A holistic approach of pathways to achieving optimum business outcomes using a Quality Management Assessment Framework (QMAF) with information communication technology (ICT) as an enabler

By

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A thesis presented to the University of Western Sydney In partial fulfilment of the requirements for the degree of Doctor of Philosophy

August 2010

© Stanislaus Roque Lobo
I dedicate this thesis to my late father and my mother for their love and prayers through the years and to my wife and daughter for their love, patience and moral support through the journey of this thesis.
Acknowledgement

I would like to thank my family and friends who supported me throughout this research. This research work could not have been completed without the help, guidance and support of various people. I am very grateful for their detailed comments, insights and invaluable suggestions. I take this opportunity to express my sincere gratitude and appreciation to them.

I would like to express my gratitude to all the company executives who participated in the questionnaire surveys on behalf of their respective organisations.

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Statement of Authentication

The work presented in this thesis is, to the best of my knowledge and belief, original except as acknowledged in the text. I hereby declare that I have not submitted this material, either in full or in part, for a degree at this or any other institution.

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Date: August 2010
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8D  The Eight Disciplines
ABEF Australian Business Excellence Framework
AGFI Adjusted Goodness of Fit Index
AI  Artificial Intelligence
AMOS Analysis of Moment Structures
ANOVA Analysis of Variance
ANZSIC Australia New Zealand Standard Industrial Codes
AOC  Area of Concern
AQA  Australian Quality Award
AQC  Australian Quality Control
BPR  Business Process Reengineering
CEO  Chief Executive Officer
CFI  Comparative Fit Index
CI  Continuous Improvement
COST  Customer Organisation Supplier Technology
CRM  Customer Relationship Management
CSCW Computer Supported Cooperative Work
CSIN  Chart Solve Implement Next
CT  Clifford Thames
CTQ  Critical to Quality
CWQC  Company-wide Quality Control
D&B  Dun and Bradstreet
DIT  Departmental Improvement Teams
DMAIC Define Measure Analyse Improve Control
DOE  Design of Experiments
EC  Electronic Commerce
EC  Excellence Centre
EDI  Electronic Data Interchange
EFQM  European Foundation for Quality Management
<table>
<thead>
<tr>
<th>Abbreviation</th>
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<td>European Quality Award</td>
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<tr>
<td>ERP</td>
<td>Enterprise Resource Planning</td>
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<tr>
<td>FMEA</td>
<td>Failure Mode Evaluation Analysis</td>
</tr>
<tr>
<td>GFI</td>
<td>Goodness of Fit Index</td>
</tr>
<tr>
<td>GOF</td>
<td>Goodness of Fit</td>
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<tr>
<td>IATF</td>
<td>International Automotive Task Force</td>
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<tr>
<td>ICT</td>
<td>Information Communication Technology</td>
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<tr>
<td>IFI</td>
<td>Incremental Fit Index</td>
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<tr>
<td>II P</td>
<td>Investors in People</td>
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<tr>
<td>IMS</td>
<td>Intelligent Manufacturing System</td>
</tr>
<tr>
<td>IOS</td>
<td>Organisational Information System</td>
</tr>
<tr>
<td>ISO</td>
<td>International Organisation of Standardisation</td>
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<tr>
<td>IT</td>
<td>Information Technology</td>
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<tr>
<td>JIT</td>
<td>Just In Time</td>
</tr>
<tr>
<td>JUSE</td>
<td>Japanese Union of Scientists and Engineers</td>
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<td>KM</td>
<td>Knowledge Management</td>
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<tr>
<td>LISEREL</td>
<td>Linear Structural Relations model</td>
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<td>LRQA</td>
<td>Lloyd’s Register Quality Assurance</td>
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<td>MBNQA</td>
<td>Malcolm Baldrige National Quality Award</td>
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<tr>
<td>MBQP</td>
<td>Malcolm Baldrige Quality Program</td>
</tr>
<tr>
<td>MCB</td>
<td>Multiple Comparison with the Best</td>
</tr>
<tr>
<td>ML</td>
<td>Maximum Likelihood</td>
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<tr>
<td>NC</td>
<td>Normed Chi square</td>
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<td>NFI</td>
<td>Normal Fit Index</td>
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<tr>
<td>NGM</td>
<td>Next Generation Manufacturer</td>
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<td>NSW</td>
<td>New South Wales</td>
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<tr>
<td>OtoD</td>
<td>Operation to Delivery</td>
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<tr>
<td>PDCA</td>
<td>Plan Do Check Act</td>
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<td>PDSA</td>
<td>Plan Do Study Act</td>
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<tr>
<td>PPMS</td>
<td>Process Performance Measuring System</td>
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<td>PSWG</td>
<td>Problem-Solving Work Groups</td>
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<tr>
<td>QF</td>
<td>Quality on all Fronts</td>
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<td>QFD</td>
<td>Quality Function Deployment</td>
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<tr>
<td>Abbreviation</td>
<td>Definition</td>
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<tr>
<td>QMAF</td>
<td>Quality Management Assessment Framework</td>
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<td>QMM</td>
<td>Quality Management Method</td>
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<tr>
<td>QMS</td>
<td>Quality Management System</td>
</tr>
<tr>
<td>QOS</td>
<td>Quality Operating System</td>
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<tr>
<td>QS</td>
<td>Quality Standard</td>
</tr>
<tr>
<td>RMR</td>
<td>Root Mean Square Residual</td>
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<tr>
<td>RMSEA</td>
<td>Root Mean Square Error of Approximation</td>
</tr>
<tr>
<td>RTA</td>
<td>Ready to Assemble</td>
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<tr>
<td>SEM</td>
<td>Structural Equation Modelling</td>
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<td>SPC</td>
<td>Statistical Process Control</td>
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<tr>
<td>SPS</td>
<td>Statistical Process Solving</td>
</tr>
<tr>
<td>SRMR</td>
<td>Standardised Root Mean Square Residual</td>
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<td>TLI</td>
<td>Tucker-Lewis Index</td>
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<tr>
<td>TOPS</td>
<td>Team Oriented Problem Solving</td>
</tr>
<tr>
<td>TQC</td>
<td>Total Quality Control</td>
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<tr>
<td>TQM</td>
<td>Total Quality Management</td>
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<tr>
<td>US</td>
<td>United States</td>
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<tr>
<td>UBD</td>
<td>Universal Business Directory</td>
</tr>
<tr>
<td>UK</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>ULS</td>
<td>Unweighted Least Squares</td>
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<td>USA</td>
<td>United States of America</td>
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Abstract

It is imperative that issues that lead to poor implementation of quality programs be addressed effectively to enable Australian companies to compete more effectively in highly competitive global markets. The development of a methodology to assess the strengths and weaknesses of the quality system in an organisation could thus be of value to organisations to enable them to rectify weaknesses and compete more effectively on the basis of customer value creation through quality enhancement.

Creating value for the customer through quality is accepted as an important component of the competitive strategy of organisations throughout the world. Its relevance and significance is well reflected by the importance attached to the “quality imperative” not only by organisations but also by governments, international agencies, and business associations. The breakthrough gains that can be made through a well-implemented Total Quality Management (TQM) program have prompted the development of award systems such as the Deming Prize, the Baldrige Award, the European Quality Award the Japanese Quality Award, and the Australian Quality Award, which also serve as frameworks for self-assessment and improvement.

The purpose of this study is to establish pathways to achieve optimum business outcomes using the Quality Management Assessment Framework (QMAF) model with ICT as an enabler and to formulate guidelines for managers. The main research question is as follows.

How do the categories which contain the TQM elements including information communication technology (ICT) in the model of the Quality Management Assessment Framework (QMAF) directly and indirectly affect the performance outputs of an organisation, namely business outcomes (business results and customer and stakeholder value)?

Based on a study of popular quality frameworks, an integrated approach for assessing quality management practices at the organisation level is proposed. Explicit attention
is then paid to the role that information and communication technology (ICT) can play in upgrading quality management practices. ICT is seen as an enabler that, through its influence on the elements of the proposed framework, can accelerate the movement of an organisation towards ICT supported quality management and strengthen an organisation’s operative technological capability.

The model consists of the following major TQM elements: leadership; strategy; quality culture; benchmarking; customer focus; partnering; education and training; empowerment; total quality tools; continuous improvement; business processes; information/knowledge/communication; business results plus feedback; and customer value plus feedback. The major TQM elements are classified into nine categories in the model, namely leadership, quality culture, information/knowledge/communication, strategy, human resources management, partnering focus, improvement methods, business processes and business outcomes (business results, customer and stakeholder value and feedback).

The model is referred to as the Quality Management Assessment Framework (QMAF). Based on a comprehensive review of the literature, a detailed checklist has been developed for each of these elements so that, through its administration, a quick assessment could be made of the status of the quality system of an organisation.

The delineation of these elements and their further elaboration through the checklist is an attempt to understand the complex interactions of these factors on business results and customer value creation. The framework also pays special attention to the role that ICT can play in upgrading quality systems. Here, ICT is seen as an enabler that, together with the major elements of TQM, can revolutionise people management, technology management, knowledge management and business management in the pursuit of organisational excellence.

This research involved a questionnaire-based survey of small, medium and large manufacturing organisations in the Western Sydney Region. A total of 60 useable questionnaires were received from organisations who received the questionnaire by mail. The management information from the data was treated with the appropriate statistical tools in order to attain secure and minimally biased conclusions.
A clear methodological path for assessing the quality management systems of organisations with the use of the Quality Management Assessment Framework (QMAF) model is presented. It introduces the concepts evaluated by the QMAF model and provides an assessment of the quality management capabilities of the industries in the Western Sydney Region of New South Wales (NSW), Australia. The assessment is based on distribution of scores of the various categories in the QMAF model, using a benchmarking process.

Furthermore, it detected significant differences between large, medium and small organisations and the various ANZSIC industry codes with regard to measures of the TQM categories of the QMAF model using ANOVA and multiple comparison with the best (MCB). The analysis verified the general reliability of the QMAF model. The QMAF model assessment has also identified many of the Western Sydney Region manufacturing industries’ shortcomings that merit further investigation. The results of this analysis can serve as valuable feedback to the managers of the industries considered in this study aiming at bettering their business processes in many ways, including benchmarking their performance against the best case scores of the QMAF.

Multiple regression and Structural Equation Modelling (SEM) - path analysis were further used to study the strengths and the relationships between the constructs in the QMAF model. The causal relationships between the various constructs in the model were used to establish optimum pathways in achieving business outcomes encompassing business results, customer and stakeholder value were established for the manufacturing industries in the Western Sydney Region.

The results of the analysis validate the QMAF model. The significance of information communication technology (ICT) as an enabler through its influence on the constructs of the proposed framework as represented by the information, knowledge and communication (IKC) construct is affirmed. Several hypotheses are substantiated establishing direct and indirect causal relationships among the constructs of the QMAF model.
The impact of the traditional Total Quality Management (TQM) constructs on business outcomes using a Quality Management Assessment Framework (QMAF) without considering the Information/Knowledge/Communication (IKC) construct was also studied.

Multiple regression and SEM - path analysis (recursive) were also used to study the strengths and the relationships between these constructs. In order to validate and reinforce the strengths of the relationships between traditional TQM constructs, several hypotheses are substantiated among the traditional TQM constructs establishing direct and indirect causal relationships among the constructs and their significance.

Finally the one-to-one direct effect of IKC on the other categories of the QMAF model was determined using regression analysis.

The quality assessment analysis using descriptive statistics, ANOVA, Hsu's MCB along with (SEM) recursive path analysis study provides vital guidelines to managers in the manufacturing industries of the Western Sydney Region in formulating strategies towards achieving business excellence through TQM using ICT as an enabler. The one-to-one direct effect of IKC provides a more holistic picture of the important role ICT plays in obtaining optimum business outcomes. The above findings supported by the QMAF assessment tool can be used to foster continual improvement and achieve business excellence.

This research concludes by pointing out the implications, strengths and limitations of the study and suggestions for future research.
Chapter 1

Introduction and Research Context

1.1 Introduction

Australian companies must be well equipped in order to compete more effectively in highly competitive global markets; hence it is of paramount importance that issues which lead to poor implementation of quality programs be addressed tenaciously to deliver optimum business outcomes. The development of a methodology to evaluate the strengths and weaknesses of the quality system in an organisation could thus be a conduit to resolve weaknesses and to compete more effectively on the basis of customer value creation through quality enhancement.

Below is a brief overview of the need for good quality. This is followed by an outline of the status of quality management in Australian companies.

The Quality Imperative

Today, companies have to survive and grow in a business setting where competition continues to intensify due to forces unleashed by globalisation, liberalisation, emergence of new trading nations, and accelerating technological change. Goetsch and Davis (1997) point out those companies, which previously competed on a local, regional, or national level, have now to compete against companies from throughout the world. Needless to say, only organisations that can produce world-class quality can compete at this level.

Empirical evidence exists to show that there is a strong link between the capacity of organisations to produce world-class quality and their ability to compete and grow (Garvin, 1991; Wisner and Eakins, 1994; Zairi et al. 1994; Mohram et al. 1995; McAdam and Bannister, 2001). Garvin (1991) found a strong positive link between Total Quality Management (TQM) practices and organisational performance measured in terms of productivity, profitability, customer satisfaction and employee
relations. Wisner and Eakins (1994) in his study of the performance assessment of the US Baldrige Quality Award winners found that the organisations performed financially as well or even better than their competitors.

Zairi et al. (1994) through their examination of studies in Europe, the US and Japan have shown that there is a strong association between TQM practice and bottom-line results. These studies strongly suggest that TQM has a direct impact on financial results, only if its implementation is well directed and planned and also there must be strong commitment in sustaining continuous improvements which are focused on end-customer benefits.

Mohrman et al. (1995), based on their study of TQM practices in large US organisations, determined that TQM practices had a positive influence on performance improvement and financial outcomes. They also found that the core practices of TQM (improvement of processes, mechanisms for employees to become involved) showed a strong relationship to market share, work performance outcomes and employee outcomes in manufacturing organisations. Production-oriented practices in TQM such as work cells, statistical process control, self-inspection and JIT deliveries were found to be related positively to company performance, employee outcomes in manufacturing, return on equity, competitiveness and profitability. Collaboration with suppliers, which is a major component of TQM, was also found to have a positive relationship to total factor productivity in both service and manufacturing organisations. In another study, McAdam and Bannister (2001) are of the view that organisations with TQM in place obtain their profits from customer satisfaction. Through a case study they also show that as the application of TQM process matures with time, all the business indicators show steady improvement.

The breakthrough gains that can be made through a well implemented TQM program prompted many countries to institute national awards for promoting TQM in their respective countries and regions. Ghobadian and Woo (1996) examined the characteristics of various awards for total quality management and drew the following conclusions.
Industrialists, politicians and trade unionists all agree that superior quality is an important contributor to improved competitiveness.

Quality awards have succeeded in generating awareness and interest in the total quality management concepts.

They establish a framework for identifying a range of intangible and tangible processes that impact the organisations’ total quality and the end result.

They also provide the organisations with a means to measure their status against a set of universal criteria and to determine their strengths and weaknesses in the key areas of business.

Below is a brief overview of the various well known international quality awards:

The Deming Prize was established by the Board of Directors of the Japanese Union of Scientists and Engineers (JUSE) in 1951. It recognises performance improvements brought about by successful implementation of company-wide or total quality control (CWQC or TQC). It has proved to be an effective instrument for spreading quality methods throughout Japanese industry.

The Malcolm Baldrige National Quality Award was founded in 1987. The application categories include manufacturing, services and small business. Only whole or part for-profit businesses located in the USA or its territories are eligible to compete for the award. It has four major elements – driver, system, measure of progress, and goal. Brown (1997) stated that most major US corporations, all US military organisations, schools, educational institutions and a variety of public and private organisations use the criteria to help them evaluate and improve their performance.

The Australian Quality Award (AQA) was established by Enterprise Australia in 1988 and awarded by the Australian Quality Council (AQC) (Ghobadian and Woo, 1996; Zink et al. 1997). The AQA is based on the Australian Business Excellence
Framework (ABEF). AQC sold the rights to the ABEF and the Australian Business Excellence awards to SAI Global who are the current custodians of the ABEF (Griggs and Mann, 2008). Its aim was to encourage local companies to improve their quality and performance to world-class level and provide a benchmark for their achievements. It was reasoned that this could assist Australian companies to compete more effectively in a highly competitive and global market place through improved quality.

The European Quality Award (EQA) was set up in 1991. The main objectives of this award were to support, encourage and recognise the development of effective total quality management by European companies. It is managed by the European Foundation for Quality Management (EFQM). The model has two parts: enablers - policies and processes that drive the business and facilitate the transformation of inputs to outputs; and outcomes and results - a measure of the level of output and outcome attained by the organisation.

Thus, over the years through initiatives such as international quality awards and standards, creating value for the customer through quality has become an important component of the competitive strategy of organisations throughout the world. Its relevance and significance is well reflected by the importance attached to the “quality imperative” not only by organisations but also by governments, international agencies, and business associations.

**Quality in Australia**

In the 1970s and 1980s, Australia experienced relative economic decline. Early attempts on quality improvement using quality circles had failed because they lacked:

- senior management involvement and leadership;
- appropriate human resources and cultural policy;
- the ability to make permanent process improvements when identified through quality circles;
- the ability for organisations to share performance information with their shopfloor workforce with a view to close the gap between improvement actions and their consequences;
- customer focus through creation of value for customers by linking back into production system objectives; and
- accountability of systems and process discipline.

In the 1980s, two programs were responsible for promotion of quality in Australia. These were:
- the establishment of a quality council which established the Australian Quality Award;
- the popularisation of the ISO 9000 initiative.

Organisations in Australia that have well implemented TQM programs have earned world-class status. Others who have had poorly implemented programs are clearly behind the leaders in business. Many Australian companies have their quality systems certified to ISO 9001, some have made significant gains in quality by using it to make improvements; however, others wear the ISO 9001 system as a badge rather than to drive improvements (Samson, 1997).

Samson (1997) conducted surveys and case studies to evaluate TQM in Australia and came to the following conclusions:

- Significant progress is being made in Australia by leading organisations, in quality-based improvement. The best companies in Australia have pursued TQM programs and have achieved world-class levels. These organisations have measured their progress in TQM through the use of local quality award frameworks that are comparable to the US Baldrige Award criteria. Samson (1997) also points out that there are organisations in Australia which are behind the leaders as a result of poor implementation of quality programs. Service organisations in Australia have started TQM implementation much later than manufacturing.
• Many organisations in Australia have quality programs designed around quality assurance systems as per requirements of ISO 9000 series version 1994 and other local equivalent standards. Some have derived benefits by achieving quality-based performance improvement through application of these systems. Others have limited their achievements by using ISO only to obtain certification rather than to document their existing quality processes and make improvements. Their reason for obtaining ISO accreditation was to retain their government or other leading customers (Samson, 1997).

• Recognition of organisations in Australia who have made significant progress in quality improvement has taken place through the Australian Quality Award program. The Australian Quality Award program has fostered a growing group of “Quality Focused” organisations (Samson, 1997).

Recent empirical studies have been conducted to comprehend the relationships between TQM practices and their relationships to organisational performances. Rahman and Sohal (2002) have conducted a comprehensive review and classification of total quality management research in Australia. Their findings revealed that the research has been unbalanced focused on case studies and empirical studies. The empirical studies examined the relationship between TQM practice and organisational performance, recognised factors impacting customer retention in service organisations, evaluated top management’s awareness of TQM and investigated the relationship between employee participation and job satisfaction. Rahman and Sohal (2002) established that though these studies provided valuable information on how TQM can be implemented to achieve competitiveness much work required to be done by way of developing conceptual and theoretical strengthening of TQM through empirical studies tested by analytical models in order to convert TQM into a coherent management discipline. They further noted that the majority of the studies focused on people, leadership and processes, products and services of TQM with less attention given to the strategic planning and customer criteria.
Prajogo and Cooper (2010) studied people related elements of total quality management and job satisfaction. The study established strong and positive relationship with job satisfaction and TQM practices. Prajogo and Sohal (2004) through an empirical case study on a large manufacturing organisation concluded that a quality management system needs to be implemented and aligned with the company’s business strategy and that the success derived from TQM therefore originates from strategic adaptation of the use of its principles rather than by simply adopting its tools and techniques.

The above findings highlight the need to develop conceptual and theoretical TQM models through empirical studies tested by analytical models. The above mentioned research would be required in order to convert TQM into a logical management discipline, hence providing a strong basis and rationale for developing sustainable and comprehensive methodologies for addressing shortcomings in quality management capabilities in the Australian organisations in particular Western Sydney region as a test case. Specifically there is compelling justification to investigate ICT interventions within a TQM framework as no work has been done in the context of Australia in this area.

1.2 Background of the Study

**Rationale for enhancing quality management capabilities**

The issues that led to poor implementation and consequent bad outcomes in quality programs need to be addressed. These issues regarding poor quality have been referred to in the previous section and have further been extensively discussed in Chapters 2 and 5. Australian companies have to compete more effectively in highly competitive global markets. This warrants the need to raise quality and performance standards to a world-class level. TQM will maximise the probability of meeting the business objectives of the industry. It will provide an assessment tool to evaluate the progress of activities. The introduction of TQM brings about significant reduction in development, cycle time, costs, and helps in achieving target quality parameters efficiently. Kayis (1998) assessed TQM implementation in Australian manufacturing companies and established that there was inadequate concern towards adopting a
holistic approach to quality management practices incorporating workforce, equipment, technology, materials, parts, purchase, design of process and organisational issues.

To facilitate the adoption of a holistic approach, McAdam and McKeown (1999) advocate that implementation of the ISO 9000 series version 1994 should be used as a step toward TQM. ISO 9000 series has undergone a major change with the introduction of the new ISO 9001:2000 standard. The new standard has aligned itself more closely with TQM principles.

The ISO 9001:2000 quality standard has once again been recently updated to ISO 9001:2008. However, the revision is not a significant modification from ISO 9001:2000 since:

- No new requirements have been added,
- Rather clarifications to the existing ISO 9001:2000 requirements have been made,
- Clarifications/changes were made to improve consistency with other management system standards such as ISO 14001:2004.

The ISO 9001:2008 Standards Australia (2008) is based on eight quality management principles:

**Customer Focus**
Organisations depend on their customers and therefore should understand current and future customer needs, should meet customer requirements and strive to exceed customer expectations.

**Leadership**
Leaders establish unity of purpose and direction of the organisation. They should create and maintain the internal environment in which people can become fully involved in achieving the organisation’s objectives.
Involvement of People
People at all levels are the essence of an organisation and their full involvement enables their abilities to be used for the organisation’s benefit.

Process Approach
A desired result is achieved more efficiently when activities and related resources are managed as a process.

System Approach to Management
Identifying, understanding and managing interrelated processes as a system contributes to the organisation’s effectiveness and efficiency in achieving its objectives.

Continual Improvement
Continual improvement of the organisation’s overall performance should be a permanent objective of the organisation.

Factual Approach to Decision Making
Effective decisions are based on the analysis of data and information.

Mutually Beneficial Supplier Relationships
An organisation and its suppliers are independent and a mutually beneficial relationship enhances the ability of both to create value.

Hence, in order for companies to comply with the ISO 9001:2000 standard and now the updated ISO 9001: 2008, a major upgrade of quality management systems will have to be conducted. This reinforces the need to establish the elements of TQM in their quality management practices. Additionally, Laszlo (2000) has identified a few potential difficulties with the implementation of the 2000 version of the ISO 9001 standard:

- Organisations will have to recognise the cultural gap that exists between the new ISO 9001:2000 as compared to the previous 1994 version.
Auditors working with the new version may not have the requisite background to audit as the emphasis has changed from one of totally-compliance-based to a new approach that also includes evaluation of management techniques requiring hands-on experience and judgement.

The above mentioned issues require strategies to be developed which can address training needs and processes to overcome these obstacles.

Many important quality elements are associated and need to be considered through an integrated framework (Prajogo et al. 2008; Singh, 2008). Hence an assessment tool to evaluate, analyse, identify gaps in the quality system and determine pathways to deliver optimum business outcomes need to be developed to support a continual improvement culture.

The research would further support the strategy development and deployment processes of an organisation which would in turn cascade into enhancing the areas of leadership, customer focus, involvement of people, the process approach, system approach to management, continual improvement, factual approach to decision making and mutually beneficial supplier relationships. Additionally there is a need to explore the enhancing aspects of information communication technology (ICT) as an enabler in quality. It should be noted that information communication technology (ICT) is represented by the information, knowledge and communication (IKC) construct in this thesis.

### 1.3 Research Problem

Evidence exists to show that many industries in Australia manage their quality systems using traditional methods. Even ISO 9000 approved companies do not have effective continual improvement systems (Eisen et al. 1992; Beattie and Sohal, 1999; Singh, 2008). It is imperative that issues that lead to poor implementation of quality programs need to be addressed to enable Australian companies to compete more effectively in highly competitive global markets.
Effective implementation of TQM can thus enhance the probability of meeting the business objectives of the industry by bringing about significant reduction in development cycle time, costs and helping in achieving target quality parameters effectively. This can be achieved by determining the limitations that an organisation may have when compared to best practices in the areas of leadership, quality culture, information/knowledge/communication, strategy, improvement methods, human resource management, business processes and business results. Strategies can then be implemented to address these gaps and improve the quality system to deliver excellent business outcomes.

This study is aimed at gaining an understanding of quality management problems in manufacturing organisations in the Western Sydney region with a view towards developing measures to overcome the above mentioned problems. The basis for studying manufacturing organisations in the Western Sydney region is outlined in Chapter 4, section 4.3.4, population and sample selection.

1.4 Research Question and Objective of the Study

A research question provides a platform for the research problem to develop a theoretical framework, data collection and analysis of the study. The research question is as follows:

*How do the categories which contain the TQM elements including information communication technology (ICT) in the model of the Quality Management Assessment Framework (QMAF) directly and indirectly affect the performance outputs of an organisation, namely business outcomes (business results and customer and stakeholder value)?*

This is the central question which will be pursued through this thesis. In order to answer the above research question, this study aims to develop and test a comprehensive model to examine the direct and indirect effects of the categories in the model of the QMAF on an organisation’s performance (business outcomes). Drawing on the literature, a conceptual research model was developed and empirically tested with primary data collected for the study.
This research sets out to identify pathways that will effectively and efficiently optimise the performance outputs (business outcomes) of an organisation.

1.5 The Research Significance

The study has significance in broadening research and empirical knowledge about the impact of the various TQM elements including ICT as an enabler on organisations’ business performance (business outcomes). The research specifically focuses on the manufacturing industries in the Western Sydney Region. The contribution falls into three categories: a conceptual framework for providing tools to facilitate advances in various organisations’ policy issues relating to quality practices promotion; management guidelines to managers in organisations to take decisions in promoting improvements in the areas of leadership, quality culture, customer focus, supplier focus, employee development and empowerment, continual improvement processes, use of total quality tools, development of business processes, applying information/knowledge/communication to achieve business excellence. In summary, the research would help managers to overcome barriers in quality management, plan, improve and implement programs to overcome barriers and strengthen capacity to enhance quality practices.

First, from a theoretical perspective, our knowledge on the impact of TQM elements on business performance is limited. This study contributes to the literature as to how the TQM elements directly and indirectly influence organisation business performance by the inclusion of leadership, quality culture, information/knowledge/communication, partnering focus, improvement methods, business processes as independent determinants in the QMAF model and empirically tests a number of hypotheses linking business performance (business outcomes) with one of more of the elements of the QMAF model.

Second, this study places special emphasis on information communication technology as an enabler to the quality management system. It helps organisations to design and develop policies and strategies by choosing pathways that would provide
the most optimum and effective route to achieving excellent business performance (business outcomes) results.

Third, the study provides guidelines for managers in organisations with a checklist to evaluate their quality management systems. Managers are able to use the checklist in conjunction with defined optimum pathways determined by the study to manage their operations on an ongoing basis and ensure enhanced business performance (business outcomes) continually.

1.6 Scope of the Study

The scope of the study will cover manufacturing organisations in the Western Sydney region. The purpose of this study is to establish pathways to achieve optimum business outcomes using the QMAF model with information communication technology (ICT) as an enabler and to formulate guidelines for managers.

The more specific objectives of the present research are as follows:
1. Conduct a comprehensive review of TQM.
2. Develop a conceptual model for understanding factors promoting and hindering TQM in manufacturing enterprises.
3. Based on the model, conduct a comprehensive survey to identify the major weaknesses of quality systems in manufacturing organisations in the Western Sydney region.
4. Provide an assessment of the quality management capabilities of manufacturing organisations in the Western Sydney region.
5. Determine pathways to achieving optimum business outcomes through the various TQM categories in the proposed quality model using structural equation modelling (SEM), specifically SEM path analysis.
6. Use the inferences drawn from the assessment of the quality management capabilities of manufacturing organisations in the Western Sydney region and the SEM path analysis results to formulate guidelines for managers.
1.7 Structure of the Thesis

This thesis is developed through seven chapters.

