funds, for this purpose, were allocated.

When exploring the opinions of respondents about their salary/wage rate compared to the average living level, all respondents at both CSOs, without any exceptions, have strongly pointed at their very low current salary. A head of a unit/division said for instance, "Actually we still operate under the legislation of salaries and wages number

15, which was issued on 1980, our salaries are very low compared to the living level". The strange thing was that despite 24 years after that time, no change in the salaries and wages have occurred. The respondents confirmed that this factor affected employees' morale, confidence and performance, as a result of quality of all business activities including maintenance. No possible reason after that except the political considerations that are generated from the high leadership of the country in general.

Some respondents in the maintenance department in both CSOs indicated that the current organisational policy distinguished operators from maintainers (no equality). This was in the way that TM is looking to operators as the backbone of the production process, and without them, the machinery and all plant will shut off. In addition, TM actually has not recognised the main role that maintenance could play in the asset availability, which leads to doing work at optimum conditions. They thought that the current organisational culture and the attitudes of all managers often supported this direction; this is because the main focus of top managers is always on the production side in which the quantity of products is produced.

Actually, no formal practises of housekeeping existed throughout the two CSOs consequently, the housekeeping practise in the maintenance area was very poor. And some informal procedures (dependant on each department, unit and person) were in place. The 5S approach was not known to the majority of respondents. Keeping places clean and tidy was the aim of everyone, but the problem was how to manage it all. It was reveled that, in CSOs, the standardisation and self discipline were not implemented, therefore, procedures and practices of continually maintaining the cleanliness of all areas was not achieved. From the interviews, it was revealed that the current organisational policy and socio-culture have had a great effect on both organisations' activities through their structure from top management to shop floor, this great impact will be discussed in depth in chapter 6.1.5.2, and the implications of these findings will be argued and demonstrated.

All respondents in both CSOs were agreeing that everyone by nature could resist new changes in every day situations (at work place or in family) particularly when he/she has no previous awareness about this change. Most respondents welcomed changes that can bring improvement and success to their organisations. Regarding the current situation in CSOs and according to what was discussed in section 5.2.1, both middle managers and

employees did not have a full understanding about the quality system that the organisations adopted. Some respondents indicated that some managers and employees felt uncomfortable about their work and future due to lack of understanding about how such change affects them personally. This is because they were not educated and even learned about the new quality programs that their organisations have been adopted.

It has been noticed that the rate of employee involvement and participation in quality programs within both cases was subjected to how the programs were generated and what procedures or techniques of such programs were applied. However, some respondents from the two CSOs have mentioned that, in the maintenance department sometimes there was a conflict between engineers, technicians and tradesmen during doing jobs, when some interventions from three or two groups have taken place. The reason was the common interference between those three elements that usually happened during doing some maintenance tasks, which require a shared work in the same time in the same place. Ambiguous accountabilities and authorities of each element of engineers, technicians, and tradesmen was the main cause of such conflicts.

To a question that asked whether the managers and employees are empowered, respondents have seen that the empowerment in general was restricted due to the current regulations and law, which are highly relying on the centred management approach that is imposed by the government. Only a small area of authority was left. However, middle managers, according to the respondents, were very controlled and directed. As a result, most respondents from both organisations have indicated that the empowerment of employees depends directly on the empowerment of managers themselves, consequently, as the authority of management in CSOs at all levels seemed to be limited, the employees' empowerment was limited as well.

Answering a question, whether the employees were confident and committed to work, most respondents were negative. The reasons were summarised by respondents as follows: poor climate at work, low salary, lack of recognition and rewards, inequality between employees, uncertainty in work future, instability, etc. These very important factors led to a question, "to what extent are the employees loyal to their organisation?" The respondents assessed the loyalty of employees to the organisation as 'messy' and 'low'. A member of respondents said, "Some people who got benefits from their current situation tend to appear to have a bogus loyalty". Some respondents from both CSOs

indicated that as a result of the low loyalty from employees to their organisation, two main features were noticed. Firstly, nonchalance (unconcern) of most employees; "unconcern" was often considered as a sign or a potential slogan of the majority of the employees. This lack of concern has a serious effect on the work performance and then the quality of all procedures. Secondly, as a result of very low employee moral; the employees did not have enough enthusiasm to carry out their jobs properly.

Some respondents particularly seniors of quality, managers and supervisors at both maintenance and production departments said that the work environment (external or internal) was very poor (see 6.1.8). The respect and appreciation of employees was the missing link, so some very necessary services were not available like, social areas, places for breakfast or lunch, soft and hot drinks and others.

5.1.7 Government interventions and support

The question related to government interventions and support was asked to only the targeted managers at top management level who were actually experienced and knowledgeable in this matter. The question was focused on whether there were any government interventions in the organisation's policy and decision-making. Most respondents pointed out that interventions were very common, particularly in issues such as top managers' appointments and the organisational structure of a company, and internal/external policy directions. The Government also controls the general strategy of an organisation. In fact, these interventions were expected due to the nature of the political regime (state socialism), however the concern should take care of what benefits could be gained from it. Unfortunately, most of those interventions were arbitrary and relied on political and social considerations; this meant it was unrelated to business objectives and requirements. In order to confirm the interventions, a manager in CSOs said, "The intervention of the Ministry of Industry and other state bodies in the companies' affairs, made managers in these companies lose their power and authority".

By the nature of socialism, all firms in the country including these CSOs were completely relying on the state support from establishment until now. However, this support was subjected to the authority of external leaderships from out of the organisations, which meant the strategic decisions, most of the time, have been taken externally. This situation made the mission of an organisation difficult and uncertain. So it was not surprising to hear from some managers that the government support was very

low and inconsistent or fluctuated. Consequently, it can be argued that the government does not encourage quality systems in general due to current legislations and rules. This matter and others related to government interventions will be argued in the next discussion chapter, and its implications will be illuminated.

5.1.8 Customer requirements and satisfactions

To a question, whether the organisation was taking customer requirements and satisfactions into its strategy consideration, in CSOX1, most of the respondents have said that despite the importance of customer satisfaction, it still has not been addressed carefully in their organisation's policy (the paucity of goods during the near past directed the local customers' requirements). However, the organisation tried to take customer requirements and satisfactions into its strategy consideration in these times after considerable changes have occurred in the Libyan economic policy due to the UN sanctions and entering the policy of open markets. In the maintenance department respondents mentioned that maintenance staff appreciated internal customers (production department and top management), for whom they were doing their best. Here also the paucity of resources allocated to MD were taken into consideration by the respondents from both suppliers (maintainers) and customers (PD and TM). Similarly, in CSOX2, the respondents were agreeing that the organisation aimed to address customer requirements, but actually, customer satisfaction is not at the level it should have been. The talk about customers leads to a question, whether the organisation gets feedback from their customers, the usual answers that there was no real recognition to this issue in general and particularly in the maintenance area. Some respondents confirmed that no formal feedback system was applied in both CSOs however, from time to time, some customers, contacted the organisation and refer to some notes related to the quality of products. The maintenance departments at both CSOs have received some comments and notes from the production departments and sometimes from other managers, verbally, after some maintenance tasks were carried out. As the respondents indicated to a shortage of appreciation to internal customer requirements, they returned that to the lack of understanding the mutual benefits would be gained from the co-operation between the different departments within the organisation in particular, between maintenance department and production department. The respondents also mentioned that, the prevalent organisational culture does not allow the required co-operation/co-ordination between the different related departments. It was evidence that neither maintenance staff nor production staff have recognised the essential link

between two departments and the interdependence between them is still ambiguous and misunderstood.

Regarding the internal customers satisfaction (TM and PD), a question asked to investigate the level of satisfaction with the performance of a maintenance department, the majority of respondents from MD were satisfied, because they thought they did their best regarding the availability of related resources. Contrary to this most interviewed from TM and PD were not completely satisfied. This pattern was similar in both CSOs. The reason why TM and PD were not completely satisfied was; both of them sometimes did not see the desired conformance between what they wanted MD to do and what actually MD did, this means, to some extent, no meeting internal customer requirements. Further to this some respondents provided valuable insights that explain the background of this problem. For instance, a member from maintenance staff at CSOX2 said "our performance depends on availability of resources, if some important equipment or spares are not found the work will slow down".

5.1.9 Communication, coordination, cooperation and information system

Communications were and still are very important activity in business; furthermore, communications became the backbone of any business and will be so in the future too (Reason & Hobbs, 2003 and Al-Khalifa, 2000). According to the question, "Has the organisation management information system (either computerised or manual) to maintain records of maintenance operations and activities?" the respondents of maintenance staff from both CSOs mentioned that, there was only a typical paper-based information system. Some respondents mentioned that both CSOs were in the process of establishing a new management information system (computerised).

It was noticed that internal communication networks in both CSOs were better than the external communication networks. All respondents agreed that the external communication network was not effective in both CSOs. For example, there still were no Internet services in CSOX2, according to the respondents, due to technical difficulties. According to many restrictions and difficulties, which are related directly to the general policy of the country in the business field, the result was a poor external communications and the lack of existing (advanced) organisations locally.

Most respondents from CSOX1 have recognised the lack of benchmarking against advanced comparable organisations, which in their opinion had a crucial effect on quality in general and in the maintenance area. For instance, there were no intercommunications with any similar organisations out of the country and no chance to share and/or exchange the views and ideas about the company activity. Meanwhile, no other organisations exist in the country that do the same activities of these two case studies which could contribute to sharing and exchanging the practices and experiences.

Answering the question, to what extent the coordination and cooperation existed between the related departments; respondents at both CSOs mentioned that there were a general welcoming from all people by the mutual cooperation and coordination between all relevant departments within the organisation. They said, "We as Libyan people prefer to work in a collective climate and accept to assist each other however, due to some managerial difficulties and unsuitable arrangements, coordination and cooperation have not been addressed officially and enough". The difficulties according to the respondents, for instance, were; no clear procedures were planned to follow, a boundaries of authorities & responsibilities in the related overlapping departments were not (distinguished) determined, lack of enthusiasm and promotion from some managers at different levels, and the shortage of cooperation & coordination facilities, e.g. methods and devices. Sometimes the enthusiasm of people to work by the spirit of team faces some obstructions, when some managers and/or supervisors do not like to work with people from other departments or/and units. So, it depends on the mood of those persons, as no clear 'official' rules organise that mutual processes, some people considered the participation from other departments or units as an intervention in their jobs, however, the others were very welcome that contribution and facilitated conducting it.

In the end of each interview, the researcher asked the respondents to name the barriers and difficulties faced by their organisations to approach quality in the maintenance departments. These barriers and difficulties were presented in table 5.1, according to the different respondents' levels; TM, MD, and PD. The sign √refers to that, the barrier was named by the respondents and the sign **X** points to that, the barrier was not named by the respondents.

Barriers and difficulties	CSOX1			CSOX2		
	TM	MD	PD	TM	MD	PD
Lack of full understanding quality management systems and benefits	X	√	√	X	√	√
Lack of co-ordination & co-operation between the different departments within the organisation.	√	√	X	X	X	√
Lack of sufficient quality training programs and education	X	√	X	√	√	√
No clear vision and mission in the organisation	X	√	X	√	√	X
Lack of expertise in quality management	X	√	√	√	√	√
Existence of bureaucracy in organisation	√	√	√	√	√	√
There are Government interventions in organisation's policy (decision making)	√	X	√	√	X	X
The maintenance processes have not been done as a complete quality process loop	√	√	X	X	√	√
Lack of managers and employees empowerment	X	√	√	√	√	X
Lack of employee confidence and commitment in work	√	√	√	X	√	√
The organisation lacks management information system (computerised)	X	√	√	X	√	√
No effective internal and external communication network	X	√	√	√	√	X
There was no proper organisational policy	X	√	X	√	√	X

Table 5.1 Barriers and difficulties encountering CSOs from the perspectives of different levels of respondents.

5.2 Questionnaire results

To enhance the findings from the interview questions, of this study, the researcher triangulated the data required through the most popular data collection method (questionnaire survey). According to Collis & Hussey, (2003) it is often possible to allow participants to give more discriminating responses by providing them with some forms of rating scale, one of the more frequently used types of scale is the '*Likert Scale*'. This turns the question into a statement and asks the respondents to indicate their level of agreement with the statement by ticking an appropriate one.

In this study, based on Ghaury, et al., (1995), the five choices Likert Scale adopted were: strongly agree (SA), agree (A), partly agree (PA), disagree (D) and strongly disagree (SD). The 'partly agree' choice was including both a negative and positive trend of the respondents' opinion as it depends on whether the statement was positively or negatively directed. It means both partly agree and partly disagree; this gives the respondents a flexibility to have a choice if they were not sure about their responses.

The questionnaires were distributed to all the maintenance staff in both CSOs (described earlier in chapter 3). The questionnaire was divided into two main parts: maintenance activities factors and common barriers affecting quality management in an organisation (Appendix 2.2). The total numbers of responses were 108 from 170 (nearly 64%). The participants were asked to rank their opinion on a series of statements related to quality and maintenance. These statements were asked to assess the respondents' thinking on the maintenance activities' factors and the quality in the maintenance department within both CSOs, in particular about the obstacles that can be faced by their organisations, in the following, analysing of the main results in each case study organisation.

Case study organisation X1

According to the questionnaire responses from CSOX1, the job functions of respondents were; 17 technicians, 9 engineers, 4 administration persons and 2 others. The responsibilities of respondents were; 12 technical inspection, 8 management, 4 replacing & preparing spares, 3 information & documentation, 2 cleaning & lubrication and 3 others. The experience of respondents are; 8 respondents have had experience more than 16 years, 10 respondents have had experience for 10 to 15 years, 9 respondents have had experience between 4 and 9 years and 5 respondents have had experience for less than 3 years.

Based on the responses that were about or more than 60 percent, the main indications can be generated from the questionnaire results (first part: maintenance activities factors) are: Relating to the resources availability in maintenance, 75% of the respondents (34% SA and 41% A) were agreed that there was a shortage of main resources in the form of methods and analysis tool and 78% of respondents (41% SA & 37% A) agreed there were no advanced instruments and machines in the maintenance department. Nearly, 84% of the respondents (28% SD & 56% D) disagreed that there was co-ordination & co-operation between the different departments within the CSO and 65% of the respondents (13% SD & 52% D) disagreed that maintenance managers had the suitable empowerment to do their jobs. The lack of training programs in the maintenance area was confirmed by 71% of respondents. 62% of respondents asserted that TM in CSO had no clear understanding of the scope of maintenance requirements and 62% of respondents (34% D & 28% SD) disagreed that there was a good housekeeping system in CSO. About 65% of respondents (28% SA &37% A) indicated

that, there was a shortage of budget allocated to maintenance. The responses showed that, the organisation has not clear rules for the use of updating of checklists by the rate of sixty five percent. (See appendix 4a for full questionnaire results).

Furthermore, the main indications that can be generated from the questionnaire results (second part: common barriers affecting quality management) are: 72% of respondents (53% D & 19% SD) disagreed that there was full understanding of quality management systems and 68% of them (52% D & 16% SD) disagreed there was a proper organisational policy in their organisation. The availability of resources within the organisations was poor (62% of respondents), and 73% of respondents were agreed that the organisation lacked the rewards systems. About 78% of respondents asserted that the organisation lacked expertise in quality management and 62% of respondents (34% A & 28% SA) agreed their organisation lacked the TM commitment and support, however, 72% of respondents (28% SD & 44% D) disagreed that there was effective leadership in their organisation. No clear vision in the organisation was advocated by 65% of the respondents, and the mission was not clearly addressed according to 69% of the respondents. Regarding the employee loyalty, 63% of respondents confirmed that it was low, also about 75% of them agreed that there is no employee confidence. Culture effect on quality programs was demonstrated by 68% and about 63% of them indicated to the lack of a customer feedback system, furthermore 69% of respondents agreed that the external communications were poor and claimed the lack of government financial support. The majority of respondents (78%) showed that, no developed measure of quality system performance was found in their organisation, and finally, 72% of respondents (19% SA & 53% A) were agreed that no sufficient training and education programs were provided in their organisations. (See appendix 4b for full results).

Case study organisation X2

From the questionnaire responses, the job functions of respondents were; 37 technicians, 34 engineers, 3 administration persons and 2 others. The responsibilities of respondents were; 31 technical inspection, 18 management, 17 replacing & preparing spares, 6 information & documentation, 2 cleaning & lubrication and 2 others. The experience of respondents are; 26 respondents have had experience more than 16 years, 37 respondents have had experience for 10 to 15 years, 11 respondents have had experience between 4 and 9 years and 2 respondents have had experience for less than 3 years.

Similar to what was discussed firstly in CSOX1, the main indications can be generated from the questionnaire results (first part: maintenance activities factors) are: about 75% of the respondents (26% SA & 49% A) agreed that TM does not pay the suitable attention to improving maintenance, and 61% of respondents (24% SA & 37% A) agreed there were no advanced instruments and machines in the maintenance department. However, 66% of the respondents (29% SD & 37% D) disagreed that maintenance managers had the suitable empowerment to do their jobs, and 76% of respondents (33% SD & 43% D) disagreed that there was good management information system in their organisation, 83% of them confirmed that their organisations had not developed any processes to evaluate the efficiency and effectiveness of maintenance performance. The lack of training programs in the maintenance area was confirmed by 70% of respondents, and 71% of respondents asserted that TM in CSO had no clear understanding of the scope of maintenance requirements and 63% of respondents (37% D & 26% SD) disagreed that there was a good housekeeping system in CSO. In this case study about 65% of respondents (21% SA & 44% A) agreed that maintenance programs were clearly expressed and communicated between units, the respondents also agreed that maintenance staff has sufficient knowledge of safety instructions, the rate was sixty six percent. The majority of responses (70%) indicated that the organisation has not provided training programs in the maintenance area related to the quality management system. (See appendix 4a for full questionnaire's results).

Furthermore, the main indications can be generated from the questionnaire results (second part: common barriers affecting quality management) are: about 62% of the respondents (38% D & 24% SD) disagreed there was a proper organisational policy in their organisation. Employee empowerment was low according to 63% of respondents, and 87% of respondents were agreed that the organisation lacked the rewards and recognition systems. About 60% of respondents asserted that the organisations lacked expertise in quality management and 80% of them (55% A & 25% SA) agreed their organisations lacked the TM commitment and support, however, 75% of respondents (45% SD & 30% D) disagreed that there was effective leadership in their organisation. No clear vision in the organisation was advocated by 64% of the respondents. Regarding the employee loyalty, 70% of respondents confirmed that it was low, also about 61% of them agreed that there is no employee confidence and finally, 65% of respondents (24% SA & 41% A) were agreed that no sufficient quality training and

education programs were provided in their organisations (for full questionnaire's results see appendix 4b).

In general, most of the questionnaire results were consistent with what has been found from the interview results, indeed this consistency works to enhance the research findings. Hence, from the questionnaire results, the researcher generated a number of statements. Those occurring with the greatest frequency across the majority of the classes of respondents are identified. Selection was based on those statements where more than 50% of the participants from one or both CSOs addressed the issue as a concern. These statements were asked to assess the respondents' thinking on the quality in maintenance; common barriers (obstacles) were facing each organisation and, the main maintenance activities' factors related to quality and improvement in each case study organisation. The statements were tabulated in the following tables, (5.2a, 5.2b, 5.2c and 5.2d).

Factor/ categories	Strongly agree	Agree	Partly agree	Disagree	Strongly disagree
The organisation has a backlog of maintenance	5 16%	12 37%	8 25%	7 22%	0 0%
There is a link between quality management and improving maintenance activities	8 25%	8 25%	9 28%	6 19%	1 3%
There is a shortage of main resources in the form of budget,	9 28%	12 37%	7 22%	4 13%	0 0%
There is a shortage of main resources in the form of skills,	6 19%	11 34%	8 25%	7 22%	0 0%
There is a shortage of main resources in the form of methods/ analysis tools,	11 34%	13 41%	7 22%	1 3%	0 0%
There is a shortage of main resources in the form of advanced instruments and machines.	13 41%	12 37%	6 19%	1 3%	0 0%
There is co-ordination & co-operation between the different departments within the organisation	0 0%	3 10%	2 6%	18 56%	9 28%
There is an empowerment for maintenance managers	0 0%	4 13%	7 22%	17 52%	4 13%
Maintenance staff has sufficient knowledge of design assumptions,	0 0%	4 13%	12 37%	10 31%	6 19%
The organisation has clear rules for the use of updating of checklists,	0 0%	6 19%	5 16%	17 53%	4 12%
The organisation has provided training programs in the maintenance area	0 0%	3 10%	6 19%	14 43%	9 28%
Top management of organisation has clear understanding of the scope of maintenance needs,	0 0%	4 13%	8 25%	15 47%	5 15%
There is a good housekeeping system (5Ss)	0 0%	3 10%	9 28%	11 34%	9 28%

Table 5.2a Samples of questionnaire responses; numbers & percentage (factors of maintenance activities in case study organisation X1)

Barrier/ categories	Strongly agree	Agree	Partly agree	Disagree	Strongly disagree
Full understanding of quality management systems.	0 0%	3 9%	6 19%	17 53%	6 19%
Full understanding of quality benefits.	0 0%	7 22%	9 28%	14 44%	2 6%
There is a proper organisational policy	0 0%	5 16%	5 16%	17 52%	5 16%
Lack of skills of top management	7 22%	10 31%	10 31%	5 16%	0 0%
Poor availability of resources	6 19%	14 43%	7 22%	5 16%	0 0%
There is an employee empowerment	0 0%	6 19%	10 31%	13 41%	3 9%
Lack of recognition system	16 50%	12 37%	4 13%	0 0%	0 0%
There is a rewards systems	0 0%	0 0%	4 13%	18 56%	10 31%
No developed measure of quality system performance	16 50%	9 28%	5 16%	2 6%	0 0%
Lack of expertise in quality management	14 44%	11 34%	3 9%	4 13%	0 0%
Full top management commitment/ support	0 0%	5 16%	7 22%	11 34%	9 28%
No proper vision in organisation	10 31%	11 34%	7 22%	4 13%	0 0%
No proper mission in organisation	8 25%	14 44%	7 22%	3 9%	0 0%
There is an effective leadership (right people in the right position)	0 0%	3 9%	6 19%	14 44%	9 28%
No existence of bureaucracy	0 0%	4 13%	10 31%	11 34%	7 22%
Culture change effect (resistance to change)	10 31%	12 37%	5 16%	4 13%	1 3%
Middle managers commitment	0 0%	8 25%	6 19%	11 34%	7 22%
Lack of employee involvement	5 16%	13 40%	9 28%	5 16%	0 0%
Lack of customer feedback system	6 19%	14 44%	8 25%	4 12%	0 0%
Lack of sufficient quality training and education	6 19%	17 53%	7 22%	2 6%	0 0%
Lack of confidence by employees (impersonal)	6 19%	18 56%	7 22%	1 3%	0 0%
There is an effective external communication net work	0 0%	3 9%	7 22%	18 56%	4 13%
Lack of government financial support	7 22%	15 47%	8 25%	1 3%	1 3%
Lack of co-operation from customer	3 9%	16 50%	11 35%	2 6%	0 0%
Employees have a loyalty to their organisation	0 0%	4 12%	8 25%	15 47%	5 16%

Table 5.2b Samples of questionnaire responses; numbers & percentage (the common barriers affecting quality management systems in case study organisation X1)

Factor/ categories	Strongly agree	Agree	Partly agree	Disagree	Strongly disagree
Top management pay more attention to improving maintenance	3 4%	6 8%	10 13%	37 49%	20 26%
The organisation has a backlog of maintenance	10 13%	30 39%	22 29%	12 16%	2 3%
There is a link between quality management and improving maintenance activities.	16 21%	29 38%	25 33%	5 7%	1 1%
Maintenance programs are clearly expressed and communicated to their relevant units and departments.	16 21%	34 44%	12 16%	12 16%	2 3%
There is a shortage of main resources in the form of methods/ analysis tools,	22 29%	23 30%	15 20%	14 18%	2 3%
There is a shortage of main resources in the form of advanced instruments and machines.	18 24%	28 37%	14 18%	15 20%	1 1%
There is co-ordination & co-operation between the different departments within the organisation	0 0%	16 21%	15 20%	20 26%	25 33%
There is an empowerment for maintenance managers	0 0%	18 24%	8 10%	28 37%	22 29%
Maintenance staff has sufficient knowledge of design assumptions,	3 4%	12 16%	18 24%	25 32%	18 24%
Maintenance staff has sufficient knowledge of safety instructions	17 22%	33 44%	16 21%	7 9%	3 4%
The organisation has clear rules for the use of handling of checklists,	16 21%	31 41%	23 30%	4 5%	2 3%
The organisation has clear rules for the use of updating of checklists,	6 8%	21 28%	11 14%	23 30%	15 20%
The organisation has clear rules for the use of storage of checklists.	7 9%	16 21%	12 16%	25 33%	16 21%
The organisation has good management information system	0 0%	8 11%	10 13%	33 43%	25 33%
The organisation has developed a process to evaluate the efficiency and effectiveness of maintenance performance	0 0%	6 8%	7 9%	43 57%	20 26%
The organisation has provided training programs in the maintenance area	0 0%	9 12%	14 18%	34 45%	19 25%
Top management of organisation has clear understanding of the scope of maintenance needs,	0 0%	10 13%	12 16%	28 37%	26 34%
There is a good housekeeping system (5Ss)	0 0%	9 12%	19 25%	28 37%	20 26%

Table 5.2c Samples of questionnaire responses; numbers & percentage (factors of maintenance activities in case study organisation X2)

Barrier/ categories	Strongly agree	Agree	Partly agree	Disagree	Strongly disagree
Full understanding of quality management systems.	0 0%	10 13%	23 30%	28 37%	15 20%
Full understanding of quality benefits.	7 9%	12 16%	14 19%	33 43%	10 13%
There is a proper organisational policy	0 0%	12 16%	17 22%	29 38%	18 24%
Lack of skills of top management	16 21%	23 30%	22 29%	15 20%	0 0%
Poor availability of resources	20 26%	25 33%	14 19%	17 22%	0 0%
There is an employee empowerment	0 0%	16 21%	12 16%	35 46%	13 17%
Lack of recognition system	20 26%	20 26%	22 29%	14 19%	0 0%
There is a rewards systems	0 0%	9 12%	11 15%	33 43%	23 30%
No developed measure of quality system performance	14 18%	27 36%	23 30%	12 16%	0 0%
Lack of expertise in quality management	22 29%	24 31%	12 16%	18 24%	0 0%
Full top management commitment/ support	0 0%	3 4%	12 16%	42 55%	19 25%
No proper vision in organisation	26 34%	23 30%	13 17%	14 19%	0 0%
There is an effective leadership (right people in the right position)	0 0%	10 13%	9 12%	23 30%	34 45%
No existence of bureaucracy	0 0%	16 21%	22 29%	23 30%	15 20%
Culture change effect (resistance to change)	18 24%	23 30%	19 25%	14 18%	2 3%
Lack of customer feedback system	11 14%	27 36%	24 32%	14 18%	0 0%
Lack of sufficient quality training and education	18 24%	31 41%	17 22%	10 13%	0 0%
Lack of confidence by employees (impersonal)	22 29%	24 32%	22 29%	8 10%	0 0%
Employees have a loyalty to their organisation	0 0%	11 14%	12 16%	28 37%	25 33%

Table 5.2d Samples of questionnaire responses; numbers & percentage (the common barriers affecting quality management systems in case study organisation X2)

5.3 Document review

The important means of gathering the empirical data for this research was the analysis of relevant documents and archival sources. They included records, files, correspondence and reports concerning various levels of the organisations. Both cases gave free access to most documents requested. This included: state regulations concerning the manufacture; organisational structure, company letters, evaluation manuals, monthly and annual maintenance departmental reports and some minutes of meetings of different levels of management and etc. Documents were collected either as originals or as photocopies or short notes describing their contents and formats.

According to the organisational documents, both CSOs were strongly relying on seasonal (unscheduled & short) training/education programs. There was no clear plan to educate and make the employees more aware of QMS in the two cases, which means no scheduled education/training programs existed. The reason was no true commitment, from top management to enhance the continuity, of such programs were presented. In fact training programs in general were not sufficient and unplanned.

It was noticed from documents (technical report) for example, in CSO X2; maintenance staff used some old spare parts because of unavailability of new ones. They also had used spares that were made in local workshops; those spares according to the technical report did not conform to the original standards, which of course affect the reliability and efficiency of that spares. A technical report in CSOX2 included some comments such as:

- The need to follow up the data and its consistency with the data that should be recorded during the operations and then recognise the variations.
- Mechanical maintenance unit should allocate, appoint technicians, tradesmen with high qualifications and experience.
- Importing advanced equipment for monitoring and measuring.

Regarding the training programs, recommendation No. 11 in a review management report issued on 2003, in CSOX2 was about the difficulties of getting agreement from the external government bodies to facilitate training procedures especially what was for external training programs. Recommendation No. 13 from that report was about assuring that maintenance management and operations management should apply the statistical approaches/procedures to help making the right decisions. The review

management reports included also the following comments: improving the performance of internal auditing, improving work environments and commitment with the planned dates for overhaul maintenance.

5.4 Possible contribution to knowledge from CSOs' findings

Regarding the results gained from in depth-interviews, supported and triangulated by the other two techniques used in this study, (questionnaire & archival documents), the researcher felt confident that he demonstrated some unique findings, that have not been reported in previous studies in the literature review. Therefore, the possible novel contributions to knowledge from these case study organisations are represented by those unique barriers and difficulties that have been faced by the case study organisations and did not reported in the literature review, some of them are:

- Maintenance programs are not clearly expressed and communicated to their relevant units and departments.
- The organisation has a backlog of maintenance work.
- Lack of research studies related to quality in maintenance and improvement.
- No proper monitoring system to preventive maintenance operations.
- No clear definitions of authority and responsibilities of management functions (the uncertainty).
- External training has faced financial and administrative difficulties.
- Lack of contacting comparable advanced organisations.
- Delay of financial supply by foreign currency.
- Low salary rate compared to living level.
- Existing workforce is much more than the actual work needs.
- Nonchalance (unconcern) of employees.
- Selections of trainees are subjected to nonstandard (social relationships criteria).

These findings and others will be highlighted and discussed thoroughly in the next chapter. The generated barriers and difficulties that have been faced by the CSOs will be classified into the main parts in the discussion chapter. A comparative discussion between these research findings and the findings of previous studies that have been addressed in the literature review chapter will be presented too. Furthermore, implications of the research findings will be clarified and demonstrated.

CHAPTER 6 DISCUSSIONS AND IMPLICATIONS

6.0 Introduction

The importance of this study exists in the potential effect of its research findings.This chapter will discuss the findings of this research and their implications, associated with a comparison to what has been written in the literature review chapter. Naturally, this discussion will focus on the main aim and the related objectives of this research, which are stated in section 1.3. In order to fulfil the aim and objectives and answer the question of this research, the findings within two case study organisations were therefore presented in chapter 5 and now this chapter aims to provide discussions and implications of these findings.

This discussion chapter consists of the following main sections; the first one will discuss the barriers and difficulties that affect QMS in the maintenance area that were generated from the CSOs findings (located in chapter 5) in the light of what was stated early in the literature reviews. The second discusses the theoretical framework of driving and restraining forces of quality in maintenance. And finally, a critique of the research methodology, and research findings and discussions will be addressed.

6.1 Discussions of barriers & difficulties that affect QMS in the maintenance area

This research has illuminated some topics in quality management systems relating to maintenance activities including of course the main principles of quality management such as; leadership (effective maintenance management), customer focus (conformance to the stakeholders' requirement), continuous improvement (recurring maintenance activities), systems approach to management (managing an interrelated processes, factual approach to decision making (measurement, monitoring, analysis, recording), and staff involvement and empowerment. Those quality principles accompanied with some important factors of improving maintenance functions formalise together the key areas that are incorporated by QMS through maintenance activities which are classified by the researcher into fourteen main areas, the reason of this classification is that the results from CSOs demonstrated how important and to what extent the interactions between these areas can help to understand and identify the barriers & difficulties affecting quality in maintenance and then to contribute in improving quality of maintenance functions.

6.1.1 Understanding quality management systems and benefits

It is indisputable that the understanding and awareness is the milestone of any successful project. According to the findings of this research, there was no clear plan to educate and make the employees more aware of QMS in CSOs, this implies that TM is still not aware enough and did not recognise the necessary need of making employees knowledgeable and more aware of QMS. Thus TM have not truly committed to enhance the continuity of such programs if they existed. As a result of poor understanding of quality issues, it was found that the two cases put a high emphasis on just ISO 9000. The most common reasons for the interest in certification were a desire to establish a quality system and to use it as a marketing tool. It seems that ISO 9000 certification is seen by both cases as a latest successful quality system can be adopted in business field, it was seen sometimes as TQM. Hence, managers of certified companies have used a certification as a tool to crow about their positions and leaderships in public sectors. In fact those managers do that because of just drawing attention of the high state leaderships, who, if they are satisfied, can secure the positions of TM for as long as possible. However, the possible implication is that some managers miss the real feeling/loyalty to the company as they are not owners/sharers. In this case, managers clearly recognise that they would not be asked about their responsibility if the companies failed to achieve the desired objectives. Furthermore, they are free of any insolvency 'bankruptcy' may happen, so at any situation, their salaries/wages are regular and not affected by their productivity.

For example, some employees, and even some managers, thought that quality management means ISO 9000; they did not recognise that ISO 9000 could be just a program from other programs of quality issues. In fact, those managers who were involved in some short quality educating and training programs have not sufficient understanding, as they lack true experience and qualifications. This finding is consistent with the work reported by Zairi (1996) who stated that many Middle Eastern countries put more emphasis on ISO certification than any other quality initiative. These are not surprising findings since the quality movement in the Arab World, and particularly Libya, have a short history. However, companies in Libya should not jump on the bandwagon without adequately examining the potential problems, issues and real meaning involved in the implementation of these quality initiatives, because some potential difficulties can be raised due to the different environments of each company. The researcher believes that, top managers need to understand that ISO 9000

certification is only the beginning of a continuous improvement process rather than the end and could be a useful stepping stone for TQM. Although, many respondents thought that bringing QMS to the maintenance area helps to get benefits in the form of such improvement, for example, an effective documentation system in addition to good communication could increase the efficiency and effectiveness of maintenance activities. In this respect, it is difficult to recognise the improvement made by the quality system at any department in just a short term of implementing a quality system; any such programs need a long period of time for thorough assessment. In other words, commitment to continuous improvement is the key element of getting high quality performance and productivity.

To participate some TM members were claiming they have had sufficient knowledge about all management matters including for example TQM and ISO 9000. Consequently, some top managers thought that there was no need to attend and participate in education/training programs. This implies that some managers had not understood the quality philosophy and even the management rules in general; this limited understanding leads indeed to unawareness of quality and to the lack of recognition of its benefits too. MM, despite their acknowledgment that they lack full quality awareness and understanding were very enthusiastic to get better through more education and training programs by consultants and professors in quality issues. MM are required to have more lectures, workshops, and training programs in order to improve the understanding of quality across the orgainsational levels of employees including top management and other management levels.

Thus, the majority of responses from both interviews and questionnaires in the two organisations have emerged that there is a shortage of an understanding of quality systems and benefits. This finding is consistent with what was written in chapter 2 where some authors such as Nagi & Cheng (1997), Rohitratana & Boon-itt (2001), Bhanugopan (2002), Masters (1996), Amer & Mohd Zain (2002) and MacDonald (1992) have mentioned that the inadequate knowledge and understanding of quality management systems could work as a barrier faced by those organiations who adopt implementation of quality management systems. Walsh, et al. (2002), Al-Khalifa & Aspinwall (2000), Salegna & Fazel (2000), Amer & Mohd Zain (2002), have cited that one barrier encounters an organisation in the way of adopting quality is the lack of awareness and misunderstanding the benefits of quality management systems. Wong

(1998) highlighted that many of the quality programs implemented in developing countries fail due to a lack of real understanding of the concept.

According to interviewees, the reasons why these findings are found in the case study organisations are; top management believes that understanding quality is not their concern's priorities. This means, TM are lacking the required awareness of what importance the understanding the quality issue is, and thus they do not fully commit to its programs. As a result, the organisation did not introduce a complete and sufficient education program in quality to all managers and employees. Top management also did not pay enough attention to learn and educate the middle managers and employees to make them understand quality programs and their benefits. They thought it is enough to train just a few people to become the seniors of quality and then the organisation relies on them. However, TM did not provide sufficient training and educational programs in quality even to those few people to make them able to transfer knowledge & skills to every one else. It was noticed that almost no respondents in the two organisations, have recognised clearly the benefits of quality management systems, because the top management did not communicate the related information (negative or positive) about the issue to all employees and even middle managers.

It is implied that, TM was looking at the understanding of quality issues as the quality staff responsibility, hence as a management function and therefore, managers did not recognise the need to involve employees from the beginning of the quality system adoption. This finding has not been found in the literature review, it is limited to this research. Top managers believed that, awareness and understanding of QMS would transfer gradually to the employees through their managers and supervisors, however these people themselves need to have more understanding of quality issues to be able to educate or train the others. The researcher believes that the understanding issue depends highly on two main factors, training and experience; these topics will be discussed in the following subtitles.

6.1.1.1 Training programs and quality management

From the findings, there were not sufficient quality training and education programs for the employees and even managers. Despite some respondents mentioning that there were some training programs, the maturity of training programs was very low. The reason for this was the overall immaturity of the entire QMS, which according to the

respondents they have just started to adopt. Hence, they have not a sufficient background and experience to build the training programs upon. It was noticed that the selection of trainees was subjected to special considerations in both CSOs and was very political. The selection was subject to relationships and power relations rather than based on experience and suitability for the job. That selection of trainees made the training programs with respect of employees useless, (the trainees have not achieved the desired improvement in their skills and performance). furthermore it made them unsatisfied and feel frustration about what they called "distinguishing" which reflected on employees' morale and then on their performance in general. This finding is limited to Libyan environment and has not been raised before in the literature reviews which make it distinctive in this research.

The research revealed that, both CSOs have lacked a specific training program to focus on the maintenance area. A respondent in the maintenance department expressed that: "I am unhappy with working in this organisation because my staff and I have not gained any kind of training, even though we as technicians usually need development". Some training programs were actually without prior planning and with a rather cloudy mission. The respondents also pointed out that the numbers of trainees between departments was also not subjected to the real needs, which means there was no analysis of training needs. Actually, there was no analysis of training needs, according to some respondents. When asked about training needs, and then programs, some quality members, managing directors, production managers, in addition, a few supervisors in maintenance department from both CSOs, have agreed that the qualifications, skills and knowledge of most engineers was rigidly relying on technical skills. In consequence, this meant that, engineers found difficulties when involved in managerial positions and situations. Therefore, training in people skills was seen by the respondents as very important in order to improve maintenance processes in the shed of a new quality system. What is needed is a good balance of technical skills and managerial skills which can be done through specific training programs. This finding is consistent with Taylor and Christensen (1998) who cited that, "with their engineering focus, maintenance managers and technicians possess highly technical skills, but sometimes lack the communication skills to ensure safety in today's complex operations".

According to the respondents, there were some remarks made by the engineers and supervisors that their immediate superiors were ineffective managers, for that it was

recommended that persons promoted to head any departments or units must be well trained on how to manage. Regarding the training issue, the researcher suggests that both organisations need to conduct a comprehensive training needs analysis of all its employees. Training all the employees with the appropriate skills and knowledge make them able to do their tasks efficiently.

The finding of this research supports the finding of many authors such as Nagi & Cheng (1997), Oakland (1997), Tamimi & Sebastianelli (1998), Masters (1996), Adebanjo & Kehoe (1998), Amar & Mohd Zain (2002), Al-Zamani et al. (2002), Sayle (1994), Whalen & Rahim (1994) All these authors and others are insisting the very need to training programs in any business and advocating that, the lack of sufficient quality training and education have a negative effect on the quality of business. They also agree a lack of quality training and education programs are the main obstacles any organisation faces in the way of getting improvement. The maintenance area is more concerned with training issues due to its "technical functions" nature compared to other departments. Consequently people in the maintenance department need to be well educated and trained.

The implementation of any new program means more involvement and teamwork, which require more responsibility and a greater level of skill and knowledge by the workforce. This should be achieved through proper, formal and systematic training and education. Depending on the needs of a particular organisation, training and education should cover the entire workforce as part of an ongoing process and more attention should be attributed to maintenance management techniques and quality management issues.

Many members of maintenance staff in the case studies need to be trained in aspects of maintenance operation tasks such as; maintenance document procedures, problem solving techniques, SPC, CMMS, continuous process improvement, benchmarking, process analysis, team development, etc. this direction is advocated from many authors such as; Al-Muhaisan & Santarisi, (2002); Mostafa, (2004); Kelly, (1989); Raouf, (1994); Duffuaa & Ben-daya, (1993); Bakerjan, (1994) and Davis, (1997). Once these basic, and more advanced, skills are acquired by managers/supervisors, they need to apply them in their workplace. As they become more familiar with the concepts and their applications, they can apply their skills to improving, for example, the staff

effectiveness of their departments and pass the knowledge and understanding on to the rest of the employees. In that way, the change process is phased into the organisation.

6.1.1.2 Experience in quality management

The majority of respondents from both CSOs were admitting that their organisations were lacking the experience/expertise in quality management. They of course referred to the relative immaturity of QMS in their organisations and in their country as well. The quality issue was known and adopted in Libya for just a short time. Only a few companies now have adopted quality programs for instance, the ISO 9000 approach (Libyan organisations started the certification in the late of 1990s). It is clear therefore, Libyan organisation have faced the paucity of experience/expertise in QMS in general. The finding is consistent with Oakland (1997), Nagi & Cheng (1997), Dale (1994), and Amar & Mohd Zain (2002), who all mentioned the importance of experience and expertise in quality for generating business within the organisations. Furthermore, those authors classified the lack of expertise/experience in the main quality management difficulties and barriers.

In the maintenance area, lack of knowledge or experience is one of the most clear local factors leading to maintenance error. In relation to this matter, there were several errors in maintenance in both CSOs, which is caused by a shortage in skilled and experienced people. This finding is consistent with some authors, for example, Reason & Hobbs, (2003); Bakerjan, (1994); Kelly, (1997); Davis, (1997); Nakajima, (1988); Cholasuke, et al. (2004) and Ingalls, (2000) who all have stated that the knowledge and experience are very essential factor to make the maintenance staff have a sufficient capability to do their jobs correctly. The way a maintainer approaches a task will be greatly influenced by whether it is one that he or she has done many times before or is performing for the first time. It is well established, for example, that the time taken to perform a maintenance task decreases the more often it is carried out. This does not mean that senior maintenance personnel will not make mistakes caused by a lack of experience. The lesson for management is that tasks that take workers into unfamiliar territory need to be managed with particular care.

6.1.2 Leadership and management commitment

From the interviews, the majority of respondents confirmed that, the wrong people are in the wrong positions by the criteria of qualification and experience, it means there is

no effective leadership (effective leadership means that the managers have had the ability to lead an organisation to getting success) in the organisation. This finding is triangulated also by the questionnaire responses, where more than 72% and 75% of respondents from CSOX1, CSOX2 respectively agreed to the lack of effective leadership. Asking about the evaluation of leadership and top managers was a slightly sensitive question in the CSOs. As a consequence, some respondents tended to avoid answering directly, and hesitated in which they were appearing very diplomatic. According to the seniors of quality at TM in the two CSOs, some managers (at different levels) were avoiding to express their opinions because they were afraid of the consequences. For instance, if something wrong was noted or recognised in an organisation, (typically related to policy, performance and productivity) managers who criticised or demonstrated a different opinion could lose their positions as a result from TM and/or Ministry of Industrial or/and any other related government bodies. According to the interviewees the reasons why these results are found in CSOs are primarily due to; the designation of top managers, which is usually under the state's control. Under this system, the decision makers are always coming from outside of the organisation. The problem is that most of the designations were not subjected to qualification and experience (standard work conditions) but they were affected by the relationships and sometimes political considerations. This finding was triangulated with some document records that showed the qualifications of some TM were low.

In Libyan organisations, autonomy varies from organisation to organisation depending on the standing of the chairman and his personal informal relationships with the Ministries and governmental bodies, such as the Ministry of Industry and Libyan Central Bank. It is an implication here that bringing people from outside may include some who have no related experience and suitable qualification; this may direct the company to a risk situation, in addition, people from outside despite the high probability that they are inexperienced and unqualified (as the effect of social, political consideration) may lack the spirit of leadership responsibility if they were appointed at high positions in the organisation. The findings are consistent with Dale (1994), Nagi & Cheng (1997), Al-Khalifa & Aspinwall (2001), Tamimi & Sebastinelli (1998) and Amer & Mohd Zain (2002), who have referred to the essential effect of leadership in any organisation, leadership can lead the organisation to success or failure. It depends on how do leadership deal and manage such an organisation in different situations, hence, inefficient leadership works as an obstacle or barrier on the way of improvement.

Respondents in both CSOs indicted that, there are people in TM and MM levels who have had a low qualification grade (did not finish the secondary school study), others are qualified in unrelated fields such as history, geography, and even teachers of basic schools! A manager said, "The appointment of the managers and employees in the organisation is based on social, tribal and friendly relationships rather than qualifications and experience". This finding supports the previous results; Lack of knowledge and skills of top management work clearly as a barrier that can affect quality management in an organisation, which was found by some authors such as Al-Khalifa & Aspinwall (2000), Adebanjo & Kehoe (1998), Amar & Mohd Zain (2002). These authors also insisted that leadership in any organisation should have an adequate amount of knowledge and skills.

The research highlighted that in both CSOs the traditional style of management is still prevailed, every department has major responsibilities and work separately to the other departments in which top down management approach is dominant. Hence, the decisions always concentrated in TM level particularly the director general who claims the ability to understand anything related to the business, for instance, plan strategies, coordinate the activities, define problems and suggest its solutions, evaluate performance, etc. in fact, the director general based on the centralisation culture, tends to impose his opinion in the forms of instructions and commands rather than to share ideas and information with other managers.

The research revealed that top management in the CSOs do not really support the quality system, for instance, they ignored most quality team recommendations and notes. They also did not allocate enough resources for quality programs. However, despite the fact that TM was recognising the importance of issues they have encountered some problems such as unavailability of resources in the forms of funds, relevant skills and qualifications. Nevertheless, some top managers showed considerable enthusiasm to support quality in their organisations, however, some internal documents in the quality office showed the opposite, which means TM support was more words than action. As a few respondents expressed contrary opinions and mentioned that TM supports and commits to quality programs, the implication here, TM support was just for getting ISO 9000 certification, instead of keeping continuous commitment and support in which quality programs should be seen as a continuous improvement program.

The respondents who are seniors of quality in the two CSOs have insisted that TM does not pay more attention to the recommendations of management review reports. Those respondents advocated that some managers feel very sensitive when they were asked to comply with the recommendations and notes of a monthly management review report. This is because they considered such recommendations as an intervention in their business which they claimed they were very understanding and qualified enough to do. This implies that most managers in CSOs were escaping from the direct evaluation and trying to avoid any kind of work monitoring. This fact was advocated by frequent related comments found in the internal documents in the quality office, it seems to be that some managers usually do not accept critique from others.

The finding is also consistent with many authors' perspectives. Those authors have considered the lack of commitment from top management to QMS as a barrier that encounters some organisations when they adopt and implement any quality systems. Authors such as; Nagi & Cheng (1997), Oakland (1997), Al-Khalifa & Aspinwall (2000), Rohitratana & Boon-itt (2001), Masters (1996), Bhanugopan (2002), Schein (1991), Walsh et al. (2002), Amer & Mohd Zain (2002), Al-Zamani et al. (2002) and Dale (1994) have insisted the crucial role that top management can successfully lead their organisations if they are very committed and supported quality systems and vice versa. Furthermore, Hamali (1999) found that one of the problems initially faced when starting the QMS was the lack of commitment, the staff believed that QMS would mean extra work for them. Managers in the two cases, particular top management, consider the quality staff who are working in the quality assurance office or/and quality control office to be obliged responsible to do the work.

This research revealed that the reasons behind the lack of TM commitment exist in the unstable situation of the management structure and managers' positions, in addition to the effect of external interventions from the state which make managers unconcerned with the actual mission of the organisation, because they feel unstable and at any time they might be out of their positions without any significant cause. This finding is unique, as it has not been reported in the literature review.

Therefore, it is not enough for managers to manifest their commitment verbally for any improvement programs. It must be transparent throughout the whole company through adequate support, monitoring, coherence and priority given to continuous improvement

in quality. Management should actively share the ideas, listen to their employees, and check progress. In general, without appropriate leadership, quality management will not succeed; only dynamic leadership can create the commitment to drive the QM strategy.