Chapter 1 – Introduction and Research Context

This chapter outlines the conceptual background, the objectives of this study, and elaborates upon the main research question and its significance. It also outlines the scope of the research. This is then followed by an elaboration of the structure of the thesis.

Chapter 2 – Literature Review

A summary of the extensive literature on the diverse issues related to quality is presented in this chapter. A historical perspective of TQM is outlined followed by a presentation of the major elements of TQM. This is then followed by an examination of the organisational factors and TQM implementation, certification and quality awards, information communication technology in TQM and future trends in TQM. The future trends in TQM covers best practices in large organisations, emerging models in TQM, paradigm shift in quality management and the impact of IT on quality management. The above mentioned plethora of quality management information will be used in deriving questions that will be incorporated in the survey questionnaire. Thus it provides a rich source of management information for developing the checklist to evaluate quality management systems.

Chapter 3 – The Quality Management Assessment Framework (QMAF)

Based on the literature review, this chapter proposes an integrated model for assessing quality at the organisation level known as the Quality Management Assessment Framework (QMAF). It specifically highlights the role of ICT as an enabler. It explains how the QMAF model can be operationalised using a scoring mechanism and deliver improvement in an organisation. Hence this chapter supports the research significance, namely the aspects of how the TQM elements link to delivering business outcomes, and the emphasis of ICT as an enabler. Additionally it
provides an inventory of management concepts which were used to aid in the formulation of the survey questionnaire.

Chapter 4 – Research Methodology

The nature of the research, operationalising the variables, the survey procedures and methods used to collect the data, an overview of the sample characteristics and statistical techniques for data analysis in this study are discussed in this chapter.

Chapter 5– Overall Quality Management Profile of Surveyed Organisations

This chapter provides an assessment of the quality management capabilities of the industries in the Western Sydney region of New South Wales (NSW), Australia. The assessment is based on distribution of scores of the various TQM categories of the QMAF model, using a benchmarking process. ANOVA and Hsu’s MCB analysis is also used to detect significant differences between large, medium and small organisations and the various ANZSIC industry codes with regard to measures of the TQM categories of the QMAF model.

Chapter 6– Further Statistical Analysis and Discussion

In this chapter the findings of the statistical analysis of the QMAF model using regression analysis and structural equation modelling, specifically SEM recursive path analysis, are reported and interpretations of the results are discussed.

Chapter 7– Conclusions and Recommendations

This chapter concludes the work with an overview and implications for management. The strengths and limitations of the study are also discussed and recommendations for further research are presented in this chapter.
Chapter 2
Literature Review

2.1 Introduction

This chapter will present a comprehensive literature review of TQM with a view to compiling a state of the art inventory of TQM knowledge. This compilation will be used to conceptualise the quality model and to develop the instrument to elucidate data in the study. The first section is an introduction to TQM, the second provides a historical perspective of TQM. It outlines how TQM evolved through the years and chronologically explains the contributions made by the various stalwarts of TQM and concludes with contemporary forms TQM programmes. The third section deals with major elements of TQM, namely Leadership, Quality Culture, Customer Focus, Partnering, Empowerment, Education and Training, Communication, Total Quality Tools, Benchmarking and Continuous Improvement. The fourth section discusses organisational factors and TQM implementation. It provides valuable information on issues encountered by organisations in implementing TQM, and models that various authors proposed and implemented in order to overcome barriers to implementing TQM. The fifth section covers certification and quality awards. It is a comprehensive review of the certifications to quality such as the ISO 9001 series, various international quality awards such as the Deming Prize, the Malcolm Baldrige National Award, The European Quality Award, The Australian Business Excellence Award and a comparison of these awards is also presented. The sixth section discusses information communication technology in TQM. The seventh section outlines future trends in TQM. It covers best practices in large organisations, emerging models in TQM, the paradigm shift in quality management and the impact of IT on quality management. This chapter finally summarises concluding remarks on TQM.

2.2 TQM Historical Development

This section outlines a chronological evolution of total quality. It starts with the definition of total quality as defined by the U.S. Department of Defence: “TQM
consists of continuous improvement activities involving everyone in the organisation, managers and workers, in a totally integrated effort toward improving performance at every level.” This improved performance is directed toward satisfying such cross-functional goals as quality, cost, schedule mission need, and suitability. TQM integrates fundamental management techniques, existing improvement activities, and tools, under an organised approach focused on continued process improvement. Ultimately the activities are focused on increased customer/user satisfaction.

TQM can be traced back to the 1920s when Taylor (1911) conducted time and motion studies. Taylor is known as “The father of scientific management”. Scientific management is based on the principle of separation of planning and execution. It did away with the old concept of craftsmanship which consisted of one highly skilled individual who performed all the tasks required to produce a quality product and replaced it by making planning the job of management and production the job of labour. This led to the creation of separate quality departments. Volume and complexity of manufacturing brought about quality engineering in the 1920s and reliability engineering in the 1950s.

The application of statistical methods and the fundamentals of workforce management were developed in the early part of the 20th century. Shewhart made a major contribution to the field of statistics in quality management and was Deming’s mentor in the 1920s and 1930s. His book ‘The Economic Control of Quality of Manufactured Product’ was the first to highlight that data obtained from industrial processes could flag if processes were in control or were being affected by special causes. However the West have ignored his work on Process Control and instead moved towards the Principle of Inspection as the main focus to Quality (Goetsch and Davis, 2006; Petersen, 1999). The Japanese developed their form of TQM at the end of World War II.

Powell (1995) states that TQM’s origins can be traced back to when the Union of Japanese Scientists and Engineers formed a committee of scholars, engineers, and government officials devoted to improving Japanese productivity, and enhancing their post-war quality of life. Towards the end of the 1970s and the beginning of the
1980’s the success of Japanese companies and the impact made by some American writers resulted in a significant focus on quality management in the USA and this spread to the rest of the world. American firms adopted TQM in 1980. The importance of TQM was acknowledged through the establishment of the Malcolm Baldrige National Quality Award and other similar awards in other countries.
Table 2.1 summarises the historical events that have influenced the development of TQM. It portrays a gradual evolution of TQM.

Table 2.1: Important events in the development of TQM

<table>
<thead>
<tr>
<th>PERIOD</th>
<th>EVENTS</th>
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</thead>
<tbody>
<tr>
<td>1911</td>
<td>Frederick W. Taylor publishes <em>The Principles of Scientific Management</em>, giving birth to such techniques as time and motion studies.</td>
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<tr>
<td>1924-1932</td>
<td>Hawthorne studies demonstrated the importance of the social and psychological climate in work.</td>
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<td>1924</td>
<td>Shewhart developed statistical process control</td>
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<td>1926</td>
<td>The Bell Telephone began to apply statistical control methods.</td>
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<tr>
<td>Mid-1940s</td>
<td>The American army pushed the use of sampling methods during World War II.</td>
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<tr>
<td>1950s</td>
<td>A large number of attempts at work improvement were undertaken (e.g. job enrichment, work redesign, participative management, quality of work life and worker involvement).</td>
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<tr>
<td>1950</td>
<td>First visit of Deming to Japan.</td>
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<tr>
<td>1951</td>
<td>Creation of “Deming Application Prize” in Japan. First edition of Juran’s <em>Quality Control Handbook</em>.</td>
</tr>
<tr>
<td>1954</td>
<td>First visit of Juran to Japan. Marslow’s theories about human needs.</td>
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<tr>
<td>1960</td>
<td>Liberalisation of economy in Japan with pressure to improve quality to compete with foreign companies. McGregor’s X and Y theories.</td>
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<tr>
<td>1961</td>
<td>First edition of Feigenbaum’s <em>Total Quality Control</em>. Martin Company (later Martin-Marietta) builds a Perishing missile that has zero defects.</td>
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<td>1962</td>
<td>The idea of quality circles appeared in the first issue of the Japanese journal <em>Quality Control for the Foreman</em>.</td>
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<tr>
<td>Late 1960s and early 1970s</td>
<td>The pressure of Japanese companies began to be felt in American companies.</td>
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<tr>
<td>1970</td>
<td>Philip Crosby introduces the concept of <em>zero defects</em>.</td>
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<tr>
<td>1972</td>
<td>QFD was developed at Mitsubishi’s Kobe shipyard site.</td>
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<tr>
<td>1973</td>
<td>After the 1973 oil crisis the JIT system was adopted by a vast number of Japanese companies. A small number of American and European companies began to apply this system in the 1980s.</td>
</tr>
<tr>
<td>Mid-1970s</td>
<td>Quality circles began to be widely introduced in the USA, the first quality circle programme was launched in Lockheed in 1974 and in the UK it was Rolls-Royce which introduced the concept in 1979.</td>
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<tr>
<td>1979</td>
<td>First edition of Crosby’s <em>Quality Is Free</em>. Xerox Corp. started to apply the benchmarking concept to processes. Publication of the BS5750 quality management series.</td>
</tr>
<tr>
<td>1980</td>
<td>An NBC television documentary about the “Japanese miracle”-<em>If Japan Can…Why Can’t We?</em> proposed Deming as key element in this miracle.</td>
</tr>
<tr>
<td>1981</td>
<td>Ouchi’s Z theory. Ford Motor Company invites W. Edwards Deming to speak to its top executives, which begins a rocky but productive relationship between the automaker and the quality expert.</td>
</tr>
<tr>
<td>1982</td>
<td>First edition of Deming’s <em>Quality, Productivity and Competitive Position</em>.</td>
</tr>
<tr>
<td>1983</td>
<td>“Quality on the line”, published by Garvin in <em>Harvard Business Review</em>, analysed the differences between Japanese and American companies, showing some of the reasons for the better performance of the former. A paper about Taguchi’s design of experiments is published in <em>Harvard Business Review</em>.</td>
</tr>
<tr>
<td>Mid-1980s</td>
<td>Bill Smith, a reliability engineer at Motorola, originated the concept of Six Sigma.</td>
</tr>
<tr>
<td>1985</td>
<td>The Naval Air Systems Command named its Japanese-style management approach “total quality management”.</td>
</tr>
<tr>
<td>1986</td>
<td>First edition of Deming’s <em>Out of the Crisis</em>. It became a bestseller.</td>
</tr>
<tr>
<td>1987</td>
<td>Publication of the Malcolm Baldrige National Quality Award.</td>
</tr>
</tbody>
</table>

Adapted from Goetsch and Davis (1997)
Below is a brief overview of the major components of TQM. It will be dealt with in greater detail in a latter section.

**Leadership:** Evans and Lindsay (2005) state that all managers, ideally beginning with the CEO, must provide the organisation leadership with regard to quality. They further add that senior management should set an example in inspiring, encouraging involvement, learning, innovation, and creativity.

**Quality Culture:** Quality culture is defined by Goetsch and Davis (1997) as an organisational value system that results in an environment that is conducive to the establishment and continual improvement of quality. It consists of values, traditions, procedures and expectations that promote quality.

**Customer Focus:** Scholtes (1992) defined external and internal customers as follows: “External customers purchase the product, financially supporting the organisation. Inside the company employees pass on their work to other employees, who are internal customers. Similarly, external suppliers are the people outside the organisation who sell the material, information, or services to the organisation, the internal suppliers.”

Whitely (1991) identifies the following characteristics of companies that have successfully implemented customer focus.

- vision, commitment and climate;
- alignment with customers;
- willingness to find and eliminate a customer’s problems;
- use of customer information;
- reaching out to customers;
- competence, capability and empowerment of people;
- continuous improvement of products and processes.
**Partnering:** Poirier and Houser (1993) described partnering as the creation of cooperative business alliances between an organisation and its suppliers and customers. Business partnering occurs through a pooling of resources in a trusting atmosphere focused on continuous mutual improvement.

**Empowerment:** Goetsch and Davis (1997) defined empowerment as employee involvement that matters. It is the difference between just having input and having input that is heard, seriously considered, and followed up on, whether it is accepted or not.

**Education and Training:** Goetsch and Davis (1997) stated that training is an organised, systematic series of activities designed to enhance an individual’s work-related knowledge, skills, and understanding and/or motivation. Education can be distinguished from training by its characteristics of practicality, specificity and immediacy.

**Communication:** Goetsch and Davis (1997) defined communication as the transfer of a message (information, idea, emotion, intent, feeling, or something else) that is both received and understood. Total quality depends on effective communication.

**Total Quality Tools:** Total quality tools enable employees (i.e. engineers, technologists, production workers, managers or office staff) to do their jobs. These tools are for collecting and displaying information in ways to help the human brain grasp thoughts and ideas that, when applied to physical processes, cause the processes to yield better results. The following are a list of some of the total quality tools:

- The Fish Bone Diagram
- The Check Sheet
- Statistical Process Control
- Run Charts and Control Charts
- The Histograms
- The Pareto Chart
- Scatter Diagrams
• The Flow Diagram
• The Survey
• Design of Experiments
• Quality Function Deployment
• Just-In-Time manufacturing

_Benchmarking and Continuous Improvement:_ Goestch and Davis (1997) viewed benchmarking as the process of comparing and measuring an organisation’s operations or its internal processes against those of a best-in-class performer from inside or outside its industry.

Joseph M. Juran (1989) suggested the following with regard to continuous improvement: Quality improvement is needed for both kinds of quality: product features and freedom from deficiencies, to maintain and increase sales income, companies must continually evolve new product features and new processes to produce those features. Customer needs are a moving target. To keep costs competitive, companies must continually evolve new product features and new processes to produce those features. Customer needs are a moving target. To keep costs competitive, companies must continually reduce the level of product and process deficiencies. Competitive costs are also a moving target.

**Organisational Factors in TQM Implementation:** Goetsch and Davis (1997) are of the view that internal politics is one of the organisational factors that inhibits implementation of Total quality. It consists of activities undertaken to gain advantage or influence organisational decision making in ways intended to serve a purpose other than the best interests of the overall organisation. Internal politics consists of the games people play to promote decisions that are based on criteria other than merit.

Goetsch explains Organisational Structure and Internal Politics as follows: “Internal politics exists in every organisation regardless of organisational structure. It is not caused by organisational structure and hence cannot be eliminated by simply changing the structure. Internal politics can be controlled in an organisation by
having the following components: strategic planning, leadership, reward/recognition, performance appraisal, customer focus, conflict management, and culture.”

**Total Quality Management Implementation:** The following factors are necessary in order to implement Total Quality Management.

- commitment by top management
- commitment of resources
- organisation-wide steering committee
- planning and publicising
- vision statement and guiding principles
- goals and objectives
- total quality implementation plan


- Management responsibility
- Quality system
- Contract review
- Design control
- Document control
- Purchasing
- Purchasing for supplied products
- Product identification and traceability
- Process control
- Inspection and testing
- Inspection, measuring, and test equipment
- Inspection and test status
- Control of nonconforming products
- Corrective actions
- Handling, storage, packaging and delivery
- Quality records
During the certification audit, the auditor evaluates the candidate’s implementation of each standard. This includes a review of written procedures for helping organisation members understand the written procedures that affect them. The audit also looks for evidence that employees actually follow the procedures. The audit evaluates methods for responding to any deviations from procedures that emerge and determines who in the organisation ensures compliance with procedures (Melnyk and Denzler, 1996).

The ISO quality standard has undergone an upgrade to ISO 9001:2000. Evans and Lindsay (2005) point out that the new standard is based on the following principles: Customer Focus, Leadership, Involvement of People, Process Approach, System Approach to Management, Continual Improvement, Factual Approach to Decision Making, Mutually Beneficial Supplier Relationships. As stated earlier, there has been a further upgrade to ISO, which is represented by ISO 9001:2008 (Standards Australia, 2008).

The ISO upgrades together with quality awards support quality practices in many situations. The Malcolm Baldrige National Quality Award is presented annually to U.S. companies that best represent the successful implementation of quality in the design, production and delivery of products for the market place. The Baldrige Award recognises companies that represent the most effective pursuit and attainment of total quality.

2.3 Major Elements of TQM

This section expands on the major elements of TQM as considered above in section 2.2 and focuses on extracting the principles, best practices and significance of the major elements of TQM as explained in the literature available on TQM. Each of these aspects is described below.
2.3.1 Leadership

Top management commitment is a key component for a successful role-out of TQM (Martinez-Lorente et al. 1999; Dewhurst et al. 2003). Top management has to be first in applying and stimulating the TQM approach, and they have to accept the maximum responsibility for the product and service offering. Top management must provide the necessary leadership to motivate all employees. These views are further emphasised by Tan (1997) who states that management must build commitment through genuine ownership and shared success. Anderson and Sohal (1999) point out that management must ensure that employees are well supported through times of change.

2.3.2 Quality Culture

Batten (1994) stated that an organisation’s philosophy or culture is the basic repository of corporate vision and value and requires that the policies, procedures and processes of the organisation be based on this philosophy.

The relationship between TQM and organisational culture was examined by Dellana and Hauser (1999). They sited the four principles of customer focus, continuous improvement, employee involvement and innovative leadership as the basis of a typical TQM framework.

Quinn, and Kimberly (1984) explained the competing values model as in Figure 2.1.

The four quadrants formed by the intersection of the two axes form the four culture types: Group, Adhocracy, Rational, and Hierarchical.

- Group: is based on the values and norms associated with affiliation.
- Adhocracy: emphasises change.
- Hierarchical: has the values and norms associated with a bureaucracy.
- Rational: has a strategic emphasis toward competitive advantage and market superiority.
Figure 2.1: Competing values model framework

<table>
<thead>
<tr>
<th>Flexible Processes</th>
<th>Control-Oriented processes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Internal</strong></td>
<td><strong>External</strong></td>
</tr>
<tr>
<td><strong>Maintenance</strong></td>
<td><strong>Positioning</strong></td>
</tr>
<tr>
<td><strong>Type:</strong> Group</td>
<td><strong>Type:</strong> Hierarchy</td>
</tr>
<tr>
<td><strong>Dominant Attribute:</strong></td>
<td>Order, rules and regulations, order, rules and regulations, uniformity, efficiency</td>
</tr>
<tr>
<td>Cohesiveness, participation, teamwork, sense of family</td>
<td><strong>Leadership Style:</strong> Coordinator, organiser, administrator</td>
</tr>
<tr>
<td>Teamwork, sense of family</td>
<td><strong>Bonding:</strong> Rules, policies and procedures, clear expectations</td>
</tr>
<tr>
<td><strong>Strategic Emphasis:</strong> Toward developing human resources, commitment, and morale</td>
<td><strong>Strategic Emphasis:</strong> Toward stability, predictability smooth</td>
</tr>
<tr>
<td><strong>Type:</strong> Adhocracy</td>
<td><strong>Type:</strong> Rational</td>
</tr>
<tr>
<td><strong>Dominant Attribute:</strong></td>
<td>Goal achievement, environment exchange, competitiveness</td>
</tr>
<tr>
<td>Entrepreneurship, creativity, adaptability, dynamism</td>
<td><strong>Leadership Style:</strong> production- and achievement-oriented, decisive</td>
</tr>
<tr>
<td><strong>Leadership Style:</strong> Innovator, entrepreneur, risk taker</td>
<td><strong>Bonding:</strong> Goal orientation, production, competition</td>
</tr>
<tr>
<td>Flexibility, risk, entrepreneur</td>
<td><strong>Strategic Emphasis:</strong> Toward competitive advantage and market superiority</td>
</tr>
</tbody>
</table>

Source: Dellana, and Hauser (1999).
Dellana and Hauser (1999) used the Baldrige Award criteria to define both organisation culture and quality management position. The covariance analysis used the Baldrige score of their research data as the dependant variable, culture type and industry type as treatments, and company size and TQM age as covariates. In general adhocracy was the culture most closely linked to TQM success. TQM may be characterised to a degree by the adhocracy culture type and secondarily by the group culture type.

The methodology used in measuring performance can play a marked role in the culture of an organisation. Plenert (1999) identified in his study of Precision Printers Inc. that a change in measurement systems can bring about significant performance improvements. He concluded that successful performance is not in systems and procedures such as ISO certification; rather, successful performance is found in a meaningfully structured measurement system focused on results instead of data collection. The measurement system is what directly motivates employee response, and measuring the wrong things brings about wrong results.

Goetsch and Davis (1997) recommend the following strategies for establishing a quality culture:

- Identify the changes needed.
- Put the planned changes in writing.
- Develop a plan for making the changes.
- Understand the emotional transition process.
- Identify key people and make them advocates.
- Take a hearts and minds approach.
- Apply courtship strategies.
- Support strategy.

### 2.3.3 Customer Focus

Goetsch and Davis (1997) considered quality to be defined by customers in a total quality setting. Customer satisfaction must be given the highest priority and can be achieved by producing high quality products that meet or exceed expectations.
It must be renewed with each purchase. Employees must be involved with customers in order to understand customer needs.

Scholtes (1992) has a six-step strategy for identifying customer needs.

- Speculate about results.
- Develop an information-gathering plan.
- Gather information.
- Analyse the results.
- Check the validity of the conclusions.
- Take action.

Lam and Dale (1999) conducted a study on a customer complaints-handling system of a flavouring manufacturer. The organisation defined customer complaint as areas of concern (AOC). The AOCs were not of a recurring nature but due to recurrence of root causes, such as manpower-and method-related problems. These were due to:

Deficiencies in the AOC handling system
- Poor categorisation;
- AOC completion time varied considerably;
- lack of preventive action follow-up;
- inadequate AOC data analysis;
- system lacks incentive to drive and motivate employees to prevent complaints.

Company environment
- lack of management support;
- lack of employee motivation inadequate;
- poor internal and external communication;
- poor employee attitudes;
- inadequate quality culture;
- inadequate education and training;
- ineffective internal customer—supplier relationships
A considerable number of AOCs arose due to problems at the latter end of the company's internal customer-supplier chain. This was partly due to the susceptibility of the associated areas to potential errors and also as a result of their relative proximity to the external customers. This finding emphasises the importance of the internal AOC system and its use as a preventive mechanism to eliminate the occurrence of external AOCs.

Juran (1989) is of the view that a customer’s needs do not remain static. He also highlighted that the Quality Function Deployment (QFD) makes customer feedback a normal part of the product development process. Therefore Goetsch and Davis (1997) prescribed constant contact with customers as essential in a total quality setting. Goetsch and Davis further stated that measuring customer satisfaction is not enough- organisations should also measure customer retention. This can be achieved by turning customers into partners and proactively seeking their input rather than waiting for a reaction to feedback provided by a problem that has occurred.

### 2.3.4 Partnering

Goetsch and Davis (1997) stated that partnering involves working together for mutual benefit. Partnerships are of two types:

**Internal partnerships**
- management-to-employee partnerships
- team-to-team partnerships
- employee-to-employee partnerships

Its purpose is to utilise the capabilities of the workforce and focus it on the continuous improvement of quality.

External partnerships are established with suppliers, customers and potential competitors.

Supplier partnerships must create and maintain loyal, trusting relationships in which both partners win through promotion of continuous improvement, productivity and competitiveness.
Poirier and Houser (1993) indicated that successful supplier partnerships require the following:

- Supplier personnel should interact with employees who are users of the product.
- Eliminate the price only criteria in buyer—supplier relationship.
- The supplier must guarantee the quality of products.
- The supplier must practise JIT.
- Both parties should be capable of sharing information electronically.

The basis of customer partnerships is customer satisfaction. This can be done by involving customers in product development.

Martinez-Lorente et al. (1998) pointed out that quality is a more important factor than price in selecting suppliers. Long-term relationship with suppliers has to be established and companies have to collaborate with suppliers to help improve the quality of products/services. All departments have to participate in the design process and work together to achieve a design that satisfies the requirements of the customer, according to the technical, technological and cost constraints of the company.

Dyer and Ouchi (1993) suggested that the length of a buyer/supplier relationship has a positive effect on product development efforts. The supplier's existing knowledge of the buying firm's internal processes and objectives enables the supplier to plan for future product development efforts and to develop, in advance, the capabilities to meet those needs. Hanfield et al. (1999) presented a model of the product development process and opportunities for supplier integration at various points of the process. His findings were that organisations which used supplier integration as a strategy for new product development achieved significant improvements in project results compared to similar new product developments where suppliers were not involved. A critical factor in supplier integration projects is an understanding of the supplier's capabilities and abilities to contribute to various stages of their technology roadmap.
Several studies have also found that Japanese manufacturers made more extensive use of supplier involvement than American manufacturers. Kamath and Liker (1994) examined Japanese product development practices and identified a variety of roles that suppliers may play; details are outlined in Table 2.2. They stated that successful partnerships depend on the right balance among a supplier’s technological capabilities, a customer’s willingness to share information, and both companies’ strategic requirements.

Table 2.2: Four Supplier Roles

<table>
<thead>
<tr>
<th>ROLE</th>
<th>DESCRIPTION</th>
<th>RESPONSIBILITIES DURING PRODUCT DEVELOPMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Partner (Full-Service Provider)</td>
<td>Relationship between equals; supplier has technology, size and global reach.</td>
<td>Entire subsystem. Supplier acts as an arm of the customer and participates from the pre-concept stage onward.</td>
</tr>
<tr>
<td>Mature (Full-System Supplier)</td>
<td>Customer has superior position; supplier takes major responsibility with close customer guidance.</td>
<td>Complex assembly. Customer provides specifications, then supplier develops system on its own. Supplier may suggest alternatives to customer.</td>
</tr>
<tr>
<td>Child</td>
<td>Customer calls the shots, and supplier responds to meet demands.</td>
<td>Simple assembly. Customer specifies design requirements, and supplier executes them.</td>
</tr>
<tr>
<td>Contractual</td>
<td>Supplier is used as an extension of customer’s manufacturing capability.</td>
<td>Commodity or standard part. Customer gives detailed blueprints or orders from a catalogue, and supplier builds.</td>
</tr>
</tbody>
</table>

Source: Kamath and Liker (1994).

McGinnis and Vallopra (1999) provided insights into the role of purchasing in new product development and the effective management of supplier involvement in new product development. They determined the following crucial issues to be considered for new product success when suppliers are involved:

- thorough analysis of whether to involve suppliers in new product development;
- close co-ordination and control of the integration of the involved suppliers;
- close co-operation in achieving new product cost objectives;
- an organisational strategic orientation that is committed to time competitiveness;
- early purchasing involvement in new product development;
• shared education, sharing of personnel and facilities, and formal risk/reward sharing agreements between customers and suppliers;
• use of business unit cross-functional teams to select and integrate suppliers into the new product development process.

Monczka et al. (1998) outlined attributes such as trust, information sharing, and joint problem-solving as success factors related to partnerships. Trent and Monczka (1998) concluded that the future required purchasing to play an active role in helping achieve an organisation’s cost, quality, time and technology goals.

2.3.5 Empowerment

Goetsch and Davis (1997) suggest that total employee involvement and empowerment (TEIE) is a good means to increase creative thinking and initiative in employees and thus enhance an organisation’s competitiveness. There are four broad steps in the implementation of TEIE:

• creating a supportive environment;
• targeting and overcoming inhibitors;
• putting the vehicles in place;
• assessing, adjusting and improving.

Vehicles include brainstorming, nominal group technique, quality circles, suggestion boxes and walking and talking.

Martinez-Lorente (1998) was of the view that workforce management has to be guided by the principles of training, empowerment of workers and teamwork. Adequate plans of personnel recruitment and training have to be implemented and workers need the necessary skills to participate in the improvement process.

Thacker (1997) identified mechanisms of enhancing team creativity via team leader styles. This can be achieved by training team leaders to exhibit a consultative/team-oriented communication style to improve team creativity, as against a directive/assertive style, such that team members perceive accurately the message the team leader is projecting. Additionally a follow-up evaluation process which includes
questions for a survey of team members’ perceptions of leader styles should also be conducted.

Rankin (1998), through a case study conducted at Labatt Breweries of Canada, developed a process of building trust among employees and thereby establishing partnering to enhance business results. The following are the steps he outlined.

Step 1: Understand the conditions required to create trust.
Step 2: Build on the conditions by revisiting past and current wounds to mutually understand and learn.
Step 3: Be mutually involved in defining the employees’ desired future.
Step 4: Conduct involved ongoing open discussion and problem solving as true partners in the business while respecting each other’s role.

Ahanotu (1998) emphasises that production workers achieve empowerment through participation in processes of innovation and through collaborative partnership with the sources of design knowledge in a company. Effective opportunities for empowerment can be created on the factory floor through knowledge development that extends beyond areas such as routine continuous improvement and efficiency-based processes and include aspects of innovation that define the paradigms of production.

Chelsom (1997) suggested a way of resolving the apparent conflicts between the compliance philosophy of ISO 9000, and the strong innovative demands of TQM by the use of a third programme of empowered training in order to provide performance-driven quality. The following critical success factors have been identified in order to turn their Quality Management System (QMS) from merely compliance to ISO 9000 tool, to something which begins to support their key business processes:

- quality policy reflects customer needs;
- personal ownership of key processes;
- audit effectiveness as well as compliance;
- evaluate efficiency through key indicators;
• a defined process to manage change;
• people development linked to business needs;
• management review of QMS against objectives;
• evaluation of QMS in helping to achieve customer satisfaction.

Hence business excellence will follow from combining ISO 9000 and TQM.

“The Big Three” of the US automotive industry (General Motors, Ford and Chrysler) launched a QMS in 1995 for their suppliers with ISO 9000 as the “highest common factor” called QS 9000. QS 9000 supplemented ISO 9000 with industry-specific (requirements that all three companies called for) and company-specific requirements (requirements unique to one company or shared by two of the three). The companies recognise ISO 9000 registrations only if they are awarded by selected certification bodies, using specially trained assessors (Chelsom, 1997). QS 9000 applies to component suppliers, and a modified version was developed for suppliers of non-production materials. The Ford quality system was known as the Quality Operating System (QOS).

Ford’s QOS is based on the Shewhart PDSA cycle. The monthly activity and analysis report required by Ford’s QOS (Figure 2.2) is as follows:

• charting actual performance against target;
• monitoring individual faults;
• identifying major causes of shortfall against target, using Pareto charts;
• Removing causes of shortfall by 8D team oriented problem solving (TOPS).
Figure 2.2: Monthly activity and analysis report required by Ford's QOS

The QOS is graphically depicted in figure 2.3. Figures 2.4 and 2.5 show how the three programmes combine.

Figure 2.3: Ford's quality operating system

Source: Chelsom (1997).
Figure 2.4: A stand alone cartoon to communicate links between ISO/TQ/QOS

Source: Chelsom (1997).
Figure 2.5: A model for "talking-through"

Source: Chelsom (1997).
Clifford Thames (CT), a supplier to Ford, concluded from its experience that a protocol-based TQ programme and a customer-imposed ISO 9000 programme did not, together, provide the spring board to cultural transformation and a significant advance in business performance (Chelsom, 1997). These objectives were achieved only through the addition of QOS and Investors in People (IiP) training. IiP training involves goal setting, performance appraisal, coaching, counselling, project management and budgeting.

Ford’s QOS consists of involvement of everyone in continuous improvement of all processes and activities (Chelsom, 1997). The International Automotive Task Force (IATF) developed ISO/TS 16949:2002 in conjunction with ISO. This specification aligns with QS 9000 (Kartha, 2004).

### 2.3.6 Education and Training

Education and training is vital element of TQM as it provides an understanding and increase of knowledge to be effective in any operation. The need for education and training can be justified by some of the following reasons:

- quality of the existing labour force;
- global competition;
- rapid and continual change;
- technology transfer problems;
- changing demographics.

The above are some of the areas identified by Goetsch and Davis (1997).

Eurich (1985) pointed out that training can be provided in-house or through corporate-owned facilities.

Another component of education and training process is knowledge management (KM). Lim et al. (1999) suggested a framework for measuring KM with a view to managing quality through knowledge management and to use the results to counter an organisation’s competitors. Knowledge originates from data. Data serves as the essential nucleus, which when combined yield meaningful information. Once
information is transferred, it is the ability to act on it that is referred to as knowledge. This dynamic relationship is shown in Figure 2.6.

**Figure 2.6:** The data-information-knowledge ripple.

The four steps for knowledge management (KM) are as follows:

1. Capturing or creating knowledge *(plan)*;
2. Sharing knowledge *(do)*;
3. Measuring the effects *(check)*;
4. Learning and improving *(act)*.

The KM model proposed by Lim et al. (1999) is coined as COST shown in Figure 2.7. The COST model is made up of four elements, namely Customer, Organisation, Supplier and Technology. They developed a checklist of questions associated with each element of the COST model.
The KM matrix is a combination of the COST model and the four steps for KM: Table 2.3. The KM matrix helps in obtaining a deeper understanding of how KM affects the organisation as a whole and provides a catalyst to practitioners to look at all the various aspects of implementing KM.

### Table 2.3: Matrix Structure

<table>
<thead>
<tr>
<th></th>
<th>Capture</th>
<th>Share</th>
<th>Measuring</th>
<th>Learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer</td>
<td>Organisation</td>
<td>Supplier</td>
<td>Technology</td>
<td></td>
</tr>
</tbody>
</table>

Source: Lim et al. (1999).

The benefits of KM as a quality strategy are as follows:

- reduces the loss of intellectual capital from employees who leave;
- reduces the cost of development of a new product/service;
- increases the productivity of workers by making knowledge accessible to all employees;
- increases employee satisfaction.

Dickenson and Blundell (2000) used a model which incorporates a learning strategy based on a learning needs assessment for transferring quality management
experience from a UK company to a Russian company. Below are some details of Dickenson and Blundell’s learning model:

**Organisational assessment and learning needs analysis in quality management**

- It is important to assist the most senior managers to assess areas of their competence in managing and leading. These include: customer awareness; fulfilment of customers’ agreed needs; teamwork and team management; innovation and creativity; decision-making, participation; communication and listening skills related to feedback; objective setting; and change management.

- Understanding an organisation’s approach to quality management requires a degree of cultural analysis. A cultural evaluation will involve accessing the views, beliefs and practices of all staff, and how staff are hired, selected, trained, appraised and rewarded.

- Evaluate the extent to which quality issues directly and indirectly inform the above mentioned processes.

**Determining the learning gap and planning the learning strategy**

The assessment process is represented diagrammatically in Figure 2.8. The same type of analysis is conducted in each partner in the alliance and the differences identified represent potential ‘learning gaps’ which may need to be addressed if a common, accepted quality standard is to be achieved between two partners. A ‘learning strategy’ needs to be agreed to address those learning gaps identified as priorities. Learning strategy can be developed with short, medium and longer term objectives.
Dickenson and Blundell (2000) summarised and contrasted the quality culture at the Russian and UK firms and indicated the remedies to bridge the learning gap in Table 2.4.

Source: Dickenson and Blundell (2000).
### Table 2.4: Quality of Western and Russian partners

<table>
<thead>
<tr>
<th>Component of culture</th>
<th>Western partner</th>
<th>Russian partner</th>
<th>Cultural gap</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technological</td>
<td>Highly automated</td>
<td>Predominantly unautomated</td>
<td>Value placed on workers, working conditions and quality of production</td>
<td>Technology transfer and investment.</td>
</tr>
<tr>
<td>Sophistication</td>
<td>production. Work</td>
<td>hand make-up. Low levels of workplace cleanliness. Out-of-date equipment. No computers.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>environment conducive to high-quality production. Well-developed support infrastructure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quality assurance</td>
<td>Quality assurance-</td>
<td>Quality control-state and</td>
<td>Lack of quality infrastructure results in ad hoc procedures, often based on intuition</td>
<td>Develop an appropriate, tailored documented quality system.</td>
</tr>
<tr>
<td>and management system</td>
<td>statistical process</td>
<td>factory technical standards.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>control. International Standard-ISO9000</td>
<td>Quality assurance system available but not implemented</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Managerial expertise</td>
<td>Managers proactive: trained and motivated. Set and work to high standards. Willing to take personal responsibility for quality</td>
<td>Managers reactive. Not trained due to lack of organisational slack. Poor line management- 'pass the buck mentality'</td>
<td>Long-term versus short-term managerial perspectives. Willingness to take personal responsibility.</td>
<td>Management training and consistent reward. Managers leading the quality process.</td>
</tr>
<tr>
<td>Staff attitude</td>
<td>Well trained, willing to abide by agreed systems and procedures</td>
<td>No training available. Staff demoralised by financial and political crisis. Unwilling to accept personal responsibility for quality</td>
<td>Extent to which staff are encouraged and rewarded for developing a positive attitude towards quality</td>
<td>Staff training. Reward. Consistent monitoring of quality standards and procedures</td>
</tr>
<tr>
<td>towards and expertise in quality management</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Dickenson and Blundell (2000).
After the strengths, weaknesses and cultural differences (learning gap) in the Russian company had been identified, a learning strategy to improve quality management was implemented based on the following points:

- Drafting of all documents would be done jointly but only after key staff of the Russian organisation had attended a course in the UK covering introduction to TQM and ISO 9000, quality culture and managing human resources, and problems of implementing total quality ideas in Russian conditions.
- Accommodate cultural differences as far as possible.
- Do not change anything unless necessary-if it is not broken do not try to fix it.
- Keep documentation to the minimum to satisfy the needs of the customer.
- Do not change the production system- just document it properly.
- Follow a step-by-step approach- consolidate the gain at each point. The best approach would be to write documents which were consistent with ISO 9000 methodology.
- Where feasible, build around existing documents.

The learning strategy adopted, was a step-by-step approach, which strived to harmonise the cultural traditions, thus creating the best conditions for a successful outcome.

Zink et al. (1998) studied excellence centres (ECs) in the US and concluded the following:

- ECs support the organisations’ willingness to cooperate and contribute to increase quality awareness in a region. However, it is necessary that they are supported and sponsored by local managers.
- When starting up an EC, management has to be included from the beginning to act as champions or initiators.
- Establishing an EC in collaboration with an existing organisation clearly improves the prospects because the centre can rely on already existing resources and the formal and informal connections of the absorbing institution.
- The introduction of discussion groups and other forums for the exchange of ideas gives important impulses for the furtherance of a new location and quality awareness in a region.
The EC concept is the right approach to initiate an effective improvement process. ECs develop a new quality awareness and generates an increased willingness to cooperate.

Martinez-Lorente et al. (1998) were of the view that companies have to stimulate positive work attitudes, including loyalty to the organisation, pride in work, a focus on common organisational goals and the ability to work cross-functionally.

2.3.7 Communication

Perry (1995) advocated that effective facilitators are a key element in successful continuous improvement processes. He provided guidelines on the selection of facilitators; their commitment to the role; training and skills development; the development of the role through the quality evolution stages of development of a world class organisation (survival, prevention and continuous improvement); and the challenges to be faced.

The role of the facilitator is to enable and train:

- Enable others to take part in the total quality process.
- Equip them with the necessary tools, techniques and skills.
- Help them to identify ways in which they can apply the above to make improvements in their own activities or to work together with others to make improvements.

Effective facilitators have the following attributes:

- command respect among others;
- good communicators- ability to communicate and listen at all levels in the organisation;
- enthusiastic towards continuous improvement;
- proactive in making things happen;
- willing to challenge;
- eager to learn;
• energetic;
• potential for development beyond their current role.

Ideally they should be part-time, performing a normal job in their function/department rather than being a full-time specialist. Volunteers to the role are preferred.

Effective facilitators need three types of skills: technical; behavioural and interpersonal; and consultancy skills (Figure 2.9).

Figure 2.9: Skills of effective facilitators

![Diagram showing the intersection of Technical, Consultancy, and Behavioural and Interpersonal skills]


Table 2.5: Effects of facilitator's incomplete skillbase

<table>
<thead>
<tr>
<th>Technical</th>
<th>Consultancy</th>
<th>Behavioural and Interpersonal</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>X</td>
<td></td>
<td>Expert-extremely competent but not listened to/no ownership with organisation.</td>
</tr>
<tr>
<td>X</td>
<td></td>
<td>X</td>
<td>Only one approach and if it fails you are stuck. You have to do it this way/inflexible. Will not be used</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
<td>Really nice people but lack credibility/cannot really help- will not be used</td>
</tr>
</tbody>
</table>


The effectiveness of the facilitators determines to a large part the effectiveness of the process. Table 2.5 illustrates the effects of facilitator’s incomplete skill base.
2.3.8 Total Quality Tools

Goetsch and Davis (1997) stated that in manufacturing total quality tools are employed to promote the process of continuous improvement which ensures that the product not only meets a customer’s expectations but also exceeds a customer’s expectations.

There are seven basic total quality tools these are discussed below:

The Pareto chart: The Pareto chart is a useful tool which enables one to separate the important from the trivial. The Pareto principle is based on the 80/20 rule (e.g. In a factory, if all the problems are identified, only 20% will produce 80% of the product defects; 80% of the cost associated with the defects will be assignable to only 20% of the total number of defect types occurring, the Pareto chart helps one to apply one’s resources by identifying the significant few from the trivial many.

The fishbone diagram: The fishbone diagram is used to identify and isolate causes of a problem. It is also known as the Ishikawa diagram or the cause and effect diagram. It is a tool to graphically represent how the various factors associated with a process affect the process’s output. A team might use brainstorming to generate a list of possible causes. The spine points to the effect. The effect represents the problem. The ribs represent the causes and are the major factors. Sub factors or lower level causes that are associated to the major factors are represented by branches to the ribs.

The check sheet: The check sheet can be used in a wide variety of applications. Data collection in a check sheet must be the equivalent of entering a check mark such that the displayed data can be easily translated into useful information.

Histogram: Histograms are called frequency distribution diagrams. The flatter and wider the frequency distribution curve, the greater the process variability.

Scatter diagram: The scatter diagram determines the correlation between two variables.
**Run charts and control charts:** The run chart records the output of a process over time. However the run chart does not help us understand if the variation is caused by special or common causes. Shewhart developed the control chart to differentiate special causes from common causes (Goetsch and Davis, 1997). Control charts for variables are X-bar and R charts. X-bar charts are a plot of means of samples over time and R charts are a plot of sample ranges over time. Control charts of attributes are known as p-charts when the data is expressed as fraction defective or percent defective of a set of process output. C-charts are charts of attributes when data is represented as number of defects in a sample.

**Stratification:** The process of investigating the cause of a problem by grouping data into categories.

**Other tools used in TQM:**
- **The flow diagram:** The flow diagram is a graphical representation of a process.
- **The survey:** The use of the survey is to elicit relevant information from areas where one would conventionally not obtain it through other means. However, the right questions have got to be asked.
- **Design of experiments:** This is a sophisticated technique of optimising processes. It is employed in complicated processes having multiple factors affecting them. Design of experiments reduces the number of runs. It also helps to determine which factors are critical and which are insignificant.
- **The seven new QC tools:** 1. affinity diagrams, 2. relations diagrams, 3. tree diagrams, 4. matrix diagrams, 5. matrix data analysis, 6. arrow diagrams, and 7. process decision program charts. The new tools were established as a means of organising verbal data diagramatically. The new tools are specifically useful at the following stages - when identifying gaps between goals and actuality and expounding the issues to be addressed and during the contemplating-over phase that takes place before a problem's final elucidation. When using the tools, the key is to continue adding information to the diagrams until everyone is agreeable with them (Nayatani, 1994).
- **Value stream mapping:** A value stream map illustrates all the process steps (including rework). Any activity that contributes a form, feature, or function of
value to the customer is defined as value-added; those that do not are termed as non-value-added (George, 2002).

Martinez-Lorente et al. (1998) had the following to say about total quality tools:

- Housekeeping should be along the 5S concept.
- Statistical and non-statistical improvement instruments should be applied as appropriate.
- Processes need to be mistake proof.
- Self-inspection should be undertaken using clear work instructions.
- The process has to be maintained under statistical control.

### 2.3.9 Benchmarking and Continuous Improvement

Martinez-Lorente et al. (1998) stated that a benchmarking policy for key processes should be in place. Naveh and Halevy (2000) proposed a hierarchical framework for managing a quality information system in order to improve quality and productivity in an organisation. It is based on three levels: control of the process; evaluation of the process; and organisational assessment. The framework provides an overall integrative view of the organisation, with hierarchical levels of information relying on ‘hard’ technological-engineering measurements together with ‘soft’ measurements of values and approaches. This is graphically depicted as a hierarchical index tree in Figure 2.10. This index tree enables us to identify processes and activities in need of improvement. It branches down to physical results and also to causes of non-conformances, enabling us to determine ways of realising the potential for improvement. The process and their results are examined on the merit of process success as well as business success of the organisation. The framework is based on the concept that the process control, process evaluation and organisational assessment lead together to the success of the organisation. It is based on the following principles:

- a focus on the improvement potential of the organisation;
- adaptation of the framework to its customers.

The hierarchical measurement system at the process control level is illustrated in Figure 2.11.
Figure 2.10: The framework of hierarchical quality information-hierarchical index 'tree'

Quality Information
  └── Process Control
      ├── Quality Indices
      │    └── Process Results
      │        ├── Physical
      │        └── Managerial
      └── Cost of Quality
          └── Process Analysis
              └── Infrastructure
                  └── Damages
                      └── Goals
      └── Process Audit
          ├── Internal
          └── External
              └── Suppliers
                  └── Organisational System
                      └── Attitudes
                          ├── Culture
                          └── Satisfaction

Source: Naveh and Halevy (2000).
Figure 2.11: The hierarchical measurement set of the process control level which was constructed in the implementation

Source: Naveh and Halevy (2000).
Keung (2000) is of the view that improvement of business processes, radically or stepwise, is essential and should be supported by a holistic process performance measuring system (PPMS). He devised a framework for conceptualising and developing PPMS.

Traditional measurement approaches are as follows:

- balanced scorecard
- self-assessment
- workflow-based monitoring
- statistical process control
- activity-based costing systems
- capability maturity model

**Figure 2.12: Positioning different measurement systems**

<table>
<thead>
<tr>
<th>Wide-angle lens (quantitative and qualitative aspects)</th>
<th>Focus on Corporations or Business Units</th>
<th>Focus on Business Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wide-angle lens (quantitative and qualitative aspects)</td>
<td>Self-assessments (e.g. EFQM) Balanced Scorecard</td>
<td>Process Performance Measurement System (PPMS)</td>
</tr>
<tr>
<td>Zoom (mainly quantitative aspects)</td>
<td>Traditional Controlling (e.g. ROI)</td>
<td>Workflow-based Monitoring Statistical Process Control (SPC)</td>
</tr>
</tbody>
</table>


Criteria for a process oriented view:

1. The measurement system should be focused on processes, not on whole organisations or organisational units.
2. The measurement system should evaluate performance holistically by measuring quantitative aspects as well as qualitative aspects.

Figure 2.12 shows that only process performance measurement systems (PPMS) meet these criteria.

Figure 2.13 outlining the PPMS model can be characterised as an information system which:
(1) gathers information-through a set of indicators that are performance relevant data of one or several business processes;
(2) compares the current values against historical and target values;
(3) disseminates the results (current value, target value, gap and trend for each selected indicator) to the process actors.

Figure 2.13: A PPMS from a conceptual point of view.

The main objective of PPMS is to provide comprehensive and timely information on the performance of business processes. This information can be used to communicate goals and current performance of a business process directly to the process team, to improve resource allocation and process output regarding quantity and quality, to give early warning signals, to make a diagnosis of the weaknesses of a business process, to decide whether corrective actions are needed and to assess the impact of actions taken.

PPMS from a stakeholder point of view: principal stakeholders are investors, employees, customers and society. The relevant aspects of performance are summarised in Figure 2.14.
Figure 2.14: Five performance-relevant aspects

![Diagram showing five performance-relevant aspects](Source: Keung (2000)).

Figure 2.15 shows that process performance indicators are derived either from business process goals (related to competitors, enterprise-wide objectives, stakeholders etc.) or from means of achieving the goals. Figure 2.16 is a partial goal and performance indicator tree.

Figure 2.15: The driving forces of process performance indicators

![Diagram showing the driving forces of process performance indicators](Source: Keung (2000)).
The steps for identifying performance indicators:

Step 1: Define high-level process goals.
Step 2: Derive performance indicators.
Step 3: Derive sub-goals.
Step 4: Refine and modify goal tree.

Figure 2.16: A partial goal and performance indicator tree

![Diagram of goals and performance indicators]


Requirements on process performance indicators:

- quantifiability
- sensitivity
- linearity
- reliability
- efficiency
- improvement-oriented
Developing methods to gather data:

- observational methods
- database methods
- subjective methods-questionnaires, interviews

Creating an information system that manages data: IT does not just support the process of data gathering, it is indispensable for data management. PPMS should be designed as a modular, separate information system which is loosely linked to other information systems throughout the organisation. This process provides some assurance that the system can cope with the dynamic nature of the business processes and their environment and with constant changes in informational needs, and that it will be able to benefit from modern technologies.

PPMS uses the dual approach radical improvement namely, Business Process Reengineering (BPR) and stepwise improvement/continuous improvement (CI) as shown in Figure 2.17.
Figure 2.17: The process management circle.

2.4 Organisational Factors and TQM

This section provides a discussion of organisational factors and their relevance in TQM and quality programs. It presents a variety of findings of various authors through their studies on this subject.

Orsini (2000) carried out assessments of quality efforts in 23 enterprises and determined that there were four of the same weaknesses embedded in each of their quality efforts:

- Inconsistencies exist between vision strategies and policies.
- Statistical malpractice: there are several major areas where misuse of statistical methods in quality efforts lead to false conclusions about data, customer and employee perceptions, or process improvement. Hence, important decisions may be made based on incorrect analysis.
- Failure to operate as a system: sub-optimisation that results from a company’s failure to operate as a system may be the most costly. No amount of hard work by the employees can make up for poor design of the organisational system.
- Impatience (don’t just sit there, do something): in the US and in many parts of the world, there is a drive always to ‘do something’. The sooner activity is seen after the discovery of a problem, the more satisfied management is. Immediate action may not always be optimal.

These are some of the issues that cost organisations millions of dollars.

Orr (1999) examined the role of quality management in manufacturing strategy in the Australian wine industry. The research found that quality assurance and control ranks as the second most important area of manufacturing process decision-making, after plant and equipment. Quality is the most important competitive priority for wine producers, followed by product cost. Quality, plant and equipment and product cost were found to be strongly related and together formed the basis for domestic and international competition in this industry. Factor analysis determined that quality control and assurance are related to production planning and control in terms of their strategic positioning. It is therefore likely that quality has a comparable role to play in manufacturing decision-making in other industries. It is interesting to note that,
Unlike most of the other competitive priorities identified in the research, the importance of quality was not significantly differently rated for a large range of different organisational characteristics. This means that quality is an industry-wide issue and that it is possible that the findings of this research are applicable to other industries.

If the industry could move quality into the realm of general business strategic planning, it would further secure its position in the world export market. Integration of quality issues into the business, as well as the manufacturing strategy, could add considerably to the organisation’s long-term competitiveness. Quality is one of the four most commonly identified competitive priorities for manufacturing. Quality practices such as quality control is one of the seven most frequently identified manufacturing decision areas in the literature.

is a model of manufacturing decision-making which clearly indicates the role and position of quality management in this process.

**Figure 2.18: Structure of decision areas and competitive priorities for the Australian wine industry**

Table 2.6 lists all the decision areas and competitive priorities identified during the project which were found to apply to the industry. Both the decision areas and competitive priorities are ranked in order of importance.

Table 2.6: Ranked decision areas and competitive priorities identified for the Australian wine industry

<table>
<thead>
<tr>
<th>Decision area</th>
<th>Competitive priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant and equipment</td>
<td>13. Work Organisation</td>
</tr>
<tr>
<td>Quality control assurance</td>
<td>14. Supplier reliability</td>
</tr>
<tr>
<td>Capacity</td>
<td>15. Process flexibility</td>
</tr>
<tr>
<td>Production planning and control</td>
<td>16. Level of integration of technology</td>
</tr>
<tr>
<td>Product design</td>
<td>17. Corporate culture</td>
</tr>
<tr>
<td>Top management involvement</td>
<td>18. Role of workforce</td>
</tr>
<tr>
<td>Inventory levels</td>
<td>19. Time control</td>
</tr>
<tr>
<td>Labour and staffing</td>
<td>20. Process integration</td>
</tr>
<tr>
<td>Integration with business strategy</td>
<td>21. Organisational design</td>
</tr>
<tr>
<td>Material flow</td>
<td>22. Facility management</td>
</tr>
<tr>
<td>Communication</td>
<td>23. Structural decentralisation</td>
</tr>
<tr>
<td>Worker involvement</td>
<td></td>
</tr>
</tbody>
</table>


Yusof and Aspinwall (2000) conducted a comparison and review of total quality management implementation frameworks. Table 2.7 summarises small business characteristics-advantages. Tables 2.8 to 2.10 summarise similarities of academic-based, consultant-based and small and medium-sized frameworks using PDCA elements.
### Table 2.7: Small business characteristics-advantages

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Advantage</th>
<th>Disadvantage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Structure</strong></td>
<td>Faster communication line, quick decision-making process, faster implementation, short decision-making chain</td>
<td>Low specialisation may result in lack of expertise in change initiatives. Need outside assistance. Owner controls everything and lack of delegation may stifle growth</td>
</tr>
<tr>
<td><strong>Systems and procedures</strong></td>
<td>Simple system allows flexibility and fast response to customer needs</td>
<td>Lack of proper system-difficulty in ensuring efficiency of work, and high variability in work outcome. ‘Gut feeling’ approach may result in wrong decisions.</td>
</tr>
<tr>
<td><strong>Culture and behaviour</strong></td>
<td>Corporate mind-set is conducive for new change initiatives, i.e. company first. Unified culture can be good starting point for, say, TQM</td>
<td>Uncommitted or dictatorial owner/manager ethos can damage new initiatives.</td>
</tr>
<tr>
<td><strong>Human resources</strong></td>
<td>High authority and responsibility can ensure job is done. Innovative environment will support improvement culture. Early union involvement needed to ensure success. Fewer employees-better relationship, knows almost everyone.</td>
<td>Lack of financial support, e.g. no training budget <em>ad hoc</em>, and small-scale approach can stifle improvement efforts. Improvement needs investment in human resources.</td>
</tr>
<tr>
<td><strong>Markets and customers</strong></td>
<td>Immediate feedback from customers can make response quicker. Understand better customer needs</td>
<td>International marketing expensive, after sales support not as extensive as large businesses. Easily suppressed/dictated by larger multinationals (if they are customers), e.g. imposed ISO 9000, QS 9000, EMS, etc.</td>
</tr>
</tbody>
</table>

Source: Yusof and Aspinwall (2000).
Table 2.8: Similarities of academic-based frameworks using PDCA elements

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning</td>
<td>Step approach Goals, targets and strategies</td>
<td>Step approach Identification and preparation, management understanding Scheme for improvement</td>
<td>System approach TQM implementation approach</td>
<td>System approach organisation</td>
<td>Step approach awareness, TQM design</td>
</tr>
<tr>
<td>Doing</td>
<td>Developing critical success factors, most critical processes</td>
<td>Scheme for improvement</td>
<td>TQM implementation system</td>
<td>Systems and techniques</td>
<td>Education, fact-based problem-solving</td>
</tr>
<tr>
<td>Check</td>
<td>Measure</td>
<td>Measure performance</td>
<td>Measure business performance</td>
<td>Measurement</td>
<td>Measure performance</td>
</tr>
<tr>
<td>Action</td>
<td>Corrective action teams</td>
<td>Critical analysis</td>
<td>Feedback</td>
<td>Continuous improvement</td>
<td></td>
</tr>
</tbody>
</table>

Source: Yusof and Aspinwall (2000).

Table 2.9: Similarities of consultant-based frameworks using PDCA elements

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Doing</td>
<td>Education employees’ alignment</td>
<td>Developing and improving business processes and systems</td>
<td>Determine customer needs, quality improvement teams, training</td>
<td>Collection and collation of external intelligence</td>
</tr>
<tr>
<td>Check</td>
<td>Detail goals, objectives</td>
<td>Monitoring and assessment</td>
<td>Monitoring and measuring</td>
<td>Measurement of performance</td>
</tr>
<tr>
<td>Action</td>
<td>Implementation of plan</td>
<td>Continuous improvement framework</td>
<td>Monitoring and measuring. Enhancing the process recognition</td>
<td>Measurement of performance. Continuous implementation of improvements</td>
</tr>
</tbody>
</table>

Source: Yusof and Aspinwall (2000).

Table 2.10: Similarities of small and medium-sized frameworks using PDCA elements

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning</td>
<td>Step approach. Recognition of needs, establish goals and objectives, plan TQM implementation</td>
<td>Step approach. Diagnostic costs of quality, system audit, customer and employee perceptions</td>
<td>Step approach. Planning through customer review, employer survey, costs of quality</td>
</tr>
<tr>
<td>Doing</td>
<td>Educate, train all employees, create systematic procedure</td>
<td>Implement quality plan, action teams, educate and train</td>
<td>Education and training., Problem-solving</td>
</tr>
<tr>
<td>Check</td>
<td>Monitor implementation</td>
<td></td>
<td>Measure business</td>
</tr>
<tr>
<td>Action</td>
<td>Continuous improvement</td>
<td></td>
<td>Measure business performance</td>
</tr>
</tbody>
</table>

Source: Yusof and Aspinwall (2000).
McAdam and McKeown (1999) analysed the impact of ISO 9000 and TQM on small businesses in Northern Ireland post-implementation. Overall their research showed that small businesses in Northern Ireland have achieved benefits from both ISO 9000 and TQM. The majority of businesses surveyed regarded ISO as their goal and had no aspirations to pursue TQM. There was a widespread lack of quantification of benefits, including customer satisfaction, by small businesses practising TQM. The businesses which gained the most from TQM had started with ISO 9000, and focused on external measures as well as internal measures. They also had full management commitment, high levels of employee participation and training. The majority of businesses said that TQM was more beneficial than ISO 9000 and that both complemented one another. ISO 9000 was seen as a starting point for TQM and an ongoing integral part of TQM. Figure 2.19 summarises a possible roadmap for small businesses progressing from ISO 9000 to TQM based on McAdam’s and McKeown’s research findings. Their conclusions and recommendations were that small businesses can benefit from implementing TQM. However, small TQM practitioners need to learn to be more externally focused (i.e. customer focused) to measure the financial impact of TQM on bottom line performance and to use direct methods to measure customer satisfaction.