6.1.3 The organisational vision and mission

The researcher believes that, it is necessary to develop a common understanding among managers and employees about what they want the organisation to look like in the future and what principles will guide the actions they take to achieve it. This should then become the basis for the establishment of the organisation's vision and values, which is currently, due to the researcher's experience, lacking in the Libyan manufacturing sector. Top management, however, must accept responsibility for, and commitment to the mission before communicating it to the rest of the workforce.

The majority of responses indicated that, there was no clear vision in the organisations, and maintenance's mission, needs and costs were not fully understood. The current mission of maintenance, according to the respondents, is to avoid as much as possible the frequent breakdowns. So, maintenance needs and costs are still affected by that view and restricted to the minimum impossible expenditure. This actually has narrowed the chances of improving maintenance processes. The respondents pointed out that the unstable situation at the governmental level is one of the main reasons of unclear vision. In Libya, the Green Book Theory (GBT) dictates laws and regulations, related to all activities in the country including manufacturing. Even though the GBT does not change, the application approaches towards the GBT change sometimes quite radically. Companies simply find it hard to predict such changes. As a result, the companies' vision and strategic direction was much obscured, which had a negative impact on maintenance. Even though some respondents from MD understood most maintenance needs, they could not tackle these issues properly, without full cooperation and coordination between all other related departments through the organisation. Typically, TM intend to just understand how much maintenance would cost them to keep the plants operating at a minimum level or how they can control the sudden breakdowns.

When a manager of a department was asked if the organisation had a plan which presented its mission and vision; he answered, "in fact the organisation's plan is only on paper, according to the government instructions" therefore, an organisational plan is faced with uncertain operating conditions. Planning is largely viewed as a paper

exercise and often is done to just meet formalities of the manufacturing ministry or government demand. The research revealed that vision and mission of organisations are not clear to all the people in both companies, including the managers. It seems that the top management is keeping the vision to itself, and does not try to make it be informed from the people who should be involved. As a head of a department said, "I do not know what top management is thinking and what they need to do. Their objectives are not clear to us; they have not discussed the issue with us as people with responsible positions in the organisation". This finding is consistent with so many other authors such as Thorsteinsson &Hage, (1991); Campbell, (1995); Mostafa, (2004); Davis, (1997); Hoffman, (2002) and Sharp et al., (1997), who all advocated that maintenance strategy (vision and mission) should be very clear to all the company's employees in order to get a sound improvement in any organisation.

By the nature of socialism, all firms in the country including these CSOs were completely relying on the state support since establishment until now. However, this support was subjected to the authority of external leaderships from out of the organisations, which meant the strategic decisions, most of the time, have been taken externally. This situation made the mission of an organisation difficult and uncertain. Therefore, it was not surprising to hear from some managers that the government support was very low and inconsistent or fluctuated. Consequently, it can be argued that the government does not encourage quality systems in general due to current legislations and rules. The applied current rules depend on the socialism view, which direct the mission of business sometimes to just saturate the social demand (produce goods or/and services as much as possible), this finding has not been mentioned in the literature review, it is unique as it limited to the Libyan environment. The focus was on how many products can be produced rather than its quality level. This happened although a plan, or mission, of each organisation exists. So, the deviation on such a plan/mission was allowed as a response to a social pressure. As a result, it can be said that both CSOs have not a clear vision; it seems to be variable according to the different situations. Hence, the mission will be affected directly.

From the previous discussion of the organisational vision and mission, it seems evident that they were non-existent beyond survival in both CSOs. This finding also supports the findings of some authors who have written about the subject, for instance, Nagi & Cheng (1997) mentioned that the managerial barriers of QMS include; lack of

manager's commitment, no proper vision and mission, high turnover/changes in key executives, and lack of leadership. Furthermore, MacDonald (1992) has mentioned nine key reasons for TQM failure, lack of vision and planning is one of them. Others such as Tamimi & Sebastianelli (1998), Masters (1996), and Dale (1994), have also indicated the importance of clear and applicative vision and mission for a company to get success.

6.1.4 Resources availability

Some respondents have seen that the top management deals with maintenance issue, as much as the availability of resources. Those respondents have recognised that there was a shortage in resources related to maintenance such as equipment, spares and funds. As a result, according to the respondents, the work in MD is limited by the resources allocated for maintenance, and hence the maintenance functions, focused on sorting out breakdowns as opposed to preventive or predictive maintenance.

The findings reflect generally, there is a shortage of skills, methods, analysis tools, etc. The reason for that shortage is due to the lack of TM care for maintenance and the unclear vision of the organisation as a whole. For example, the workforce was distributed within the departments, arbitrary, so always the number of employees in any department/unit is more than what it should be. However, instead of that overemployee, some departments and sections/units still need specific skills and qualifications. Both organisations also lack the suitable methods and the tools of analysis that ease conducting analysis of the desired quality. This shortage of methods and analysis tools is because the organisations have not enough experience in the quality field. Some respondents from three levels TM, MD and PD mentioned that the main resource, which they have missed, was the sufficient budgets, because most of the resources depend on it. For example, currently, CSOs were unable to provide some very important things such as advanced machines, instruments and methods/analysis tools etc. this finding supported the view that resources availability (tools, equipment, facilities and data processing) serve as a very essential factor in improving maintenance activities in an organisation. Authors such as: Al-Muhaisan & Santarisi (2002), Sharp et al. (1997), Reason & Hobbs (2003), Mostafa, (2004), Thorsteinsson & Hage (1991), Campbell, (1995), Raouf (1994) and Cholasuke, et al. (2004) advocated this direction as well.

It was revealed that it is difficult to get spare parts on time on several occasions; the reason according to the respondents was that spare parts availability depends on some

external and internal factors such as the allocated budget, stock control and the system of storing, which they found difficult to manage. In the current situation spare parts and most of the maintenance equipment and instruments are imported into the country, which of course depend on hard currency to complete the sanctions. Maintenance management, and even top management, in both CSOs did not have the authority to do that action freely, because of state control and difficulties of bureaucratic procedures. However, they sometimes tend to eliminate that pitfall from their responsibility by using a policy of blaming others. It was implied that there was an inadequacy in managing the available resources of maintenance effectively.

This finding is consistent with Tamimi and Sebastianelli (1998) who found several factors working against TQM implementation, one of them inadequate resources. It is also consistent with Masters (1996) who found the insufficient resources are working as a factor leading to ineffective TQM implementation. Al-Khalifa and Aspinwall (2000) mentioned that an obstacle faced implementing quality in Qatar was limited resources to implement change. In addition many other authors such as, (Oakland 1997, Amar & Mohd Zain 2002, Whalen & Rahim 1994, Sayle 1994, MacDonald 1992) all insisted that the lack of provided resources are considered to hinder quality management implementation.

6.1.5 Maintenance procedures: documents, housekeeping and benchmarking

Poorly designed procedures are a common source of maintenance error. Reason and Hobbs (2003) mentioned that unclear cards or vague procedures were among the main reasons for deviations from maintenance procedures. There are many reasons why people choose not to use written procedures, not the least of which is that it is very hard to read and to do the job at the same time, it also depends on how the workforce perceives the risks associated with a particular task. From the findings, there was a basic system in the form of checklists on how work was to be performed. Recording the work steps is relying on the staff to work individually; some people do not follow the rules and ignore recording activities. As it regards managing maintenance activities, some forms of procedures for the maintenance work exist in the organisation. Nevertheless, TM and MD also believed that sometimes it would be difficult to subject their work to any standardised procedure. The rational for this belief was the nature of the maintenance work, which varies from one to the other. Some work is too complicated

and needs a long time to finish maintenance activities include many different jobs (each job has its own circumstances and enablers for the work success).

A question asked to maintenance staff if they comply with the written procedures in doing tasks, they answered sometimes they chose not to comply with procedures due to the reason, if they follow the letter, the job would not get done; people are not aware that a procedure exists; people prefer to rely on their own skills and experience; and people assume that they know what the procedure is. Actually, there are no formal (proper) audits conducted in the maintenance department in both CSOs; there are only some simple checks on the status of their task regarding the progress made and discussion on problems faced. Whatever ways MDs in the two CSOs do work, this is normally passed verbally (on memory) or on some form of checklists, usually by the person who perform the tasks plus the relevant supervisor.

It was noticed that no proper preventive maintenance has been established, which affected the maintenance function and processes. Actually, it was meant by this that the preventive maintenance procedure had not been documented accurately and the work done was not recorded completely. This is consistent with some authors' beliefs such as Al-Muhaisan & Santarisi, (2002); Kelly, (1989); Duffuaa & Ben-daya, (1993); Mostafa, (2004) and Ben-daya & Duffuaa, (1995), who all advocated the importance of the preventive maintenance and equipment history in improving the asset availability. Consequently, without the proper information, recording and documents, monitoring of the maintenance operations and follow-up were so difficult. Possible implications are that there is no certain procedure to be followed in doing a preventive maintenance, and no full commitment from TM or/and MD to processing correctly all maintenance operations, furthermore, the focus was on corrective actions rather than preventive and predictive actions.

Regarding the findings of this research, the urgent jobs were carried out collectively by all people who were involved in the maintenance functions and operations despite the current formal legislation routine. It was because the formal steps take a lot of time and sometimes it was impossible to find all the persons who are specialised in particular tasks in their work place. MD mentioned that from their experience, carrying out the urgent job directly is better than relying on the current procedure routine. It was noted that it is very common to see all the people, even if they are from different departments,

participate collectively in such urgent jobs. It is of course, a Libyan culture effect (collectively). As this action has its advantages there are a disadvantages too, for example, coming to the place of such a job in the same time and with so many people may affect the work negatively by hindering the free movement of processes. However, the co-ordination and co-operation was not adequately addressed between the different departments through the CSOs organisations.

In CSOX2 for example, the respondents (such as, general production manager, maintenance manager, heads of mechanical and electrical division in maintenance department, in addition to some maintenance supervisors) have recognised that when some breakdowns happened in the same time at different pieces of plant, the work was highly chaotic. Due to the limited skilled people in some maintenance tasks and the lack of active communications between the different sections and units in MD, maintenance management failed to coordinate and distribute the required maintainers across the different pieces of plants in the same time. This meant that the central maintenance system failed to address breakdowns at different plants at the same time, this finding is unique, as it has not been referred in the literature review. Furthermore, a member of quality staff in CSOX2 said, "there were no research/studies related to quality in maintenance area that can help the organisation to overcome some encountered obstacles". Lack of studies related to quality in maintenance, according to quality staff respondents, could be considered as one of the difficulties affecting quality in maintenance within their organisation, this finding has not been reported in the literature review which means, it is limited to this research. This means no attention has paid to improving maintenance in general and to continuous improvement in particular.

Latent conditions arise from the strategic decisions made by designers, manufacturers, regulators and top-level managers. These decisions relate to good setting, scheduling, policy, standards, the provision of tool and equipment, and the like. Each of these decisions is likely to have some adverse consequences for some part of the system lack of experience & skill, shortage of resources and so on (Reason & Hobbs, 2003). In summary, maintenance departments have to change the human condition when they should be changing the conditions under which people work and should be treating errors as an expected and foreseeable part of maintenance work.

6.1.5.1 Documentation

From the interviews, it was revealed that in both CSOs the work procedures at maintenance departments were not fully documented and sometimes tasks were done based on memory. Another problem faced, initially when trying to implement quality in maintenance, according to the maintenance MDs, was finding time to document the procedures. It was said that it was quite a challenge to get the staff 'technicians and tradesmen' to sit down and write what they had been doing, this was because the staff regarded the system as an additional task on top of their day-to-day work. Furthermore, a sound reason could be implied after lack of maintenance staff commitment to document is most of the technicians and tradesmen were poorly educated, even in local language, the majority could not read or write in English taking into consideration the high percentage of maintenance operations in addition to the quality documents, reports were written in English.

As maintenance jobs typically start and finish with documentation, documents not only convey instructions about task performance, but also play an important part in communication by recording the completion of tasks and the extent of system disturbance. Documentation may guide performance on new or unfamiliar tasks, but as people become more familiar with a task, they are less likely to refer to the paperwork. This has its risks, particularly if procedures change. For the importance of paper records in maintenance, it is not surprising that poorly designed documents lie at the heart of many incidents. In this direction, authors, Sharp et al., (1997); Thorsteinsson &Hage, (1991); Campbell, (1995); Mostafa, (2004); Al-Muhaisan & Santarisi, (2002); Raouf, (1994) and Reason & Hobbs, (2003) have mentioned the great role that documentation and recording can play to approach the desired maintenance improvement in an organisation.

Procedures that are ambiguous, wordy or repetitive are likely to promote violations. While rewriting an organisation's documentation may not be a feasible short-term objective, some improvements can be made incrementally is simplified English, for example, can make the language of maintenance documentation clearer and more accessible, particularly in the case of staff for whom English is second language (AECMA, 1989). Importantly, some instructions procedures in maintenance (particular what are related to the machines) were in English, a consideration that some people could not understand English language. This finding is consistent with the

recommendations of Association European for Constructers of Material Aerospatial reported in 1989 (AECMA, 1989).

6.1.5.2 Housekeeping

The house keeping practises of an organisation reflect beliefs about people and how they, do their jobs. Poor housekeeping and tool control practises increase the chances of mistaken assumptions and memory lapses. The way tools and components are arranged and stored is not just a matter of convenience. It is an important form of communication that provides situational awareness and reduces the chances of error. In this issue, the researcher believes that, two main questions maintenance staff should always bear in mind, are work areas tidy? and are disassembled components stored and labelled in appropriate ways?

Generally, people in both CSOs seemed to be unaware of the importance and role of housekeeping policy, particularly in the maintenance department; they believe cleaning work places is the responsibility of people that were already appointed for this purpose. However, they have to recognise the effect of poor cleaning, organisation, neatness and discipline on maintenance activities (such as machines, equipment, instruments, replaced parts and lay out of all of them). Consequently, in absence of one or some of those activities a negative effect on efficiency and effectiveness of maintenance takes place. By the observation it can be said that there was no real existence of good housekeeping in both organisations, furthermore, the 5S terminology was mostly unfamiliar to all people. This finding is consistent with some authors' perspectives, Reason & Hobbs (2003), Al-Muhaisan & Santarisi (2002), Mostafa (2004), Ho & Fung (1994), Osada (1991) and Senju, (1992) have mentioned that, poor housekeeping and layout arrangement affect negatively in quality of maintenance in organisations.

6.1.5.3 Benchmarking

It has been recognised that in both CSOs there was no benchmarking technique against advanced comparable organisations, which had an effect on quality in general and in the maintenance area. For instance, there were no intercommunications with any similar organisations out of and within the country and no chance to share and/or exchange the views and ideas about the company activity. The possible reason was the lack of existing (advanced) organisation locally and no contact with other similar foreign organisations which was faced by a financial and administrational difficulty.

Benchmarking and auditing are very important issues to promote continuous improvement in an organisation.

Thorsteinsson &Hage, (1991); Al-Muhaisan & Santarisi, (2002); Raouf, (1994) and Richard, et al., (2000) have indicated to the importance of auditing and benchmarking in an organisation to achieve the quality target. Benchmarking is a powerful management concept that is usually linked to QM. It is seen within the context of TQM as an accelerator towards achieving TQM by learning from the best (Al-Khalifa, 2000). Benchmarking is more than a way of gathering data on ones own company and comparing it with others to improve processes and hence meeting customers' expectations. Its processes provide a management tool for measuring and comparing parts of an organisation against the best which leads to excellent performance on a continuous basis.

6.1.6 Coordination and cooperation

In agreement with Predmore and Werner (1997) senior maintenance mechanics identified the most challenging part of their job, was "human relations or dealing with people". It was evident that each department in CSOs had its privacy on dealing with people; Libyans, as most Muslim people, always tend to work with team spirit in groups. However, according to respondents from two CSOs, in the maintenance department sometimes there was a conflict between engineers, technicians and tradesmen during doing jobs, when some interventions from three or two groups have taken place. In other words, when two or three parts are doing the same task in one place at the same time, conflict happened. For instance, some engineers were very sensitive to work under the supervision of technicians; engineers simply believed they are on higher level than the technicians. Some technicians and tradesmen have a feeling that their work experiences are better than engineers! It is common to see engineers, technicians and tradesmen doing one task together by the nature of maintenance job overlap. Consequently, if the job descriptions, jurisdictions and functions are not very clear, mutual conflict had a way to appear, and when this happened the work was disturbed. This implies the sensitivity between that groups possibly advocated by such bias towards engineers from TM as a reflection of culture issue; this is consistent with Bait-Elmal, (2000) who found in his study that there is a bias towards engineers in the culture of the industrial (manufacturing) sector in Libyan environment.

It has been noticed that co-ordination & co-operation between the different departments within the two organisations is low. However, co-operation sometimes was freely undertaken only during some urgent cases. The reason is due to the collectively culture effect. Co-ordination & co-operation through all departments in both organisations were not at the desired level. These findings are advocated by many authors, for example, Amar and Zain (2002) uncovered eleven factors seen to be barriers against the successful implementation of TQM in Indonesian manufacturing organisations, the factors are: human resource, management, attitude towards quality, organisational culture, interdepartmental relations, materials, machines, equipment, information, method, and training. This finding is also consistent with authors such as Oakland (1997), Nagi & Cheng (1997), and Whalen & Rahim (1994).

Some respondents in the maintenance department in both CSOs indicated that the current organisational policy distinguished operators from maintainers (no equality). They thought that the current organisational culture and the attitudes of all managers often supported this direction. Hence, operators from the production department are usually more appreciated from top management in comparison to maintainers, even though maintainers usually have the higher skills! This favouritism made the collaboration between these two departments very sensitive and some times quite negative. This finding is unique and has not been indicated in the literature review. TM was very concerned about the production department, most of their attention was focused there, and this made them blind to other functions and activities, including maintenance. In the current situation, the maintenance function was not outsourced and each CSO has to generate their maintenance in-house.

Reason and Hobbs (2003) indicate that coordination problems such as misunderstandings, poor teamwork or communication are very important. In addition, in many cases, coordination breaks down when people make unspoken assumptions about a job, and fails to communicate with one another to confirm the situation, because sometimes maintainers fear that they will give offence if they are seen to check the work of colleagues too thoroughly or ask too many questions. Hence, the coordination and cooperation between different departments in both CSOs were not addressed well and still under the level, this matter has had a great effect on efficiency and effectiveness of maintenance operations, this finding is consistent with Thorsteinsson &Hage, (1991); Reason & Hobbs, (2003); Campbell, (1995); Mostafa, (2004) and Sharp

et al., (1997) who insisted that maintenance to be effective and efficient, cooperation and coordination between all related department and sections should be highly activated.

6.1.7 Communications and management information system

Regarding the concept of quality, for a company to achieve successes in the quality management it needs a better information system for reporting the changes in the maintenance and production parameters in the shortest possible time. Therefore, information system (IS) contributes greatly in the success of the quality programs (Riis, et al., 1997; Raouf, 1994; Coetzee, 2000 and Duffuaa & Ben-daya, 1993). From the findings, there was only a typical paper-based information system. For example, there still were no Internet services in CSOX2, due to technical difficulties. Because information is an essential resource for setting and meeting management objectives, the role it plays within the organisation is of vital importance as it helps to build knowledge and measure the overall performance of the organisation. As a result, information systems are no longer used to supply support to the operation of a business, or in the case of maintenance, to collect and analyse data. The IS must contain modules that can provide management with value added information necessary for decision support and decision making. For example, computerisation of the maintenance management activities can improve the quality of equipment maintenance, which improves the working condition of the equipment. It was noticed that both CSOs have not used the information technology system, which means so many advantages of that system were missed. This finding is consistent with many authors who considered the information technology system is very important in a maintenance department to facilitate all maintenance tasks in an optimum level (Riis, et al. 1997, Raouf, 1994, Coetzee 2000, Duffuaa & Ben-daya 1993, Mjema & Mweta 2003, Kelly 1989, Fernands, et al. 2003, Mostafa 2004, Wilson 1999, Ingalls, 2000 and Cholasuke, et al. 2004).

There is an increasing recognition that non-technical skills such as delegation of tasks, communication, management and leadership are as important within maintenance operation (Reason & Hobbs, 2003). As Al-Khalifa, (2000) mentioned, regular and effective communication is necessary for all phases of the change process. This will enable the new change to be clarified and to ensure that those who will be affected by the change are kept informed from the early stages, about progress and about their particular role in the process. Communication therefore needs to be managed coherently

and honestly. Performing in a team requires more than technical know-how, and should often overlook the need to develop the important communication and people skills. The research revealed that, strategies and methods were not clearly expressed in the maintenance area and communicated to the relevant units. In addition, those methods often were not communicated on time. This finding is limited to this study and has not found in the literature review.

It was noticed from respondents (such as seniors of quality and some maintenance department supervisors in both CSOs) that there was no availability of options/choices to contact other organisations who are specialist in maintenance work. Perform maintenance work in the organisation for instance by external part (out-source maintenance) can make the maintenance work faster and sometimes reduce the overall maintenance cost. This implies that contacting external parts may open the door for competition and knowledge/experience sharing, which had a positive impact on the quality of maintenance.

Regarding the finding, both CSOs were lacking a good communication and information system. Consequently, the maintenance operation as any other activities was affected negatively in which the work has slowed down. This finding is consistent with some authors' opinion such as Oakland (1997), Nagi & Cheng (1997), Salegna & Fazel (2000) and Al-Zamani et al (2002). These authors also mentioned that ineffective internal and external communication networks in an organisation put a lot of barriers in the way of improving business.

6.1.8 The work environment and employees' confidence

Concerning employees and managers, the organisation could hardly be described as satisfying them. Work conditions were poor: wages and salaries were poor in comparison with income in the private sector and standard of living in the country as a whole. These dissatisfactions were mentioned by many respondents in the two organisations. A respondent in the production department said: "most of the people in the organisation are dissatisfied with their situation. The organisation does not provide its employees with any work incentives or motivations". Consequently, the employees were not confident, the reasons were summarised by respondents as follows: poor climate at work, low salary, lack of recognition and rewards, inequality between employees, uncertainty in work future, instability, etc. for proving that difficult

conditions, a respondent in the organisations said: "I have been in this organisation more than 15 years, but if I find a good chance elsewhere, I will leave the organisation".

This finding is consistent with Adebanjo and Kehoe (1998), who studied TQM implementation in UK manufacturing organisations, and identified the quality problems as follows: worker evaluation lacks a systematic approach and hence salary adjustments are not commensurate with job functions. The finding is also consistent with authors, Oakland (1997), Nagi & Cheng (1997), Amer & Mohd Zain (2002), and Whalen & Rahim (1994) who advocate that the lack of employees' confidence in the organisation is the major problem against quality programs.

The work environment (external or internal) was very poor. The respect and appreciation of employees was the missing link, so some very necessary services were not available like, social areas, places for breakfast or lunch, soft and hot drinks and others. Among the most influential local conditions influencing work quality are the tools and equipment available to do the job. Equipment deficiency, most often a lack of correct ground equipment or tools, for example, a required tool may not have been available, leading to an improvisation. Many of the equipment problems resulted in hazards to maintenance workers themselves. The maintenance of maintenance equipment is itself a crucial task for management, yet one that sometimes does not get the attention it deserves. The very adaptability of maintenance workers is part of the problem. This finding has not been reported in the literature review, so it is unique for Libyan manufacturing organisations.

These very important factors made the respondents assess the loyalty of employees to the organisation as 'messy' and 'low'. Some respondents from both CSOs indicated that as a result of the low loyalty from employees to their organisation, two main features were noticed. Firstly, nonchalance (unconcern) of most employees; "unconcern" was often considered as a sign or a potential slogan of the majority of the employees. This unconcern has a serious effect on the work performance and then the quality of all procedures. Secondly, as a result of very low employee moral, the employees did not have enough enthusiasm to carry out their jobs. The managerial morale was poor too, since many middle managers resented the continued intervention in their work by the top management. Top management also resented the interference in their jobs by the governmental bodies like ministry of industry and so on. Top management, in general,

were recognising the interference they conducted from time to time in the departments and units' affairs, however, they returned that to the company situation and external governmental bodies that force them to do so.

It is tempting to say that both organisations failed to some extent to satisfy their interest groups in the long run, and consequently failed the test of organisational effectiveness. However, this failure to satisfy the employees should not be seen in isolation to the wider socio-economic and political context of each organisation. Because there are many reasons responsible for this failing that are out of the organisation's control. Therefore, it can be seen that a discussion of the impact of environmental factors on the quality management in the organisations is important. This will be the subject of the next section. As a result, further to the researchers' observations, some skilled people in the maintenance area have left the organisations recently. The possible reason, it was thought, for getting better opportunities in other places. It is an implication here that the employees were not satisfied due to their current situation, especially what was related to the salary and rewards, in addition of course to poor work environment. This finding is consistent with Reason & Hobbs, (2003) who indicated that "Frustrating circumstances in maintenance such as a lack of proper tools, delays and unreasonable pressures can all combine to cloud judgement with emotion".