**Figure 2.19: Step approach from ISO9000 to TQM**

![Figure 2.19: Step approach from ISO9000 to TQM](image-url)

Source: McAdam and McKeown (1999).
Ahire and Golhar (1996) found that in the motor vehicle parts industry TQM implementation in either large or small businesses represents a good strategy to execute quality management practices in an integrated manner.

1. TQM businesses (large and small) reported better product quality than non-TQM businesses.
2. Small businesses reported that they can and do implement TQM elements as effectively as large businesses, and in turn achieve high product quality.

Luzan (1993) in his study of small manufacturing businesses in Valencia (Spain) found that development of a quality culture improved training and improved labour productivity, these were the three main positive effects achieved by introducing TQM. TQM encourages businesses to be customer oriented and equips them with the tools to satisfy their customers’ demands.

Taylor (1995) conducted a survey of Northern Ireland’s businesses, particularly small enterprises, consistently show lower levels of awareness and understanding, even among TQM practitioners, leading to lower implementation levels of total quality. This was due to smaller organisations primarily (related to poorer understanding) having an internal focus on cost and efficiency. Large businesses were more interested in customer focus and marketing advantage. A large percentage of TQM businesses did not measure customer satisfaction at all. This could possibly explain why the perceived impact of TQM is less dramatic for smaller businesses as it is linked to the propensity to measure customer satisfaction.

Savolainen (2000) suggests two successful strategies for gaining business excellence through total quality management (TQM). The most significant factors in the implementation process are top and/or upper management role and commitment ‘the champion and the persuader’, the contribution of an external expert, participative strategy and the tactic of gradual implementation with persistent, gentle persuasion: Figure 2.20.
The two successful strategies (Figure 2.21) are:

The coach-leadership strategy: driven by the champion with ‘resilient coaching’ through indigenous pioneering efforts and in cooperation with organisation members.

The leadership-expertise strategy: driven by the founder-manager with ‘gentle persuasion’, supported by cooperation with the external expert as a supplier of quality theory.
The leadership strategies are based on strategic choices and operational decisions that probably fit one organisation more effectively than the other. The cultural, holistic ‘mode of implementation’ is advantageous. The logic of innovation and the entrepreneurial spirit originate from the founder’s/owner-manager’s beliefs and values, and prove to be the ultimate catalyst of maintaining an endeavour for continuous improvement (see Figure 2.22).

**Figure 2.22: Organisational culture: a powerful force in the embedding of TQM**

- **Logic of innovation**
- **Entrepreneurial spirit**
- **Shared values**

**EMBEDDED TQM IDEOLOGY**

A mental buffer

Challenges of business environment

Source: Savolainen (2000).

Savolainen has made the following recommendations for companies wishing to improve managerial leadership skills:

1) It is important for management to enforce unified values and beliefs. Top management plays a crucial role in propagating values in the organisation. This
requires making the strategic values explicit to the closest subordinates first, and then to the entire organisation.

2) Value management is of utmost importance to keep up the spirit of continuous improvement in the organisation. If managers advocate the spirit of innovation, the entire organisation incrementally absorbs the same spirit, and it becomes a unified mind-set/value for the organisation.

3) Promotion of the entrepreneurial spirit. In entrepreneurial firms, the owner-entrepreneur’s deeper commitment to business in general makes it more involved in propagating values. But the implantation of internal entrepreneurship (intrapreneurship) cannot be overstated in segmentalist, and often larger, organisations.

4) Leadership education and training are needed for improving conceptual skills in managing change processes that involve ideological renewal.

Steensma and Tetteroo (2000) studied attitudes toward cross-functional quality projects from a net utility and procedural justice theory perspective. They determined that positive attitudes toward cross-functional quality project groups covary with the perception of positive outcomes. There are only minor between-group differences in the perception of outcomes.

According to Hackman and Wageman (1995), four interlocked assumptions about quality, people, organisations and the role of senior management are essential in TQM. The first is that costs of poor quality are greater than the costs of processes that produce high-quality products and services. Second, it is believed that employees have a natural tendency to care about the quality of their work. Third, organisations should be seen as systems of interdependent parts (subsystems). Finally, top management’s commitment to total quality is essential, since senior managers are responsible for creating the organisational systems that determine the workflow of products and services.

The utility model of (cross-functional) quality control project groups suggests that preferences, attitudes and behaviours can be explained by the expected and/or the experienced ‘outcomes’ of the attitude objects and/or the behaviours involved. The ‘net utility’ of a job can be defined as the difference between the sum of the
perceived rewards and the sum of perceived burdens (perceived stressors, i.e. negatively evaluated outcomes). The more positive the net utility of a job is, the higher the job satisfaction will be. The same reasoning can be applied to quality control projects. As for separate outcomes, it may be expected that, all other things being equal, positive outcomes covary with a positive attitude, while negative outcomes covary with a less positive (or even negative) attitude.

Quality on all fronts (QF) groups come from several departments and from different hierarchical levels. Steensma and Tetteroo (2000) found that persons with positive attitudes toward QF groups will perceive more positive outcomes than will be perceived by persons with negative attitudes toward such groups, while ‘positive’ persons will also perceive fewer outcomes. Some outcomes seem to be more important than other outcomes in contributing to a positive attitude toward QF groups. These outcomes can be classified into three categories:

1. outcomes that are related to the opportunity to exercise ‘control’;
2. outcomes to do with the level and quality of information and communication between hierarchical levels in organisations;
3. outcomes that may be characterised as ‘direct reward’ or ‘direct costs’ of participation in QF groups.

Three significant between-group differences in the perception of outcomes were found:

1. Improved social climate: higher hierarchical levels see a high level of improvement (85%), but only one out of every three workers see real improvement of social climate.
2. Problems with superiors: superiors and workers hardly see problems, but the majority of higher (top) managers and staff members of quality departments do think this negative outcome might be true.
3. Stressful and fatiguing activities: again, top managers and staff members of quality departments are more pessimistic than superiors (department heads) and rank and file workers.
Ruggieri and Merli (1998) identified the critical factors for the implementation of total quality management in Italy. Below is a summary of the results (Table 2.11):

Table 2.11: Critical factors for the implementation of TQM in Italy: An empirical study

<table>
<thead>
<tr>
<th>FACTORS</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top Management commitment</td>
<td>Strong evidence that management believe in quality. More or less all the firms committed to the accomplishment of this variable. TQM application has most dependence on this factor.</td>
</tr>
<tr>
<td>Co-makership</td>
<td>Advanced techniques being used for supplier management. More or less all the firms committed to the accomplishment of this variable. Low correlation between TQM application and this factor.</td>
</tr>
<tr>
<td>Customer satisfaction</td>
<td>Advanced techniques being used for customer management. TQM application significantly dependent on this factor.</td>
</tr>
<tr>
<td>Benchmarking</td>
<td>Still not considered practicable in Italian companies. Low correlation between TQM application and this factor.</td>
</tr>
<tr>
<td>Training</td>
<td>Constantly conducting training programs. More or less all the firms committed to the accomplishment of this variable. TQM application significantly dependent on this factor.</td>
</tr>
<tr>
<td>Open organisation</td>
<td>Organisations being constructed on the basis of trust and autonomy. More or less all the firms committed to the accomplishment of this variable. TQM application significantly dependent on this factor.</td>
</tr>
<tr>
<td>Employee involvement</td>
<td>Implementation of employee empowerment not very successful in Italian companies. Modest dependence of TQM application and employee involvement.</td>
</tr>
<tr>
<td>Zero defects mentality</td>
<td>Low application level. Strong correlation with TQM application.</td>
</tr>
<tr>
<td>Flexible manufacturing</td>
<td>Advanced techniques being used such as JIT. Low correlation between TQM application and this factor.</td>
</tr>
<tr>
<td>Process improvement and control</td>
<td>Low application level.</td>
</tr>
<tr>
<td>Statistical Process Control</td>
<td>Not applied in an integrated way. Strong correlation with TQM application.</td>
</tr>
</tbody>
</table>

Adapted from Ruggieri and Merli (1998).

Zhang (2000) developed a model of quality management methods (QMMs) and concluded that this model could be used to assess an organisation’s strengths and weaknesses with regard to its use of QMMs. The following 11 elements were considered to be the most primary TQM elements: leadership; supplier quality management; vision and plan statement; evaluation; process control and improvement; product design; quality system improvement; employee participation; recognition and reward; education and training; and customer focus.

It was also established that

- different companies have employed different QMMs on the basis of their own requirements;
- QMMs have a positive effect on product quality;
• TQM can lead not only to improvement in product quality, but also to improvement in strategic business performance, process quality, supplier quality management, customer focus and human resource management; ISO 9000 has a much lower impact than TQM.

2.5 Certification and Quality Awards

This section outlines some of the factors involved in ISO 9000 implementation and certification and also discusses the criteria of some of the international and national quality awards. The advantages and disadvantages of ISO 9000 registration and the quality awards have been examined.

Certification

A review of literature on quality in small businesses shows that the benefits of ISO 9000 can far outweigh the costs of achieving registrations (even for small businesses) and that ISO 9000 should be viewed as a step towards TQM and not the end of the quality journey (McAdam and McKeown, 1999).

Porter and Rayner (1991) studied small and medium size businesses with ISO 9000 in the UK and the findings were:

(1) Developing and installing a system is a major exercise for small businesses and therefore should be properly planned.

(2) The attitude of the chief executive officer is a key determinant in the effectiveness of ISO 9000.

(3) The primary motivation for implementing ISO 9000 appeared to be customer pressure, with retention of existing customers being perceived as the main benefit.

(4) A minority of businesses discovered that internal benefits such as greater control turned out to be more valuable.

(5) The cost of registration can usually be recovered within three years through reductions in quality costs.
The Lloyd’s Register Quality Assurance (LRQA) (1995) customer benefits survey also found that the primary reasons for small businesses pursuing ISO 9000 were external pressure and that the impact of internal benefits was greater than anticipated.

- **Positives**: well documented system, internal audits and a certificate demonstrating businesses’ hard work.
- **Negatives**: over bureaucratic, doesn’t necessarily improve quality within the organisation.

This is in agreement with Witcher’s (1994) claim that ISO 9000 promotes accountability of processes but does not impinge upon all these business activities which determine the capability of the organisation to satisfy customer requirements.

Taylor (1995) determined the following with respect to businesses in Northern Ireland:

1. High awareness of ISO 9000 among most senior executives, but poorer understanding of it.
2. Lack of measurement of the financial impact of ISO 9000 on their businesses.
3. The majority of senior executives expressed an intention to move from ISO 9000 to TQM.

Zhu and Scheurmann (1999) conducted a review of the literature on quality programs (TQM and ISO 9000 series) and summarised the major differences between TQM and the ISO 9000 series.

**Focus**
- TQM: internally on management commitment, and employee training and education, and externally on meeting customer requirements exactly.
- ISO 9000 series version 1994 registration: on consistency in the production of a product or service.

**Objective**
- TQM: to improve continuously every facet of organisation culture.
• ISO 9000 series version 1994 registration: to provide a common basis for assuring buyers that specific practices are in conformance with the provider’s stated quality systems.

Sensitivity to environment

• TQM: considers customer needs and satisfaction as a part of their strategy to gain competitive advantage.
• ISO 9000 registration: does not address what should be improved in order to gain a company’s competitive position.

The ISO 9000 series has undergone a major change in requirements (Kantner, 2000). The new standard known as ISO 9001:2000 has strongly focused on process management, on understanding and meeting customer needs and (most significantly) on improvement – of product/service, process, and quality system. The emphasis on measurement, analysis of data, and use of that data to improve the ability of the process to meet customer needs is more pronounced in the new standard. Top management will have to demonstrate its involvement/commitment to developing/improving the quality management system through communications to the organisation, conducting management reviews, establishing policy/objectives and providing needed resources. In summary the new standard has eight quality management areas: customer focus, leadership, involvement of people, process approach, system approach to management, continual improvement, factual approach to decision making, mutually beneficial supplier relationship.

Conti (1999) identified ambiguities in ISO 9004-2000 arising from two different requirements:
• to provide the logical fundamentals and the necessary knowledge for building a quality management system that fits the company’s needs in relation to its products, services and customers; a system that meets or exceeds the requirements specified by ISO 9001:2000;
• to extend the scope of the quality system beyond the ISO 9001 level, to the whole organisation and its interested parties (TQM view).

Conti (1999) recommends that the ISO 9004:2000 should take the following format:
1. The ISO 9001 standard that gives the basic requirements of the product-related quality subsystem.

2. A guideline for building such a subsystem, starting from the basic level of certification but open to customer-driven competition.

3. A TQM migration path, aiming mostly at the extension from the product/service-based quality subsystem to the whole company system.

Laszlo (2000) points out the areas in which both applicants and examiners have to develop competencies in order to implement and maintain the requirements of the new ISO 9001:2000 version of the standard. The organisations have to recognise that there is a cultural gap between the new approach as compared to the previous 1994 version. Similarly, auditors working with the new version may have backgrounds and experiences which evaluated compliance-based systems compared to the new approach which includes evaluation of management techniques that requires hands-on experience and judgement.

Laszlo categorises applicants for the new ISO 9001:2000 as follows:

a. those that have to bridge the gap between quality assurance approach of 1994 version of ISO 9000 and the principles of quality management included in the new ISO 9001:2000 version;

b. those that are registered as “paper certificates” (i.e. organisations that have somehow managed to convince their registrar that they conform to the requirements but in fact do not). These organisations have to make a double shift-first from being deceptive to being open, and then a move from quality assurance approach to that of quality management.

Laszlo states that the evaluation of the approach used by the applicant and the degree of success attained in implementing the ISO 9001:2000 standards by the applicant lies principally with the auditors. Hence the auditor’s prior experience with organisations that have successfully demonstrated their ability to understand and apply the principles of quality management is a critical factor of success. If auditors lack such experience it can be acquired through a process of having inexperienced auditors being accompanied and mentored by someone who has prior experience.
This practice can be conducted on a repeated basis till the inexperienced examiner can be satisfactorily validated.

Larsen and Haversjo (2000) discuss the likely impact the ISO 9001:2000 will have on quality. The standard is changing from a technical-practical tool to a management tool.

Larsen and Haversjo identify four issues with this development:

1) The sum of demands on management: the sum of demands from different functions and systems in the company may be larger than management can handle. Hence, though engagement of management is important, the practical work load created by the new standard may not be relevant when the demands are added up.

2) This puts into question the shift of ISO 9000 from a system that largely worked without heavy management involvement to a system that requires management time and support.

3) The comparative strength of ISO 9000: Larsen and Haversjo considered the ISO 9000:1994 (earlier) standard to foster management and self-management processes at a lower level of the organisation. Danish surveys showed that ISO registered companies score higher on people management, resource management, processes and results, though their leadership scores were average. Based on these results Larsen and Haversjo do not view the shift of the new standard positively, which reduces the emphasis of the lower level of the organisation in favour of more jobs to be done by management.

4) The changed role of the certifying bodies that this change implies: the competencies of third-party auditors are mostly of a technical nature which was compatible with of the earlier standard. The auditors will have to change their profile to one of a management consultant, resulting in conflict with the current management consultant market. The autonomy of the ISO 9000 series auditors is threatened by the requirements of the new standard as management who pay for their services are subjected to closer scrutiny by the auditors.

5) The implied paradigm of management: the ISO 9000:1994 standard had a relatively rudimentary involvement of management: formulate policy; define the work and authority of the employees whose work affects the
quality that customers experience; assure availability of resources for training and verification activities such as audit etc.; appointment of a manager as management representative in relation to the quality system and review of the quality system.

The new ISO 9001:2000 requires a much larger management involvement: further to the earlier standard requirements the policy must include continual improvement, quality objectives, management has to assure resources to achieve quality objectives, management reviews have to be based on data management and evaluation of audit results, customer feedback, process and product performance analysis, status of preventive and corrective actions, follow-up actions from previous management reviews, changing circumstances.

Larsen and Haversjo (2000) fear that the new requirements, though well sounding, are unrealistic, thus making it the tool of the talking organisation -a correct way to talk about quality. This might cause the managerial work to become even more ritualised and ceremonial, being cut off from what really happens.

Since 2008 the ISO quality standard has been upgraded to ISO 9001:2008 as stated previously in Chapter 1 and section 2.2 TQM Historical Development. The upgrade was conducted in order to align it with ISO 14001 though there are no changes to the clauses and the requirements of the standard.

**Quality Awards**

Total quality management programmes that have been well implemented have produced breakthrough results, thus prompting many countries to institute national awards for quality. Ghobadian and Woo (1996) have conducted a comprehensive analysis of the quality awards: below is a summary of some of their findings.

The Deming Prize was established by the Board of Directors of the Japanese Union of Scientists and Engineers (JUSE) in 1951. It recognises performance improvements brought about by successful implementation of company-wide or total quality control (CWQC) or (TQC). It has proved to be an effective instrument for spreading quality
methods throughout Japanese industry. Table 2.12 comprises of the Deming Application Prize checklist and Table 2.13 outlines details of the Deming Application Prize for senior executives.
<table>
<thead>
<tr>
<th>Items</th>
<th>Check points</th>
<th>Items</th>
<th>Check points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Policies</td>
<td>• Management, quality and quality control/management policies • Methods for establishing policies • Appropriateness and consistency of policies • Utilisation of statistical methods • Communication and dissemination of policies • Checks on policies and status of their achievement • Their relationship to long-and short-term plans</td>
<td>Standardisation</td>
<td>• System of standards • Methods of establishing, revising and abolishing standards • Actual performance in establishing, revising and abolishing standards • Contents of standards • Utilisation of statistical methods • Accumulation of technology • Utilisation of standards</td>
</tr>
<tr>
<td>The organisation and its operations</td>
<td>• Clarity of authority and responsibility • Appropriateness of the delegation of authority • Inter-departmental co-ordination • Committee activities • Utilisation of staff • Utilisation of QC activities • Quality control/management diagnosis</td>
<td>Control/Management</td>
<td>• Management systems for quality and other related elements, such as cost and delivery (quantity) • Control points and control items • Utilisation of statistical methods and concepts, such as control charts • Contribution of QC circle activities • Status of control/management activities • In-control situation</td>
</tr>
<tr>
<td>Education and dissemination</td>
<td>• Educational plans • Consciousness of quality and how it is managed, and understanding of quality control/management • Education on statistical concepts and methods and the degree to which they are disseminated. • Grasp of effects • Education of associated companies (especially group companies, vendors, contractors and distributors) • QC circle activities • The system of improvement suggestions and its status</td>
<td>Quality Assurance</td>
<td>• New products and service development methods (quality deployment and analysis, reliability testing and design review) • Preventive activities for safety and product liability • Degree of customer satisfaction • Process design, process analysis and process control and improvement • Process capabilities • Instrumentation and inspection • Management of facilities, vendors, procurement and services • Quality assurance system and its diagnosis • Utilisation of statistical methods • Quality evaluation and audit • Status of quality assurance</td>
</tr>
<tr>
<td>Information gathering, communication and its utilisation</td>
<td>• Collection of external information • Inter-departmental communication • Speed of communication (utilisation of computers) • Information processing (statistical) analysis and utilisation of information</td>
<td>Effects</td>
<td>• Measurement of effects • Tangible effects such as quality, service, delivery, cost, profit, safety and environment • Intangible effects • Conformity of actual performance to planned effects</td>
</tr>
<tr>
<td>Analysis</td>
<td>• Selection of important issues and improvement themes • Appropriateness of analytical methods • Utilisation of statistical methods • Linkage with industry-intrinsic technology • Utilisation of analysis results • Action taken on improvement suggestions</td>
<td>Future plans</td>
<td>• Concrete understanding of current situation • Measures for solving defect problems • Future promotion plans • Relationship between future plans and long-term plans</td>
</tr>
</tbody>
</table>

Source: Ghobadian and Woo (1996).
Table 2.13: Deming Application Prize list for senior executives

<table>
<thead>
<tr>
<th>Items</th>
<th>Check points</th>
<th>Items</th>
<th>Check points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understanding and enthusiasm</td>
<td>How well do senior executives understand the concepts of quality, quality assurance, reliability, etc.? How knowledgeable and enthusiastic are they in managing quality? Do they understand and utilise statistical concepts? Is there overall co-ordination between QC and other management systems? How knowledgeable and enthusiastic are they in scientific management (management consciousness and responsibility)? How do they understand, respect and pursue scientific logic (statistical concepts)? Are they enthusiastic? How knowledgeable and enthusiastic are they about QC activities?</td>
<td>Education, dissemination and thorough implementation</td>
<td>What are the educational policies for QC management, QC circle activities, necessary scientific technology, managerial techniques and statistical methods? How knowledgeable and enthusiastic are senior executives about these policies? What are the promotional measures for education, dissemination and thorough implementation? How are the educational programmes reviewed and evaluated, and how are necessary improvement actions taken? What educational programmes are offered to associated companies (especially group companies, vendors, contractors and distributors?)</td>
</tr>
<tr>
<td>Policies, objectives and targets</td>
<td>Have policies for management and QC been established? Have policies and objectives for quality and quality assurance been established? How (on what basis) have these policies been established? How are they deployed? How are the implementations measures developed and promoted? How is the evaluation (check) of results and effects planned and designed? Are appropriate actions being taken? How are changes in objectives and plans managed? What are their annual and long-term plans?</td>
<td>Implementation</td>
<td>How is the budget for QC management, quality assurance, etc. established? How are the necessary facilities maintained? Are implementation measures properly carried out? How are the necessary elements and conditions for control/management identified? Is proper guidance and research conducted for the above? Is the quality of the company’s own products and services, as well as QC management practices, reviewed and evaluated? Is the statistical way of thinking used for analysing and implementing improvement measures? How are different management systems co-ordinated? Are the management activities in different departments well balanced and practiced? Are the contributions of improvement activities to business performance studied and reviewed? How are the measures for associated companies implemented? How does the company fulfil its social responsibilities? How is the new product development system managed?</td>
</tr>
</tbody>
</table>

Source: Ghobadian and Woo (1996).
Table 2.13: Deming Application Prize list for senior executives (Cont’d)

<table>
<thead>
<tr>
<th>Items</th>
<th>Check points</th>
</tr>
</thead>
<tbody>
<tr>
<td>The organisation, systems and human resources</td>
<td>How are the organisations for managing QC and other issues established?</td>
</tr>
<tr>
<td></td>
<td>What are the senior executives’ roles in QC management?</td>
</tr>
<tr>
<td></td>
<td>How are human resources for such organisations allocated?</td>
</tr>
<tr>
<td></td>
<td>How is the job authority and responsibility established and allocated?</td>
</tr>
<tr>
<td></td>
<td>How are the external activities (with associated companies and other organisations) managed for co-ordination, co-operation, support, guidance and advertisement?</td>
</tr>
<tr>
<td></td>
<td>How well is organisational education and training co-ordinated?</td>
</tr>
<tr>
<td>Future policies plans and measures</td>
<td>What are the future policies, plans and measures for managing quality and other related issues?</td>
</tr>
<tr>
<td></td>
<td>What are the future policies, plans and measures for quality, price and demand in response to economic growth?</td>
</tr>
<tr>
<td></td>
<td>Does the company have future policies, plans and measures for new products?</td>
</tr>
<tr>
<td></td>
<td>What are the future policies, plans and measures for quality, product lines, production methods, management methods, equipment and new product development in response to the progress of science and technology?</td>
</tr>
<tr>
<td></td>
<td>What are the sales plans and sales expansion plans?</td>
</tr>
<tr>
<td></td>
<td>What are the future policies, plans and measures for the business scope, finance and human resources?</td>
</tr>
</tbody>
</table>

Source: Ghobadian and Woo (1996).

The Malcolm Baldrige National Award was founded in 1987 in the United States of America. The application categories include manufacturing, services and small business. Only whole or part for-profit businesses located in the U.S. or its territories are eligible to compete for the award. It has four basic elements: driver, system, measures of progress and goal. Brown (1997) stated that most major US corporations, all US military organisations, schools, educational institutions and a variety of public and private organisations use the criteria to help them evaluate and improve their performance. Figure 2.23 graphically represents the Baldrige Award framework and table 2.14 provides the Baldrige Award criteria.
Figure 2.23: Baldrige Award framework

Source: Ghobadian and Woo (1996).
Table 2.14: Baldrige Award criteria

<table>
<thead>
<tr>
<th>Examination categories and items</th>
<th>Point values</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Leadership</strong></td>
<td>95</td>
</tr>
<tr>
<td>Senior executive leadership</td>
<td>45</td>
</tr>
<tr>
<td>Management for quality</td>
<td>25</td>
</tr>
<tr>
<td>Public responsibility</td>
<td>25</td>
</tr>
<tr>
<td><strong>Information and analysis</strong></td>
<td>75</td>
</tr>
<tr>
<td>Scope and management of quality and performance data and information</td>
<td>15</td>
</tr>
<tr>
<td>Competitive comparisons and benchmarking</td>
<td>20</td>
</tr>
<tr>
<td>Analysis and uses of company-level data</td>
<td>40</td>
</tr>
<tr>
<td><strong>Strategic quality planning</strong></td>
<td>60</td>
</tr>
<tr>
<td>Strategic quality and company performance planning process</td>
<td>35</td>
</tr>
<tr>
<td>Quality and performance plans</td>
<td>25</td>
</tr>
<tr>
<td><strong>Human resource development and management</strong></td>
<td>150</td>
</tr>
<tr>
<td>Human resource planning and management</td>
<td>20</td>
</tr>
<tr>
<td>Employment involvement</td>
<td>40</td>
</tr>
<tr>
<td>Employee education and training</td>
<td>40</td>
</tr>
<tr>
<td>Employee performance and recognition</td>
<td>25</td>
</tr>
<tr>
<td>Employee wellbeing and satisfaction</td>
<td>25</td>
</tr>
<tr>
<td><strong>Management of process quality</strong></td>
<td>140</td>
</tr>
<tr>
<td>Design and introduction of quality products and services</td>
<td>40</td>
</tr>
<tr>
<td>Process management: product and service production and delivery processes</td>
<td>35</td>
</tr>
<tr>
<td>Process management: business processes and support services</td>
<td>30</td>
</tr>
<tr>
<td>Superior quality</td>
<td>20</td>
</tr>
<tr>
<td>Quality assessment</td>
<td>15</td>
</tr>
<tr>
<td><strong>Quality and operational results</strong></td>
<td>180</td>
</tr>
<tr>
<td>Product and service quality results</td>
<td>70</td>
</tr>
<tr>
<td>Company operational results</td>
<td>50</td>
</tr>
<tr>
<td>Business process and support service results</td>
<td>25</td>
</tr>
<tr>
<td>Supplier quality results</td>
<td>35</td>
</tr>
<tr>
<td><strong>Customer focus and satisfaction</strong></td>
<td>300</td>
</tr>
<tr>
<td>Customer expectations: current and future</td>
<td>35</td>
</tr>
<tr>
<td>Customer relationship management</td>
<td>65</td>
</tr>
<tr>
<td>Commitment to customers</td>
<td>15</td>
</tr>
<tr>
<td>Customer satisfaction determination</td>
<td>30</td>
</tr>
<tr>
<td>Customer satisfaction results</td>
<td>85</td>
</tr>
<tr>
<td>Customer satisfaction comparison</td>
<td>70</td>
</tr>
<tr>
<td><strong>Total points</strong></td>
<td>1,000</td>
</tr>
</tbody>
</table>

Source: Ghobadian and Woo (1996).

The European Quality Award (EQA) was set up in 1991. The main objectives of the award were to support, encourage and recognise the development of effective TQM by European companies. It is managed by the European Foundation for Quality Management (EFQM). The model has two parts: enablers - policies and processes that drive the business and facilitate the transformation of inputs to outputs and outcomes; and results - a measure of the level of output and outcome attained by the organisation. Figure 2.24 shows the EQA framework and Table 2.15 outlines the EQA criteria.
Figure 2.24: EQA framework

Source: Ghobadian and Woo (1996).

Table 2.15: European Quality Award Criteria

<table>
<thead>
<tr>
<th>Elements</th>
<th>Percentage score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Leadership</strong></td>
<td></td>
</tr>
<tr>
<td>Visible involvement in leading quality management</td>
<td>100</td>
</tr>
<tr>
<td>A consistent total quality culture</td>
<td></td>
</tr>
<tr>
<td>Recognition and appreciation of the efforts and success of individuals and teams</td>
<td></td>
</tr>
<tr>
<td>Support of total quality by provision of appropriate resources and assistance</td>
<td></td>
</tr>
<tr>
<td>Involvement with customer and suppliers</td>
<td></td>
</tr>
<tr>
<td>Active promotion of quality management outside the organisation</td>
<td></td>
</tr>
<tr>
<td><strong>Policy and strategy</strong></td>
<td>80</td>
</tr>
<tr>
<td>How policy and strategy are based on the concept of total quality</td>
<td></td>
</tr>
<tr>
<td>How policy and strategy are determined using relevant information</td>
<td></td>
</tr>
<tr>
<td>How policy and strategy are the basis of business plans</td>
<td></td>
</tr>
<tr>
<td>How policy and strategy are communicated</td>
<td></td>
</tr>
<tr>
<td>How policy and strategy are regularly reviewed and improved</td>
<td></td>
</tr>
<tr>
<td><strong>People management</strong></td>
<td>90</td>
</tr>
<tr>
<td>How continuous improvement in people management is effected</td>
<td></td>
</tr>
<tr>
<td>How the organisation preserves and develops core skills through the recruitment, training and career progression of its people</td>
<td></td>
</tr>
<tr>
<td>How the organisation’s performance targets are agreed and reviewed continuously with staff</td>
<td></td>
</tr>
<tr>
<td>How the organisation promotes the involvement of all its people in quality and continuous improvement</td>
<td></td>
</tr>
<tr>
<td><strong>Resources</strong></td>
<td>90</td>
</tr>
<tr>
<td>Financial resources</td>
<td></td>
</tr>
<tr>
<td>Information resources</td>
<td></td>
</tr>
<tr>
<td>Material resources</td>
<td></td>
</tr>
<tr>
<td>Application technology</td>
<td></td>
</tr>
<tr>
<td><strong>Processes</strong></td>
<td>140</td>
</tr>
<tr>
<td>How key processes are identified</td>
<td></td>
</tr>
<tr>
<td>How the organisation systematically manages its key and support processes</td>
<td></td>
</tr>
<tr>
<td>How process performance parameters, along with all relevant feedback, are used to review key processes and to set targets for improvement</td>
<td></td>
</tr>
<tr>
<td>How the organisation stimulates innovation and creativity in process improvement</td>
<td></td>
</tr>
<tr>
<td>How the organisation implements process changes and evaluates the benefits</td>
<td></td>
</tr>
<tr>
<td><strong>Customer satisfaction</strong></td>
<td>200</td>
</tr>
<tr>
<td><strong>People satisfaction</strong></td>
<td>90</td>
</tr>
<tr>
<td><strong>Impact on society</strong></td>
<td>90</td>
</tr>
<tr>
<td><strong>Business results</strong></td>
<td>150</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1,000</td>
</tr>
</tbody>
</table>

Source: Ghobadian and Woo (1996).
The Australian Quality Award (AQA) was established by Enterprise Australia in 1988 and awarded by the Australian Quality Council (AQC) (Ghobadian and Woo, 1996; Zink et al. 1997).

The Australian Quality Award is based on the Australian Business Excellence Framework (ABEF) which was developed in 1987 about the same time when the US Baldrige Award framework was introduced. The ABEF was promoted by the AQC, which operated until 2001. AQC eventually sold the rights to the ABEF and the Australian Business Excellence Awards to SAI Global who are the current custodians of the ABEF (Grigg and Mann, 2008).

The ABEF symbolises a systems approach to management (Australian Business Excellence Awards, 2000). It consists of seven main categories, namely Leadership and Innovation, Customer and Market Focus, Strategy and Planning Processes, People, Processes, Products and Services, (Data, Information and Knowledge) and Business Results (Figure 2.25) (Khoo and Tan, 2003).

Figure 2.25: The Australian Business Excellence Framework (ABEF)
The aim of the AQA was to encourage local companies to improve their quality and performance to world-class level and provide a benchmark for their achievements. It was reasoned that this could assist Australian companies to compete more effectively in a highly competitive and global market place through improved quality.

Zink et al. (1997) examined in detail the criteria and purpose of the Australian Quality Award. The Australian Quality Awards Foundation has responsibility for the evaluation and selection of applicants for the award.

Figure 2.26: Structure of the Australian Quality Award

An applicant for the AQA can obtain a maximum of 1000 points. They are shared between seven categories in the percentage outlined in Figure 2.26.

- **Leadership**
  Executive’s commitment and behaviour in relationship to total quality aspects. Areas of leadership assessed are senior executive leadership, leadership throughout the organisation and leadership in the community.

- **Strategy, policy and planning**
  Areas examined are corporate strategies, policies, development of operative plans, methods of imparting results and policy deployment processes inside the organisation. Employees contributions and outside stakeholders involvement in these activities are also evaluated.

Source: Zink et al. (1997).
• Information and analysis
  The organisation’s data collection and information gathering is reviewed. The effective analysis of the same to deliver continuous improvement is evaluated.

• People
  Employees’ involvement and empowerment to deliver continuous improvement is assessed. This section is divided into six areas:
  1. human resource management planning
  2. employee involvement
  3. performance management
  4. education and training
  5. communication
  6. wellbeing and satisfaction

• Customer focus
  It examines how customers are identified, how requirements are defined and definite measures deduced.

• Quality of process, product and service
  The cooperation with suppliers, process management systems and methods are assessed. The organisation’s methods of determining, predicting, fulfilling and surpassing customer requirements are estimated.

• Organisational performance
  The management and leadership initiatives contribution to outstanding organisational performance and achievement of corporate goals are assessed.

Table 2.16 summarises the respective areas for which points are given. The four dimensions for which an organisation is assessed are:
  1. Approach: methods and tools employed to cover the criteria of assessment.
     A description of the organisation’s ability to conduct improvement of processes, products and services.
  2. Deployment/integration: degree of application to all relevant areas. Integration of the approach in management systems overall and daily.
3. Results or outcomes: assessment of organisation’s performance with regard to goals set and benchmarks.

4. Improvement: assesses methodology used to enhance efficiency through extent of employment and results achieved.

Table 2.16: Criteria for the Australian Quality Award

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leadership</td>
<td>140</td>
</tr>
<tr>
<td>Senior executive leadership</td>
<td>60</td>
</tr>
<tr>
<td>Leadership throughout the organisation</td>
<td>40</td>
</tr>
<tr>
<td>Leadership in the community</td>
<td>40</td>
</tr>
<tr>
<td>Strategy, policy and planning</td>
<td>80</td>
</tr>
<tr>
<td>Integration of values</td>
<td>30</td>
</tr>
<tr>
<td>The planning process</td>
<td>50</td>
</tr>
<tr>
<td>Information and analysis</td>
<td>80</td>
</tr>
<tr>
<td>Scope and collection of data</td>
<td>40</td>
</tr>
<tr>
<td>Analysis and use of data and information</td>
<td>40</td>
</tr>
<tr>
<td>People</td>
<td>200</td>
</tr>
<tr>
<td>Human resource management planning</td>
<td>30</td>
</tr>
<tr>
<td>Employee involvement</td>
<td>40</td>
</tr>
<tr>
<td>Performance management</td>
<td>30</td>
</tr>
<tr>
<td>Education and training</td>
<td>30</td>
</tr>
<tr>
<td>Communication</td>
<td>30</td>
</tr>
<tr>
<td>Wellbeing and satisfaction</td>
<td>40</td>
</tr>
<tr>
<td>Customer focus</td>
<td>180</td>
</tr>
<tr>
<td>Knowledge of customers’ needs and expectations</td>
<td>60</td>
</tr>
<tr>
<td>Customer relationship management</td>
<td>60</td>
</tr>
<tr>
<td>Customer satisfaction</td>
<td>60</td>
</tr>
<tr>
<td>Quality of process, product and service</td>
<td>200</td>
</tr>
<tr>
<td>Design and innovation</td>
<td>40</td>
</tr>
<tr>
<td>Supplier relationships</td>
<td>30</td>
</tr>
<tr>
<td>Management and improvement of processes</td>
<td>70</td>
</tr>
<tr>
<td>Quality of products and services</td>
<td>60</td>
</tr>
<tr>
<td>Results</td>
<td>120</td>
</tr>
<tr>
<td>Measures of success</td>
<td>120</td>
</tr>
</tbody>
</table>

Source: Zink et al. (1997).
An analysis of the quality awards

Ghobadian and Woo (1996) provided an analysis of the quality awards by comparing the Deming Prize, the European Quality Award, the Baldrige Award and The Australian Quality Award (Table 2.17) and also by outlining the benefits and limitations of the quality award models.

Table 2.17: Comparison of the awards

<table>
<thead>
<tr>
<th>The Deming Prize</th>
<th>The European Quality Award</th>
<th>The Malcolm Baldrige National Quality Award</th>
<th>The Australian Quality Award</th>
</tr>
</thead>
<tbody>
<tr>
<td>• No underlying framework linking concepts, activities, processes and results together. However philosophy and values are presented as a checklist.</td>
<td>• Model TQM by identifying its constituent parts</td>
<td>• Model TQM by identifying its constituent parts</td>
<td>• Model TQM by identifying its constituent parts</td>
</tr>
<tr>
<td>• Does not assume an underlying causality</td>
<td>• Assumption of causal relationship between different constituents of TQM</td>
<td>• Assumption of causal relationship between different constituents of TQM</td>
<td>• Assumption of causal relationship between different constituents of TQM</td>
</tr>
<tr>
<td>• Focuses on policies, plans, implementation of plans, information collection, analysis and control; results and effects of policies implemented; future improvement plans.</td>
<td>• Implies the importance of top management role</td>
<td>• Based on the premise that management leadership and customer/external focus are the key factors in introducing TQ</td>
<td>• Based on the premise that management leadership and customer/external focus are the key factors in introducing TQ</td>
</tr>
<tr>
<td>• Prescriptive in terms of tools</td>
<td>• Explicitly emphasises the importance of customer focus</td>
<td>• Prescriptive with respect to their philosophy and values</td>
<td>• Prescriptive with respect to their philosophy and values</td>
</tr>
<tr>
<td>• All factors are weighted equally, evaluation based on overall success of organisation rather than numerical score to each individual factor.</td>
<td>• Not prescriptive in relation to total quality tools to be used</td>
<td>• Not prescriptive in relation to total quality tools to be used</td>
<td>• Not prescriptive in relation to total quality tools to be used</td>
</tr>
<tr>
<td>• Emphasises factors concerned with management of facilities, vendors, procurement and service.</td>
<td>• Emphasises management and provision of resources</td>
<td>• Emphasises projection of the competitive environment, management of data and information and human resources</td>
<td>• Emphasises projection of the competitive environment, management of data and information and human resources</td>
</tr>
<tr>
<td>• Overall emphasis on quality assurance of products and services</td>
<td>• Places significant importance on results and is the only one that addresses financial results.</td>
<td>• Evaluate impact on society</td>
<td>• Evaluate impact on society</td>
</tr>
<tr>
<td>• Not competitive no restrictions on number of winners</td>
<td>• Evaluate impact on society</td>
<td>• Scoring methodology relies on three dimensions—Approach, Deployment and Results.</td>
<td>• Scoring methodology relies on three dimensions—Approach, Deployment and Results.</td>
</tr>
<tr>
<td>• Only award that ascertains the views of suppliers and customers of the applicant organisation</td>
<td>• Scoring methodology uses a total of four dimensions—two for enablers (approach and deployment), two for results (excellence of results and scope).</td>
<td>• Overall broader scope lesser depth</td>
<td>• Overall broader scope lesser depth</td>
</tr>
<tr>
<td>• Recognises the need to introduce a higher order award to encourage past winners to continue to improve their quality efforts and set new standards</td>
<td>• Overall broader scope lesser depth</td>
<td>• Competitive, restriction on number of winners</td>
<td>• Competitive, restriction on number of winners</td>
</tr>
<tr>
<td>• Have a specific prize for small business</td>
<td>• Does not have a specific prize for small business</td>
<td>• Have a specific prize for small business</td>
<td>• Have a specific prize for small business</td>
</tr>
</tbody>
</table>

Adapted from Ghobadian and Woo (1996).
Areas of commonality among the awards:

- formulation of quality policies;
- assigning responsibility to top management;
- constant improvement in the level of understanding of the quality policies within and without the organisation;
- managing quality procedures and control;
- reviewing the progress of the improvement process;
- delegation of authority, recognition of quality behaviour, and empowerment of the workforce.

Benefits of the awards:

- A universal framework for evaluating: aspects of management practice; quality methods techniques; tools and procedures; deployment of quality plans; and the results attained. A structure for implementation of total quality.
- The EQA, Baldrige and AQA models identify key total quality processes and attempt to establish cause and effect between these and the results generated.
- The awards have captured the attention of top management of many businesses.
- A perception has been established that winning one of the quality awards enhances the organisation’s competitiveness and position as a leader in its field.
- Customers rate companies by their efforts to apply for the award.
- The awards have raised quality consciousness among industrialists and the general public.
- The awards have facilitated sharing of experiences and have encouraged co-operative behaviour.
- They have helped organisations to establish benchmarks from which all future progress can be measured.
- Winners of the awards were able to augment a more effective integration of the wills and activities of all employees. This has led to a strengthened corporate structure, improved product and service quality followed by larger profits.
- Winners were instrumental in encouraging subsidiaries and affiliated organisations to apply for the awards.
- Award winners have achieved major breakthroughs in key areas of business
• Companies that embrace total quality and score high against the award criteria are more robust and are better equipped to recover from setbacks caused by exterior factors.

Limitations of the awards:
• The models should have a continuous improvement mechanism which will ensure that the criteria meet the requirements of the time. They are static and not dynamic.
• The time involved in preparing an application and financial investment involved is viewed as a disadvantage.
• Baldrige, the AQA and to a lesser degree EQA are viewed as having a weak focus on business results. EQA have, however, included financial results in their criteria.

2.6 Information communication technology in TQM

Information communication technology can be considered to be an enabler in total quality Management. Zadrozny and Ferrazi (1992) are of the view that the information systems play a key role in the TQM initiative through the strategic, human resources, and technology areas.

Dewhurst et al. (1999) conducted a comprehensive review of the applications of ICT in TQM.

Top management support:
Dewhurst et al. (1999) state that senior management support is a vital need for the success of TQM and the introduction of ICT. ICT applications may lead to an increase of top management control, hence top management needs to manage this change without creating undue stress and concerns.

Customer relationship:
Customer relationships can be greatly enhanced through ICT applications such as bar-coding, product recognition systems and electronic point of sales (EPOS) as these systems contribute to an increase in the accuracy and speed of sales leading to
improved customer device. ICT has also made it possible for conducting business transactions with customers in geographically remote locations specially for SMEs (Quelch and Klein, 1996). Gilmore and Pine (1997) point out that customisation can be better achieved through ICT. Stone et al. (1996) are of the view that, in the future, customers will increasingly seek to manage the relationship using new technologies and that companies need to be prepared for this change.

Customer surveys can be conducted using ICT. The information obtained through the surveys can be stored electronically in a database and analysed efficiently by computer-based statistical packages. This will allow for speedier and effective decision-making related to new/improved products and processes.

Supplier relationship:
Electronic data interchange (EDI) can be used to develop improved communication links with suppliers by electronically placing orders, sending product specifications, design details, confirmation of invoices and supplier payment (Jonscher, 1994). Suppliers can be involved earlier on in the design process through IT applications. Organisations can have access to suppliers’ inventory systems and production scheduling systems, thus facilitating automatic order placing (Teague et al. 1997). Several authors have established that use of EDI systems by organisations and their vendors have resulted in significant improvements in organisational efficiencies, and reduction in the level of shipment discrepancies. Bakos and Brynjolfsson (1993) and Stump and Sriram (1997) argue that use of IT in a supplier development/partnership type approach quickens the reduction in the number of suppliers used by an organisation.

Hence electronic transactions and their related systems will re-structure business organisation functions which in turn will impact on the development and advancement of TQM.

Workforce management:
ICT applications in workforce management is a rather controversial area. Pinsonneault and Kraemer (1997) discovered that ICT brought about a decrease in the number of middle management in organisations with centralised decision
authority but the converse was true in organisations with decentralised decision authority. There are arguments for and against ICT applications leading to deskillling. Some authors are of the view that ICT would result in reducing job satisfaction and diminish skill requirements as:

- Work would be routinised.
- Work would be subdivided into small, highly specialised and repetitive tasks.
- Humans would be subject to machine control.
- Low-level clerical jobs would be replaced by high-skill professional jobs and the more mundane tasks would be automated.

Benijer (1986) and Wilson (1994) believe that the use of ICT as an agent to control work processes leads to deskillling and monitored jobs, higher productivity, increased control and command, and inflexibility. On the other hand, Wilson (1994) focuses on the view of ICT as an enabling mechanism where jobs are enriched and job satisfaction increases. This may not necessarily lead to higher productivity (though it is not likely to decrease), but performance, employee initiative and flexibility would increase.

The training requirements of the workforce change to meet the demands of introduction of ICT systems.

Employee attitudes and behaviour:
Dewhurst et al. (1999) state that introduction of new ICT systems may involve organisational restructuring which may cause employees to reduce their commitment to company goals and objectives. There are some who favour this view and others who oppose it. Either way it is important to consider any change in workforce attitudes that might result post introduction of ICT in order to ensure that there is no decrease in factors such as loyalty to the organisation, pride in work, ability to work with employees from other departments, job satisfaction and stress.

ICT can be a good tool in information sharing among different departments and functions.
Product design process:
Innovation is greatly enhanced through ICT: Schein (1994). CAD technologies have made it possible to design products to customer needs at a much faster rate. Design of products requires inputs from multifunctional groups (production, marketing and R&D) and ICT enables speedier communication and transfer of information among these groups resulting in effective and quicker product design: Dewhurst et al. (1999). ICT has facilitated a more complete use of tools such as design of experiments, FMEA and QFD (Mezgar et al. 1997; Webber, 1990; Rangaswamy and Lilien, 1997; Zhang et al. 1996).

Process flow management:
ICT has made significant contributions to process flow management. It automated systems in maintenance management in the areas of scheduling and diagnostics (Dilger, 1997; Krouzek, 1987).

Variation reduction in processes has taken place through automation, resulting in an enhancement of quality and output speed (Freund et al. 1997). Electronic detection and signalling devices have not only reduced process variation but have also contributed to eliminating inspection-type activities (Litsikas, 1997).

The automation of measuring product and processing parameters, collection and processing of data have facilitated application of Statistical Process Control (SPC) (Kendrick, 1995; Papadakis, 1990). Layden and Pearson (1992) explain how ICT applications have enhanced the use of Statistical Problem Solving (SPS) in conjunction with SPC.

A variety of software to manage the process of implementation, maintenance and self assessment of quality systems such as ISO 9000 series and QS-9000 are available (Ward, 1998).

Global organisations can manage their businesses on one standardised system through ICT. This allows organisations to obtain real time data from any country in order to determine the current state of the business anywhere in the world.
Quality data and reporting:
ICT makes it easier to access different databases, and to conduct subsequent analysis faster and more accurately (Lawler, 1991). Automated means of gathering data, recording and acting on ideas during workgroup meetings can be brought about through ICT (Jackson et al. 1995). Internet-based newsgroups and listservers can be useful tools to improve quality (Finch and Luebbe, 1997).

ICT can be used in the areas of determining quality costs, feedback of quality performance measurements, and improving the availability of quality-related data.

ICT and its relationship with the quality department:
Dewhurst et al. (1999) believe that the work of the quality department will be made easier by the use of ICT as these technologies aid in the collection and analysis of data and transfer information to other departments.

Benchmarking:
Dewhurst et al. (1999) outline the contributions ICT can make to benchmarking. ICT can help the benchmarking process in the following ways:
- easier communication with partners;
- identification of best in class companies;
- facilitates simulation of performance measures and gap analysis;
- provides a vehicle for internal communication of data gathered from benchmarking and formulation of resulting action plans is made faster.

Artificial intelligence can be utilised in manufacturing systems to provide flexibility and efficiency. Meziane et al. (2000) have conducted a review of intelligence systems in manufacturing. They have defined the components of intelligent manufacturing systems (IMS) and artificial intelligence (AI) techniques under the following categories.
- KBs: incorporate human knowledge about an application area. These are obtained from experts in the particular domain, thus permitting the system to automatically replicate aspects of best practice.
• NNs: input stimuli are connected through a network of nodes to output nodes. It has applications in classification and optimisation situations.

• Fuzzy logic: it is a means of quantifying information that otherwise could not be used in mathematical modelling or target setting.

• GAs: candidate solutions evolve through reproduction and mutation of the fittest. The elimination of the least promising solutions of each generation are made ‘extinct’.

• CBR: contains a history of past problems and the successful solutions applied. The most likely solutions of future problems can be viewed through analogy with past cases.

Figure 2.27: Highlights the components of an intelligent manufacturing system.

Source: Meziane et al. (2000).

**Intelligent quality management**

Meziane et al. (2000) defined the areas of intelligent quality management below:

• KBSs: statistical quality control uses control charts to ensure quality products and services. The efficient use of this tool is dependant on correct interpretation of chart patterns, trends and associated diagnosis. Knowledge-based quality control information systems can assist decision makers in selecting the best quality tools and techniques relevant to a particular shopfloor problem. These
systems can also provide non-specialised staff involved in quality with expert knowledge.

- NNs can provide high processing and classification capabilities. It can be used in fault diagnosis to identify causes and failures. Optimisation of controllable variables of a process can be achieved, resulting in real-time quality control.

- Fuzzy logic: it has applications in acceptance sampling and statistical process control. Fuzzy logic can be used in quality improvement and quality function deployment. A fuzzy multicriteria decision theory framework can provide a means for modelling quality decisions such as purchasing new machinery, workforce training, preventive maintenance, supplier quality and inspection. Customer needs have been analysed through fuzzy logic and has helped in achieving customer satisfaction and a balanced design product.

- CBR: Malek et al. (1998) developed an operator support system which provides guidance in decision making during the control of the plastic injection moulding process, thus enhancing quality during production.

2.7 Future Trends in TQM

This section reviews best practices in large organisations, emerging models of TQM, the paradigm shift in quality management, and the likely impact of ICT on quality management.

2.7.1 Best Practices in Large Organisations

“The Big Three” of the US automotive industry established a QMS for their suppliers called QS 9000. This system supplemented ISO 9000 with industry-specific requirements called for by all three companies and company-specific requirements unique to one company or shared by two of the three. The QMS supports their key business processes compared to just being an ISO 9000 compliance tool.

- Quality policy reflects customer needs.
- Personal ownership of key processes.
• Audit effectiveness as well as compliance.
• Evaluate efficiency through key indicators.
• A defined process to manage change.
• People development linked to business needs.
• Management review of QMS against objectives.
• Evaluation of QMS in helping to achieve customer satisfaction.

Ford based its quality operating system on Shewart’s PDSA cycle. Ford’s monthly activity and analysis report required the following:
• Charting actual performance against target.
• Monitoring individual results.
• Identifying major causes of shortfall against target, using Pareto Charts.
• Removing causes of shortfall by 8D team-oriented problem solving (TOPS).
• Ford also practised training of people in the areas of goal setting, performance appraisal, coaching, counselling, project management and budgeting.

The quality system used by Ford required everyone to be involved in continuous improvement of all processes and activities.

The businesses which gained most from TQM had started with ISO 9000 and had focused on external and internal measures. These organisations also had full management commitment, and high levels of employee participation and training.

Motorola was the originator of the Six Sigma program. The outcome of six sigma process is near perfect quality.

2.7.2 Emerging Models of TQM

This section examines some of the newer developments that have contributed to innovative and values-adding methodologies that build on the existing principles of TQM.

Bajaria (1998) explains the importance of vertical systems in quality management. The success of the horizontal system depends on its ability to stay current with, and
responsive to, on-going organisational and technological changes. In contrast, vertical systems are everlasting and robust to all changes. Horizontal systems themselves cannot deliver complete solutions; they can only increase the efficiency of the vertical systems.

The usage of vertical systems frequently defines elements of horizontal systems that need to be strengthened, modified or discarded. With horizontal systems, one reiterates known methodologies and encounters familiar solutions to familiar problems. With vertical systems, we are always discovering something unique. Knowledge acquired through vertical efforts can always be spread horizontally. It is clear that we need both vertical and horizontal systems. Imai (1986) states that understanding a new concept brings profit: executing effectively what we know allows us to keep the profit.

Examples of Horizontal systems:
ISO 9000, gauge repeatability and reproducibility studies, statistical process control (SPC), total quality management (TQM), Taguchi methods, 5S, massive method-focused training etc.

Examples of vertical systems:

The creation of any organisation arises through a vertical system. An establishment is formed around beginning, intermediate and end steps of any product or service to be marketed. The process of planning, controlling or improving quality also has beginning, intermediate and end steps.

Figure 2.28 illustrates the difference between horizontal and vertical systems. There are at least two ways to institutionalise control charting.

(1) Apply control charting throughout all operations, because it is helpful for controlling processes is an example of a horizontal system.
(2) Apply control charting to define the problem to be resolved, because the control chart is a tool to convert problem symptoms into statistical problem conditions. Using control charting as one of the substeps in solving a problem is an example of a vertical system.

Figure 2.28: Vertical system versus horizontal system

Vertical system
Define the problem (use control charting)

Solve the problem

Implement a solution

Horizontal system

Use control charting

Use control charting

Use control charting

Use control charting

Use control charting

Use control charting

Use control charting

It is the vertical system that must drive the need to create horizontal systems. Vertical systems cannot be outdated with the advance of computer technology. Bajaria (1991) developed the vertical system C-S-I-N shown in Figure 2.29.

![Diagram of C-S-I-N vertical system](Source: Bajaria (1998).)

The chart (C) solve (S) implement (I) next (N) vertical system can be used to solve a wide variety of problems. Several things can be accomplished simultaneously: training, synthesis of many tools, problem-solving and a handsome return on investment. A successfully solved problem through C-S-I-N provides stimulus for developing horizontal system elements.
The vertical systems should be the horse and horizontal systems the cart. The comparison between the two systems is shown in Table 2.18.

Table 2.18: Comparison between vertical and horizontal systems

<table>
<thead>
<tr>
<th>Vertical system</th>
<th>Horizontal System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Robust with respect to time</td>
<td>Changes with respect to time</td>
</tr>
<tr>
<td>Has a well defined beginning and a well defined end</td>
<td>Increases efficiency of one of the sub-steps required to execute a vertical system</td>
</tr>
<tr>
<td>requiring many steps</td>
<td></td>
</tr>
<tr>
<td>Reports results</td>
<td>Reports activities</td>
</tr>
<tr>
<td>Shorter ROI cycle</td>
<td>Longer ROI cycle</td>
</tr>
<tr>
<td>It cannot be cancelled</td>
<td>It can be delayed or cancelled</td>
</tr>
<tr>
<td>Increases competence</td>
<td>Increases efficiency</td>
</tr>
<tr>
<td>At no time are we away from a real problem</td>
<td>We lose touch with real problems</td>
</tr>
<tr>
<td>Flexible: we can expand or narrow, based on the real need</td>
<td>Inflexible: we have to view every situation as requiring the same degree of detail</td>
</tr>
<tr>
<td>We need to be organised to execute vertical systems</td>
<td>We need to be organised to execute horizontal systems</td>
</tr>
</tbody>
</table>


- Vertical systems allow us to solve the problems. Horizontal systems accelerate the problem-solving process.
- Vertical systems should be the drivers. Horizontal systems should be driven.

Defoe (2000) defines Six Sigma as a data-driven method for achieving near-perfect quality by using a traditional set of quality tools that have been evolving for years. Motorola gave the Six Sigma name to the above process. The greater the number of sigmas within a specification, the fewer the defects.

Defoe (2000) describes Six Sigma as a five-step standardised process that finds mistakes before they occur, a disciplined regime that examines a company’s processes for product designs, production, suppliers, services and organisations very precisely.