6.1.9 Impact of socio-cultural factors on quality of maintenance performance

This research revealed that the impact of socio-cultural factors on quality of performance was very common. The personal and social relationships clearly affect the function of the management in these organisations. Therefore, in order to get a comprehensive understanding of the quality function, the external environment and its impact on management and organisation should be considered. As public sector, the CSOs are subjected to socio-political and economic impacts regarding their affairs and activities. In this sense, it can be argued that the inherent quality problem in the manufacturing sector can be rationalised in terms of what is designated as state involvement, economics factors, cultural and social relationships. Despite the changes, that Libyan society has witnessed during the last three decades, in its social, political and economic conditions as a result of the oil wealth, the tribal structure and social connections have played, and still exert, a significant role in this society (Mogherbi, 1998). The socio-cultural factors affect the human resources that the industrial sector

obtains from society. They also have an effect on the various services provided by the sector to the society in which they exist.

As some respondents indicated that, many employees are appointed according to social relations and nepotism more than skills or qualification, this situation helps to exist the continued corruption in forms of; increasing employees' absence, carelessness, lack of punctuality etc. This is consistent with Elabedy (1995) who found in his study that 32% of the people who participated in his study were appointed through social and personal relationships. Existence of these relations in such organisation hinders the management controlling and doing its functions successfully. Therefore, this could be a barrier in the way of getting quality performance.

Hence, even though the jobs were over-resourced, in general, some shortage in skills was still present. This situation made it difficult to manage both, people and processes, and respondents clearly recognised its negative effect on the organisation. However, these respondents acknowledged the wider social and cultural reasons for this situation and were to accept it. It is the government that forces businesses to absorb a huge number of redundant workforce and, this social approach has to be appreciated as an effect of Libyan culture, this finding is considered unique in this research because it has not been mentioned or reported in the literature review studies. Indeed this negatively affected the level of performance throughout all organisational departments. This implies that, maintenance work by the nature was more sensitive than other departments due to its special technical criteria. It is essential therefore to recognise that the technical and professional work is unable to be subjected to any other considerations (social, political and relationship), people who are working in this area must be professionally and technically qualified.

The top management knows what is going on very well. However, they have not done anything against those people who are absent or late or have no commitment because of their strong social relationships prevalent in the company and society. A respondent who is a head of a department pointed out that, despite the existence of some uncommitted employees in the department, their bosses do not like to punish them or to complain about them to the top management, because they have recognised early no action will be taken against them due to the socio-culture consideration. Respondents go far away to empathise with employees that because (for the respondents) most of the

employees are responsible for their families and no one like to cause problems to them. This finding is especially related to the Libyan culture and it has not been reported in the previous studies.

This research revealed that social relationships and politics are leading in organisational management culture. Tribal affiliation and social relationships are the most important factors in determining the choice of management members at different levels. These social relationships have an obvious effect on the management functions in Libya; this was expressed by Elabedy, (1995), as "there is a large effect of social relationships on the management processes which have created groups of people who have the same interests, advantages and benefits. These groups play an important role in reducing the effectiveness of organised management".

The research revealed that the organisational policy existing in the case study organisations was very disorderly, ambiguous and unstable, which highly affected the quality of performance, in general and in particular, in maintenance activities. There is a consensus about this fact from many authors such as Oakland (1997), Nagi & Cheng (1997), Al-Khalifa & Aspinwall (2000), Tamimi & Sebastianelli (1998), Amer & Mohd Zain (2002), Al-Zamani et al. (2002), Dale (1994), (2002),Whalen&Rahim (1994) and Sayle (1994). These authors and others clearly mentioned that the organisational policy has played a very crucial role in doing business, if the organisational policy was very clear and have enough flexibility to deal with all conditions and circumstances, a company has to be go forward and visa-versa.

6.1.10 Resistance to change

Although, everyone by nature could resist new changes in every day situations (at work place or in family) particularly when he/she has no previous awareness about this change, most respondents welcomed changes that could bring improvement and success to their organisations. Regarding the current situation in CSOs and according to what was discussed in section 6.1.1, both middle managers and employees did not have a full understanding about the quality system that the organisation adopted. They felt uncomfortable about their work and future due to a lack of understanding about how such change affects them personally. Some respondents have seen resistance to change from particularly lower levels in the organisations. The size of the current workforce is so much greater than actually needed and this factor made some employees (especially

unskilled and inexperienced) very worried about their future, because they are more subjected to elimination than others. Due to the 'over-employees' matter some people often were doing very simple tasks when the qualified one asked them to help. They also were free of responsibility, and had flexibility in attendance, movement and transfer at any time during the official work hours. Consequently these extra people tend to resist the change because they fear losing jobs, status affected, (improvement programs do not absorb unskilled people), they liked to keep their positions as they were stable, this finding is unique as it has not been reported in previous studies. The possible implications after that, resistance occurs because proposed reforms threaten the values protected by present arrangements. Those people actually had not a certain job to do, furthermore, they were inexperienced and not qualified, and so the organisation did not actually rely on their performance as they are considered just an encumbrance.

Pursuing change and transforming organisations is hard work. The researcher believes that many change initiatives could fail because cultures do not readily accept change and do not effectively anticipate the impact on human systems. Increasing the success of implementation strategies demands leadership in the management of resistance and it is important to map the resistance factors if leadership is to create a new context which will break the hold of the forces of resistance (Raymond, 2002 and Campbell, 1995). Executive leadership at the strategic political level must assure that all stakeholder employees have a clear vision about the nature of the change. They should understand the full impact of the change, understand the vision and be clear about expected outcomes. Leaders should develop guidelines for ethical behaviour and interactions, which includes development of a set of principles around how people are to be treated, informed, and listen to. This could insure that marginalised voices are heard and that a concern is demonstrated for the effects of radical change. Cultures with very strong traditions require clear signals about the commitment of leadership to avoid a crisis of legitimacy in the change initiative (Bait-Elmal, 2000).

Managing implementation success requires constant vigilance over forces working in the opposite direction, and requires constant adjustment to the implementation strategy to assure that genuine concerns are addressed and that outcome success is not sub-optimised. A feed back from MD pointed out a big cultural change was required by the QMS. Whereas in the past tasks were done informally, the QMS may force maintenance staff to follow certain procedures (discipline) and disclose information that has not been

available in the past. As a consequence, those respondents felt that the QMS created more constriction and more tension, which means in their opinion; it may not be enough to improve maintenance activities. The implications here are, those respondents in fact were expressing their opinion with respect of the lack of awareness and understanding of quality systems and its benefits. They were not educated or/and trained well in quality issue, they have not recognised the benefits could be gained if implementing QMS successfully.

Some MD managers believe that relying on a stable workforce is much better than frequent shifts of staff from one section/unit to another. The possible reason is working in one place with a determined task for a long time is making people very familiar to their jobs and leading to establish a common attitude for doing tasks smoothly. However, the implications after that were, some maintainers preferred the stability in their work environment, which means that they tend to resist any new program requires some changes in their current situation.

A respondent from the maintenance staff said, "Resistance to change from some middle managers was very clear, those managers feared losing their positions because they are actually not qualified and lacked the experience and skills". Some other respondents indicated that, managers at different levels might also have resisted change if they have not fully understood quality systems, benefits and their crucial requirements. Hence, some of the MM did not fully commit and support such change programs. This finding is consistent with Oakland (1997), Al-Khalifa & Aspinwall (2000), Amar & Mohd Zain (2002) who all advocated that middle management some times appear to have resistance against any change their company has to conduct.

It can be said that typical resistance to any change can exist from both employees and managers. It depends on how such change is introduced and the amount of involving people in that change, time and place of change are very important. Many authors recognised this issue and admitted that employee commitment has a main effect on adopting change in an organisation, Oakland (1997), Nagi & Cheng (1997), Al-Khalifa & Aspinwall (2000), Walsh et al (2002), Masters (1996), Salegna & Fazel (2000), Amer & Mohd Zain (2002), Dale (1994), MacDonald (1992) and Whalen & Rahim (1994). Thus, the researcher believes that the commitment from both employees and MM to any

change processes could be active only with full understanding of the mission and objectives of that change.

6.1.11 Maintenance performance and continuous improvement

The managers mentioned that the tools used to measure performance in the organisation were basically job sheets, time sheets and reports. The current performance measurement practices were criticised for being just reports of the departmental activities rather than an indicator of target achievement. According to the respondents, the current system failed to measure the department's effectiveness and efficiency. The measurement indicators were also seen as just a series of inconsistent measures that people have to fulfill and which did not add value to the organisation. Moreover, the measurement was perceived to be very subjective without measuring 'real' quality, in which the efficiency and effectiveness of maintenance can be measured. The current performance indicators could be easily manipulated by departments themselves, hence the data and targets can be adjusted to provide a wanted picture for the initiator of the performance report. It was suggested by some respondents that a performance measurement should incorporate best value principles in quality maintenance. This means, measuring and analysing the maintenance activities should be based on the quality principles and using appropriate methods including statistical techniques.

Almost all of the respondents in the maintenance departments were considering the job sheet as the basic tool that their management used to measure their individual performance. Most of the respondents at different levels (TM, MD, and PD) believe that the organisation needs to have a suitable performance measurement system to assess or evaluate the employees individually. Another suggestion was to adjust the maintenance performance measures and base them on outcome and result. Measurement should be made on how well maintenance tasks were managed instead of how many tasks were managed. There was a need, it was suggested, to design an instrument or technique that is more advanced than current practise and which can measure the quality of performance more realistically. The Manager of quality assurance in CSOX2 said that, "top management in many cases had no reply to comments (recorded recommendations) related to some difficulties that the organisation had encountered. And if TM replies, it took a long time". Hence, the decision-making process was very slow. Members of quality staff in both CSOs have mentioned that if the organisation likes to improve its maintenance function, top management should need to;

- be fully committed. Management should not just talk about the improvement but need to ensure that whatever was discussed and recommended gets implemented.
- be trained on how to manage the departments. It was said that if managers have the necessary management skills then they would be able to handle people and manage any interventions' activities.
- convince the staff that real change can happen and will happen.

In reply to a question that asked what improvement could be made in maintenance activities, the respondents pointed out that, there was a need to have a quality system that includes continuous improvement, benchmarking and measurement of performance. It is an implication here that the maintenance performance was not at the appropriate level.

The research uncovers that in both of these organisations there was no well-structured performance measurement system available for quality in the maintenance department and in all other departments as well. Most of the respondents interviewed were unsatisfied with the performance measurement of the whole of the organisation's activities, they concluded that the performance measurement in both X1 and X2 organisation do not reflect the actual performance of the maintenance department. It was said that the data could only reflect what is going on rather than how well things are going. It was also claimed that the performance measurements were subjected to some degree of manipulation by the department who reports them. This was thought to be so because variables were determined and data was collected by the respective departments themselves. It thus allows the department to pick and report only things that were advantageous to them. Therefore, it is necessary to have an independent body within the organisation that looks into what variables need to be measured and how the data is to be collected, this to ensure getting the right results. However, the most important element is how to manage and develop the suitable processes related to the results of such measures. The feedback from the interviews referred that there is no personal performance appraisal in either organisation, which means not enough recognition for the individuals' efforts.

The research shows the lack of recognition of continuous improvement program in the organisations as a whole and in particular in the maintenance area. No attempts were

made, for example to improve the quality of maintenance operations. The only control documents expressed in maintenance terms were the monthly and annual operating reports, which gave no indication of the organisation's maintenance performance as continuous integrated processes. Therefore, the findings in this study suggest that there is no tool, technique, or mechanism in the organisations to evaluate their performance. That finding is consistent with Reason & Hobbs (2003) who stated out "Effective error management requires a wide variety of counter-measures directed at different levels of the system: the individual, the team, the task, the work place and the organisation as a whole".

The majority of respondents strongly agreed that top management do not pay enough attention to improving maintenance. They were not looking to the maintenance activities as an integrated process in which the output of such process is the input of the followed one, this was triangulated by the questionnaire responses. It is in their opinion just a fire-fighting reactions must be done when any breakdowns occurred. This misunderstanding of the real function of maintenance made TM pay no attention to the continue improvement especially in maintenance area. In fact, TM think they have to spend much money if they conduct an improvement program into maintenance department, and no tangible benefits 'direct profit' could be earned. Top management therefore are looking to the maintenance from only the cost side, more than any others, for that reasons it is not in their priorities. On the contrary, some respondents were arguing that some top managers try to do their best for maintenance activities in general particularly after organisations certified to ISO 9000 quality system but the problem is latent in many external and internal factors such as; empowerment, instability, maintenance staff's skills/qualifications and available resources. The implication here is, even someone try to do their best but still be useless, unless no positive results have appeared. In general the majority of respondents mentioning that not enough attention has been paid to improving maintenance. Therefore, continue improvement in maintenance is still far away from top management priorities, as most managers in the TM level still have the traditional view to maintenance activities when maintenance is considered as a subordinate job. Top managers always have seen maintenance from the costs side rather than its possibility to add value and increase the organisational outcome.

Continuous improvement rather than it is one of main quality principles, it was mentioned by many authors such as Al-Muhaisan & Santarisi, (2002); Mostafa, (2004); Kelly, (1989); Duffuaa & Ben-daya, (1993); Cholasuke, et al. (2004); Ingalls, (2000); Nakajima, (1988); Ollila and Malmipuro, (1999); Juran, (1988); Bamber, et al., (2002); Sherwin, (2000); Riis, et al., (1997); and Al-Najjar, (1996) as a very important factor that can lead to a reasonable improvement in maintenance area. Continuous improvement usually is working as a progressive source to development; hence recurring maintenance activities can be done through addressing the improvement processes, identifying improvements, and reviewing documents and processes for chances to achieve improvement.

As a result of inadequate performance in maintenance, some work was delayed in both CSOs, but with some differences. The difference was about the amount of delayed work. Most of the respondents were referring to the lack of resources in the maintenance department, others referring to the inadequacy of maintenance staff performance. It was noticed from the organisations' documents in CSOX2 that the size of delayed work varied from pieces of plant to others and no planned procedure has been in place to deal with it. This delayed work, according to some respondents could work as a barrier to improving maintenance activities because always the allocated resources had to fire-fight current problems. So, delayed work accumulated gradually, which required a fast and enough attention from TM of the CSOs. This finding is unique as it has not been reported in previous studies of literature review.

It was clearly noticed from most of the interviewed managers in both cases that there should be a sound link between quality and maintenance activities, doing maintenance work properly and correctly means doing things right and doing the right things together in the same time, which leads to high quality performance. In the same way, members of quality in both CSOs asserted that, quality in maintenance is a very important issue. It plays an essential role to make organisations achieve a sound improvement, in both quantity and quality of products. This happen if the quality programs are integrated through all departments and sections in the form of total quality management. Furthermore, respondents from quality staff indicated that applying QMS in the maintenance area affects positively in a circulation of data related to spare parts and machine history through the principle of a factual approach system to decision making, where measurement, monitoring, analysis, and recording activities should be addressed

well. Thus, if the maintenance plant has an accurate measurement; very effective monitoring and precision recording system, analysing all of these activities properly will lead to appropriate decisions.

6.1.12 Management and employee involvement and empowerment

The issue of middle managers and employee involvement in decision-making and in day-to-day activities is at the centre of the QM concept. It is essential to empower the workforce to make decisions and to solve problems in their workplace since they are the closest to the problem and are in the best position to make decisions for improvement if they have ownership and authority of the improvement process. The findings are however contrary to that with regards to the limited empowerment of both managers and employees as a result of a high reliance on the centred management approach that is imposed by the government on CSOs. Therefore, for instance, managers in different departments cannot discipline or fire any employee without involving the top management, and top management itself cannot take action against employees freely because it is subjected to many factors such as the general policy of state regarding employment regulations, social relations and nepotism. This finding is unique, it is limited to the Libyan organisational culture and has not been stated in the literature review. This has resulted in formal control systems which were/are not useful in management; social connections and politics were prominent in the organisational culture.

The existence of external political and administrative mechanisms for implementing a central plan can be expected to affect the process and structure of decision-making in these organisations. It emerged from discussions with participants that they are under pressure from their parent Ministry, and other governmental bodies, such as ministry of finance and Central Libyan Bank. They all have the right to influence policy and require specific information. This administrative control is also accompanied by judicial and political control over the enterprise.

This research revealed that there was not enough empowerment to both managers and employees at both CSOs. This is consistent with authors; Al-Khalifa & Aspinwall (2000) and Salegna & Fazel (2002) who found that a lack of employees' empowerment was very considered factor to get success in adopting quality management systems. The research revealed also an unclear definition of the authority and responsibility. This is

consistent with Kilani, (1987) saying, "the absence of a clear definition of the authority and responsibility of various departments within an enterprise is one of the most serious problems which is facing Libyan public enterprises". Sharp et al., (1997); Mostafa, (2004) and Campbell, (1995) mentioned that to get an improvement in maintenance area, the accountability of maintenance staff should be identified and the relevant work undertaken.

6.1.13 External impacts and interventions

There was rich evidence to say that government interventions were really affecting the ability of these two organisations in achieving quality in general and in particular in maintenance. All of the times, decision making was slowed down (normally by the number of weeks expanded to months) because all issues have to be approved by top management, who is already under the external effect of state by the role. Top managers cannot decide directly to issues related to fund or resources, they first have to discuss that with such responsible people in high levels in government like ministry of industry and so on. Of course, this journey of decision-making takes a long time. Furthermore, some internal issues also have to wait before the next scheduled meeting is in session. This finding is pertaining to Libyan organisational culture; it has not been reported in the previous studies which makes it unique to this research. The staff and the managers of maintenance in two cases strongly insist that they have the professional ability to decide and determine the proper and correct action for some internal (organisational and technical) matters. In the maintenance area there are a lot of issues have to be sorted out immediately and even a little delay can cause a very concerned risk.

From the findings, government interventions were very common, In fact these interventions were expected due to the nature of the political regime (state socialism), however the concern should be on what benefits that the CSOs have gained, especially in which is related to resources and financial support. Unfortunately, most of those interventions were arbitrary and relied on political and social considerations; this meant it was unrelated to business objectives and requirements. In this sense, it can be argued that the management function and procedures are not at the desired level. Therefore, the implication is that, the efficiency and effectiveness of employees' performance in both CSOs are largely affected which then affect the quality of maintenance operations. Furthermore, such interventions of the state bodies in the companies' affairs, made managers in these companies lose their power and authority.

It is obvious from the above discussion that Libyan public manufacturing firms are very influenced by the state controls. These controls could be categorised into three levels, namely; controls at the supervisory ministry level (Ministry of Industry), controls at Finance Ministry level and controls at the central Bank level. The controls at the Ministry of Industry are maintained with a view to ensuring that the policies followed by the public organisations are consistent with national economic policy. The controls at the Finance Ministry level, has come about through the appointment of a "financial controller" for each organisation. This controller is responsible for periodically sending their reports to the Ministry of Finance, as they have to approve in writing each dinar spent in the organisation. The controls at the Libyan Central Bank (LCB) are for the responsibility of this Bank to provide and control the use of the hard currency which is used by the public organisations for importing raw materials, spare parts and operational requirements. This finding is limited to the Libyan organisational culture, it has not reported in the related studies. It was noticed that the impact of LCB on the availability of spares for the machinery was big, which affected maintenance operations.

From the above, the public manufacturing organisations in Libya are clearly under the state accountability. It is also true while the public organisations are under the control of the ministries, these firms, together with the ministries, are accountable to the General People's Congress (Parliament). Like other types of social organisations, manufacturing organisations must operate in some kind of legal and political environment. Political or legal factors influence the operation and function of the economic system to which they are related and vice versa (Bait-Elmal, 2000). Almost all of the respondents at both cases said that government interventions in the affairs of an organisation restricted the organisation managements' freedom to act. They also condemned the constraints placed upon the manufacturing sector by centralised laws and regulations.

Regarding the budgeting system, the budget of the Ministry of Industry and its organisations are subject to many restrictions and interventions from the government, such as the Ministry of Finance regarding capital and administration expenses budgets, and the Ministry of Economy and the Libyan Central Bank regarding foreign currency and operation budgets (e.g. raw materials and spare parts). The main emphasise in the budget plan is laid on production targets which are determined by the Ministry, based roughly on the organisation's previous year's budgets, and within the general framework of the country plan's requirements (Bait-Elmal,2000). Maintenance in this case has not

received the suitable care, consequently, the allocated budget for maintenance would be under the level, which means more relying on the breakdowns approach than any others for example, preventive, predictive and TPM. This of course affects the quality and improvement issues in the maintenance area. This finding is advocated by some authors such as Al-Muhaisan & Santarisi, (2002); Mostafa, (2004); Kelly, (1997); Cholasuke, et al. (2004); Ingalls, (2000) and Thorsteinsson &Hage, (1991), who all mentioned the shortage of allocated budget for maintenance activities, in the organisations, and its indirect negative effect on business in general. It is implied that TM have not recognised and appreciated the importance of maintenance in business. As a result, they usually tend to avoid spending much money in the maintenance area.

Salaries/wages and work incentive systems are other areas, which receive clear and direct intervention from the government with regard to management systems in the industrial sector. Since 1981, all the salaries in the public sector organisations are calculated according to law no 15 in 1981, which established 16 scales for wages and salaries, with a basic monthly salary ranging from 85 LD on the lowest scale, to 590 LD for the highest scale, excluding monthly bonuses. These salary after adding bonuses, range from 120LD to almost 700 LD per month before taxes. The main problem in this issue is that this law has not changed or been adjusted (even for inflation) since it was established about 24 years ago. A head of a unit/division said for instance, "Actually we still operate under the legislation of salaries and wages number 15, which was issued on 1981, our salaries are very low compared to the living level". The strange thing was that despite of 24 years after that time, no change in the salaries and wages have occurred. The respondents confirmed that this factor affected employee morale, confidence and performance, as a result of quality of all business activities including maintenance.

Indeed all of this has affected the performance and attitude of employees; this made some employees look for additional jobs to improve their income. In other cases, employees are absent or late or even leave their jobs early (Mogherbi, 1998). This issue was expressed by many respondents. One of them said, "One of our main problems is the lack of an incentive system and adherence to law no 15 in 1981, which has not changed since it was issued". This finding is unique as it has not been mentioned in previous studies.

As has been discussed in the chapter 4, political factors are central to the overall social structure of this country. This in turn affects the functioning of these organisations. The most prevalent aspects of state involvement over management can be exemplified through the two main aspects:

Structure of top management: The structure of the management in the two ogranisations is a reflection of the prevalent political structural system in the state. The government is involved through the top manager, who has the authority to do many things in the organisation. The ministry has the power to appoint the top manager of the management committee and its members. The responsible Minister also has extensive powers to suspend the top manager and the other members. Consequently, this management is neither capable nor independent in the functioning of its duty. Therefore, management in these cases has faced difficulties to manage, whether people or processes, through all of the departments. The structure of management in the maintenance department is a reflection of the TM structural system. TM was involved through all maintenance activities which mean limited empowerment of maintenance management and very narrow flexibility to involvement and participation.

The procurement function: A main area in which the government has significant influence is the procurement function of the organisation, particularly the external procurement; the kind of procurement which uses foreign currency to buy raw material, operational requirements, spare parts, external training programs, new machines and equipment etc. as a result maintenance is very affected, because most of its operations highly rely on foreign currency; buying spare parts, equipment and instruments and training programs, no local alternatives are possible. In addition to the difficulty of getting permission to import the equipment and spare parts from government bodies out of the organisation, the main other difficulty was the very rigid bureaucratic and formalistic system, in which through it all the relevant procedures will be carried out. This supports the finding that, bureaucratic and formalistic are very common obstacles are facing organisation when adopting quality programs according to authors Oakland (1997), Al-Khalifa & Aspinwall (2000), Amar& Mohd Zain (2002), Al-Zamani et al., (2002) and MacDonald (1992).