1. *Define* by identifying, prioritising and selecting the right project(s).
2. *Measure* key product characteristics, process parameters and performance.
3. *Analyse* by identifying key causes and process determinants.
4. *Improve* by changing the process and optimising performance.
5. *Control* by holding the gains.
Figure 2.30: Sigma Capability

**Figure 2.31: Designing for Six Sigma Capability** (Tollgates corresponding to project steps provide checks and balances to ensure only quantified and qualified projects are approved for implementation)

<table>
<thead>
<tr>
<th>External CTQs</th>
<th>Internal CTQs</th>
<th>Design</th>
<th>CTQ Validation</th>
<th>Implementation</th>
<th>Sustainability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project opportunity identification</td>
<td>Scope definition</td>
<td>Conceptual Design</td>
<td>Basic Engineering</td>
<td>EPC commission start-up</td>
<td>Operation, project close-out</td>
</tr>
<tr>
<td>Tollgate completion</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>- Define what is going to be done.</td>
<td>- Develop project master plan.</td>
<td>- Verify and test CTQs.</td>
<td>- Develop project responsibility matrix.</td>
<td>- Perform detailed engineering.</td>
<td>- Evaluate actual results and planned results.</td>
</tr>
<tr>
<td>- Identify external customer CTQs</td>
<td>- Verify and freeze internal CTQs.</td>
<td>- Define raw material CTQs and procurement plan.</td>
<td>- Develop project execution plan.</td>
<td>- Procure materials</td>
<td>- Modify quality management plan (if necessary).</td>
</tr>
<tr>
<td>- Define business plan and risk</td>
<td>- Quality and technical risk assessment.</td>
<td>- Establish process tolerances.</td>
<td>- Obtain permits.</td>
<td>- Construct</td>
<td>- Close project.</td>
</tr>
<tr>
<td>- Assign team leader.</td>
<td>- Assign cross-functional team.</td>
<td>- Perform process risk assessments.</td>
<td>- Develop communication plan.</td>
<td>- Control and audit project plan.</td>
<td></td>
</tr>
<tr>
<td>- Define project timeline.</td>
<td>- Define project timeline.</td>
<td>- Determine freedom to use.</td>
<td>- Verify and test CTQs.</td>
<td>- Develop operations integration and handover plan.</td>
<td></td>
</tr>
<tr>
<td>- Define regulatory requirements.</td>
<td>- Define project timeline.</td>
<td>- Freeze process design.</td>
<td>- Freeze final process design.</td>
<td>- Develop product and raw material distribution plan.</td>
<td></td>
</tr>
<tr>
<td>- ID and screen alternatives.</td>
<td>- ID and screen alternatives.</td>
<td>- Obtain pre-engineering authorisation.</td>
<td>- Obtain final authorization to spend funds.</td>
<td>- Commission and startup.</td>
<td></td>
</tr>
<tr>
<td>- Obtain pre-engineering authorisation.</td>
<td>- Obtain pre-engineering authorisation.</td>
<td>- Obtain pre-engineering authorisation.</td>
<td>- Obtain pre-engineering authorisation.</td>
<td>- Obtain pre-engineering authorisation.</td>
<td>- Obtain pre-engineering authorisation.</td>
</tr>
</tbody>
</table>

Figure 2.32: Four Phases and Eight Key Tools for Six Sigma

Measure ➔ Analyse ➔ Improve ➔ Control ➔ $

<table>
<thead>
<tr>
<th>Tool</th>
<th>Tool</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maps and metrics</td>
<td>Design of Experiments (When appropriate)</td>
</tr>
<tr>
<td>Cause –and effect-matrix</td>
<td></td>
</tr>
<tr>
<td>Measurement and validation study</td>
<td></td>
</tr>
<tr>
<td>Capability analysis</td>
<td></td>
</tr>
<tr>
<td>Multivariable analysis</td>
<td></td>
</tr>
<tr>
<td>Failure mode and effects analysis</td>
<td>SPC/Control plans</td>
</tr>
</tbody>
</table>

Source: Control Engineering with input from Sigma Breakthrough Technologies.
Harrold and Bartos (1999) recommend the following to optimise existing processes in order to achieve Six Sigma capability (Figure 2.30):

1. Select the critical to quality (CTQ) characteristics.
2. Define the required performance standards.
3. Validate measurement system, methods and procedures.
4. Establish the current processes capability.
5. Define upper and lower performance limits.
6. Identify sources of variation.
7. Screen potential causes of variation to identify the vital variables needing control.
8. Vary relationships for the vital variables.
9. Establish operating tolerances on each of the vital variables.
10. Validate the measurement system’s ability to produce repeatable data.
11. Determine the capability of the process to control the vital variables.
12. Implement statistical process control on the vital variables.

Figure 2.31 outlines the process for designing for Six Sigma capability and Figure 2.32 depicts the four phases and eight tools of Six Sigma.

Defoe (2000) stresses that it is vital that commitment and involvement starts with the CEO. The CEO must drive the whole process from setting the vision, to providing encouragement, assessing results and rewarding participants.

The CEO must do the following to successfully lead a Six Sigma revolution:

1. Set up and serve on the company’s management council to get Six Sigma started.
2. Establish goals for the process.
3. Lead the deployment process.
4. Allocate needed resources.
5. Assign responsibilities for review and measurement.
6. Lead the recognition ceremonies.
7. Revise the company’s reward system.
Defoe further identified the following senior management responsibilities:

1. Identify the business or businesses with the best opportunities for improved performance.
2. Establish the infrastructure and set up or revise management systems for projects, organisational reporting, accountability, appraisal, reward and recognition.
3. Select projects, leaders, teams and missions critical to meeting the goals.
4. Support projects and monitor progress, and provide necessary training, resources, budget, time, and support to keep project on track.
5. Ask the right questions throughout until completion of each project.

Defoe points out that organisations which were successful with Six Sigma processes resulted from the following actions of executives:

- deployment versus delegation;
- defined quality costs;
- made time available for training;
- stressed rewards and recognition;
- learned about Six Sigma.

He is of the view that human resource professionals are a critical link to understanding Six Sigma and in working with management to find the right people to build and maintain a critical mass of talent.

- Six Sigma begins with the selection of employees whom outside specialists will train as leaders. Many of them will devote full time in carrying out each project.
- Executives will then be briefed to help them gain a common understanding of the Six Sigma approach.
- This is followed by a two-day “champion” workshop.
- First, four days of training teaches participants to learn methods of achieving Six Sigma levels of quality, using a problem-solving and improvement methodology in addressing chronic situations through root-cause analysis. On completion of these sessions employees achieve Green Belt status.
• Second, four interactive sessions of four days each over about sixteen weeks certify a small number of employees as Black Belts. After the first week the company selects projects and the candidate must apply what they learn to their project during three to four weeks before the next session. They must demonstrate results to graduate. Candidates are typically at managerial or technical specialist level and will have responsibility to implement Six Sigma in a business unit. They are responsible for developing, coaching and leading process improvement teams; mentoring and advising management on prioritising, planning and launching projects. They teach and disseminate tools and methods to Green Belt associates and team members.

• The third and the top level of experience is Master Black Belt status. They are experts on the theory and implementation of Six Sigma. They are company-wide quality experts on the methodologies, tools and applications in all functions and levels of the company. They provide leadership in integrating the Six Sigma approach into a company’s business strategy and operational plans.

Defoe categorises Six Sigma projects as follows:
1. Transactional business process projects – large scale improvement of a business process, such as order taking that extends across an organisation.
2. Traditional improvement projects aimed at solving chronic problems crossing multiple functions of an organisation.
3. Work team project within one department.

Six Sigma provides the means of reducing unnatural sources of variation and removes them. If variations do return, a “statistical” warning detects them quickly. The possibilities in quality improvements, cost savings, customer satisfaction and loyalty, and employee development are enormous through Six Sigma, but it requires a commitment of time, talent, dedication, disciplined persistence and an investment in company funding.

There is a view that Six Sigma simply puts traditional quality management practices in a new package (Zu et al. 2008). Zu et al. (2008) investigated both the traditional quality management and Six Sigma literatures and recognised three new practices that are critical for implementing Six Sigma’s concept and method in an organisation.
namely: Six Sigma role structure, Six Sigma structured improvement procedure, and Six Sigma focus on metrics. The three Six Sigma practices are distinct practices from traditional quality management practices, and that they complement the traditional quality management practices in improving performance.

The findings of the study by Zu et al. (2008) suggest a synergy between the Six Sigma practices and traditional QM practices in improving quality performance. This substantiates the view that QM practices work as an integrated, interdependent system to achieve competitive advantage (Flynn et al. 1995; Kaynak, 2003; Yeung et al. 2005).

Zu et al. (2008) confirms that top management support is critical for traditional QM and it is also important for Six Sigma. Top management support directly supports the Six Sigma role structure and the Six Sigma focus on metrics as well as three traditional QM infrastructure practices. They also suggest the potential of using Six Sigma to enhance traditional human resource management practices, particularly in the areas of human resource planning and management, training, and employee recognition. The black and green belt system is used as a means to develop the future leaders in some firms (Schroeder et al. 2005).

This study determined that customer relationship directly affects quality information, and supplier relationship directly affects product/service design and process management. The significant relationships between these practices are consistent with the findings of previous studies such as Forza and Flippini (1998), Kaynak (2003), and Mohrman et al. (1995). Quality information is then found to have direct effects on supplier relationship and Six Sigma focus on metrics. Applying the Six Sigma structured procedure ensures that teams use data and metrics during the process of solving quality problems (Zu et al. 2008). Furthermore, an integration of Six Sigma core and traditional QM core practices confirm the important role of goals (which is defined by various Six Sigma metrics) in continuous improvement as promoted by Linderman et al. (2003, 2006).

Six Sigma has evolved out of traditional QM methods and many traditional QM practices are acknowledged as important for Six Sigma implementation (Bhote,
2003; Breyfogle et al. 2001; Gale, 2003; Henderson and Evans, 2000; Hendricks and Kelbaugh, 1998; Lee and Choi, 2006; Pyzdek, 2003; Schroeder et al. 2008). However, Six Sigma does not abolish the traditional QM practices, nor does it simply repackage them (Zu et al. 2008).

2.7.3 Paradigm Shift in Quality Management

Quality management has undergone significant evolution over the years. The following are some of the contributing factors:

1. Theories have been propounded by stalwarts such as Taylor, Deming, Crosby, Taguchi and Ishikawa etc.

2. Certification bodies and international awards such as ISO 9000, Malcolm Baldrige Award, Deming award/ and various other national and international awards for quality.

3. Empirical evidence established by organisations practising the principles and theories developed by the gurus and obtaining certification from the standard bodies mentioned in no. 2 have provided an impetus for other organisations to adopt these practices. The positive outcomes have been demonstrated in the areas of competitiveness, customer satisfaction, productivity, quality of product/service.

Taylor’s theory of scientific management replaced the concept of craftsmanship. This led to creation of quality departments which conducted 100% inspection on manufactured goods to eliminate non-conforming product.

The Japanese at the end of World War II developed total quality Management by adopting applications of statistical methods and the fundamentals of workforce management. TQM practices were later incorporated in the quality management of some US organisations and consequently it spread to the rest of the world. The emphases in organisations that embraced TQM philosophy were in the following areas: customer focus, partnering, empowerment, education and training, communication, total quality tools (The fish bone diagram, check sheets, statistical process control, flow diagrams, surveys, design of experiments, quality function deployment, just-in-time, benchmarking, continuous improvement).
In 1987 the establishment of the International Standards Organisation as a quality certification organisation started the Quality Assurance movement in manufacturing and service operations. The achieving of ISO 9000 registration required its clients to set up quality systems that ensured consistency in the production of a product or service. It provided a basis for customers that its standards ensured that manufacturers/service providers who obtained ISO 9000 registration conformed to their respective quality systems. This led to a two-tier standard in quality: -those that stopped at ISO 9000 and those that followed TQM; the difference being TQM practitioners focused internally on management commitment, employee training and education and externally on meeting customer requirements, their goal being to improve every aspect of organisational culture. Some TQM organisations set much higher goals and achieved them through Six Sigma. The shift to Six Sigma involves achieving near perfect quality.

ISO 9000 standards have also undergone an evolution, shifting to a customer-oriented system. The updated quality standard is ISO 9000:2008 - it requires users to add value to their activity and provides guidance for a business process, stakeholder and performance driven management system. The new system expects business objectives to be deployed to processes, and integration of process measures into the business management reporting system. Top management involvement in the quality systems and also evidence of leadership needs to be demonstrated by top management. The new standard appears to be closing the gap between the old ISO 9000 standard and TQM. The paradigm shift is a synopsis of the literature discussed in previous sections of this chapter and has led to the following general path (Figure 2.33):
The benefits of TQM have been demonstrated significantly by organisations that have implemented it. The national awards such as Malcolm Baldrige, Deming Prize, European Quality Award and Australian Quality Award have made concrete steps in recognising organisations in their respective countries. The recent upgrade of ISO 9000 to its 2008 version has progressed markedly with respect to aligning with TQM principles. This change in ISO 9000 will contribute to a major paradigm shift of ISO 9000 registered companies from one of conformance to that of continual improvement. The above factors would certainly steer organisations to incorporate principles of continual improvement (P-D-C-A), customer focus, leadership, people involvement and empowerment, process approach to systems, management by fact, and meaningful partnerships in supplier customer relations.

2.8 Similarities and Differences between TQM, Six Sigma and Lean

This section discusses the similarities and differences between TQM, Six Sigma and Lean. Andersson and others (2006), are of the view that -though TQM, Six Sigma and Lean have many parallels, principally relating to origin, methodologies, tools and effects, -they differ in some areas, specifically concerning
the main theory, approach and the main criticism. The Lean concept is slightly different from TQM and Six Sigma. However, there is a lot to achieve if organisations are able to merge these three concepts, as they are harmonising. Six Sigma and Lean are outstanding road-maps, which could be used individually or combined, together with the principles in TQM (Andersson et al. 2006). Table 2.19 highlights the similarities and differences between TQM, Six Sigma and Lean.
Table 2.19:  The similarities and differences between TQM, Six Sigma and Lean

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Total Quality Management</th>
<th>Six Sigma</th>
<th>Lean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Origin and Theory</td>
<td>TQM is often associated with well-known people e.g. Deming and Juran. TQM has aspects of achieving no defects, eliminate waste increase external and internal customer satisfaction with reduced resources (Hellsten and Klefsjo, 2000).</td>
<td>Six Sigma is associated with Motorola. Six Sigma Focuses on no defects (George et al. 2004).</td>
<td>Lean has its origins at Toyota. Lean involves improving process flow and reducing waste (George et al. 2004).</td>
</tr>
<tr>
<td>Process view and approach</td>
<td>Six Sigma programs involve reduction in variation. The results of six sigma projects is increased profit which are visualised by top management. Top management are also involved in managing projects. There is a strong focus on process. (Andersson et al. 2006)</td>
<td>TQM emphasises the commitment and involvement of all employees (Bergman and Klefsjo, 2003). There is a strong focus on process (Andersson et al. 2006).</td>
<td>There is a strong focus on process (Andersson et al. 2006).</td>
</tr>
<tr>
<td>Methodologies and Tools</td>
<td>The seven quality control tools (Shewhart, 1980; Ishikawa, 1985), and the seven management tools (Mizuno, 1988). The improvement cycle plan, do, study and act (PDSA). (Evans and Lindsay, 1996). Methodology cyclical (Andersson et al. 2006).</td>
<td>Successful six sigma implementation involves management involvement, organisation, infrastructure, training and statistical tools (Henderson and Evans, 2000; Eckes, 2001). The hierarchy of responsibilities and roles are: Champions and Sponsors, Master Black Belts, Black Belts, Green Belts, White Belts (Magnusson et al. 2003; Sanders and Hild, 2000). Six Sigma Tool Box: seven design tools, seven statistical tools, seven project tools, seven Lean tools, seven customer tools, seven quality control tools and seven management tools (Magnusson et al. 2003). Six sigma is successful at integrating advanced improvement tools with methodologies and the training involves how to use appropriate tools as well (Andersson et al. 2006). Five phases of Six Sigma: Define, Measure, Analyse, Improve, Control (DMIAC) (Pyzdek, 2003; Magnusson et al. 2003). Methodology cyclical (Andersson et al. 2006).</td>
<td>Fundamentally customer value driven suitable for manufacturing and distribution. The five basic principles of Lean: Understanding customer value, Value stream analysis, Flow, Pull and Perfection (McCurry and McIvor, 2001). Approaches in are values stream analysis, total productive maintenance, Kaizen costing and cost analysis, engineering and change management and document management; Tools used are Kanaban cards and JIT. Methodology not cyclical (Andersson et al. 2006).</td>
</tr>
<tr>
<td>Effects</td>
<td>Benefits of quality estimated by cost of poor quality (Juran, 1989 and Sorqvist, 1998); customer satisfaction an element of TQM has increased market share and profitability (Anderson and Fornell, 1994; Hendricks and Singhal, 1997; Eriksson and Hanson, 2003). Project selection closely linked to business goals. Economical savings require to be demonstrated before starting a project (Andersson et al. 2006).</td>
<td>Positive financial impact (Magnusson et al. 2003). Benefits achieved are reduced work-in-process, increased inventory turns, increased capacity, cycle-time reduction and improved customer satisfaction (NIST, 2003).</td>
<td>Lean is very liable to impact of changes i.e. reduced flexibility limited ability to react to changing situations (Dove, 1999). JIT deliveries may result in obstruction in the supply chain (delays, pollution shortage of workers etc.) (Cusumano, 1994).</td>
</tr>
<tr>
<td>Criticisms</td>
<td>About 20 to 30% success rate of TQM programs reported (Brown et al. 1994; Eskildson, 1994; Harari, 1997, Cao et al. 2000; Nwabueze. TQM failures are attributed to a vague definition of TQM (Eskildson, 1994). Pyzdek (1999) suggests that TQM professionals require to continuously update knowledge of quality and the methodologies in order keep abreast with the changing concept of TQM</td>
<td>Same common features as TQM in principle no new content. Six Sigma is a highly regimented, data based, top-down approach which includes DMIAC. The overt linking of the tactical and the strategic aspects is the additional feature of six sigma methodology. (Klefsjo et al. 2001).</td>
<td></td>
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</tbody>
</table>
Anthony (2004) outlined the pros and cons of Six Sigma:

Pros

- Six Sigma strategy has an unequivocal focus on attaining measurable and quantifiable financial returns to the bottom-line of an organisation.
- Six Sigma strategy places an exceptional significance on strong and zealous leadership and the support required for deployment.
- Six Sigma methodology emphasises human aspects (cultural change, customer focus, belt system, and infrastructure etc.) and process aspects (process management, statistical analysis of data, measurement system analysis etc.) of improvement.
- Six Sigma utilises tools and techniques in a sequential and regimented manner.
- Six Sigma creates an infrastructure of Champions, Master Black Belts, Black Belts and Green Belts who provide leadership and are involved in deployment and implementation.
- Six Sigma accentuates the importance of data based on facts. Measurement is a primary part of the process.
- Six Sigma uses the concept of statistical thinking and promotes the application of well established statistical tools and techniques.

Cons

- The challenge to obtain quality data in processes where no data is available.
- There are situations where solutions driven by data are expensive.
- Prioritisation of projects could be subjective.
- The statistical definition of Six Sigma is 3.4 defects per million. In service processes, a defect is classified as anything that does not meet customer expectation. Hence the appropriateness of the six sigma definition of defect in the service industry is questionable.
- The calculation of defect rates or error rates assumes normality of data.
- The CTQs set at the start of a project may not be meaningful as the project progresses due to the dynamic nature of the market.
- Limited work has been done on the optimisation of multiple CTQs.
- Assumption of 1.5 shift for all service processes may be inappropriate.
• Non–standardisation in the certification of Black Belts and Green Belts is an issue.
• The startup costs for Six Sigma can be significantly high.
• Six Sigma has the risk of deviating into a bureaucratic exercise if the focus shifts to things such as number of trained Black Belts and Green Belts, number of projects completed etc. instead of bottom-line savings.
• The overselling by too many consulting firms who lack expertise.
• The association between cost of poor quality (COPQ) and process sigma quality level needs more justification.
• The linkage between six sigma and organisational culture is not dealt with adequately in the current literature.
• The decision of redesign efforts over continuous improvement depends on a number of variables such as risk, technology, cost, customer demands, time, complexity etc.

Black and Revere (2006) are of the opinion that several reasons contributed to shortfalls in some TQM implementations - one of which was it did not have quantifiable dollar benefits that could be tied to the bottom-line. Hence implementing and/or expanding TQM was hard to justify (Folran, 2003). Evans and Lindsay (2005) noted that the board of directors and/or top management together with not getting visual measurable returns also frequently did not understand TQM and additionally did not view it strategically. Six Sigma methodology filled the gaps created by TQM failures, namely quality improvement projects are carefully defined facilitating successful completion within relatively short time frames. Financials are applied to each completed project, providing management with the savings attained through the completed project (Black and Revere, 2006).

Green (2006) states that TQM is undergoing a revival under a new name Six Sigma. He further elaborates that six sigma offers a highly disciplined approach to quality improvement, guarantees follow-through using a five-step process, and undoubtedly allocates personnel responsibility. Specific customer-focused metrics are identified until a control system is established to sustain improved processes. Green (2006) concludes that correct application of Six Sigma contains all the features of TQM.
Cheng (2007) carried out an empirical study on Six Sigma and TQM in Taiwan. The conclusions of this study were as follows:

- Implementing Six Sigma is a common theme in organisations. Six Sigma is not restricted to large-scale or multinational organisations but is also implemented in small and medium sized organisations as well.
- It is not obligatory for an organisation to implement Six Sigma activities; however, it is adequate that the organisation implements Six Sigma using the TQM infrastructure, since TQM has the inherent contents of a Six Sigma system. The key thing is for organisations to integrate quality activities with business strategy, and this will logically lead to improved business performance.
- Quality performance can be improved by implementing both TQM and Six Sigma. The study also determined that TQM and Six Sigma are positively impacted by business strategy variables.

The improvement methods category of the QMAF model assesses total quality tools, lean and six sigma aspects and future research could address the impact of similarities and differences of TQM, lean and six sigma on business outcomes.

2.9 The Impact of ICT on Quality Management

The growth of information communication technology will impact significantly in augmenting effective and efficient implementations of TQM principles through collection and analysis of data, management of quality systems electronically, effective communication and training through the use of the internet and intranet.

Soliman and Youssef (2001) examined the impact of e-business on the management of next generation manufacturing. They noted that three components of ICT (Internet based e-business; knowledge management systems; and enterprise integration using ERP systems) were the tools for achieving sustainable competitive advantage. Below is a model suggested by them which explains the role of ICT in enhancing next generation manufacturers.
They concluded that the fundamental processes of next generation manufacturers (NGM) will be knowledge based and would ensure that these processes would create value for the organisation and its clients. The knowledge-based systems would provide: shorter opportunity to delivery (OtoD) cycle times, clearer market focus, more reactive to environment and customer changes, and increased customer regard.

The following will be some of the benefits from a material procurement knowledge-base system:

- reduction in scrap levels, reworks and non-conforming material;
- improves communication between various parts of the organisation;
- improves the vendors selection method;
- comparing of various suppliers on a number of selection criteria;
- reduction in lead time.
Figure 2.34 shows the role of ICT in enhancing the capabilities of next generation’s manufacturing.

Chan (2000) has designed a framework to explain the role of ICT in a business process as shown in Figure 2.35. The roles of ICT are defined as:

Initiators
Acts as an initiator of change. This may involve a causal relation and may also lead to the establishment of some needs.

Facilitators
ICT may serve as a means of making work or a work load easier.

Enablers
ICT will provide support to accomplish the necessary operations, procedures that have to be followed or implemented and may also augment new product innovation.

The framework has three related aspects:

- The logical view
  It provides a rationale for understanding the interrelationships of the roles of ICT by answering the Why/What/How questions of a business process in an organisation.

- The physical view
  The physical consequence and implementation can be seen in the organisational functions, operations, and procedures.

- The conceptual view
  The conceptual aspect of the effects of ICT can be observed in the establishment of a need, a product innovation and/or a process innovation.

Figure 2.35: Role of information communication technology in process reengineering

Source: Chan (2000).
Howe et al. (2000) suggests that new product development can be greatly enhanced through the integration of information communication technology with innovative management practices. The internet and related ICT systems along with the stage-gate approach can speed up the generation of winning ideas through the product development process and also minimise risks associated with this process by filtering out poor ideas.

The use of the Internet/intranet at the respective stages of the product development process minimise the time to launch and also facilitates the integration of viewpoints/recommendations from the various sources (customers, marketing, engineering etc.) during development.

Knowledge management is not just a process of capturing, storing and transferring information. Bhatt (2001) views knowledge management as a process of knowledge creation, knowledge validation, knowledge presentation, knowledge distribution and application. He further states that the above can be brought about effectively only through a balanced interaction between people, technologies and the techniques used by people in working with these technologies. Organisations can sustain a competitive advantage by creating a “learning-by-doing” environment.

Organisations will not only have to embrace e-learning but will also have to consider factors for its effective deployment. Young (2001) outlines strategies for effective deployment of e-learning. The internet, intranets and extranet have provided individual workers access to:

- interactive self-paced multimedia instruction;
- assessment of knowledge and skills;
- performance support materials such as references, job aids, etc.;
- online communication with instructors, experts and colleagues.

Young (2001) provides the following checklist for management in order to make an informed decision regarding their training programmes:
• Are the training deployment options capable of reaching the broadest possible audience (intranet, internet, extranet, etc.)?
• Can these courses be easily accessed by employees at their convenience and with the least amount of effort?
• Can the training be accessed using the current desktop computing resources available in the organisation?
• Can the training be made available through the organisation’s current state of existing network resources?
• Can this training be deployed over the organisation’s network with a minimum effect on overall network performance?
• Are options available for learners who do not have Web access capabilities on their workstations (i.e. CD-ROM, etc.)?
• Who are the learners and what is the state of their access to the organisation’s network technology (i.e. are they local, remote or monadic learners)?

In developing a training deployment strategy Young further recommends that organisations must examine:
• who the learners would be;
• what kinds of desktop technology would the learners most likely use;
• what kind of network technology would the learners be using;
• what technology would be acceptable to customer’s information communication technology.

E-learning is cost-effective, flexible, and convenient to users, has a wide reach, it is easily accessible, consistent and repeatable. However, it works best by training courses designed with a blend of traditional methods and technology-led learning.

Dawes and Rowley (1998) found that the customer satisfaction was greatly enhanced through ICT applications in service delivery:
• Information systems manage the random demand for service efficiently.
• ICT systems can simultaneously carry out a monitoring function and collect customer information which can be used to support its improvement.
• Location constraints are minimised in relation to delivery of service.
• Information regarding the product or service is better known to the service agent and the customer through the use of ICT.
• ICT reduces the dependence on human skills, thus increasing the consistency of the product or service.
• ICT introduces structured and standardised transaction processes.
• Waiting time for service is reduced through ICT systems.
• In cases where a service agent is used he or she may have to deal with less routine transactions and would therefore have to be more highly skilled. However, the service agent would be empowered to take decisions based on available customer information through databases.

Table 2.20 summarises the influence of ICT on quality management.

Table 2.20: Influence of ICT on quality management processes

<table>
<thead>
<tr>
<th>Quality Management processes</th>
<th>Capability</th>
<th>Impact and Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human resource utilisation</td>
<td>Automational</td>
<td>ICT can replace or reduce human labour in a process</td>
</tr>
<tr>
<td>Information and analysis</td>
<td>Analytical</td>
<td>ICT can improve analysis of information and decision making</td>
</tr>
<tr>
<td>Process flow management</td>
<td>Disintermediation</td>
<td>ICT can be used to connect two parties within a process and eliminate intermediaries from a process</td>
</tr>
<tr>
<td>Customer Relationship</td>
<td>Geographical</td>
<td>ICT can transfer and coordinate information with rapidity and ease across distances, making processes independent of geography</td>
</tr>
<tr>
<td>Supplier Relationship</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Information and analysis</td>
<td>Informational</td>
<td>ICT can capture vast amounts of detailed process information for the purpose of understanding</td>
</tr>
<tr>
<td>Product design process</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Process flow management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quality data and reporting</td>
<td>Integrative</td>
<td>ICT can coordinate tasks and processes</td>
</tr>
<tr>
<td>Education and Training</td>
<td>Knowledge management</td>
<td>ICT allows the capture and dissemination of knowledge and expertise to improve the process.</td>
</tr>
<tr>
<td>Process flow management</td>
<td>Sequential</td>
<td>ICT can enable changes in the sequence of tasks in a process, often allowing parallelism.</td>
</tr>
<tr>
<td>Quality data and reporting</td>
<td>Tracking</td>
<td>ICT allows the detailed monitoring of process status, inputs and outputs.</td>
</tr>
<tr>
<td>Process flow management</td>
<td>Transactional</td>
<td>ICT can transform unstructured processes into routinised transaction</td>
</tr>
</tbody>
</table>

Adapted from Chan (2000)

**ICT Interventions for Quality Enhancement**

There is tremendous potential to achieve breakthrough benefits through ICT interventions. Zadrozny and Ferrazi (1992) are of the view that information communication technology (ICT) and information systems can play a key role in the TQM initiative through their ability to influence the various elements that are of relevance in managing quality. More recently, Jabnoun and Sahraoui (2004)
advocate that organisations considering a TQM program should integrate it within the agenda of its strategic plans where business strategies are simultaneously developed with ICT plans. To be truly effective, a TQM organisation has to be a process-based cross-functional organisation with a Lean structure and one way to achieve this is through ICT-enabled TQM (Jabnoun and Sahraoui, 2004). This section elaborates on how ICT interventions can be deployed with advantage in strengthening the twelve elements of the QMAF.

**Leadership**

The use of FXTV, a live television network, by Fred Smith of Federal Express to communicate on a routine basis with his staff provides a very early example of how a leader can use ICT not only to communicate but also to continually demonstrate top management commitment to quality. It is stated that when FedEx won the Malcolm Baldrige Award, the report noted the effective use of TV and interactive video by the organisation in communicating with and training staff (Bounds et al. 1994). However, leadership in today’s e-business setting is not only about using specific technologies. Harris et al. (2001) point out that today, when it comes to knowing technology, leaders need to have skills to experiment, develop, and integrate along with a sophisticated understanding of important technologies, technology trends, and implications of technical decisions. Diamante and London (2002) also observe that organisations need leaders who are passionate about continuously learning about technology to manage technological infusion, and point out that the use of ICT to strengthen the various elements of TQM requires expansive leadership.

**Quality Culture**

Pfeffer and Leblebici (1977) perceive ICT as a key determinant of organisational structure. A TQM organisation is flexible (Vokurka et al. 2002) and is supported by telecommunication and network technology as they have offset the dichotomy between centralised and decentralised business (Jabnoun and Sahraoui, 2004). Human intervention is minimised rendering real time services to customers through the application of e-commerce and restructuring of the organisation into a set of inter-connected processes. Madu and Madu (2003) remark that the use of enterprise resource planning (ERP) systems promotes “doing things right the first time” by making every part of the organisation responsible to the customer through timely and
accurate responses. Dewhurst et al. (1999) state that the introduction of new ICT systems may involve organisational restructuring and, while warning of possible attitudinal changes in the workforce post-introduction of ICT, emphasise that ICT can be a good tool to promote information sharing among different departments and functions. Virtual groups are enabled by network technology, while mobile computing supports teams from different functional areas and geographies (Jabnoun and Sahraoui, 2004).

**Continuous Improvement**

Innovation can be greatly enhanced through ICT (Schein, 1994). Studies (Davenport, 1993a; Venkatraman, 1993; Hammer 1990; Davenport and Nohria, 1994; Linden, 1993 and Hammer and Champy, 1993) suggest that Business Process Reengineering (BPR) implementation in conjunction with ICT can provide businesses with elimination of non-value added activities, cost reduction, time elimination, error minimisation, and others. Communication and quality of services are enhanced when one or more self-contained processes are managed by a single person or a group of people through the use of ICT-based BPR (Davenport and Nohria, 1994; Davenport, 1993a; Hammer, 1990). In product development a well-designed database, linked to CASE tools that enable the exchange of design specifications, can be used to speed up design time by accomplishing tasks in parallel rather than in sequence. The use of ICT interventions such as computer-based laboratory modeling and analysis, CAD and physical modeling, design-for-manufacturability expert systems, component performance history databases, and concurrent engineering conference systems can facilitate continuous improvement while simultaneously strengthening new product development and engineering design processes.

**Strategy**

The use of ICT in strategic planning has not been explicitly explored. Howe et al. (2000) point out that ICT interventions such as Web-based forums, newsgroups, and bulletin board systems can be used to solicit ideas from internal and external sources such as customers, scientists, employees, and competitors while the Internet can be used for market research. They also add that intranets and Groupware can be used for collaborative decision-making. Stough et al. (2000) state that in today’s global setting computer supported cooperative work (CSCW) is a strategic necessity and that
Groupware such as e-mail, collaborative writing/programming, workgroup database management systems, workflow automation systems, workgroup scheduling, workgroup shared textbase systems, specialised group support systems (GSSs), and group decision support systems (GDSSs) can be used very productively in intellectual collaborative work. Killen et al. (2005) provide an interesting instance of how QFD can be used with ICT interventions to carry out strategic planning. Motwani et al. (2000) suggest that it is paramount that top management and the ICT department agree on the areas where ICT should provide leadership and vision, and also explore means for successfully deploying ICT to strengthen the strategy element. Gardener and Ash (2003) affirm that a clear comprehension of change dynamics at the people/technology interface and the synergetic relationship between information systems and strategy is imperative for successfully achieving excellent business results in ICT and e-business projects.

**Benchmarking**

The importance of ICT in benchmarking exercises is well recognised. Dewhurst et al. (1999) and Sharif (2002) point out that ICT applications can strengthen the benchmarking process through: better and easier communication with partners; identification of best-in-class companies; facilitating simulation of performance measures and gap analysis; and providing a vehicle for internal communication of data gathered from benchmarking and formulation of resulting action plans is made faster.

**Customer Focus**

Stone et al. (1996) are of the view that customers will increasingly seek to manage the relationship using new technologies and that companies need to be prepared for this change. Mulligan and Gordon (2002) suggest several ways by which ICT can strengthen customer focus. Gilmore and Pine (1997) point out that customisation can be better achieved through ICT. Mass-customisation is facilitated by capabilities to track copious amounts of customer information supported by the Web and adjust production processes using TQM enabled by ICT in order to meet changing needs in the market (Jabnoun and Sahraoui, 2004).
Customer service can extend beyond customising and online ordering to other areas such as answering customer queries, providing technical information, and letting customers track accounts or order status. Turban et al. (2000) give examples of intelligent agents (ranging from software agents to learning agents) that can be used to enhance customer search, information provision, and personalise content. Kotorov (2002) establishes that the development of ICT has permitted a significant increase in the scale and scope of customer service and adds that scope can be increased through the realisation of transactional complementarities.

Dewhurst et al. (1999) are of the view that customer relationships can be greatly enhanced through ICT applications such as bar-coding, product recognition systems and electronic point of sales (EPOS) as these systems contribute to an increase in the accuracy and speed of sales leading to improved customer service. The capability for managing customer relationships, often known as customer relationship management (CRM), requires the ability to effectively integrate sales, marketing, and service strategy with the aim of using existing relationships to enhancing the profitability of existing customers, retaining profitable customers, and acquiring new customers. Madu and Madu (2003) stress that CRM goes beyond clustering and segmenting customers to looking at specific needs of individual customers. In this context Poulymenakou and Tsironis (2003) show how electronic commerce (EC) can enhance service quality and strengthen credibility by reducing the gap with respect to customer interpretation, translation, communication, and perception. They illustrate this by elaborating upon the enabling capabilities of EC in creating customised products, personalisation of the interface, storage of customer data such as demographics and person-specific attributes and preferences, electronic service delivery that affords wider product selection with lowered transaction costs, permitting customer behaviour tracking, sending personalised messages to customers based on their preferences, and collecting and distributing customer data across other business processes. Implementing effective CRM requires integration of telephony, Web, and database technologies. The technologies required for this integration are legacy systems (middleware and messaging tools), computer telephony integration, data warehousing, and decision support tools such as data mining tools (intelligent agents, neural networks, association analysis etc.). (Kalakota and Robinson, 1999;
Turban et al. 2000). It would be difficult for firms to upgrade their capability for managing customer relationships without resorting to these technologies.

**Supplier Focus**

Strategic long-term supplier partnerships are maintained through inter-organisational information systems (IOS), extranets and other e-commerce technologies that empower business partners and other stakeholders (Jabnoun and Sahraoui, 2004). From an ICT perspective, electronic data interchange (EDI) can be used to develop improved communication links with suppliers by electronically placing orders, sending product specifications, design details, confirmation of invoices and supplier payment (Jonscher, 1994). Organisations can also have access to a supplier’s inventory systems and production scheduling systems, thus facilitating automatic order placing (Teague et al. 1997). Stump and Sriram (1997) argue that use of ICT in a supplier development/partnership type approach, and helps to reduce the number of suppliers used by an organisation, and Madu and Madu (2003) suggest that online catalogue information facilitates easier evaluation of different suppliers, products and services.

**Employee Development**

Local presentations using multimedia and software with multimedia compression capability can be used in a variety of instances such as employee orientation, product familiarisation, and delivering operating and maintenance instructions (Ramanathan, 2001). These instructions can be easily updated and is a powerful means of providing training in well-defined areas. Young (2001) points out that the Internet, intranets and extranets have provided individual workers access to: interactive self-paced multimedia instruction; assessment of knowledge and skills; performance support materials such as references, job aids etc.; and online communication with instructors, experts and colleagues. Streaming media technology can be used to create impressive Internet media presentations featuring a synchronised combination of video, images, sound and text. The use of teleconferencing is now becoming popular and remote-based training through the Web (one-to-many or one-to-one) is possible. Virtual classrooms are another ICT intervention being used increasingly to provide training to employees and customers. Leung et al. (1995a) report that multimedia/hypermedia are particularly useful for TQM in the areas of
documentation, training, information and knowledge management, support of a teamwork environment and integration and also discuss a hypermedia-based ISO-9000 training system.

**Employee Empowerment**

Wilson (1994) regards ICT as an enabling mechanism that can be used to enrich jobs and enhance job satisfaction. Stewart and Kleiner (1996) state that ICT can be used as a tool to enable empowered teams to accomplish their goals effectively. ICT has made it possible for frontline workers to have access to information that was formerly available only to management. This, along with easy-to-use analysis, modeling tools and training, provides frontline people with premium decision-making capabilities leading to quick problem-solving (Hammer and Champy, 1993). Jabnoun and Sahraoui (2004) comment on the enabling role of ICT in empowering team members through Groupware, workflow management, group decision support systems and computer-supported collaborative work (CSCW). This aspect has also been discussed earlier under strategic planning.

**Total Quality Tools**

Meziane et al. (2000) refer to ICT-based quality tools as intelligent quality management. These include knowledge-based systems (KBSs), neural networks (NNs), fuzzy logic, and case-based research (CBR). ICT has also facilitated a more complete use of techniques such as DOE, FMEA, and QFD (Webber, 1990; Zhang et al. 1996; Mezgar et al. 1997; Rangaswamy and Lilien, 1997). Hodges and Sanett (1992) describe the use of multimedia in the implementation of QFD. The automation of measuring product and processing parameters, collection and processing of data have facilitated the application of SPC (Papadakis, 1990; Kendrick, 1995). Dewhurst et al. (2003) observe that ICT applications reduced the need for inspectors by increasing the number of automated inspection points, resulting in the reduction of inspection cost per unit. Electronic detection and signalling devices have not only reduced process variation but have also helped to eliminate inspection-type activities (Litsikas, 1997; Freund et al. 1997). A variety of software to manage the process of implementation, maintenance and self-assessment of quality systems such as ISO 9000 series and QS-9000 are also available (Ward, 1998).
**Business Processes**

Barnes et al. (2002) consider an organisation to possess e-operations if it uses ICT in the management of its order fulfilment and delivery processes. Jabnoun and Sahraoui (2004) and Madu and Madu (2003) cite ICT as an important factor in promoting process-based TQM by analysing existing processes and restructuring them into value-adding processes by the use of workflow software and enterprise resource planning (ERP) approaches. Carbone (1997) states that e-procurement could lead to benefits such as reduction in transaction costs, quicker and more accurate transaction processing, elimination of maverick buying, reduced inventory, improved order tracking, improved information management, increased contract compliance, lower prices, and increased employee satisfaction.

ICT has made significant contributions to process flow management such as automated systems in maintenance management in the areas of scheduling and diagnostics (Dilger, 1997; Krouzek, 1987). Howe et al. (2000) suggest that new product development can be greatly enhanced through the integration of innovative management practices with the Internet and related ICT systems. Chang and Jiang (2002) have elaborated on the use of on-line sensor measurements using neural networks to improve quality in a continuous mass production system. Attaran (2003) provides evidence to show that organisations that have used ICT to reengineer processes have benefited enormously in terms of business results. Attaran’s (2003) illustration of ICT use in process planning and implementation suggests that ICT can indeed be used with advantage in all four stages of the Deming cycle (Plan-Do-Check-Act).

**Information, Knowledge, and Communication**

The growth of ICT will have a major influence on data and information gathering, processing, and dissemination especially with regard to concurrent engineering-based product design (Dewhurst et al. 1999) and accessing different databases for decision-making (Lawler, 1991; Jackson, 1995). Internet-based newsgroups and listservers have also become useful tools for the effective exchange of information (Finch and Luebbe, 1997). Howe et al. (2000) have proposed the extensive use of ICT interventions, based on the Internet and intranet, to improve communication and
transfer information and expert knowledge when using the stage-gate model for new product development. This view is supported by Jabnoun and Sahraoui (2004) who state that Web-based applications in new product development have enhanced communication and dissemination of information.

Bramorski et al. (2000) have proposed a quality-driven open system to facilitate timely information flow in the manufacture of ready-to-assemble (RTA) products so that customer service orientation is enhanced. They further add that the information flow must be supported by integrated business management systems, consolidated databases, hardware with audio and video capabilities, Wide Area Networks and electronic systems supporting internal and external communications.

Rowley (2002) describes knowledge management tools as facilitating information storage and sharing and structuring of data. Common tools include ICT interventions such as the Internet, intranets, Groupware, data warehousing and data mining. The knowledge management cycle consists of knowledge capture, knowledge development, knowledge sharing, and knowledge utilisation. Lee and Hong (2002) propose the use of ICT-based techniques at each of these stages as follows:

- Knowledge capture – database systems, data warehouses, digital library.
- Knowledge development – data mining, online analytical processing, competitive intelligence.
- Knowledge sharing – GSS, Internet.
- Knowledge utilisation – graphical user interface with automation, multimedia technology.

**Business Results**

From a business results perspective, ICT can be used to provide timely feedback based on quality performance measurements, and improve the availability of quality-related data for corrective action and planning (Dewhurst et al. 1999). Dawes and Rowley (1998) have found that customer satisfaction was greatly enhanced through ICT applications mainly because of the convenience it affords to the customer. Madu and Madu (2003) have indicated that the use of ERP helps organisations to improve performance. Baldwin and Sabourin (2002), based on a ten-year study of Canadian
manufacturing companies, found that plants that had adopted ICT-based advanced technology had higher productivity growth than those that did not. However, they concluded that real growth came from the joint adoption of software, hardware and network communications.

2.10 Summary

TQM Historical Development
TQM has evolved gradually from application of statistical methods to areas of business management systems with a particular emphasis on customer focus, partnering, empowerment, education and training, communication, total quality tools, benchmarking, continuous improvement, organisational factors and TQM implementation, certification and quality awards.

Major Elements of TQM
Table 2.21 provides a synthesis of the major elements of TQM.

Table 2.21: Synthesis of the major elements of TQM

<table>
<thead>
<tr>
<th>Elements</th>
<th>Salient Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leadership</td>
<td>☑ Top management commitment is one of the major determinants of successful TQM implementation. Top management has to be first in applying and stimulating the TQM approach, and they have to accept the maximum responsibility for the product and service offering. Top management also has to provide the necessary leadership to motivate all employees.</td>
</tr>
<tr>
<td>Quality Culture</td>
<td>☑ An organisation’s philosophy or culture is the basic repository of corporate vision and value.</td>
</tr>
<tr>
<td></td>
<td>☑ An organisation’s policies, procedures and processes must be based on its philosophy.</td>
</tr>
<tr>
<td></td>
<td>☑ Adhocracy is the culture most closely linked to TQM success</td>
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<td></td>
<td>☑ TQM may be characterised to a degree by the adhocracy culture type and secondarily by the group culture type.</td>
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<tr>
<td></td>
<td>☑ Quality department needs access to top management and autonomy and also has to combine the work of other departments.</td>
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<tr>
<td></td>
<td>☑ Successful performance is found in a meaningfully structured measurement system focused on results rather than on data collection.</td>
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<tr>
<td></td>
<td>☑ Quality information has to be readily available and the information should be part of the visible management system. Records about quality indicators have to be kept, including scrap, rework and cost of quality.</td>
</tr>
<tr>
<td>Customer Focus</td>
<td>☑ Customer satisfaction must be given the highest priority and can be achieved by producing high quality products that meet or exceed expectations.</td>
</tr>
<tr>
<td></td>
<td>☑ It is important to identify and address internal areas of concern and establish a preventive mechanism to eliminate the occurrence of external areas of concern.</td>
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<tr>
<td></td>
<td>☑ Constant contact with customers is essential in a total quality setting</td>
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<tr>
<td></td>
<td>☑ Quality function deployment (QFD) makes customer feedback a normal part of the product development process.</td>
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<tr>
<td>Partnering</td>
<td>Partnering involves working together for mutual benefit</td>
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<tr>
<td></td>
<td>Internal Partnerships:</td>
</tr>
<tr>
<td></td>
<td>☑ All departments have to participate in the design process and work together to achieve a design that satisfies the requirements of the customer, according to the technical, technological and cost constraints of the company.</td>
</tr>
<tr>
<td>Elements</td>
<td>Salient Features</td>
</tr>
<tr>
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</tr>
</tbody>
</table>
| **Partnering cont’d** | Supplier partnerships:  
| | - Supplier personnel should interact with employees who are users of the product.  
| | - Eliminate the price only criteria in buyer-supplier relationship. Quality is a more important factor than price in selecting suppliers.  
| | - The supplier must guarantee the quality of products.  
| | - The supplier must practise JIT.  
| | - Both parties should be capable of sharing information electronically.  
| | - Long-term relationship with suppliers has to be established.  
| | - Organisations must collaborate with suppliers to help improve the quality of products/services.  
| Customer partnerships: | Involve customers in product development  
| | The supplier's existing knowledge of the buying firm's internal processes and objectives enables the supplier to plan for future product development.  
| | Organisations which used supplier integration as a strategy for new product development achieved significant improvements in project results compared to similar new product developments where suppliers were not involved.  
| | Successful partnerships depend on the right balance among a supplier’s technological capabilities, a customer’s willingness to share information, and both companies’ strategic requirements.  
| | Issues to be considered in new product success involving suppliers:  
| | - thorough analysis of whether to involve suppliers in new product development;  
| | - close co-ordination and control of the integration of the involved suppliers;  
| | - close co-operation in achieving new product cost objectives;  
| | - an organisational strategic orientation that is committed to time competitiveness;  
| | - early purchasing involvement in new product development;  
| | - shared education, sharing of personnel and facilities, and formal risk/reward sharing agreements between customers and suppliers.  
| | Use of business unit cross-functional teams to select and integrate suppliers into the new product development process.  
| **Empowerment** | Total employee involvement and empowerment (TEIE) is a good means to increase creative thinking and initiative in employees.  
| | Workforce management has to be guided by the principles of training, empowerment of workers and teamwork. Adequate plans of personnel recruitment and training have to be implemented and workers need the necessary skills to participate in the improvement process.  
| | Team leaders must exhibit a consultative/team-oriented communication style with a follow-up evaluation process.  
| | Team leaders must build trust among employees.  
| | Step 1: Understand the conditions required to create trust.  
| | Step 2: Build on the conditions by revisiting past and current wounds to mutually understand and learn.  
| | Step 3: Be mutually involved in defining the employee’s desired future.  
| | Step 4: Conduct involved ongoing open discussion and problem solving as true partners in the business while respecting each other’s role.  
| | Knowledge development must extend beyond areas such as routine continuous improvement and efficiency-based processes and include aspects of innovation that define the paradigms of production.  
| | Empowered training involves goal setting, performance appraisal, coaching, counselling, project management and budgeting. |
### Table 2.21: Synthesis of the major elements of TQM (Cont’d)

<table>
<thead>
<tr>
<th>Elements</th>
<th>Salient Features</th>
</tr>
</thead>
</table>
| **Education and Training**      | Companies have to stimulate positive work attitudes, including loyalty to the organisation, pride in work, a focus on common organisational goals and the ability to work cross-functionally.  
   - The four steps for knowledge management:  
     - capturing or creating knowledge (plan);  
     - sharing Knowledge (do);  
     - measuring the effects (check);  
     - learning and improving (act).  
| **Communication**               | Effective facilitators have the following attributes:  
   - command respect among others;  
   - good communicators -ability to communicate and listen at all levels in the organisation;  
   - enthusiastic towards continuous improvement;  
   - proactive in making things happen;  
   - willing to challenge;  
   - eager to learn;  
   - energetic;  
   - potential for development beyond their current role.  
   - Effective facilitators need three types of skills: technical; behavioural and interpersonal; and consultancy skills.  
| **Total Quality Tools**         | ✓ Housekeeping along the 5S concept.  
   - Statistical and nonstatistical improvement instruments should be applied as appropriate.  
   - Processes need to be mistake proof.  
   - Self-inspection undertaken using clear work instructions.  
   - The process has to be maintained under statistical control.  
| **Benchmarking and Continuous Improvement** | ✓ A benchmarking policy for key processes should be in place.  
   - Quality information system has three levels: control of the process; evaluation of the process; and organisational assessment.  
   - The quality information framework is based on the following principles:  
     - a focus on the improvement potential of the organisation;  
     - adaptation of the framework to its customers.  
   - Improvement of business processes, radically or stepwise, is essential and should be supported by a holistic process performance measuring system (PPMS) which:  
     - gathers, through a set of indicators, performance-relevant data of one or several business processes;  
     - compare the current values against historical and target values;  
     - disseminates the results (current value, target value, gap and trend for each selected indicator) to the process actors.  
   - PPMS should be designed as a modular, separate information system which is loosely linked to other information systems throughout the organisation.  

**Organisational Factors in TQM Implementation**

Organisations must ensure that their vision, strategies and policies are properly aligned. Top management’s commitment to total quality is essential. Organisations should be made up of interdependent subsystems which operate smoothly as a whole. The right analysis of information is fundamental as incorrect analysis will lead to wrong conclusions and poor decision making.

Quality, plant, equipment and product cost are strongly related and together form the basis for competition. Integration of quality issues into the business and manufacturing strategy could add considerably to the organisation’s long-term
competitiveness. Employees have a natural tendency to care about the quality of their work. Attitudes toward cross-functional quality projects covary with positive outcome. Quality on all fronts (QF) groups must come from several departments and from different hierarchical levels. Cost of poor quality is greater than costs of processes that produce high quality products and services.

The businesses which had started with ISO 9000 and focused on external measures as well as internal measures gained the most from TQM. TQM introduction was found to develop a quality culture, improve training and labour productivity. It also encouraged businesses to be customer oriented and provided businesses with the tools to satisfy customer demands.

Leadership strategies for TQM implementation:

- The coach-leadership strategy: driven by the champion with ‘resilient coaching’ through indigenous pioneering efforts and in cooperation with organisation members.

- The leadership-expertise strategy: driven by the founder-manager with ‘gentle persuasion’, supported by cooperation with the external expert as a supplier of quality theory.

Managerial leadership skills:

- Management must enforce unified values and beliefs.
- Value management is vital to keep up the spirit of continuous improvement in the organisation.
- Promotion of the entrepreneurial spirit is needed.
- Leadership are needed skills to manage change process involving ideological renewal.
Certification and Quality Awards

A study of small and medium size businesses in the UK regarding ISO 9000 revealed the following:

- Developing and installing a system is a major exercise.
- The CEO is key to the effectiveness of ISO 9000.
- Customer pressure was the reason for implementing ISO 9000, and it was perceived that retention of existing customers would be the main benefit.
- Cost of registration could be recovered within three years through reduction in quality costs.

ISO 9000 was found to deliver well documented systems, and promoted accountability of processes; however, it was also considered to be over bureaucratic. ISO 9000 leads to consistency in the production of a product or service. The ISO 9000 series version 1994 assures buyers that specific practices are in conformance with the providers’ stated quality systems but it does not address what must be improved in order to gain a company’s competitive position.

The 2000 version of the ISO standard has undergone a major change compared to the 1994 standard. The ISO 9001:2000 series has eight management areas: customer focus, leadership, involvement of people, process approach, systems approach to management, continual improvement, factual approach to decision making, and mutually beneficial supplier relationships. Auditors and organisations have to recognise the cultural gap between the new standard and the 1994 version. They will have to address the deficiencies in their skills and systems in order to be compliant with the requirements of the ISO 9001:2000 standard. Since 2008 the ISO quality standard has been upgraded to ISO 9001:2008 in order to align it with ISO 14001 though there are no changes to the clauses and requirements of the standard.

The Deming Prize was instrumental in spreading quality methods throughout the Japanese industry. The European Quality Award aimed at supporting, encouraging and recognising the development of effective TQM by European organisations. The Australian Quality Award (AQA) was set up to encourage local companies to
improve their quality and performance to world class level and provide a benchmark for their achievements.

Benefits of the awards:

- A universal TQM framework was provided for evaluating organisations.
- A method to identify total quality processes and establish cause and effect relationships was provided.
- The awards attracted the attention of top management of organisations.
- Winners of awards were viewed as having competitive edge.
- Awards have raised quality consciousness, promoted experience sharing and benchmarking.
- Winners of awards have stronger corporate structure, improved quality in products and services, achieved breakthroughs in different areas of business and made larger profits.
- Winners have encouraged subsidiaries and affiliated organisations to apply.
- Organisations that have obtained high scores in evaluation criteria of the awards are robust and are able to withstand negative external factors.

Limitations of the awards:

- The award models are not subject to a continuous improvement review process.
- Time and financial investment for preparation are viewed to be large.
- The awards are not strongly focused on business results, though the EQA includes financial results in its criteria.

Information communication technology in TQM

Information communication technology is considered as an enabler in TQM. ICT increases the accuracy and speed of sales and permits business transactions in geographically remote locations. ICT facilitates better customisation. ICT provides the means to conduct customer surveys and collect and analyse data electronically, resulting in speedier effective decision-making in relation to products and processes. ICT is a good tool for information sharing, and innovation has received a big boost through use of ICT.
EDI systems have enhanced organisational efficiency by reducing the level of shipment discrepancies. ICT applications have resulted in the decrease of middle management. Some authors are of the view that introduction of ICT has led to reduction in job satisfaction and has diminished skill requirements; others feel that ICT applications bring about an increase in performance, employee initiative and flexibility.

ICT has been responsible for the automation systems in maintenance management. Automation of other processes through the use of ICT have reduced variation, thus giving better quality and speedier output. Quality-related data can be collected, analysed and reported faster and more accurately through ICT. The information can be shared among different departments as well. Benchmarking has become much easier through improved communication among partners, identification of best in class companies, simulation of performance measures and gap analysis and formation of action plans.

Future Trends in TQM
Businesses which gained most from TQM had started with ISO 9000 and had focused on external and internal measures. These organisations also had full management commitment, high levels of employee participation and training.

Vertical systems allow us to solve problems while horizontal systems accelerate the problem-solving process. Vertical systems should be drivers and horizontal systems should be driven.

Six Sigma is a data driven method for achieving near perfect quality. The greater the number of sigmas within a specification, the fewer the number of defects.

Quality management has undergone significant transformation from Craftsmanship to scientific management followed by quality assurance and TQM. The quality assurance aspect has been steered by the ISO series from one of conformance (ISO 9000 series version 1987/1994) to business systems that have a customer focus and continual improvement component (ISO 9001:2008). TQM on the other hand started with statistical methods and progressed through using tools to improve business
systems in the areas of customer focus, partnering, empowerment, education and training, communication, benchmarking, continuous improvement, organisational factors and TQM implementation, certification and quality awards. The statistical component has advanced from three sigma model to the six sigma model which advocates near perfect quality through further reducing defects.

The growth of information communication technology will impact significantly on augmenting effective and efficient implementations of TQM principles through collection and analysis of data, management of quality systems electronically, and effective communication, training and knowledge management through the use of the internet and intranet.

All in all, total quality management will gain wider acceptance via the new ISO 9001:2008 standard and the applications of information communication technology in TQM.

Similarities and differences between TQM, Six Sigma and Lean
The pertinent similarities and differences between TQM, Six Sigma and Lean were elucidated based on the current literature.

Impact of ICT on Quality Management
A scanning of the literature to examine the impact of ICT on quality management has revealed extensive developments in the ICT field which can enhance quality systems. The applications of ICT interventions for quality enhancement were strongly evident in all elements of TQM.

Use of Literature Review to Develop the Quality Management Assessment Framework (QMAF)
The plethora of quality management information compiled through the extensive literature review will be used in deriving questions that will be incorporated in the survey questionnaire. Thus it provides a rich source of management information for developing the checklist to evaluate quality management systems.
The survey questions which constitute an inventory of state-of-the-art quality management knowledge will be categorised among the TQM elements in the QMAF model. A scoring mechanism will be used to evaluate the companies surveyed in order to obtain the empirical data to validate the QMAF model. Chapter 3 discusses the QMAF model.
Chapter 3
The Quality Management Assessment Framework (QMAF)

3.1 Introduction

Empirical evidence exists to show that there is a strong link between the capacity of organisations to produce world-class quality and their ability to compete and grow. Garvin (1991) found a strong positive link between Total Quality Management (TQM) practices and organisational performance measured in terms of productivity, profitability, customer satisfaction and employee relations. Wisner and Eakins (1994) in their study of the performance assessment of the US Baldrige quality award winners found that these organisations performed financially as well or even better than their competitors. Zairi et al. (1994) through their examination of studies in Europe, the US and Japan have shown that there is a strong link between TQM practice and bottom-line results. Mohrman et al. (1995), based on their study of TQM practices in large U.S. firms, determined that TQM practices had a positive influence on performance improvement and financial outcomes. They also found that the core practices of TQM showed a strong relationship to market share, work performance outcomes and employee outcomes in manufacturing organisations. In yet another study, McAdam and Bannister (2001) expressed the view that organisations with good quality management practices in place enhance their profits through customer satisfaction. They also show, through a case study that, as the application of TQM process matures with time, all the business indicators show steady improvement.