6.1.14 Customer requirements and feedback

Customer satisfaction still has not been addressed carefully in the organisation's policy in general (the paucity of goods/services during the near past directed the local customers' requirements in the country). However, the CSOs tried to take customer requirements and satisfactions into their strategy consideration. An organisation should have a good understanding of what the customer wants through keeping customer contact and obtaining customer feedback. It should be recognised that customers are not only those to whom organisations sell products but are also their internal staff. Managers at both CSOs clearly recognised that the current regulations and work rules were the main barriers to achieve customer requirements and satisfactions not only in maintenance departments, but also in the entire organisation. Current regulations and rules, which rely on the principles of state socialism, put some constrictions on the business competition and advocate the monopolistic policy.

Adebanjo and Kehoe (1998), who studied TQM implementation in UK manufacturing organisations, identified some quality problems such as, upper management does not insist on systematic measuring of customer satisfaction level and training programs. In an organisation it can consider MD as a supplier and PD as a customer. In this case good cooperation and coordination between the two departments is essential, for example involving maintainers when making improvement to such products help to get a fast understanding from maintainers to their maintenance operations after that. And making maintenance staff familiar with such change can ease the repairing and replacement functions, which contributes to the improvement and quality in maintenance area.

The research uncovered that no real feedback from both suppliers (maintainers) and customers (top management and production department) was found in CSOs. What was found just some informal notes in verbal forms from time to time between those departments. It is essential therefore, to monitor progress at every phase of maintenance functions and to identify the objectives that are being met. This also allows plans to be modified in the light of experience. A post-audit should be carried out to establish that objectives have really been met and to ascertain what lessons can be learnt for the future. The findings of this study concerning customers' requirements and feedback are consistent with some authors view such as Tamimi & Sebastianelli (1998), Nagi & Cheng (1997), and Adebanjo & Kehoe (1998) who considered the Lack of customer

requirements and feedback system one of the very important barriers facing the organisations in the way of adopting quality management system techniques.

In general, it appears that the CSOs could not satisfy both its suppliers (maintainers) and customers (top management and production department), due to the lack of commitment to a desired objectives of each organisation, because of the unavailability of the necessary resources that linked directly to a hard currency, which is out of the organisation's control. TM should be concerned with the customer and supplier's requirements, in maintenance area, effective factual relationships (coordination & cooperation) have to be addressed properly between MD and other related departments particularly PD.

6.2 Revising the theoretical framework (driving and restraining forces of quality in maintenance)

In the initial framework (figure 2.8), many key elements of quality, maintenance and change management were discussed. A definition of quality in maintenance was developed and the main barriers of quality management were stated. The key factors affecting maintenance activities improvement (in the light of the principles of quality management) were pointed out. All of these issues were studied under the CSOs' environment, they were tested and discussed thoroughly. The comparison between the theoretical findings that were based on the initial framework (figure 2.8) and those who generated from this empirical study has shown a significant consistency. However, some new other barriers and factors related to quality in maintenance were revealed. Therefore, based on the principles of quality management with regards to maintenance activities into both CSOs, and the generated barriers of quality in maintenance from the CSOs, the initial framework has to be revised and improved. Consequently, the researcher modified such a framework of driving and restraining forces of quality in maintenance activities. The revised framework, shown in figure 6.1, illustrates that, considering quality in maintenance as a change technique in an organisation, the three categories; quality, maintenance and change can be interacted together under the effect of combined factors in such organisation. Hence, the enablers and inhibitors of quality in maintenance are categorised into two main parts, drivers and restraints forces, these two issues will be discussed in sections 6.2.1 and 6.2.2.

6.2.1 The drivers forces

In this research, the principles of quality management system have been considered as the enablers' factors of improving maintenance, they were discussed and tested with regards to maintenance activities into both CSOs. Such principles concern functionality and performance capabilities of assets in general and, therefore, machines and equipment in particular. According to the CSOs' findings, the researcher found that the principles of quality management can be converted into drivers/enablers of quality in maintenance from which they are:

1. *Leadership;* "effective maintenance management" maintenance managers should understand and encourage quality system and objectives in maintenance area with the organisation's total quality policy. They should work with active cooperation and support from TM, in which they together create the suitable environment for both maintainers and operators to become fully involved in achieving the defined objectives.

2. *Customer focus;* "conformance to the stakeholder requirements", in the issue of maintenance the customer is owners, top management and machinery operators. Therefore, maintenance managers should understand the current and future maintenance requirements and manage to meet the stakeholders' requirements.

3. *Involvement of people;* "staff involvement and empowerment", peoples at all maintenance levels are the most important quality resources, and their involvement, participation and empowerment make the organisation achieve its defined objectives and get a maximum benefit from the organisation's assets.

4. *Continues improvement;* "recurring maintenance activities" a permanent objective in maintenance is continual improvement of organisation's assets, and their maintenance processes managing, to increase the plant ability and reliability.

5. *Process approach;* "managing maintenance activities as a process", desired results in maintenance are achieved more efficiently when related resources and activities are managed as a process.

6. *Factual approach to decision making;* performance measurement, equipment monitoring, inventory control, documentation and information system using the suitable analysis of data and information including computer support enables

effective decisions concerning maintenance policy, maintenance tasks execution including optimal utilisation of all resources.

7. *Mutually beneficial supplier relationship;* it relies first on relationships between maintenance (suppliers) and production (operators) and on the ability to create the mutually beneficial relationships with aim to improve assets management.

8. *System approach to management;* "managing an interrelated processes" identifying maintenance quality needs, characteristics and particular processes, understanding and managing a system of the interrelated processes for the given maintenance objectives contributes to the effectiveness and efficiency of the organisation.

6.2.2The restraints forces

Based on the findings that were demonstrated in chapter 5 and thoroughly discussed in this chapter, the researcher has generated general barriers affecting quality in maintenance in the CSOs. The unique barriers related to these case study organisations will be concluded and presented in the next chapter, table 7.1. Many authors have classified the barriers affecting quality into several categories (see 2.4.5). However, regarding to the elements of maintenance system, Thorsteinsson and Hage (1991) have grouped the maintenance tasks into three primary categories: technical, human and economic parts (see section 2.2.2). This classification is based on viewing the maintenance system as a production system where the 'products' are maintenance services. Hence the researcher has classified the barriers affect quality in maintenance into three main categories, technical & economical, managerial & organisational, and cultural & environmental barriers. This classification is based on what has been found in the literature survey related to the issue, and in addition to that, the most difficulties and barrier affect quality in maintenance within both CSOs were consisted in these elements. This classification was also built on the overlapping relationship and interdependence between the connected 'subdivisions' categories, for instance; managerial and organisational factors have a shared criteria and high interdependence, cultural and environmental factors and so on. Therefore, based on the empirical results of this study, the restraints or inhibitors of quality in maintenance are;

Technical & economical barriers:

- Maintenance programs are not clearly expressed and communicated to their relevant units and departments. And poor documentation and recording system.
- Lack of quality management training, education, and shortage of specific training in maintenance area. External training has faced financial and visa difficulties.
- Lack of interdependent departments (production) feedback system.
- Lack of suitable planning and scheduling for doing maintenance tasks (time considerations). And the organisation has a backlog of maintenance work.
- Lack of good housekeeping system (5Ss).
- Difficulty of getting spare parts on time.
- Poor internal & external communication network and poor management information system in maintenance area.
- Lack of auditing and benchmarking, and no developed measure of quality system performance in maintenance area.
- Lack of expertise in quality management.
- No proper tools & instruments are used in maintenance activities (equipment deficiency). And no proper monitoring system to preventive maintenance.
- Lack of main resources in the form of methods/ analysis tools, instruments and advanced equipment & machines.
- Lack of contacting a comparable advanced organisation, and no studies related to quality in maintenance and improvement.
- The organisations are influenced by multiple state controls' bodies (Financial Ministry, Industry Ministry and Libyan Central Bank).
- Lack of recognition and rewards system.
- Delay of financial supply by foreign currency.
- Low salary rate compared to living level.

Managerial & organisational barriers:

- No clear definitions of authority and responsibilities of management functions (the uncertainty).
- Lack of commitment to continuous improvement (top management does not pay enough attention to improving maintenance).
- Low co-ordination & co-operation between the different departments within the organisation. No well co-operation between engineers, technicians and tradesmen.

- Lack of clear strategy vision and misunderstanding of the scope of maintenance needs, mission, and costs.
- Low understanding of quality management systems and benefits. And the lack of continuous top management commitment/ support.
- No proper organisational policy (inadequacy of the available resources' management). Some legislations and rules do not encourage quality systems.
- No effective leadership (wrong person in wrong position). And some engineers who are involving maintenance work have low management skills.
- Very rigid bureaucratic system and decision-making policy takes a long time.
- Low empowerment for maintenance managers and employees.
- Inappropriate maintenance structure (unstable management structure and managers' positions).
- Top management do not pay attention to the recommendations of quality management review reports.
- Lack of equality, (the organisation policy has appreciated the operators than maintainers).

Cultural & environmental barriers

- Culture change effect (typical resistance to change), and middle managers resistance.
- Lack of employees' confidence and commitment.
- Top management does not fully commit to quality systems due to social and political considerations.
- Direct and indirect government interventions in organisation policy.
- Existent workforce is much more than actual work needs.
- Poor internal and external work circumstances.
- Very low employee moral and loyalty to their organisation lead to nonchalance (unconcern) of employees.
- Selections of trainees are subjected to nonstandard (social relationships).
- Employees' evaluation and promotion are subjected to relationships' considerations rather than standards issues.
- No available chances to doing maintenance by external body (there are no local special maintenance organisations).
- No actions against the uncommitted (truant) employee.

- Shortage of local experience in quality field (Just few organisations are adopting quality systems cross all country).

Figure 6.1 The revised framework of driving and restraining forces of quality in maintenance

6.3. A critique of the research methodology, findings and discussions

In this section, the research methodology (approach, strategy and data collection methods) adopted in this research will be criticised firstly, and then the findings (case study organisations) of research argued secondly.

6.3.1 A critique of the research methodology

The adopted methodology of this research is based on the conviction that it provides a suitable and more insightful 'framework' research design for study the difficulties and barriers encountering quality issues in maintenance into two case study organisations within their environmental and organisational context. In this study, the use of the qualitative approach was argued to be a good means of understanding, exploring and identifying the barriers that affect quality in maintenance management and activities in their organisational context.

The strategy of this research was to adopt a case-study approach, allowing the researcher to understand an organisational phenomenon in its real life context. It offered the potential of more holistic understanding of the nature, context, and processes of quality management practices from the point of view of the participants. This research also adopted multiple data collection methods, in what has been called 'triangulation' so that collected data from one type of source could be checked against data from another. These methods included; a semi-structured interview, in what has been called in-depth interview, questionnaire and analysis of documentary materials such as annual reports, monthly maintenance reports, production reports, and other technical and quality reports; direct observation and archival records.

Based on the barriers, difficulties, critical factors and variables that affect the quality in maintenance within an organisation found in the literature review, the researcher has generated and developed the questions that have been conducted in both interviews and questionnaires. Open-ended questioning was used by the interviewees at different levels of managers and supervisors at maintenance, production department in addition to the top managers and quality seniors of case study organisations. To enhance validity and reliability issues, the researcher's supervisor who has quality expertise reviewed the questions of both interviews and questionnaires. His comments were taken into consideration. Furthermore, to support the validity and reliability issues, feedback from the pilot study resulted in some of the questions being modified and changed. To ease

the understanding of questions, making respondents more comfortable and familiar, the researcher provided question forms to the interviewees in advance, this provision allowed the interviewed people to make comments about the questions before conducting the interview. This provision promoted validity and reliability by enabling the interviewee to consider the information being requested and allowing them the opportunity to assemble supporting organisational documentation from their files.

From the case studies of this research, the quantitative approach to quality management based upon industrial and economic rationality seemed inadequate for research in the Libyan context. It was found that the missing elements within this narrow perspective to quality is its ignorance of the large social, cultural, political and economic factors that govern the ways in which humans behave and management operates in organisations. Consequently, given the practical issues of research and the environmental context of the manufacturing sector of Libya, it was found that interpretive and systems perspectives could better produce a wider and richer understanding of the operation of management and maintenance activities in the organisations studied.

This research has adopted systems and interpretive approaches in order to gain a wider understanding of the difficulties and barriers affecting quality in the case study organisations. The research reveals wider interactions of societal factors within the organisations, ontologically emphasising the subjective aspects of human behaviour. The social reality of the practices of maintenance activities and management have been highlighted under the consideration that the effect of the social, economic and political factors with their interrelationships are the main factors in constituting the management and quality practices in the organisation. Thus, a qualitative (holistic) approach was considered suitable for guidance in the studies of social constructionism nature like this one, it enabled the researcher to understand the phenomenon of quality in general and in the maintenance area at a deeper level of meaning and consequence. Hence, the barriers that affect quality in maintenance within the CSOs were identified.

Based on what Yin (2003, p. 54) stated, " Having two cases can begin to blunt such criticisms and scepticism", the researcher conducted two case studies, he felt confident that the data collected from the two case studies was suitable and enough because they verified a proper saturation through getting appropriate information, they gave more opportunity to go deep for investigation, they to some extent enhanced the

generalisability of the research due to the similarity of all Libyan manufacturing firms, particularly in the management procedure and control system. The reason why these chosen organisations were from Libyan manufacturing sector is found in section 3.11.2.

The researcher believed that the two case studies selected were the right sort of organisations being studied as they are the first two organisations in Libya that have been certified to ISO 9000 which make them the pioneers of adopting quality systems in the country. They have played a significant role in the Libyan market. Furthermore, the researcher has had good relationships with some people in top and middle management positions, in both CSOs which made the accessibility into the organisations very easy. This relationship was particularly important factor and it was thought that this helped in a number of ways, such as assisting communication with interviewees and other employees, and collecting particular documents appropriate for research. To reduce the problems such as "bias, poor recall, and poor inaccurate articulation", based on Yin, (1994), the researcher strengthened (triangulated) the information from each interview with that from other sources (questionnaire and archives/documents).

This study supports that, the qualitative research is an approach to producing a deeper recognition of how managers and employees in organisations understand, think about, interact with, and use quality in maintenance. This approach assumes that an adequate explanation of human behaviour must incorporate the subjective meanings attributed to actions by actors themselves. This approach also, is able to capture the richness and complexities of the phenomenon in terms of, personal and social meanings and understandings. Achieving an interpretive understanding of the meanings of actions and interactions of the individuals who contribute to the social behaviour needs so much detailed knowledge of the system to understand how the participants within a system understand it. Thus, explanations of events arise through inductive insights rather than from deductive logic.

This study advocates to carry out more intensive field- research (case-based research) as a research strategy for understanding why particular organisations have the management systems they presently use, what they are used for, in what specific circumstances, and to what effect. The case study approach also provides the opportunity for a more holistic understanding of the nature, contexts, and processes of quality management practices from the point of view of the participants who are involved in management and

maintenance activities. In order to avoid some hesitation which came from few respondents when they asked to evaluate 'criticise' their bosses, the researcher made an effort to be familiar and trusty, consequently, they felt confident and exceeded that position.

6.3.2 A critique of the research findings and discussions

The important factor after many of the findings of the study is the uncertainty. Uncertainty, however, is not uncommon in organisational life. Rather it is an essential feature which can have a major influence on other organisational processes. The evidence in this study suggests that the management and organisational system did not operate as officially intended in their uncertain environment. Therefore, the formal processes of management, which emphasise a variety of rules and regulations, played insignificant roles in the day-to-day management and control in the organisation. Indeed, the empirical evidence in this study showed that the unclear mission, vision and objectives confusion over authority and responsibility of organisational management, as *well as the interventions from the government in* day-to-day operations of these organisations, resulted in them working in an uncertain environment. *It therefore, seems* clear that the absence of clear vision and mission is one of the main problems within managerial processes, and thus responsible for significantly lower maintenance effectiveness and in general lower productivity and profitability.

The research revealed that no clear definitions of authority and responsibilities 'uncertainty' of management functions across the different levels of management in two case study organisations. Boundaries of authorities/functions in the different 'overlapping' departments, sections and units were ambiguous. This uncertainty was one of the most serious problems facing the manufacturing organisations in Libya and could be facing all Libyan firms. Another important thing is the complexity and ambiguity of operating procedures and forms. Furthermore, organisational structure and responsibilities of management within the organisations are changing frequently, thereby creating undesirable instability. Evidence in this study shows the organisations mostly had little authority and empowerment over their operational activities. The sponsoring ministry was prominent in planning and control processes of the organisations, while government interventions over their day-to-day operations restricted the freedom of organisational management to act appropriately. This made the managers in the organisations dissatisfactory and unable to achieve the desired quality

objectives. Therefore, government interventions are significant factors affecting the quality of management systems and then of maintenance management. Managers in the case study organisations do not have a clear vision of the boundaries of their empowerment or responsibilities. In this situation the problem, in brief, is how to find the proper balance between autonomy and control, which often appears that this balance has not yet been achieved.

Libya as a socialist country, to some extent, has organisational performance measured by the physical volume of production rather than quality and profits. The main point revealed in the research findings is the lack of an effective and efficient maintenance system; no proper maintenance management, procedures and performance existed in two organisations, resulting in loss of production capacity and quality. Even though, these CSOs are certified to ISO 9000 they do not fully commit to its standard's requirements. An effective and efficient maintenance system can be achieved through the accurate planning and scheduling of all maintenance activities in maintenance departments.

The procurement function was found in this research the major area in which the government has significant influence. The organsations were highly affected by restrictions on the procurement system due to unavailable funds. Furthermore, the purchasing procedures could be described as very slow, long bureaucratic, and centralised in terms of efficient decision making. The great impact was on getting spare parts on time.

The empirical evidence in this research revealed that as a public sector, case study organisations are subjected to socio-political and economic impacts regarding their affairs and activities. These enclose: (1) the appointment of managers, occurred through the political and social process rather than qualification and experience (2) salaries and rewards systems controlled directly from the government (3) many employees are appointed according to social consideration and nepotism rather than as a result of their skills and qualifications or/and rather than real organisations' need for their services.

The researcher has drawn attention to the fact that quality improvement programs for developing countries should be tailored to their specific conditions, in particular their existing knowledge of quality management, their experience, their own culture, the

economy system, the social and political situation, and the workforce. Therefore, this research has shown that the improvement objectives can be achieved through appropriate programs when both the general environment (social, cultural, political, economic and technological) and substantial environment (suppliers, customers and governmental bodies) are associated with appropriate IT and utilisation of computer system in addition to mathematical, statistical and operational research techniques.

The empirical evidence in this study showed a significant similarity in the results generated from two case studies. The reasons of that were: both cases are controlled by the government's bodies and worked under united regulations and laws. Organisational procedures, structure and management are the same. However, there were some different results belonging to each case organisation separately, for instance; results generated from only CSOX1 are:

- There was no clear vision in the organisation.
- Strategies and methods of maintenance were not clearly expressed and communicated to the relevant units.
- Urgent jobs were carried out collectively by all people who were involved in the maintenance operations.
- Customer satisfaction still has not been addressed carefully.
- Lack of benchmarking in maintenance area.

And results were generated from only CSOX2 are:

- Some methods of maintenance were expressed but have not been communicated easily between the units and sections.
- Urgent jobs were carried out relying on the current procedure routine.
- The central maintenance system failed to address breakdowns at different plants at the same time.
- Maintenance staff, some times, used old spare parts due to the unavailability of new ones.

Finally, the key elements of the theoretical framework were tested and discussed, and regarding the maintenance functions, this research found that in general, the two organisations shared similar characteristics, thus both case study organisations

according to their empirical findings, encountered almost of such previous difficulties 'barriers', in quality issue, which were identified in the literature review (see 2.4.2) to a different degree. Furthermore, some other unique difficulties (presented early in chapter 5 and discussed in this chapter) have been found in the case study organisations. Consequently, the investigation of the barriers and difficulties affecting maintenance activities within Libyan case study organisations has been successfully achieved. The empirical evidence in this research revealed that the principles of quality management can be worked as the driving forces 'enablers' of quality in maintenance area as they are converted to the main factors of improving maintenance in the organisation. Therefore the modified framework (figure 6.1) has contributed to the achievement of the objectives and aim of the research as it clarified the factors that improve quality in maintenance activity from one side and illustrated the barriers affecting quality maintenance from the other.

CHAPTER 7 CONCLUSIONS AND RECOMMENDATIONS FOR FURTHER WORK

7.0 Introduction

This research has studied the barriers and difficulties that affect quality in maintenance context. It aimed to investigate and identify such barriers that affect quality in maintenance within two Libyan manufacturing organisations (CSOs). The research methodology adopted in this study was a phenomenological (social constructionism) philosophy based, and case study research 'design' strategy approach. The required and enough data was collected to achieve the aim and objectives of research through two main stages; secondary data collection method, an intensive literature review to understand the quality and maintenance aspects, in addition to the issue of change management. And primary data collection method, in-depth 'semi-structured' interviews were used to investigate and identify the current barriers that affecting quality in maintenance into both CSOs.

The theoretical framework (see section, 2.4, figure 2.8) has guided the researcher to select the suitable approach, design, techniques and methods of the research methodology to achieve the research aim and objectives. It was revised and improved in the light of the empirical findings that have got from the CSOs. The modified framework (figure 6.1) contributed to the achievement of the objectives and aim of the research as it clarified the factors that improve quality in maintenance activity from one side and illustrated the barriers affecting quality maintenance from the other.

Semi-structured interviews were conducted to gain an in-depth understanding of barriers affecting quality in maintenance in the two CSOs. A questionnaire was submitted to all the staff of maintenance to supplement and support the findings of interviews and to triangulate the collected data. Archival documents were also used for the same purpose as well.

Finally, an analysis and discussion for data collected were carried out to investigate and interpret the participants' responses and their implications to identify and understand in-depth the barriers affecting quality in maintenance within the two CSOs, the barriers clearly investigated and identified.

7.1 Meeting the aim and objectives of the research

The overall research question was answered through achieving the aim and objectives of this study. Hence, "Identifying the barriers and difficulties affecting quality in maintenance within two Libyan manufacturing organisations", was the precise aim of this research. Ultimately, this aim has been achieved successfully through the research objectives being fulfilled. The specific objectives of this research are defined accordingly as:

First, to gain a theoretical and critical understanding of quality management philosophies, maintenance management issue and models, and change management, a survey of relevant literature has been stated in chapter two. The following aspects have been covered through the first three main parts: Part one; the quality management principles, quality management barriers & difficulties, quality benefits, definition and philosophy of TQM and quality in developing countries. Part two; elements of maintenance system, evaluation of maintenance management system, the link of maintenance and quality, maintenance and continuous improvement, building a maintenance strategy and developing the vision, and the overall maintenance management models. Part three; culture difference and its effect on management systems, the cultural transferability of management models, understanding change, maintenance improvement connected to organisational learning, resistance to change, and managing change in maintenance.

Second, from the theoretical and critical understanding obtained from the literature survey, part four has included; definitions for both quality and maintenance issues, a specific definition of quality in maintenance, summarising of common barriers affecting quality (table 2.4), summarising the key factors that improve quality in maintenance activities (table 2.5) and steps to managing change into an organisation. The theoretical framework of driving and restraining forces of quality in maintenance was developed (figure 2.8) and has been revised in figure 6.1. Consequently, investigating the factors of improving quality in maintenance and developing a theoretical framework of driving and restraining forces of quality in maintenance has been successfully achieved.

Third, this research has adopted systems and qualitative (interpretive) approaches in order to gain a wider understanding of the difficulties and barriers affecting quality in the case study organisations. It also strengthens the earlier emphasis from social science

researchers for a consistency between the purpose of research and its theoretical, methodological and methodical choices. A commitment to understanding quality and maintenance management issues, and the barriers affecting quality in maintenance activities in their environmental, social, economical and political interactions between the researcher and the researched. This is in keeping with researchers who employ and adopt an approach in which theory and empirical investigation are interwoven. Therefore, the objective of this study "developing an appropriate research methodology to facilitate conducting case study organisations" has been successfully achieved.

Fourth, in this research, most of the common barriers affecting quality in maintenance, which were previously found by many authors, have been presented in the literature review chapter. Regarding the maintenance functions, this research found that in general, the two organisations shared similar characteristics, thus both case study organisations, according to their empirical findings, encountered almost of such previous difficulties 'barriers', in quality issue, which were identified in the literature review, to a different degree. Furthermore, some other unique difficulties (presented early in chapter 5 and discussed in chapter 6) have been found in the case study organisations. Consequently, the investigation of the barriers and difficulties affecting maintenance activities within Libyan case study organisations has been successfully achieved.

7.2 Contribution to knowledge

There is a paucity of previous studies related to quality in maintenance in general and in particular within developing countries, and namely in a Libyan context. This study has included many contributions to existing knowledge. The contributions have been distributed through both theoretical and empirical sides of this research. Theoretically, the significance and importance of this research is clear for the following:

- A specific definition of "quality in maintenance" was developed and introduced. This definition was not reported in the literature review. Hence, a contribution to existing knowledge exists in its specific terms that are directly converted quality concepts such as customer and supplier into maintenance function. The maintainers are the suppliers whereas the production operators are the customers. Accordingly, the aims are namely keeping or restoring the equipments and facilities (plant), used to make products, to effective conditions.

- Common barriers and difficulties of implementing quality management systems in an organisation were summarised and tabulated (table 2.4).
- The key factors of improving maintenance activities were summarised and tabulated (table 2.5).
- Four steps to implement and manage change in an organisation were suggested (section 2.4.4).
- A framework of driving and restraining forces of quality in maintenance was derived (see figure 2.8). It was revised and presented in figure 6.1.

Empirically, the importance of quality management in practise, and the need to develop knowledge for the benefits of organisations in the developing countries, suggests that expanding the existing knowledge of quality management literature in these countries is a contribution. However, the significance and importance of this research is clear for the following aspects:

- It should be noted that there is a lack of empirical studies on barriers affecting introducing quality in maintenance area in Arabic countries specifically, and other countries over the world. Therefore, this research contributes to this area by adding to the limited work that does exist in publications.
- Many results generated from this study were consistent with what the other studies from different national context identified. Thus this study has reinforced those previous results.
- This study, in fact, is the first study in Libyan manufacturing sector, which focuses on the quality in maintenance area and its barriers. It has reduced the gap in knowledge in Libyan studies in specific and in Arabic studies in general (due to the similarity of culture and environment context).
- Some generated barriers are unique in the Libyan culture context because they have not been reported in the literature review, or similar to other countries. These barriers are summarised in table 7.1.

From the discussion of the findings of this research, it was concluded that, although these CSOs were certified to ISO 9000, the quality issue was not addressed effectively in maintenance area, some very important issues should be taken into consideration to improve maintenance in both CSOs such as: sound maintenance management strategy and policy, up-to-date maintenance technology, and reliable maintenance service

systems are equally important. Improvement programs should be comprehensive (increase the involvement of maintenance staff in plant improvement) and cover strategic, procedural, technical, administrative, and cultural issues. The need to have good performance measurement, calculate the workload more precisely (including backlog) and cost the maintenance activities. Management needs to be trained on how to manage the departments and provide suitable training programs for all employees.

Technical & Economical barriers	Managerial & organisational barriers	Cultural & Environmental barriers
No proper tools & instruments are used in maintenance activities (equipment deficiency)	*No clear definitions of authority and responsibilities of management functions (the uncertainty)*	*Top management does not fully commit to quality systems due to social and political considerations.*
Maintenance programs are not clearly expressed and communicated to their relevant units and departments	*Some engineers who are involving maintenance work have low management skills in general*	*Shortage of local experience in quality field (Just few organisations are adopting quality systems cross all country)*
No proper monitoring system to preventive maintenance operations	*Lack of equality, (the organisation policy has appreciated the operators than maintainers)*	*Existent workforce is much more than actual work needs*
The organisation has a backlog of maintenance work	*Some of current legislations and rules do not encourage quality systems*	*Poor internal and external work circumstances*
Difficulty of getting spare parts on time	*Top management do not pay attention to the recommendations of quality management review reports*	*Employees' evaluation and promotion are subjected to relationships considerations rather than standards issues*
Lack of main resources in the form of methods/ analysis tools, instruments and advanced equipment & machines.	*Lack of good co-operation between engineers, technicians and tradesmen*	*Selection of trainees are subjected to nonstandard (social relationships)*
External training has faced financial and visa difficulties.	*Decision-making policy takes a long time*	*No actions against the uncommitted (truant) employee*
Lack of contacting a comparable advanced organisation, and no studies related to quality in maintenance and improvement	*The organisations are influenced by multiple state controls' bodies (Financial Ministry, Industry Ministry and Libyan Central Bank).*	*Nonchalance (unconcern) of employees*
Delay of financial supply by foreign currency.		
Low salary rate compared to living level		

Table 7.1 The unique barriers, that affect quality in maintenance within the CSOs

7.3 Recommendations for further research

It would seem that one major direction for further research could be towards using the same theoretical framework of this study with other organisations which would extend the findings of the current study and would also contribute towards a wider generalisation, thus in part resolving its present problems. In this direction further study can be undertaken for example, to:

1- Investigate and identify the barriers and difficulties affecting quality in maintenance in other sectors for example, service public sector. This could help make a comparison of real life practices between manufacturing and service organisations operating in Libya.

2- Replicate this study with similar organisations in different countries in order to conduct a comparative analysis to facilitate the development of greater understanding of the issues which have been investigated. The similarities and differences of environmental and internal factors would permit further explanation of how the characteristics of organisations, across different countries work. Such an investigation, in the context of similar organisation in different countries, would assess the validity of the findings and conclusion reached by the present study.

3- The present study was conceived as an initial investigation into an area of quality in maintenance in Libyan organisations, but obviously it cannot deal with all of the ramifications of these problems. Therefore further studies can be conducted to investigate in depth other quality and maintenance issues, including for instance, quality in maintenance and continuous improvement, developing maintenance vision and strategy, management and cultural transferability, maintenance improvement and organsational learning, managing change in maintenance, organising the maintenance structure, and etc.

5- Further studies can be conducted to test and evaluate the four steps that were suggested by the researcher to implement and manage change in an organisation.

7- Finally, as the present study has identified the barriers and difficulties affecting quality in maintenance, it would be very interesting and useful to study further how these barriers can be overcome by developing a suitable framework based on the findings of this thesis. It is suggested to use the theoretical framework that was derived in this research (section 6.2, figure 6.1) which could help with such future studies.

7.4 Limitations of research

In this study, as any others, there are some constraints and limitations. One of limitations of this research is, according to Easterby-Smith, et al., (2002), the researcher in the social constructionism research philosophy is part of what is being observed. Hence, the researcher cannot work as a participant observer; he was given a chance just to observe some activities inside the two organisations for short times during his visits which actually was allocated to do interviews.

This study was limited to exploring the quality in maintenance activities within two Libyan manufacturing organisations, thus, one of the potential limitations of the case study approach is that results can not be generlised. Therefore, there is a limitation in the generalisability of the findings. Whilst it may be possible, to implement the findings in other Libyan organisations, (due to their similarity in culture and work environment), and also within the Arab and North Africa countries, (because of their similar environment and culture), it may or may not be the case for other countries.

REFERENCES

Achary, S. (1996), A Theory of Silence in Accounting: A Fijian Case of Development Discourse and Social Accountability. PhD, Thesis, UMIST

Adam, F. and Healy, M. (2000), A practical Guide to Postgraduate Research in the Business Area. Blackhall Publishing.

Adebanjo, D. and Kehoe, D. (1998), An evaluation of quality culture problems in UK companies. International Journal of Quality Science, Vol. 3 No. 3, pp. 275-86

Adler, J. and Jelinek, M (1986), Is organisation culture culture bound. Human resource Management, Vol. 25 No. 1

AECMA (1989), A guide for the preparation of aircraft maintenance documentation in the international aerospace maintenance language. (Paris: Association European for Constructers of Material Aerospatial, 1989).

Aghila, A. (2000), Job Satisfaction and Work Commitment in the Context of Libya, PhD. Thesis, The Manchester Metropolitan University. Manchester, UK

Aguayo, R. (1991), Dr Deming: the man who taught the Japanese about quality, Mercury Books, London

Ahmed, A. (1992), The postmodernism and Islam. Rutledge, London

Al-Khalifa, N. (2000), Understanding the Cultural Constraints of TQM Implementation in Qatar Industries. PhD. Thesis, University of Birmingham UK

Al-Khalifa, N. and Aspinwall, E. (2000), The development of total quality management in Qatar. The TQM Magazine, Vol. 12 No. 3, pp. 194-204

Al-Muhaisen, M. and Santarisi, N. (2002), Auditing of the Maintenance System of Fuhais Plant/ Jordan Cement Factories Co., Journal of Quality in Maintenance Engineering, Vol.8 No.1, MCB UP Limited.

Al-Najjar, B. (1996), Total Quality Maintenance: An approach for continuous reduction in costs of quality products. Journal of Quality in Maintenance Engineering Vol.2 No.3, pp 4-20

Al-Sultan, K. (1996), Maintenance in Saudi Arabia: needs and recommendations for improvement. Journal of Quality in Maintenance Engineering. Vol.2 No.4 pp. 5-16 University Press.

Al-Zamani,Y., Hoddell, S. and Savage, B. (2002), Understanding the difficulties of implementing quality management in Yemen. The TQM Magasine, Vol. 14 No. 4, pp. 240-247, MCB UP Limited

Al-Zubaidi, H. (1993), Maintenance modelling of a major hospital complex. PhD, thesis. Department of Mathematics and Computer Science, University of Salford.

Amar K.and Mohd Zain Z.(2002), Barriers to implementing TQM in Indonesian manufacturing organisations, The TQM Magasine, vol.14 No. 6 pp. 367-372, MCB UP Limited

Amaratunga, D., Baldry, D., Sarshar, M. and Newton, R. (2002), Quantitative and Qualitative Research in the Built Environment: application of "mixed" research approach, Work Study, Vol.51, No.1, pp. 17-31

Angeli, I., Jones, J.and Sabir, B. (1998), Factors affecting a senior management culture change for total quality metamorphosis. Managing Service quality, Vol. 8 No.3 MCB University Press

Arbnor, I. and Bjerke, B. (1997), Methodology for Creating Business Knowledge 2nd Ed, sage Publications, Thousand Oaks, California

Armstrong, H. (1987), Maintenance Building Services: A guide for managers. Mitchell Publishing Company Limited, UK

Attir, M. (1995), Direction of Urbanisation in the Arab Society, Casablanca: Innovation Publishing Co.

Attir, M. (1985), 'Ideology, Value Changes and Women's Social Position in Libyan Society' in Eliazaeth Fernea, Middle Eastern Women: New Voices of Change, Austin: University of Texas Press

Bakerjan, R. (1994), Tool and Manufacturing Engineers Handbook, vl.7, Continuous Improvement, 4th ed., An ASME Publication, Chapter 15

Bait-Elmal, A. (2000), The Role of Management Control Systems in Libyan Organisations: A Libyan development policy case study with special reference to the industrial sectore, Phd. Thesis, The Manchester Metropolitan University.

Bamber, C., Sharp, J. and Hides, M. (2002), The role of the maintenance organisation in an integrated management systems, Managerial Auditing Journal, 17/1/2.

Bamber, C. (1998), Factors affecting Successful implementation of Total Productive Maintenance., Msc. Research dissertation, University of Salford, UK

Bell, J. (1999), Doing Your Research Project. 3rd ed. Buckingham, Open University Press.

Ben-Daya, M. and Duffuaa, S. (1995), Maintenance and quality: the missing link, Journal of Quality in Maintenance Engineering, Vol.1, No.1, pp.20-26, MCB University Press

Bengharbia, S. (1994), Phenomenon of Increase of Production Cost in Industrial Factories. Conference of Reality of Libyan Industries, 4-6/10/1994. Benghazi, Libya.

Bergman, B. and Klefsjo, B. (1993), Quality for Customer Needs to Customer Satisfaction. Studentlitterature, Lund, Sweden, P.478

Berkel, A., Jonssen, P., Martin, H. and Tuijl, H. (1995), Managing the Performance of Maintenance Personnel. IFRIM Conference, TUB, Eindhoven- Martin, Netherland

Beskese, A. and Cebeci, U. (2001), Total Quality Management and ISO 9000 application in Turkey. TQM Magazine, Vol. 13 No. 1, MCB University Press

Bhanugopan, R. (2002), Total quality management in Papua New Guinea: a survey of current practices. The TQM Magasine, Vol. 14 No. 2

Brannick, T. and Roche, W. (1997), Business Research Methods: Strategies, Techniques and Sources. Oaks Tree Press. Dublin.

Brown, A. and Van Der-Wiele, T. (1995), Industry experience with ISO 9000. Asia Pacific Journal of Quality Management, Vol. 4 No. 2, pp. 8-17

Brown, A. (1998), Organisational culture. 2nd ed.,Fainancial Times, Pitman Publishing.

British Standards Institute (1984), BS 3811: 1984 Glossary of Maintenance Terms in Terotechnology. London, BSI.

Bryman, A. (2001), Social Research Method, Oxford University Press.

Bryman, A. (1995), Research Methods and Organisation Studies. Rutledge Publishers, London

Campbell, J. (1995), Up Time: Strategies for Excellence in Maintenance Management. Productivity Press, Portland, Oregon.

Cholasuke, C., Bhardwa, R. and Antony, F. (2004), The status of maintenance in UK manufacturing organisations: results from a pilot survey. Journal of Quality in Maintenance Engineering, Vol. 10 No. 1 pp. 5-15

Coetzee, J. (1999), A holistic approach to the maintenance 'problem'. Journal of Quality in Maintenance Engineering. Vol.5 No.3 pp. 276-280 MCB University Press.

Coetzee, J. (2000), The maintenance Strategy Gap. Proceedings of the World Trends in Maintenance Engineering Conference: 16-18/08/2000, Pretoria, South Africa

Collis, J. and Hussey R. (2003), Business Research: A Practical Guide for Undergraduate and Postgraduate Students. Macmillan Press Ltd, London

Crosby, P. (1996), Quality is still free: making quality certain in uncertain times. McGraw Hill.

Crumrine, B. and Runnels, T. (1991), Total Quality Management in Vocational Technical Education. Moore-Norman Voc Tech Centre, Norman, OK

Cutler, P. and Kleiner, B. (1997), Implementing a successful quality program: lessons from those that have failed. Industrial and commercial Training, Vol. 29. No. 7, pp.236-240

Dale, B. (1999), Managing Quality. 3rd –ed. Blackwell Publishers Inc. Oxford,UK

Dale, B. (1994), Managing Quality. 2nd-ed. Prentice-Hall International, Hemel Hempstead.

Davenport, T. (1993), Process Innovation: Re-engineering Work through Information Technology. Harvard Business School Press, Boston, MA.

Davis, R. (1997), Making TPM a Part of Factory Life. TPM Experience (Project EU 1190, Sponsored by the DTI), Findlay.

Deming, W. (1986), Out of the Crisis. Massachusetts Institute of Technology. Cambridge University Press.

Denzin, N. (1989), The Research Act: A Theoretical Introduction to Sociological Methods. (3rd -ed), Englewood Cliffs, NJ, Prentice- Hall.

Dia, M. (1996), Africa's Management in the1990s and Beyond: Reconciling Indigenous and Transplanted Institutions. The World Bank, Washington, DC

Duffuaa, S., Ben-Daya, M., Al-Sultan, K., and Andijani A. (2001), A generic conceptual simulation model for maintenance systems, Journal of Quality in Maintenance Engineering. Vol.7 No. 3, MCB University Press

Duffuaa, S., Raouf, A. and Campbell, J. (1999), Planning and Control of Maintenance Systems, Modeling and Analysis. John Wiley, New York, NY.

Duffuaa, S. and Ben-Daya, M. (1995), Improving maintenance quality using SPC tools. Journal of Quality in Maintenance Engineering Vol.1 No.2, pp. 25-33 MCB University Press

Duffuaa, S. and Ben-Daya, M. (1993), Improving maintenance productivity through structure audit. Proceedings of the Second Symposium on Maintenance Planning and operations, Riyadh

Dunn, C. (1995), Factors Affecting Successful Implementation of Total Quality Management. MSc. Thesis. University of Salford, UK.

Dwight, R. (1994), Concepts for Measuring Maintenance Performance. IFRIM Proceedings, annual workshop, Eindhoven University of Technology

Easterby-Smith, M., Thorpe, R. and Lowe, A. (2002), Management Research: An Introduction. 2nd –ed. London; sage

Ejigu, M. and Sherif, M. (1994), Towards a Management Reform Program in: Great Socialist People's Libyan Arab Jamahiriya. The United Nations Development Program

Eisenhardt, K. (1991), Building theories from case study research. Academy of Management Review, Vol. 14, No.4, pp. 532-53

Elabedy, O. (1995), Management and Development in Libya. Garyounis University, Benghazi

Evans, J., and Lindsay, W. (1996), The Management and Control of Quality. West Publishing Company. USA

Feigenbaum, A. (1991), Total Quality Control. 3rd ed, McGraw-Hill, New York. USA

Fernandez, O., Labib, A., Walmsley, R. and Petty, D. (2003), Quality and Reliability Corner: a decision support maintenance management system. International Journal of Quality and Reliability Management, Vol. 20 No. 8 Pp. 965-979 MCB UP Limited

Fine, C. (1985), Managing Quality: A Comparative Assessment, manufacturing issues. NY press.

Flick, U. (2002), An Introduction to Qualitative Research. SAGE Publications, Ltd 6 Bonhill Street, London EC2A 4PU.

Flick, U. (1992), Triangulation Revisited: Strategy of or Alternative to Validation of Qualitative Data. Journal for the Theory of Social Behavior, No. 22, pp 175-97

Fox, M. (1993), Quality Assurance Management, Second Edition, London; Chapman & Hall.

Frick, J., Gersten, F., Hansen, P., Riis, J. and Sun, H. (1992), "Evolutionary CIM implementation-an empirical study of technological-organisational development and market dynamics", proceedings of the 8th CIM Europe- Annual Conference, Birmingham

Gaddafi, M. (1981), The Green Book, Part 2: The Solution of the Economic Problem, 'Socialism'. Tripoli-Libya. Public Establishment for Publishing, Distributing and Advertising.

General Secretariat of the production's affairs (2002), The Evaluation of Industrial Performance. Libya: General Secretariat of the production's affairs

Geraghty, T. (1996), Beyond Total Productive Maintenance. Manufacturing Engineer. August.

Geraerds, W. (2000), The Academic Contribution to Maintenance. World trend in Maintenance, A three days conference, Pretoria

Gertsen, F., Sun, H. and Riis, J. (1994), Compare your company with the World's best. Report of International Manufacturing Strategy Survey (IMSS), University of Aalborg

Ghauri P., Gronhauge K. and Kristianslund, I. (1995), Research Methods in Business Studies. Prentice- Hall, London

Giles, L and Campbell, M (2003),The productivity and skills challenge: Industrial and Commercial Training. Vol.35 No. 3, MCB UP Limited.

Gill, J. and Johnson, P. (1991), Research Methods for Managers., London: Paul Chapman Publishing

GSESR (1999), General Secretariat for Education and Scientific Research: A Report on the Devlopment of Education, 1999, Tripoli

Gummesson, E. (1999), Qualitative Methods in Management Research, Sage Publications, Incorporated.

Gummesson, E. (2003), Case Study Research for Business Schools, forthcoming

Hamali, J. (1999), Quality Management Systems and Performance Measurement in a Public Sector Organisation. PhD. Thesis, Salford University. UK

Hansson, J., Backlund, F. and Lycke L. (2003), New Research: Managing commitment: increasing the odds for successful implementation of TQM, TPM or RCM, International Journal of Quality& Reliability Management Vol. 20 No.9 Pp. 993-1008 MBC UP limited

Hartmann, E. (1992), Successfully Installing TPM in Non-Japanese Plant: Total Productive Maintenance. TPM Press Inc

.

Hartmann, E. (1987), Maintenance Management. Institute of Industrial Engineers. Norcross, GA.

Hayes, M. (1994) ISO 9000: the new strategic consideration. Business Horizons, pp.52-60

Hoffman, P. (2002), Converting tribology principles into measurable maintenance improvements: Industrial Lubrication and Tribology. Vol. 54 No. 5, MCB UP Limited.

Hofstede, G. (1991), Cultures and Organisations: Software of the mind. McGraw-Hill, London

Hofstede, G. (1980), Cultures Consequences. Sage Publication, Beverly Hills,CA

Hollick, L. and Nelson, G. (1995), Rationalising Scheduled-Maintenance Requirements Using Reliability Centred Maintenance- a Canadian Air Force Perspective. Proceedings of the Annual Reliability and Maintainability Symposium, IEEE.

Ho, S. and Fung, C. (1994), Developing a TQM Excellence Model. The TQM Magazine, Vol.6 No.6 pp. 24-30

Hoyle, D. (2001), ISO 9000: Quality system handbook, Butterworth-Heineman. Oxford

Humphreys, M. (1996), Culture difference and its effect on the management of technical education. Leadership & Organisation Development Journal, MCB University Press.

Hussey, J. and Hussey, R. (1997), Business Research: A Practical Guide for Undergraduate and Postgraduate Students. Macmillan Press Ltd, London.

IMF (2003), International Monetary Fund Report: Article IV Consultation with the Libyan Jamahiriya

Ingalls, P. (2000), World class maintenance. (Online), Total Productive Maintenance online, available at: www.tpmonline.com/articles_on_total_productive_maintenance/tpm/newpractices.htm (accessed on 04-08- 2004)

International Organisation for Standardisation (ISO), online, The Principles of Quality Management. Available at: http:/www.iso.org/iso/en/iso9000-14000/iso9000/qmp.html (Accessed on 20-09-2004).

Ishikawa, K. (1990), Introduction to Quality Control. Chapman & Hall. London.

Ismail, M. and Hashmi, M. (1999), The state of quality management in the Irish manufacturing industry. Total Quality Management,Vol.10 No. 6 London

ISO 9000 standard (2000), Quality Management System-Fundamentals and vocabulary, International Organisation for Standradization, Geneva, Switzerland

ISO 9001 Standard (2000), Quality Management System-Requirements. International Organisation for Standardisation. Geneva, Switzerland.

ISO 9000 Survey (2001), The ISO 9000 and ISO 14000 Certificates, Retrieved, August 20,2002 from the internet: www.iso.ch.

JANA (2002), The Jamahiriyia News Agency, Libya's Official News Providers. From internet: www.jamahiriyianews.com.

Jankowicz, A. (2000), Business Research Project for Student. London: Chapman & Hall

Jankowicz, A. (1993), Business Research Project for Student. London: Chapman & Hall

Jones, E. and Rosenthal, D. (1997), Assessing maintenance performance. Maintenance Technology Magazine, available at:www.maintenanceresources.com.

Jonsson, P. (1997), The status of maintenance management in Swedish manufacturing firms. Journal of Quality in Maintenance Engineering, Vol. 3 No. 4, pp. 233-58

Jostes, R. & Helms, M., (1994), Total Productive Maintenance and Its Link to Total quality Management, Work study, MCB University Press, Vol.43, No.7, pp. 18-20.

Juran, J .and Gryna, F. (1993), Quality Planning and Analysis. 3rd ed, McGraw-Hill New York. NY

Juran, J. (1988), Quality Control Handbook, 4th ed, McGraw-Hill New York. NY

Kelly, A. (1997), Maintenance Organisation& Systems. Business-Centred Maintenance, Butterworth- Heinmann, Biddles Ltd, UK

Kelly, A. (1989), Maintenance and Its Management. Conference Communication, London

Kilani, K. (1987), The Evolution and Status of Accounting in Libya. PhD Thesis, the University of Hull

Klefsjo, B., Wiklund, H. and Edgeman, R. (2001), Six sigma seen as a methodology for total quality management. Measuring Business Excellence, Vol. 5 No. 1, pp. 31-35

Laughlin, R. (1995), Empirical Research in Accounting: Alternative Approaches and a Case for 'Middle Range' Thinking. Accounting, Auditing & accountability Journal, Vol. 8, No. 1, pp 63-87

Leavy, B. (1994), The Craft of Case-Based Qualitative Research. Irish Business and Administrative Research, Vol.15, pp105-118

Leonard, D. and McAdam, R. (2001), Grounded theory methodology and practitioner reflexivity in TQM research, International Journal of Quality &Reliability Management, Vol.18, No.2, pp.180-194, University Press.

Ludwig-Becker, M.(1999), Quality Management Principles as Top Team Performance Practices, ISO 9000 Criteria-reinterpreted, Team Performance Management, Vol.5, No.7 pp. 207-211

Lyonnet, P. (1991,) Maintenance Planning: Methods and Mathematics, Chapman& Hall

Mann, L. (1976), Maintenance Management. Lexington, MA: Heath

Mac Donald, J. (1992), Reasons for failure. Total Quality Management, August, 1992, pp 237-240

Masters, R. (1996), Overcoming barriers to TQM's success. Quality Progress, Vol. 29 No. 5, pp. 53-55

McBride, V. (1986), In Today's Market: Quality is Best Focal Point for Management. Industrial Engineering, Vol.18 (7), pp.51-55.

McQueen, G. (1999), The buzz on benchmarking, compare your performance with best to improve production and cut costs. Maintenance technology Magazine, May, available at: http:maintenanceresources.com.

Mersha, T. (2000) Quality, competitiveness and development in Sub-Saharan Africa. Industrial Management& Data Systems, MCB University Press

Mjema E. and Mweta A. (2003), An analysis of economics of investing in IT in the maintenance department. Journal of Quality in Maintenance Enginering Vol. 9 No.4 Pp. 411-435 MCB UP Limited

Mogherbi, M. (1998), Civil Society and Democratisation in Libya: 1977-1994, Tripoli-Libya

Montgomery, D. (1985), Introduction to Statistical Control. John Wiley & Sons, Inc., New York, NY.

Mostafa, S. (2004), Implementation of proactive maintenance in the Egyptian Glass Company, Journal of Quality in Maintenance Engineering, Vol. 10 No. 2 pp.107-112

Motwani, J., Kumar, A. and Youssef, M. (1996), Implementing quality management in the hospitality industry: current efforts and future research directions. Benchmarking for Quality management& Technology, Vol. 3 No. 4, MCB University Press.

Muhlemann, A., Oakland, J. and Lockyer, K. (1993), Production and Operations Management. Sixth edition, Pitman Publishing.

Murthy, D., Atrens, A. and Eccleston, J. (2002), Strategic Maintenance Management. Journal of Quality in Maintenance Engineering, Vol. 8 No. 4 Pp.287-305 MCB UP Limited

Nagi,E. and Cheng, T. (1997), Identifying potential parries to total quality management using principal component analysis and correspondence analysis. International Journal of Quality & Reliability Management, Vol. 14 No. 4 University Press

NAID (2002), National Authority for Information & Documentation: Libya, information and facts, Tripoli

Nakajima, S. (1988), Introduction to TPM, Productivity Press. Cambridge. MA.

Nakajima, S. (1989), TPM Development Program: Implementing Total Productive Maintenance. Productivity Press.

Naylor, J. (1996), Operations Management. Pitman Publishing, pp. 255-282.

Narayan,V.(1998), The raison d'etre of maintenance. Journal of Quality in Maintenance Engineering, Vol.4 No.1, pp.38-50. MCB University Press.

Niebel, B. (1994), Engineering Maintenance Management. Marcel Dekker, New York, NY.

Nisbett, J. and Watt, J. (1980), Case study, Rediguide 26, University of Nottingham, School of Education.

Nollet, J., Leenders, M. and Diorio, M. (1994), Supply challenges in Africa. International Journal of Purchasing and Materials Management, Vol. 30 No. 1

Oakland, J. (1997), Total Quality Management. 2nd ed, Butterworth-Heinemann Ltd, Oxford, UK

Oakland, J. (1993), Total Quality Management, Butterworth-Heinemann, Ltd.

Ollila, A. and Malmipuro, M. (1999), Case studies: Maintenance has a role in quality. The TQM Magazine Vol.11 No.1, pp. 17-21, MCB University Press.

Oppenheim, A. (1992), Questionnaire Design, Interviewing and Attitude Measurement. London: Pinter

Osada, T. (1991), The 5-S: Five Keys to a Total Quality Environment, Asian Productivity Organisation, Tokyo.

Oxtoby, R. (1993), Planning technical and vocational education and training in developing countries: editorial introduction. The Vocational Aspect of Education Vol. 45 No. 3

Paton, R. and McCalman, J. (2000), Change Management: A guide to effective implementation. 2nd ed., Sage Publications Ltd.

Perry, C. and Coote, L. (1994), Processes of a new case study research methodology: tool for management development. Australian and New Zeland Association for management (ANZAM) Conference, December, Victoria University of Wellington, Wellington.

Pheng, L. (1996), Total Quality Facilities Management: A framework for Implementation. Journal of Facilities, Vol.14, No.5/6, MCB University Press.

Phillips, E. and Pugh, D. (2000), How to get a PhD: A handbook for students and their supervisors, (3rd edition), Open University Press, Buckingham

Predmore, S. and Werner, T. (1997) Maintenance human factor and error control. Paper given to 11th Symposium on Human Factors in Aviation Maintenance, 12-13 March, San Diego

Raouf, A. and Ben-Daya, M. (1995), Total maintenance management; a systematic approach. Journal of Quality in Maintenance engineering, Vol.1, No.1 pp. 6-14, MCB University Press.

Raouf, A.(1994), Improving Capital productivity through Maintenance, International Journal of Operations & Production Management, Vol. 14 No.7, pp. 44-52, MCB University Press.

Raymond, J. (2002), Human Resource Management, Fourth edition, John Wiley&Sons, Australia, Ltd.

Reason, J. and Hobbs, A. (2003), Managing Maintenance Error: A practical guide. Ashgate Publishing Company. Hampshire. UK

Remenyi, D., Williams, B. Money, A. and Swartz, E. (1998), Doing Research in Business and Management, Sage, Publications, London.

Richard,C., Yan, T., Ling, L. and Fung, F. (2000) Enhancement of maintenance management through benchmarking. Journal of Quality in Maintenance. Vol. 6 No. 4 Pp. 224-240 MCB University Press

Riis, J., Luxhoj, J. and Thorsteinsson, U (1997), A situational maintenance model. International Journal of Quality7 Reliability Management, Vol.14 No.4 pp. 349-366, MCB University Press.

Rohitratana, K. and Boon-itt, S. (2001), Quality standard implementation in the Thai seafood processing industry. British Food Journal, Vol. 103 No 9, MCB University Press

Roney, J. (1997), Cultural Implications of Implementing TQM in Poland. Journal of World Business, 23(2), pp. 152-162

Ruthven, M. (1992), Mohammed, the maze and the cultural mutant. Book review, The Guardian, 25 June,p 29

Salegna, G. and Fazel, F. (2000), Obstacles to implementing TQM. Quality Progress, Vol. 33 No. 7, Milwaukee

Sanders, D, and Scott, C. (1997), Passing Your ISO 9000/QS-9000 Audit: A step-by-step Guide, St Lucie Press, Boca Raton, FL

Saunders, M., Lewis, P. and Thornhill, A., (2000), Research methods for Business Students, 2nd-ed, Prentice Hall, Financial Times.

Sayle, A. (1994), Meeting ISO 9000 in a TQM World, England AJSL Publishing

Schein, L. (1991), Communicating Quality in the Service Sector. The Conference Board, New York, NY.

Schein, E. (1985). Organisational Culture and Leadership, Jossey-Bass, SanFrancisco, CA

Secretariat of Industry (2002). The Secretariat Annual Report. Libya: Secretariat of Industry

Secretariat of Industry and Minerals (1997). The Secretariat Annual Report, Libya: Secretariat of Industry.

Secretariat of Industry and Minerals (1995). The Secretariat Annual Report. Libya: Secretariat of Industry.

Sekaran, U. (2003). Research Methods for Business. 3ed ed., John Wiley Books, New York

Senior, B. (2002). Organisational Change. 2nd ed., Financial Times, Prentice Hall.

Senju, S. (1992). TQM and TPM Asian Productivity Organisation, Tokyo

Sharp, J., Kutucuoglu, K. and Erzincanli, F. (2000), Integrating TQM and TPM into a Management Information system. 'IFRIM'2000 Meeting Proceedings, Conference, South Africa, Pritoria.

Sharp, J., Irani, Z., Wyant, T. and Firth, N. (1997), TQM in Maintenance to Improve Manufacturing Performance. Proc.of the PICMET Int. Conf., Portland, Oregon

Sharp, J. and Kutucuoglu, K. (1997), Striving for quality in maintenance within manufacturing organizations. IFRIM-1997 Meeting Proccedings, the Hong Kong Polytechnic University, Hung Kong.

Sharp, J. and Marsh, S. (1991), Key Management Factors Affecting the Implementation of a Condition Based Maintenance System. Proceedings of 3rd Int.COMADEM Conference. Southampton Institute, 158-162. Edited by R B K N Rao& A D Hope. Adam Hilger

Sherwin, D. (2000), A review of Overall Models for Maintenance Management. Journal of Quality in Maintenance Engineering, Vol. 6 No. 3, pp 138-164 MCB University Press.

Sherwin, D. (1994), Maintenance: An Important Factor Forgotten in Manufacturing Planning Systems. Lund University Institute of Technology. Sweden.

Shirose, K. (1992), TPM for Workshop Leaders, Productivity Press.

Silverman, D. (1985). Qualitative Methodology and Sociology. Gower

Smith, M. (1994), Understandings and Images of Management Activities: A comparative study of UK and Hong Kong Teachers. Educational Management and Administrations, Vol. 22 No. 2

Spitzer, R. (1991), TQM in commercial banking. Proceedings of the Louisiana Quality Symposium, Baton Rouge, LA.

Stake, R. (1995), The Art of Case Study Research. Thousands Oaks, Sage Publications, Inc.

Sullivan, R. and Lytton, S. (2000), Change Management: just doing it. Management Books Ltd, London

Sun, H., (1999), The patterns of implementing TQM versus ISO 9000 at the beginning of the 1990s. International Journal of Quality& Reliability Management. Vol. 16 No. 3 pp.201-214, MCB University Press.

Sutcliff, W. and Pollock, J. (1992), Can the total quality management approach used in industry be transferred to institutions of higher education?. Vocational Aspect of Education, Vol. 44 No. 1

Taguchi, G., Elsayed, E. and Hasiang, T.(1989), Quality Engineering in Production Systems. McGraw-Hill,New York, NY

Tajiri, M. and Gotoh, F. (1992), Implementation: A Japanese Approach, McGraw- Hill

Tamimi, N. and Sebastianelli, R. (1998), The barriers to total quality management. Quality Progress, Vol. 31 No. 6, pp. 57-60

Tannock, J. and Krasachol, L. (2000), The Thai foundation quality system standard. The TQM Magazine, Vol. 12 No. 1

Taylor J. and Christensen T. (1998), Airline Maintenance Resource Management. Warren dale, PA: Society of Automotive Engineers.

The General Congress of the People (1981), Law of Salaries and Rewards. Salaries and Rewards Law 15/1981. Tripoli-Libya.

The Oxford Dictionary (2001), The Tenth (revised) Edition, Oxford University Press.
Thorsteinsson, U. and Hage, C. (1991), Maintenance management profiles for idustrial systems. in Holmberg, K. and Folkeson, A. (Eds), Operational Reliability and Systematic Maintenance, Elsevier Applied Science.

UNDP (2000), Human Development Report, 2000, pp. 158-166 New York: Oxford University Press

Vorley, G. (1998), Quality Management: Principles and Techniques. Quality Management & Training (Publications), Limited, Guildford, Survey, England.

Walsh, A., Hughes, H. and Maddox, D. (2002), TQM continuous improvement: is the philosophy a reality?. Journal of European Industrial Training, MCB UP Ltd

Westerkamp, T. (1985), Using the computer to audit your maintenance productivity. Proceeding of Annual International Maintenance Conference, No.3, Atlanta, GA

Whalen, M. and Rahim, M. (1994), Common Barriers to Implementation and Development of a TQM Program. Total Quality Management. March/April (1994)

Williams, A., Dobson, P. and Walters, M. (1993), Changing Culture, New Organisational Approaches. 2nd ed., London: Institute of Personnel management.

Willmott, H. (1996), Thinking Accountability: Accounting for Disciplined Production of Self. In "The Role of Management Control Systems in Libyan Organisations", PhD Thesis. Bait-Elmal, A. (2000), the Manchester Metropolitan University.

Willmott, P. (1997), TPM: Total Productive Maintenance: The Western Way. Butterworth- Heinemann.

Willmott, P. (1994), TPM: Total Productive Maintenance: The Western Way. Butterworth- Heinemann.Ltd. GB

Windle, W. (1993), TPM: More Alphabet Soup or a Useful Plant Improvement Concept. Plant engineering, 47.2,February, pp. 62,63.

Wilson, A. (1999), Asset management and maintenance strategy. Maintenance and Asset Management, Vol. 14 No. 1, pp. 3-10

Wireman, T. (1991), Productive Maintenance: An American Approach Industrial Press Inc.

Wong, W. (1998), A holistic perspective, on quality quests and quality gains: the role of environment. Total Quality Management. Vol. 9, No. 4& 5, PP. S241-S245.

Yin, R. (1994), Case Study Research: Design and Methods, (2nd ed.), Applied Social Research Methods Services. Vol. 5. Sage Publications.

Yin, R.K. (2003), Case Study Research: Design and Methods, (3rd ed.), Applied Social Research Methods Services. Vol.5. Sage Publication.

Zairi, M. (1996), Economic Development and Global Competitiveness: Why Should Arab Managers Take Note of Total Quality Management, the Fourth Arab Management Conference, University of Bradford, Bradford-UK, PP. 408-423

Zickmund, W. (2000), Business Research Methods (6th ed.), The Dryden Press, Harcourt College Publishers

APPENDIX 1

The similarities and the differences of the various approaches of the three gurus, Juran, Crosby, and Deming in tabular form classified under 12 different factors.

	Crosby	**Deming**	**Juran**
Definition of quality	Conformance to requirements	A predictable degree of uniformity and dependability at low cost and suited to the market.	Fitness for use
Degree of senior-management responsibility.	Responsible for quality	Responsible for 94% of quality problems.	Less than 20% of quality problems are due to workers.
Performance standard / Motivation	Zero defects	Quality has many 'scales'. Use statistics to measure performance in all areas. Critical of zero defects	Avoid campaigns to 'do perfect work'
General approach	Prevention, not inspection	Reduce variability by continuous improvement. Cease mass inspection	General management approach to quality-especially 'human' elements
Structure	Fourteen steps to quality improvement	Fourteen points for management	Ten steps to quality improvement
Statistical process control (SPC)	Rejects statistically acceptable levels of quality	Statistical methods of quality control must be used	Recommends SPC but warns that it can lead to 'tool-driven' approach
Improvement basis	A 'process', not a program. Improvement goals	Continuous to reduce variation. Eliminate goals without methods	Project-by-project team approach. Set goals
Teamwork	Quality improvement teams. Quality council	Employee participation in decision-making. Break down barriers between departments	Team and quality circle approach
Costs of quality	Cost of non-conformance. Quality is free	Non optimum -continuous improvement	Quality is not free-there is an optimum
Purchasing and goods received	Start requirements. Supplier is extension of business. Most faults due to purchasers themselves	Inspection to late - allows defects to inter system through AQLs. Statistical evidence and control charts required	Problems are complex. Carry out formal surveys
Vendor rating	Yes *and* buyers. Quality audits useless	No, critical of most systems	Yes, but help supplier improve
Single sources of supply		Yes	No, can neglect to sharpen competitive edge

Table 1.The (Crosby, Deming, Juran)'s quality gurus compared. Source, Oakland, (1993)

APPENDIX 2.1

The interview (protocol) questions

Understanding quality management systems and benefits

- In your belief, what is the importance of understanding quality system in the organisation?
- What are the benefits can the organisation gain from adopting QMS in general and in maintenance department in particular?

Leadership, management support and commitment to QMS

- Has the leadership an ability to make the effective decisions related to the strategy and mission of organisation?
- To what extent do leadership "top management" support and commit to quality programs?
- Does top management support a continuous improvement in maintenance area?

Managing maintenance activities

- Has the organisation a strategy vision and clear understanding of the scope of maintenance mission, needs and costs?
- Are the organisation's strategies and methods (procedures, e.g. preventive maintenance, inspections, testing, monitoring, etc.) clearly expressed and communicated to the relevant units?
- does the maintenance function have available resources in the forms of skills, methods, analysis tools, etc. to conduct analysis of the desired quality?
- Does the organisation have any backlog of a maintenance work?
- What are the links between the quality management and the maintenance activities, from your perspective?
- How are urgent jobs in maintenance area carried out?

Quality and maintenance system performance

- How do you manage or cope with the current management system practiced
- Is there a clear set of procedures or practices available for all the tasks that are in the maintenance department? And are the maintenance procedures fully documented?
- How do you measure a performance in general? And has your organisation developed processes to evaluate the efficiency and effectiveness of maintenance (quality performance)?

Experience in quality and training programs

- Has the organisation enough experiences and expertise in quality management?
- Does the organisation provide training programs in general and in particular in quality for their employees?

The organisational policy and socio-culture impact

- Are you satisfied about the current organisational policy, and why?
- How would you describe the salary/wage, recognition and reward system in the organisation?

- Does the organisation apply the housekeeping policy (5-Ss) in maintenance activities?
- How would you see the employees and managers influence on change management?
- To what extent are the employees involved and participated in quality programs, And do they feel confidence in their work?
- To what extent are the employees and managers of maintenance department empowered?

Government intervention and support

- Are there any government interventions in your organisation policy? If so, how they affect your strategy program?

Customer requirements and satisfaction

- Are you taking the customer requirements and satisfactions into consideration in your organisation strategy?

Communication networks and management information system

- How satisfied are you with the current co-operation & co-ordination between all departments of the organisation, and the level of external and internal communication network?
- Does the organisation have a management information system (either computerised or manual) to maintain records of department maintenance activities?

General questions

- What are the main barriers your organisation is faced with, in general and particularly in maintenance activities towards implementing quality systems?
- Can you please describe what you see necessary to improve quality in maintenance?

APPENDIX 2.2

The questionnaire

(a) *The attached letter*

Questionnaire No.,.....

Dear participants

I am a Ph.D. student at the School of Management in Salford University. My research project addresses the barriers affecting quality in maintenance activities within Libyan manufacturing organisations.

I have selected your company as a case study of this research. So, your participation is very essential to complete my research. This questionnaire is completely anonymous and your identity is not marked on it. The information gathered for this project would be aggregated and statistically analaysed for the purpose of my academic studies. Also the results of the study might help to get some benefits for your company.

I will be very grateful if you could spare few minutes of your valuable time to complete the attached questionnaire and return it to me.

I would like to thank you very much for taking part in this study.

Obaid Ahmed Mohamed

(b) *The questions form*

1-General information; Please tick the appropriate box for each question below?

a- please what is your qualification? ☐ Engineer ☐ Technician ☐ Employee ☐ Other

b- please what is your job? ☐ Management ☐ Information &Documentation ☐ Technical Inspection ☐ Cleaning & Lubrication ☐ Replacing & Preparing Spares ☐ Other

c- your experience in the work is; ☐ Less than 3 years ☐ From 4 to 9 years ☐ From 10 to 15 years ☐ More than 16 years

2- **Maintenance activities questions;** please tick the appropriate choice for each question listed in the following table, where the categories are; ***strongly agree (SA), agree (A), partly agree (PA), disagree (D), and strongly disagree (SD)***.

** Please note that "Organisation" means your company.

Question/ categories	**SA**	**A**	**PA**	**D**	**SD**
Top management pay more attention to improving maintenance					
You are satisfied about the current performance of maintenance staff					
The organisation has a backlog of maintenance					
There is a link between quality management and improving maintenance activities					
Maintenance programs are clearly expressed and communicated to their relevant units and departments					
The organisation has available reports/statistics from its own installation that indicate how implementation of maintenance is carried out					
There is a shortage of main resources in the form of budget,					
There is a shortage of main resources in the form of skills,					
There is a shortage of main resources in the form of methods/ analysis tools,					
There is a shortage of main resources in the form of advanced instruments and machines.					
There is co-ordination & co-operation between the different departments within the organisation					
There is an empowerment for maintenance managers					

Question/ categories	SA	A	PA	D	SD
Maintenance staff has sufficient knowledge of design assumptions,					
Maintenance staff has sufficient knowledge of operational conditions,					
Maintenance staff has sufficient knowledge of safety instructions.					
The organisation has clear rules for the use of handling of checklists,					
The organisation has clear rules for the use of updating of checklists,					
The organisation has clear rules for the use of storage of checklists.					
The organisation has described work processes for all control functions in the maintenance system.					
The organisation has described work processes for all supplementary functions in the maintenance system.					
The organisation has good management information system					
The organisation has developed a process to evaluate the efficiency and effectiveness of maintenance performance					
The organisation has provided training programs in the maintenance area					
Top management of organisation has a clear understanding of the scope of maintenance needs,					
Top management of organisation has a clear understanding of the scope of maintenance mission,					
Top management of organisation has a clear understanding of the scope of maintenance costs.					
There is good housekeeping system (5-Ss)					

3- **Factors affecting quality management;** please tick the appropriate choice for each factor listed in the table below: - where the categories are; ***strongly agree (SA), agree (A), partly agree (PA), disagree (D), strongly disagree (SD).***

** Please note that the factors listed below are the common factors affecting organizations during implementing or preparing to implement quality management systems.

** If you wish to say more about this issue, please you can write your valuable comments in the end of this questionnaire.

Factor/ categories	SA	A	PA	D	SD
Full understanding of quality management systems					
Full understanding of quality benefits					
There is an organisational policy					

Factor/ categories	SA	A	PA	D	SD
Lack of knowledge of top management					
Lack of skills of top management					
Availability of sufficient resources					
There is an employee empowerment					
No sufficient time to implementation					
Lack of recognition system					
There is a rewards systems					
No developed measure of quality system performance					
Lack of expertise in quality management					
Full top management commitment/ support					
No proper vision in organisation					
No proper mission in organisation					
There is an effective leadership					
No existence of bureaucracy/ formalistic					
Culture change effect					
Middle managers commitment					
Lack of employees participation,					
Lack of employees involvement,					
Full employees' commitment.					
Lack of customer feedback system					
Lack of sufficient quality training and education					
Lack of confidence by employees (impersonal)					
There is an effective internal communication net work.					
There is an effective external communication net work					
Lack of government financial support					
Lack of co-operation from customer					
Lack of co-operation from supplier					
Customer's satisfaction and requirements are appreciated					
Employees have a loyalty to their organisation					
Other factors (problem area) you wish to say …..					

Other comments, ...

Thanks a lot for your great participation

THE QUESTIONNAIRE TRANSLATION TO ARABIC LANGUAGE

إستبيان رقم (.....)

بسم الله الرحمن الرحيم

السيد المحترم/

بعد التحية..... هذا الاستبيان جزء من الدراسة العملية التي أقوم بها الان, كطالب دراسات عليا لنيل درجة الدكتوراة في جامعة سالفورد ببريطانيا، والتي تتعلق بتحديدالصعوبا ت والمشاكل التي تؤثر في تطبيق أنظمة إدارة الجودة داخل المؤسسا ت الصناعية الليبية بغرض تجويد وتحسين فاعليا ت اقسام الصيانة.

و حيث أ نه قد تم إ ختيار مؤسستكم هذه كحالة دراسية لهذا البحث، نامل تعاونكم ومساهمتكم الجادة في تعبئة و إستكمال الاستبيان المرفق، علما بان كل المعلومات التي سيتم تجميعها سوف تستخدم و تحلل اكاديميا لتحقيق الغرض المطلوب من هذا البحث, بالاضافة الى إمكانية الاستفادة من النتائج في تطوير وتحسين جودة الاداء في مؤسستكم.

أننا نقدر عاليا تخصيص جزء من وقتكم الثمين بمشاركتكم الفاعلة في الاجابة على اسئلة الاستبيان وبكل شفافية و شعور بالمسؤلية حيال مؤسستكم والبحث العلمي في آ ن واحد.

شكرا على حسن اهتمامكم ودعمكم..... والسلام عليكم ورحمة الله وبركاته

مهندس/ عبيد احمد محمد الرقيق

أولا معلومات عامة من فضلك ظلل المربع الموافق لاجابتك فيما يلي:-

أ- ما هو تأهيلك العلمي؟ مهندس ☐ فني ☐ موظف ☐ أخرى ☐

ب- ما هي وظيفتك الحالية؟ إدارة ☐ توثيق ومعلومات ☐ فحص فني ☐ تزييت وتنظيف ☐

إستبدال وتصليح الغيار ☐ أخرى ☐

ج- خبرتك في العمل با لسنوات هي:- اقل من 3 سنوات ☐ من 4 الى 9 سنوات ☐

من 10 الى 15سنة ☐ اكثر من 16 سنة ☐

ثانيا فاعليات الصيانة

من فضلك ضع علامة √ أمام الخيار المناسب لكل فقرة في الجدول التالي علما بان الخيارات مصنفة على نحو:- (موافق جدا- موافق- موافق جزئيا- غير موافق- غير موافق مطلقا)

لاحظ من فضلك ان كلمة (مؤسسة) يقصد بها الشركة او المؤسسة التي تعمل بها حاليا

الفاعلية/ الخيار	موافق جدا	موافق	موافق جزئيا	غير موافق	غير موافق مطلقا
الادارة العليا في المؤسسة تولي إهتماما كبيرا بتحسين الصيانة					
أنت راض عن معدل الاداء الحالي لطاقم الصيانة					
توجد صيانة مؤجلة متراكمة في المؤسسة					
توجد علاقة بين انظمة إدارة الجودة وتحسين فاعليات الصيانة					
برامج الصيانة واضحة ومعروضة امام كل الاقسام ذات العلاقة داخل المؤسسة					
توفر التقارير والمعلومات حول كيفية إجراء الصيانة للالات من قبل مورديها الاصليين في المؤسسة					
يوجد نقص في الموارد الاساسية المالية					
يوجد نقص في الموارد الاساسية (المهارات/ الكفآت)					
يوجد نقص في طرق وادوات التحليل لاعمال الصيانة					
يوجد نقص في إستعمال المعدات المتطورة في الصيانة					
يوجد تنسيق وتعاون بين الاقسام المختلفة في المؤسسة					
مدراء الصيانة والمشرفون لديهم صلاحيات كافية في العمل					
طاقم الصيانة لديهم معلومات كافية عن تصاميم الالات ومعدلات عملها الافتراضية					
طاقم الصيانة لديهم معلومات كافية حول شروط تشغيل الالات					
طاقم الصيانة لديهم معلومات كافية عن إرشادات السلامة					
المؤسسة لديها قواعد واضحة لاستعمال نماذج الفحوصات					
المؤسسة لديها قواعد واضحة لمتابعة و تحديث نماذج الفحوصات					
المؤسسة لديها قواعد واضحة لحفظ وتخزين نماذج الفحوصات					
المؤسسة توضح طرق العمل لكل الوظائف الرئيسية في نظام الصيانة لعامليها					
المؤسسة توضح طرق العمل لكل الوظائف المكملة في نظام الصيانة لعامليها					
لدى المؤسسة نظام ادارة معلومات جيد					
المؤسسة تعمل على تطوير طرق تقييم كفأة و فاعلية أداء الصيانة					
المؤسسة تقدم برامج تدريبية للعاملين في مجال الصيانة					
إدارة المؤسسة لديها فهم واضح لمدى إحتياجات الصيانة					

الفاعلية/ الخيار	موافق جدا	موافق	موافق جزئيا	غير موافق	غير موافق مطلقا
إدارة المؤسسة لديها فهم واضح لمدى مهمة ووظيفة الصيانة					
إدارة المؤسسة لديها فهم واضح لمدى تكاليف الصيانة					
تطبق المؤسسة ما يسمى بنظام التاءات الخمس(تنظيم- تبسيط النفاذ- تنظيف - تعيير - ترسيخ الانضباط الذاتي)					

ثالثا العوامل التي تؤثر في إدارة الجودة

من فضلك ضع علامة √ أ مام الخيار المناسب لكل فقرة في الجدول التالي علما بان الخيارات مصنفة على نحو:- (موافق جدا- موافق- موافق جزئيا- غير موافق- غير موافق مطلقا)

لاحظ أن جميع العوامل المدرجة أدناه تمثل مجموع العوامل الشائعة التي تؤثر في المؤسسات أثناء او عند الاعداد لتطبيق برامج أنظمة إدارة الجودة

بإمكانك إضافة ماتريد من ملاحظات او أراء في الورقة المخصصة نهاية الاستبيان مع جزيل الشكر

الفاعلية/ الخيار	موافق جدا	موافق	موافق جزئيا	غير موافق	غير موافق مطلقا
يوجد فهم كامل لأنظمة إدارة الجودة في المؤسسة					
يوجد فهم كامل لفوائد إدارة الجودة في المؤسسة					
توجد سياسة تنظيمية ثابتة وواضحة للمؤسسة					
الادارة العليا في المؤسسة تفتقد المعلومات الكافية عن أنظمة الجودة					
الادارة العليا لا تتمتع بالمهارات المناسبة					
المصادر الاساسية للعمل(بشرية-مادية) متوفرة في المؤسسة					
يتمتع العاملون داخل المؤسسة بالصلاحيات و التخويل الكافي					
لا يعطى الوقت الكافي لتطبيق برامج الجودة داخل المؤسسة					
لا يوجد نظام واضح لتقدير وتكريم العاملين داخل المؤسسة					
يوجد نظام مكافآت واضح للعاملين بالمؤسسة					
لا توجد مقاييس متطورة لمعدل أداء نظام الجودة في المؤسسة					
لا يوجد خبراء في إدارة الجودة داخل المؤسسة					
الادارة العليا ملتزمة بدعم أنظمة إدارة الجودة في المؤسسة					
لا توجد رؤية مستقبلية واضحة للمؤسسة					
مهمة المؤسسة الصناعية غير واضحة وغير محددة					
توجد قيادة فاعلة بالمؤسسة					
لا وجود للبيروقراطية أو الروتين الاداري بالمؤسسة					
التقاليد والظروف الاجتماعية وثقافة العاملين الادارية تؤثر في تطبيق اى برامج تستهدف تغيير وتطوير المؤسسة					
الادارة المتوسطة(مدراء الادارات-رؤساء الاقسام) ملتزمون بتطبيق أنظمة إدارة الجودة في المؤسسة					
العاملون لا يشاركون بفاعلية في برامج الجودة داخل المؤسسة					
العاملون لا يقحمون فعليا من قبل الادارة في برامج إدارة الجودة بالمؤسسة					
العاملون ملتزمون بتطبيق أنظمة إدارة الجودة في المؤسسة					
لا يوجد نظام" التغذية المسترجعة" بمعنى لا يلتفت الى ملاحظات و إنتقادات الزبائن لمنتجات المؤسسة بغرض التطويرو التحسين					
لا يوجد تعليم وتدريب كاف على برامج أنظمة الجودة بالمؤسسة					
العاملون لا يشعرون بالارتياح أثناء العمل					
توجد شبكة إتصالات داخلية فاعلة بين إدارات و اقسام المؤسسة					

الفاعلية/ الخيار	موافق جدا	موافق	موافق جزئيا	غير موافق	غير موافق مطلقا
توجد شبكة إتصالات خارجية فاعلة(بين المؤسسة والجهات الخارجية سواء زبائن او مزودين او مساهمين)					
الدعم المالي من الدولة للمؤسسة محدود					
لا يوجد تعاون بين المؤسسة و الزبائن					
لا يوجد تعاون بين المؤسسة و المزودين					
المؤسسة تقدر رضاء ومتطلبات الزبائن					
العاملون لديهم ولاء للمؤسسة					
اية عوامل أخرى على نفس المنوال تريد اضافتها					

اية ملاحظات أخرى :-

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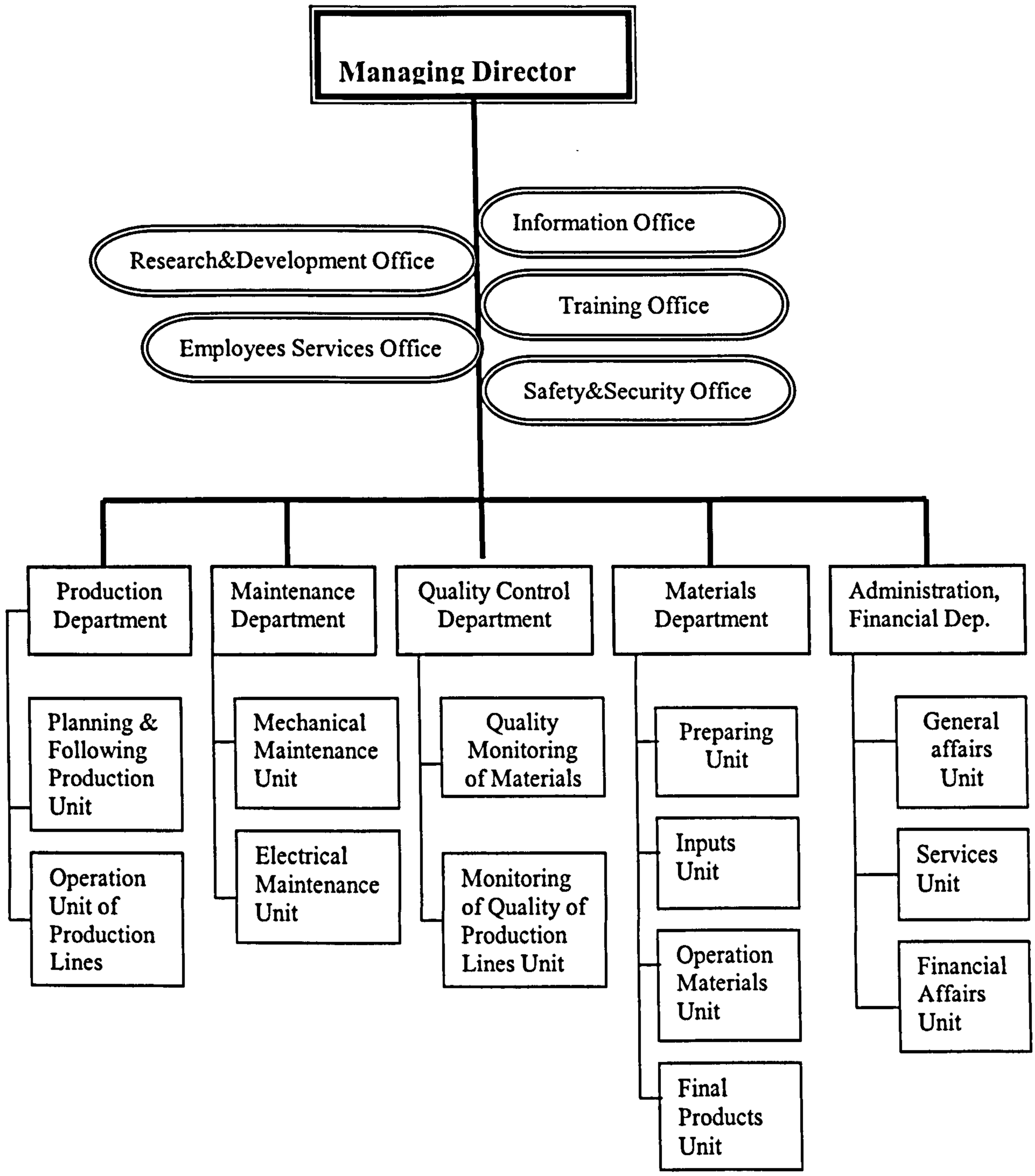
شكرا جزيلا على صبركم وتعاونكم

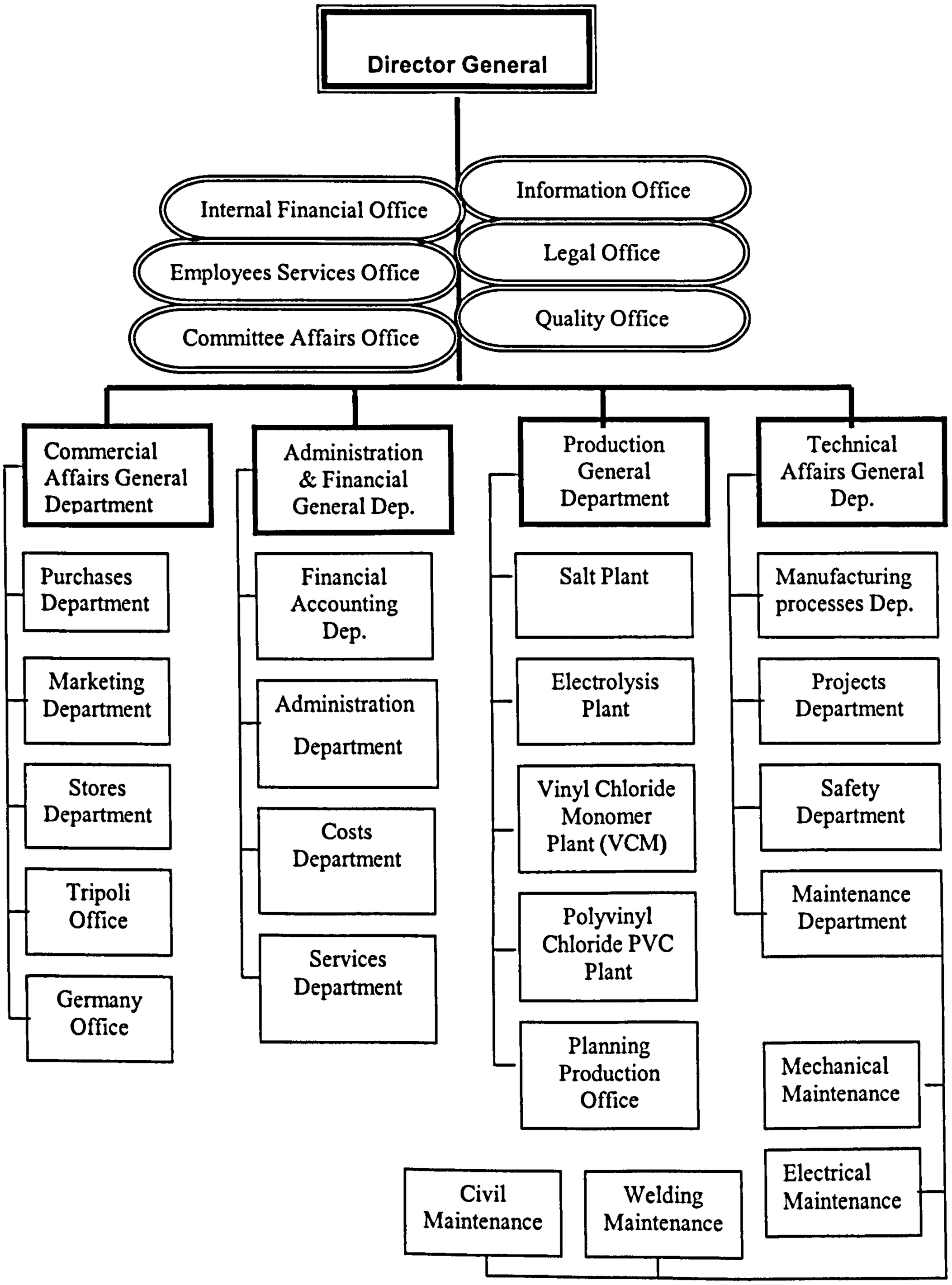
APPENDIX 3.1

The organisational structure of case study organisation X1



APPENDIX 3.2

The organisational structure of case study organisation X2



APPENDIX 4

The full results of questionnaire

a - Maintenance activities factors;

Factor/ categories	SA	A	P A	D	S D	Number of respondents& percentage
Top management pay more attention to improving maintenance	0 0% 3 4%	2 6% 6 8%	16 50% 10 13%	7 22% 37 49%	7 22% 20 26%	Case X1 Case X2
You are satisfied about the current performance of maintenance staff.	2 6% 7 9%	4 13% 28 37%	16 50% 25 33%	10 31% 16 21%	0 0% 0 0%	
The organisation has a backlog of maintenance	5 16% 10 13%	12 37% 30 39%	8 25% 22 29%	7 22% 12 16%	0 0% 2 3%	
There is a link between quality management and improving maintenance activities	8 25% 16 21%	8 25% 29 38%	9 28% 25 33%	6 19% 5 7%	1 3% 1 1%	
Maintenance programs are clearly expressed and communicated to their relevant units and departments	0 0% 16 21%	10 31% 34 44%	8 25% 12 16%	10 31% 12 16%	4 13% 2 3%	
The organisation has available reports/ statistics from its own installation that indicate how implementation of maintenance is carried out	5 16% 2 3%	4 12% 21 27%	11 34% 25 33%	6 19% 23 30%	6 19% 5 7%	
There is a shortage of main resources in the form of budget,	9 28% 13 17%	12 37% 22 29%	7 22% 26 34%	4 13% 13 17%	0 0% 2 3%	
There is a shortage of main resources in the form of skills,	6 19% 11 14%	11 34% 20 26%	8 25% 25 33%	7 22% 18 24%	0 0% 2 3%	
There is a shortage of main resources in the form of methods/ analysis tools,	11 34% 22 29%	13 41% 23 30%	7 22% 15 20%	1 3% 14 18%	0 0% 2 3%	
There is a shortage of main resources in the form of advanced instruments and machines.	13 41% 18 24%	12 37% 28 37%	6 19% 14 18%	1 3% 15 20%	0 0% 1 1%	
There is co-ordination & co-operation between the different departments within the organisation	0 0% 0 0%	3 10% 16 21%	2 6% 15 20%	18 56% 20 26%	9 28% 25 33%	
There is an empowerment for maintenance managers	0 0% 0 0%	4 13% 18 24%	7 22% 8 10%	17 52% 28 37%	4 13% 22 29%	

Maintenance staff has sufficient knowledge of design assumptions,	0 0% 3 4%	4 13% 12 16%	12 37% 18 23%	10 31% 25 33%	6 19% 18 24%	
Maintenance staff has sufficient knowledge of operational conditions,	2 6% 10 13%	12 38% 24 32%	10 31% 30 39%	8 25% 10 13%	0 0% 2 3%	
Maintenance staff has sufficient knowledge of safety instructions.	3 9% 17 22%	10 31% 33 44%	13 41% 16 21%	6 19% 7 9%	0 0% 3 4%	
The organisation has clear rules for the use of handling of checklists,	2 6% 16 21%	13 41% 31 41%	10 31% 23 30%	5 16% 4 5%	2 6% 2 3%	
The organisation has clear rules for the use of updating of checklists,	0 0% 6 8%	6 19% 21 28%	5 16% 11 14%	17 53% 23 30%	4 12% 15 20%	
The organisation has clear rules for the use of storage of checklists.	2 6% 7 9%	9 28% 16 21%	8 25% 12 16%	10 31% 25 33%	3 9% 16 21%	
The organisation has described work processes for all control functions in the maintenance system.	1 3% 6 8%	12 38% 28 37%	10 31% 21 27%	8 25% 19 25%	1 3% 2 3%	
The organisation has described work processes for all supplementary functions in the maintenance system.	0 0% 3 4%	9 28% 20 26%	8 25% 23 30%	12 38% 24 32%	3 9% 6 8%	
The organisation has good management information system	0 0% 0 0%	7 22% 8 11%	11 34% 10 13%	10 31% 33 43%	4 13% 25 33%	
The organisation has developed a process to evaluate the efficiency and effectiveness of maintenance performance	0 0% 0 0%	6 19% 6 8%	11 34% 7 9%	12 38% 43 57%	3 9% 20 26	
The organisation has provided training programs in the maintenance area	0 0% 0 0%	3 9% 9 12%	6 19% 14 18%	14 44% 34 45%	9 28% 19 25%	
Top management of organisation has clear understanding of the scope of maintenance needs,	0 0% 0 0%	4 13% 10 13%	8 25% 12 16%	15 47% 28 37%	5 15% 26 34%	
Top management of organisation has clear understanding of the scope of maintenance mission,	2 6% 6 8%	7 22% 17 22%	12 38% 22 29%	8 25% 24 32%	3 9% 7 9%	
Top management of organisation has clear understanding of the scope of maintenance costs.	2 6% 3 4%	6 19% 12 16%	10 31% 26 34%	12 38% 28 37%	2 6% 7 9%	
There is no good housekeeping system (5-Ss)	0 0% 0 0%	3 9% 9 12%	9 28% 19 25%	11 35% 28 37%	9 28% 20 26%	

b- Factors (barriers) affecting quality management

Barrier/ categories	**SA**	**A**	**PA**	**D**	**S D**	**Number of respondents &percentage**
Full understanding of quality management systems.	0 0% 0 0%	3 9% 10 13%	6 19% 23 30%	17 53% 28 37%	6 19% 15 20%	**Case X1** **Case X2**
Full understanding of quality benefits.	0 0% 7 9%	7 22% 12 16%	9 28% 14 19%	14 44% 33 43%	2 6% 10 13%	
There is a proper organisational policy	0 0% 0 0%	5 16% 12 16%	5 16% 17 22%	17 52% 29 38%	5 16% 18 24%	
Lack of knowledge of top management	5 16% 11 14%	10 31% 25 33%	8 25% 22 29%	9 28% 16 21%	0 0% 2 3%	
Lack of skills of top management	7 22% 16 21%	10 31% 23 30%	10 31% 22 29%	5 16% 15 20%	0 0% 0 0%	
Poor availability of resources	6 19% 20 26%	14 43% 25 33%	7 22% 14 19%	5 16% 17 22%	0 0% 0 0%	
There is an employee empowerment	0 0% 0 0%	6 19% 16 21%	10 31% 12 16%	13 41% 35 46%	3 9% 13 17%	
No sufficient time to implementation	1 3% 1 1%	10 31% 13 17%	11 35% 27 36%	10 31% 26 34%	0 0% 9 12%	
Lack of recognition system	16 50% 20 26%	12 37% 20 26%	4 13% 22 29%	0 0% 14 19%	0 0% 0 0%	
There is a rewards systems	0 0% 0 0%	0 0% 9 12%	4 13% 11 15%	18 56% 33 43%	10 31% 23 30%	
No developed measure of quality system performance	16 50% 14 18%	9 28% 27 36%	5 16% 23 30%	2 6% 12 16%	0 0% 0 0%	
Lack of expertise in quality management	14 44% 22 29%	11 34% 24 31%	3 9% 12 16%	4 13% 18 24%	0 0% 0 0%	
Full top management commitment/ support	0 0% 0 0%	5 16% 3 4%	7 22% 12 16%	11 34% 42 55%	9 28% 19 25%	
No proper vision in organisation	10 31% 26 34%	11 34% 23 30%	7 22% 13 17%	4 13% 14 19%	0 0% 0 0%	

No proper mission in organisation	8 25% 10 13%	14 44% 27 36%	7 22% 23 30%	3 9% 12 16%	0 0% 4 5%	
There is an effective leadership (right people in the right position)	0 0% 0 0%	3 9% 10 13%	6 19% 9 12%	14 44% 23 30%	9 28% 34 45%	
No existence of bureaucracy	0 0% 0 0%	4 13% 16 21%	10 31% 22 29%	11 34% 23 30%	7 22% 15 20%	
Culture change effect	10 31% 18 24%	12 37% 23 30%	5 16% 19 25%	4 13% 14 18%	1 3% 2 3%	
Middle managers' commitment	0 0% 0 0%	8 25% 21 28%	6 19% 19 25%	11 34% 27 35%	7 22% 9 12%	
Lack of employee participation,	0 0% 0 0%	10 31% 21 28%	10 31% 20 26%	6 19% 27 35%	6 19% 8 11%	
Lack of employee involvement,	5 16% 7 9%	13 40% 28 37%	9 28% 22 29%	5 16% 18 24%	0 0% 1 1%	
Full employees' commitment.	2 6% 11 14%	6 19% 16 21%	10 31% 21 28%	12 38% 25 33%	2 6% 3 4%	
Lack of customer feedback system	6 19% 11 14%	14 44% 27 36%	8 25% 24 32%	4 12% 14 18%	0 0% 0 0%	
Lack of sufficient quality training and education	6 19% 18 24%	17 53% 31 41%	7 22% 17 22%	2 6% 10 13%	0 0% 0 0%	
Lack of confidence by employees (impersonal)	6 19% 22 29%	18 56% 24 32%	7 22% 22 29%	1 3% 8 10%	0 0% 0 0%	
There is an effective internal communication network.	4 12% 3 4%	6 19% 15 19%	12 38% 22 29%	10 31% 18 24%	0 0% 18 24%	
There is an effective external communication net work	0 0% 0 0%	3 9% 14 18%	7 22% 28 37%	18 56% 26 34%	4 13% 8 11%	
Lack of government financial support	7, 22% 14, 18%	15, 47% 20, 26%	8, 25% 28, 37%	1, 3% 9, 12%	1, 3% 5, 7%	
Lack of co-operation from customer	3, 9% 2, 3%	16, 50% 28, 37%	11, 35% 29, 38%	2, 6% 17, 22%	0, 0% 0, 0%	
Lack of co-operation from supplier	1, 3% 13, 17%	11, 34% 21, 28%	12, 38% 28, 37%	8, 25% 14, 18%	0, 0% 0, 0%	
Customer's satisfaction and requirements are appreciated	0, 0% 0, 0%	9, 28% 20, 26%	9, 28% 27, 36%	14, 44% 29, 38%	0, 0% 0, 0%	
Employees have a loyalty to their organisation	0, 0% 0, 0%	4, 12% 11, 14%	8, 25% 12, 16%	15, 47% 28, 37%	5, 16% 25, 33%	