Juran (1995) states that, to be competitive in the global marketplace, most companies must go beyond the basic quality management system that is prescribed by ISO 9000. Though Dick (2000) establishes that better quality has a consistent, positive relationship with business performance, he makes the distinction between organisations with quality certification to ISO 9000 and further states that there is no proven link between quality certification and improved business performance. Ovretveit and Gustafson (2003) are of the opinion that although focused quality team
programs have been shown to be effective, there is little evidence that large-scale quality programs bring important benefits or are worth the cost. However, they further qualify their view by stating that there is also no conclusive evidence that there are no benefits or that resources are being wasted through large-scale quality programs.

It appears that, in spite of some evidence about the lack of a clear link between quality and business performance, creating value for the customer through quality has become an important component of the competitive strategy of organisations throughout the world. Its relevance and significance is well reflected by the importance attached to the “quality imperative” not only by organisations but also by governments, international agencies, and business associations. The breakthrough gains that can be made through a well-implemented TQM program have prompted many countries to institute national awards for promoting TQM in their respective countries and regions. Examples include the Deming Prize, the Baldrige Award, the European Quality Award, and the Australian Quality Award.

The development of a methodology to assess the strengths and weaknesses of the quality system in an organisation could thus be of value to organisations to enable them to rectify weaknesses and compete more effectively on the basis of customer value creation through quality enhancement which is part of the broader objective of achieving business outcomes. This chapter describes a methodology for making such an assessment. To meet this objective, the next section of this chapter develops a conceptual framework for assessing quality management practices at the organisation level. The framework also pays explicit attention to the role that information communication technology (ICT) can play in upgrading quality systems. Here, ICT is seen as an enabler that, together with the major elements of TQM, can revolutionise people management, technology management, knowledge management and business management in the pursuit of organisational excellence. Figure 3.1 is a graphical synopsis of ICT supported TQM.
Figure 3.1: A graphical synopsis of ICT supported TQM

Based on this framework, it is then shown how a checklist can be developed to assess the critical elements of the framework. It is envisaged that, through the administration of this checklist approach, an assessment could be made of the status of the quality system of an organisation.

3.2 The Quality Management Assessment Framework (QMAF)

A comprehensive review of the literature suggests that there really is no unanimity as to the concept and definition of TQM. This problem is further compounded by the use of terms such as company-wide quality control and strategic quality management. The increasing popularity of national quality awards has also led to consultants, academics, and even textbooks using the structure of popular quality awards to elaborate upon the meaning of TQM.

Hellsten and Klefsjö (2000) have pointed out, using Deming’s definition of system, that TQM may be viewed as a management system comprising of a network of interdependent components that work together to try and accomplish the aim of the system. They (Hellsten and Klefsjö, 2000) delineate the components as core values, techniques, and tools. Core values are the basis for the culture of the organisation and consist of values such as top management commitment, customer focus, subscribing to continuous improvement, and process focus. The second component, techniques, are defined as ways of working by which the values can be realised, and consist of activities performed in a certain order. Examples include quality circles,
benchmarking, and training. Lastly, tools consist of popular statistical and related information generating methods of analysis such as tree diagrams, cause and effect diagrams, and process maps. Evans and Lindsay (2005) also propose a similar way of looking at TQM. They review the TQM system as consisting of four components; namely, principles, infrastructure, practices and tools. Their principles, practices, and tools are similar to the values, techniques, and tools of Hellsten and Klefsjö (2000). However, the fourth component, infrastructure, is defined as the basic management system needed to implement TQM and essentially consist of the six categories of the Baldrige framework. The seventh category in the award, - business results, is regarded as an outcome and not part of the infrastructure.

The Malcolm Baldrige National Quality Award (MBQNA) has turned out to be a vital stimulus for improving the competitiveness of US companies and increasing awareness of quality improvement methods (Main, 1990; Garvin, 1991; Hart, 1993; Moore, 1995; ASQ, 1998). The Baldrige criteria offers a comprehensive framework or tool for self-assessment (Garvin, 1991; Evans, 1997). Pannirselvam and Ferguson (2001) obtained data from the Arizona Governor's Quality Award, which is based on the MBNQA, to study the strength of the relationships between the various quality management constructs and between quality management and organisation performance using path analysis. The results of their analysis confirm the validity of the MBNQA framework.

Jayamaha et al. (2008) empirically established the validity of the Baldrige Criteria for Performance Excellence (CPE) for New Zealand organizations and also determined methodological gaps. They used self–assessment data of 91 New Zealand organizations and conducted the analysis with partial least squares (PLS) method of structural equation modeling. The measurement validity of the CPE was confirmed; from among 13 implied causal relationships, 11 were found to be statistically significant. Additionally the results inferred some key quality management aspects: dependence on measurement, analysis and knowledge management; people involvement, and the function of leadership in setting direction.

Bou-Llusar et al. (2005) conducted an exhaustive study of the EFQM Excellence Model which involved assessing the interrelationships between the enablers and
result criteria in the model. The data was obtained from a sample of Spanish firms. The study concluded that the set of enabler criteria is strongly related to the result criteria set. All the enabler criteria contribute in a similar way to result enhancements, hence a balanced approach in the development of enablers aids correlation between enablers and results to be enhanced, this optimises the benefits from the EFQM Excellence model.

The concept of ICT supported TQM depicted by the graphical synopsis in figure 3.1 is further developed as described below. Based on a synthesis of the literature and quality award schema, a comprehensive framework consisting of twelve important elements of quality is presented. For the sake of expository ease this framework will be referred to as the Quality Management Assessment Framework (QMAF). The QMAF is shown schematically in Figure 3.2 and each of the elements is described below briefly.

**Figure 3.2:** The Quality Management Assessment Framework (QMAF).

The elements of quality are further classified into nine categories and the nine categories are arranged into six groups. The six basic groups are: core drivers, roadmaps & implementation methods, quality value infrastructure, tools & techniques, processes and performance outputs. The core drivers are leadership, quality culture and information/knowledge and communication. Leadership focuses on how top management accentuates quality at all levels and communicates this emphasis throughout the organisation. Quality culture encompasses the extent to which employees work as a
team accepting their responsibilities for quality with clear quality objectives and team skills to deliver to these objectives. Information, knowledge and communication management systems deliver an agile quality management system facilitating speedy and accurate data collection, analysis, reporting and decision-making tools. The roadmaps and implementation techniques of the organisation are delivered by the strategy management system of an organisation. The quality value infrastructure is represented by the human resources management and partnering focus of an organisation. Human resources management consists of employee development and empowerment; partnering focus is made up of the level of customer and supplier focus that an organisation possesses. The tools and techniques are dependant on the level of improvement methods used by an organisation. Improvement methods consist of benchmarking, total quality tools and continuous improvement programs. The processes, identified as one group, are measured by the quality of business processes in an organisation. The performance outputs are represented by business outcomes which include business results, customer and stakeholder value and the relevant feedback systems. Henceforth the QMAF is presented as an eight construct model.

The manner in which the twelve major elements interact and influence each other will determine the scope and extent of customer value created and the business results achieved. In today’s context, where ICT plays a major role as an enabler, the elements described in the model and their interplay will be studied to verify if their effectiveness is enhanced through appropriate ICT interventions.

Organisations that aspire at being world-class focus on infusing a few core values such as good leadership, customer focus, respect for employees, and continuous improvement. The QMAF criteria are devised around such core values and are exemplified in the QMAF framework.

The QMAF theorises the role and impact that leadership, quality culture, information/knowledge/communication, strategy, human resources management, partnering focus, improvement methods, and business processes have on the business outcomes (business results, customer and stakeholder value and feedback).
Core Drivers Group

Leadership

Martinez-Lorente et al. (1999) and Dewhurst et al. (1999) view top management commitment as one of the major determinants of successful TQM implementation. These views are echoed by Tan (1997) who states that management must build commitment through genuine ownership and shared success and by Anderson and Sohal (1999) who state that management must ensure that employees are well supported through times of change. Leadership for quality requires the creation and sustenance of a corporate setting that fosters a culture that subscribes to quality-based competitiveness, customer and market focus, process focus, fact-based decision-making, innovation, continuous improvement, empowerment and participatory decision-making, and continuous learning.

Quality Culture

Goetsch and Davis (1997) define quality culture as an organisational value system that results in an environment that is conducive to the establishment and continual improvement of quality. Batten (1994) states that an organisation’s philosophy or culture is the basic repository of corporate vision and value and an organisation’s policies, procedures and processes must be based on its philosophy. Martinez-Lorente et al. (1999) and Plenert (1999) point out that a quality culture is fostered when quality departments enjoy autonomy and easy access to top management; a good quality information system that is part of a visible management system is available, and a meaningfully structured measurement system is in place.

Information, Knowledge, and Communication

As pointed out by Peter Drucker, information is data endowed with relevance and purpose. Knowledge is a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information. Davenport, and Prusak, (1998); Lim et al. (1999); Perry, (1995); Young, (1995); Kindler, (1996) and Keung, (2000) argue that quality management and sustained quality improvement depends not only on knowledge management but also on effective communication.
Information and communication technology (ICT) is defined, for the sake of convenience, as the deployment of computers, telecommunication networks, related software, and computer-based data management techniques to capture, store, process, and deliver data, information, and knowledge to decision-making entities of an organisation to strengthen their capacity to enhance business performance. Though ICT, as an enabler, does not have a direct impact on business results and customer value, it can help to improve communication between various parts of an organisation and enhance customer convenience and satisfaction (Dawes and Rowley, 1998). From a business results perspective, ICT can be used to determine quality costs, provide feedback based on quality performance measurements, and improve the availability of quality-related data (Dewhurst et al. 1999).

Roadmaps & Implementation Group

Strategy
Strategic planning for business excellence involves the development of potent policies and action sequences, creating appropriate partnerships, mobilising resources, establishing performance measurement frameworks, and modifying organisational structures with explicit attention being paid to quality issues. The need to integrate quality aspects explicitly into both operation and business plans through a cascading approach is well elaborated by Sohal and Terziovski (2000) and Leonard and McAdam (2002).

Quality Value Infrastructure Group

Human Resources Management

Employee Empowerment
Goetsch and Davis (1997) define empowerment as employee involvement that matters. They state that total employee involvement and empowerment (TEIE) is a good means to increase creative thinking and initiative in employees. Thacker (1997) advocates that team leaders must exhibit a consultative/team-oriented communication style with a follow-up evaluation process when practicing empowerment, while Rankin (1998) emphasises the need for building trust. Chelsom
(1997) indicates that skills in areas such as goal setting, performance appraisal, coaching, counselling, project management and budgeting need to be well developed to truly practice empowerment.

**Employee Development**

The term employee development is used here to refer to the education, training, and strengthening of the learning capacity of employees with a view towards strengthening their work-related skills and knowledge, encouraging them to accept responsibility, creating a sense of achievement and pride in their work, and fostering an attitude for continuous improvement. It is not uncommon to come across the view that employee development is perhaps one of the most significant factors in improving quality and business performance. The role of education and training, and ensuring their relevance, in enhancing quality has been well documented (Martinez Lorente, 1999; Ahanotu, 1998; Athanasou, 1998).

**Partnering Focus**

**Supplier Focus**

Suppliers of material and service inputs influence quality outcomes significantly. The quality of purchased inputs such as materials, components, distribution and logistics services, and ICT support, have a strong bearing on customer satisfaction. In today’s global business setting, working well with suppliers poses numerous challenges and much has been said about supplier partnering. Such partnering occurs through a pooling of resources in a trusting atmosphere focused on continuous mutual improvement and includes both internal and external suppliers and customers (Goetsch and Davis, 1997; Martinez Lorente et al. 1999). Instances of companies working closely with their suppliers to achieve desired quality are well documented in the quality literature. The scope of such cooperation has broadened to involving suppliers in new product development (McGinnis et al. 1999).

**Customer Focus**

Numerous writers have articulated the importance of an internal and external customer focus to foster a total quality setting. To create delighted and loyal customers an organisation needs to understand their needs holistically so that product and service delivery processes can be well designed and operated. Whitely (1991)
states that companies that have successfully developed a customer focus have common attributes such as vision, commitment and climate, alignment with customers, willingness to find and eliminate customers’ problems, use of customer information, reaching out to customers, competence, capability and empowerment of people, and continuous improvement of products and processes. Lagrosen (2001) stresses that companies need to go beyond customer focus and strive for customer understanding.

Tools & Techniques Group

Improvement Methods

Benchmarking

The role of benchmarking in quality improvement initiatives is well recognised. Spendolini (1992) defines benchmarking as a continuous process for evaluating products, services, and work processes of organisations that are recognised as representing best practices for the purpose of organisational improvement. Benchmarking is therefore a powerful technique for setting targets for company-wide quality improvement. Benchmarking can, in conjunction with an effective performance measuring, provide a means for developing realistic improvement programs.

Total Quality Tools

A basic principle of TQM is “management by fact.” Total quality tools enable employees responsible for quality management to practice management by fact. Hellsten and Klefsjö (2000) caution that the terms tools and techniques are often used interchangeably. McQuater et al. (1995) define a tool as device with a clear role and narrow focus while techniques can be thought of as a collection of tools. In this paper we use the term tools as referring to both specific well-defined tools that generate information for decision-making and also techniques that are intensive in the use of tools. Modifying the classification of McQuater et al. (1995) we divide tools into five categories as follows:

- Seven basic tools (graphs/charts, checksheets, histograms, Pareto analysis, scatter diagram, Ishikawa diagram, and control charts)
• Seven management and planning tools (affinity diagrams, interrelationship dia
graph, tree diagram, matrix diagram, matrix data analysis, process decision program chart, and arrow diagram)
• Broad application tools (brainstorming, mind mapping, flowcharting, force-field analysis, ranking and rating, questionnaire based surveys, and sampling)
• Techniques (quality costing, design of experiments (DOE), failure modes and effect analysis (FMEA), quality function deployment (QFD), statistical process control (SPC), and departmental purpose analysis)
• Emerging techniques (the seven product development tools, etc.)

Quality tools are today viewed in a more structured manner due to Six-Sigma efforts. McQuater et al. (1995), Bunney and Dale (1997), Rowlands et al. (2000) and Hellsten and Klefsjo (2000) have provided suggestions on the manner and mode of introduction of such tools to ensure their effective deployment.

Continuous Improvement

Subscribing to the continuous improvement philosophy and putting it into practice has become a competitive imperative in today’s global, competitive marketplace. Maintaining the status quo in areas such as quality, new product development, performance improvement, adoption of new technologies, and process performance will lead to loss of competitiveness and lower business performance. This task is made more difficult due to the constant changing of customer needs and expectations, and the need to keep costs down. Naveh and Halevy (2000) and Chapman and Hyland (2000) provide valuable insights into the continuous improvement process.

Processes Group

Business Processes

Davenport et al. (1990) define business processes as a set of logically related tasks performed to achieve a defined business outcome. Olson (2004) states that business process may be regarded as consisting of a logical set of interrelated activities that create economic value by converting prescribed inputs into desirable outputs. He
classifies business processes under two major categories – operational and infrastructure - and provides a comprehensive list of process under each of these. From a quality perspective, business process management involves planning and administering the activities necessary to achieve a high level of performance in a process and identifying opportunities for improving quality and operational performance and ultimately, customer satisfaction (Evans and Lindsay, 2005). Anderson and Sohal (1999) and Tan (1997) highlight the need for the involvement of key functional personnel in the design and development of business processes based on a systems approach while Keung (2000) proposes a holistic process performance measuring system (PPMS) for improvement of business processes.

Performance Outputs Group

Business Outcomes

Business outcomes encompass Business Results, Customer & Stakeholder Value and Feedback.

The QMAF model can be further expressed as a quality value chain. The value chain being driven by the core drivers Leadership, Quality Culture and Information/Knowledge/Communication followed by Strategy, Partnering Focus, Human Resources Management and subsequently Improvement Methods, Business Processes, culminating in Customer and Stakeholder Value and Business Results. This quality value-based push approach is depicted below in Figure 3.3.

Figure 3.3: Quality value-based push approach
3.3 Operationalising the QMAF

The major elements highlighted in the proposed QMAF have been well covered in the literature and are embodied in many international quality award schemes. The key characteristic of the proposed QMAF model is that it not only incorporates the elements highlighted in the international awards but has greater explanatory power by incorporating state of the art concepts in quality management found in the literature and contemporary applications of ICT in quality. Table 3.1 below provides a summary of the main features of some well-known awards (this has been adapted from Ghobadian and Woo (1996)).

At this stage of the development of the proposed QMAF it may be said that an attempt has been made to combine the TQM elements of the four awards (indicated under “Approach” in Table 3.1 below) so that the assessment can be made in a more comprehensive manner. Additionally, the QMAF specifically establishes the importance of the role of ICT as an enabler in promoting TQM, knowledge management and in enhancing communication.
Table 3.1: A Comparison of Some Established Quality Management Awards

<table>
<thead>
<tr>
<th>Features of the International Quality Awards</th>
<th>The Deming Prize</th>
<th>The European Quality Award</th>
<th>The Malcolm Baldrige National Quality Award</th>
<th>The Australian Quality Award</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Approach</strong></td>
<td>No underlying framework linking concepts, activities, processes and results together. However, philosophy and values are presented as a checklist. TQM Elements: Policies; The organisation and its operations; Education and dissemination; Information gathering, communication and its utilisation; Analysis; Standardisation; Control/Management; Quality Assurance; Effects; Future Plans.</td>
<td>Models TQM by identifying its constituent parts TQM Elements: Leadership; People; Policy and Strategy; Partnerships and Resources; Processes; People Results; Customer Results; Society Results; Key performance Results.</td>
<td>Models TQM by identifying its constituent parts TQM Elements: Leadership; Strategic Planning; Customer and Market Focus; Information and Analysis; Human Resource Focus; Process Management; Business Results.</td>
<td>Models TQM by identifying its constituent parts TQM Elements: Leadership and Innovation; Customer and Market Focus; Data Information and Knowledge; Strategy and Planning Processes; People; Processes, Products and Services; Business Results.</td>
</tr>
<tr>
<td><strong>Constituent Relationships</strong></td>
<td>Does not assume an underlying causality.</td>
<td>Assumption of causal relationship between different constituents of TQM.</td>
<td>Assumption of causal relationship between different constituents of TQM.</td>
<td>Assumption of causal relationship between different constituents of TQM.</td>
</tr>
<tr>
<td><strong>Underlying Emphasis</strong></td>
<td>Overall emphasis on quality assurance of products and services.</td>
<td>Customer and stakeholder focus.</td>
<td>Prescriptive with respect to their philosophy and values. Evaluate impact on society.</td>
<td>Based on the premise that management leadership and customer/external focus are the key factors in introducing TQ. Prescriptive with respect to their philosophy and values. Not prescriptive in relation to total quality tools to be used. Emphasises projection of the competitive environment, management of data and information and human resources. Evaluate impact on society.</td>
</tr>
<tr>
<td><strong>Managerial Utility</strong></td>
<td>Prescriptive in terms of tools. Emphasises factors concerned with management of facilities, vendors, procurement and service. Only award that ascertain the views of suppliers and customers of the applicant organisation.</td>
<td>Implies the importance of top management role. Explicitly emphasises the importance of customer focus. Prescriptive with respect to their philosophy and values. Not prescriptive in relation to total quality tools to be used. Emphasises management and provision of resources. Places significant importance on results and is the only one that addresses financial results. Evaluate impact on society.</td>
<td>Prescriptive with respect to their philosophy and values. Not prescriptive in relation to total quality tools to be used. Emphasises projection of the competitive environment, management of data and information and human resources. Evaluate impact on society.</td>
<td>Emphasises organisational values.</td>
</tr>
<tr>
<td><strong>Main Focus</strong></td>
<td>Focuses on policies, plans, implementation of plans, information collection, analysis and control; results and effects of policies implemented; future improvement plans.</td>
<td>Based on the premise that management leadership and customer/external focus are the key factors in introducing TQ.</td>
<td>Based on the premise that management leadership and customer/external focus are the key factors in introducing TQ.</td>
<td>Emphasises organisational values.</td>
</tr>
<tr>
<td><strong>Categories</strong></td>
<td>All factors are weighted equally, evaluation based on overall success of organisation rather than numerical score to each individual factor. Not competitive - no restrictions on number of winners. Recognises the need to introduce a higher order award to encourage past winners to continue to improve their quality efforts and set new standards. Have a specific prize for small business.</td>
<td>Scoring methodology uses a total of four dimensions - two for enablers (approach and deployment), two for results (excellence of results and scope). Overall broader scope, lesser depth. Competitive restriction on number of winners. Does not have a specific prize for small business.</td>
<td>Scoring methodology relies on three dimensions - Approach, Deployment and Results. Overall broader scope, lesser depth. Competitive, restriction on number of winners. Have a specific prize for small business.</td>
<td>Scoring methodology relies on three dimensions - Approach, Deployment and Results. Overall broader scope, lesser depth. Not competitive - no restrictions on number of winners. Recognises the need to introduce a higher order award to encourage past winners to continue to improve their quality efforts and set new standards. Have a specific prize for small business.</td>
</tr>
</tbody>
</table>

Adapted from Ghobadian and Woo (1996).
Based on this framework, a comprehensive survey instrument has been developed. Appendix 3 contains a copy of the survey questionnaire. The scheme for assessing the questions is as follows: If an answer to the question is ‘Yes’ a Likert scale from 1 to 5 is used (very slightly agree=1, slightly agree=2, agree=3, strongly agree=4, very strongly agree=5: circle one of the scores) if it is ‘No’ the score =0. Using the survey instrument it is proposed to develop indexes for the various elements in the framework. A high value of this index for an element would suggest that, with respect to quality management practices, specific element performs well. Table 3.2 in Appendix 1 provides an inventory of the management principles used to formulate the questionnaire.

3.4 Using the QMAF to Assess Quality Management Practices in Manufacturing Organisations in Western Sydney

This section focuses on outlining the process utilised in assessing the quality management practices of manufacturing organisations in the Western Sydney Region.

3.4.1 Using the Rating Scheme

It is proposed to conduct a survey of several organisations in New South Wales, with a sufficiently large sample size. It is then proposed to use the indexes computed for each of the respondents to test several hypotheses.

The computation of the indices of the elements in the survey questionnaire would help to provide a quick profile of a organisation with respect to its quality management practices vis-à-vis the elements in the framework. This can highlight areas that need improvements.

Jabnoun and Sahraoui (2004) advocate that organisations considering a TQM program should integrate it within the agenda of its strategic plans where business strategies are simultaneously developed with ICT plans. The QMAF reinforces Jabnoun and Sahraoui’s concept. Both TQM organisations and network organisations
(virtual corporations) are process based cross-functional organisations with lean structures, hence supporting the need for ICT enabled TQM (Jabnoun and Sahraoui, 2004). The QMAF checklist contains sections which ensure emphasis to auditing the management system of an organisation with a view to achieving the above organisational structure enabled by ICT. Khoo and Tan (2003) state that the MBQNA “Information Management” sub-criterion examines the quality of information systems used in business processes and analyses business performance. However, the QMAF through its checklist evaluates the ICT systems of an organisation in the various dimensions of its TQM model and specifically in the ‘Employee Development’, ‘Supplier Focus’, ‘Information, Knowledge, Communication’ criteria in a manner which facilitates focused identification of gaps which can be translated into business strategies to overcome the same. The QMAF is designed as a checklist with a facile methodology of scoring the various elements and determining quantitative indexes for the respective elements. The scoring process of the QMAF like the Baldrige Award as stated by Garvin (1991) can be used to classify companies along a continuum from best to worst: the mature high scoring quality programs, the medium rung performers, and the low scorers. This process can be extended further in developing continuums for the elements in the QMAF model with regard to their relationship with the quality culture element. This methodology will provide a concise and complete mapping process of the profile of an organisation which can immediately provide an inventory of its current status with regard to its TQM capabilities and highlight deficient areas with regard to contemporary state of the art best practices in quality systems.

The rationale for scoring the elements in the QMAF can be supported using the litmus tests recommended by Garvin (1991).

3.4.2 Using the Framework for Improvement

The information from the QMAF framework survey questionnaire and the assessment and analysis as outlined in section 3.4.1 could be used as a powerful tool in decision making and formulating/prioritising strategies/action steps. Hence the QMAF can be used as a tool for implementing and monitoring quality programs. It could also be a useful supplement in preparing organisations that might wish to
pursue national awards such as MBNQA, AQA, EFQM, Deming Prize etc. without incurring risks of high costs of implementation. Besides, it can be useful to check the health of an organisation’s management systems and take timely corrective and preventive actions through a spirit of continual improvement. Additionally the assessment will provide an impetus to formulate business strategies for the elements in the QMAF model in conjunction with ICT to deliver business results and foster customer value creation. Table 3.2 provides a prescriptive inventory of action steps for each element of the QMAF that would assist an organisation to achieve business excellence.

3.5 Using the QMAF as a Basis to Introduce ICT Interventions for Quality Enhancement

The emergence of information communication technology will influence radically the effective and efficient implementations of TQM principles through collection and analysis of data, management of quality systems electronically, improved communication and training through the use of the internet and intranet.

The impact of information communication technology (ICT) and information systems in promoting TQM initiatives through their ability to influence the various elements of quality and the importance of integrating strategic business plans with plans to develop ICT to support TQM programs has been advocated by Zadrozny and Ferrazi (1992) and Jabnoun and Sahraoui (2004).

Rommel et al. (1994) reported, based on a study of quality practices of automotive industry suppliers in Europe and Japan, that it is possible to discern four progressive levels of quality management as follows.

Phase 1 (Inspection): Quality through inspection
Phase 2 (Assurance): Improvement of core processes and use of quality tools for such improvement
Phase 3 (Prevention): Robust processes, use of quality tools for prevention, design to manufacture, and emerging customer focus
Phase 4 (Perfection): Total customer orientation, quality focus along entire value-added chain, “zero defect” targets, extensive use of tools and techniques, cross-border quality management.

ICT may be used to accelerate the movement of organisations from Phase 1 to Phase 4 (Figure 3.4).

Figure 3.4: The influence of ICT in driving the movement from Phase 1 to 4

For instance, the rapid movement through these phases requires the effective development of core competencies such as team building and communication skills (Appleton, 1997). The clever use of ICT in creating a quality culture, employee development, empowerment, and strategy formulation could facilitate speedy creation of these core competencies. Leadership and support of top management is needed to get all the functions to work together, share information, and maintain a reliable and secure ICT operating system (Madu and Madu, 2003).

As explained under the discussion of business processes in Chapter 2, section 2.7.4 ‘The Impact of ICT on Quality Management’, ICT can be used with great advantage in re-engineering critical processes. It may be said that an organisation must develop a substantial degree of in-house business process re-engineering skills if it is to rapidly move from Phase 2 through Phase 4. In today’s context an organisation needs to excel in customer relationship management (CRM) if it is to reach Phase 4 and move beyond. Zhu et al. (2002) and Xu et al. (2002) stress that ICT alone does not ensure customer service - it is beholden on service providers to have an understanding of how ICT will enhance customer service. This comprehension could be achieved through conducting customer evaluations of ICT-based
services and establishing the factors that impact their evaluations. The deployment of ICT for achieving business excellence through quality clearly would require senior management, quality managers, and the ICT project managers to take several factors into consideration.

Firstly, there must be a consensus on a phased program of ICT deployment to help the organisation move towards Phase 4 and beyond. The QMAF provides a convenient basis upon which the program can be built. A critical evaluation of the current status of the QMAF elements could help identify activities and factors that are acting as barriers to quality enhancement and are failing to continuously enhance customer value. Lack of such a consensus will make it difficult to obtain top management commitment and resource allocation. Secondly, organisations must ensure that as they gradually implement new ICT interventions there should be compatibility with existing ICT systems within the organisation as well as with other business partners in the supply chain. System security can also become an area of concern. Considerable investment will be needed in employee development so that skills are available not only for using the ICT interventions but also in designing and improving these on a continuing basis. Lastly, the justification, acceptance, and implementation of ICT interventions will require a favourable culture within the organisation, especially at senior management levels. This is where the leadership element becomes critical and senior managers will have to clearly convey the “business excellence through quality” message and also become adept at playing the roles of gatekeeper, sponsor, and project champion.

3.6 Hypotheses

3.6.2 Hypotheses for the Comparison of the QMAF Categories by Size

Below are the hypotheses of the comparison of the QMAF categories by size.

Leadership

$H_{01}$: The mean of leadership is the same for all sizes of organisations.

$H_{a1}$: The mean of leadership is not the same for at least two sizes of organisations.
Quality Culture
H₀₂: The mean of quality culture is the same for all sizes of organisations.
Hₐ₂: The mean of quality culture is not the same for at least two sizes of organisations.

Improvement Methods
H₀₃: The mean of improvement methods is the same for all sizes of organisations.
Hₐ₃: The mean of improvement methods is not the same for at least two sizes of organisations.

Partnering Focus
H₀₄: The mean of partnering focus is the same for all sizes of organisations.
Hₐ₄: The mean of partnering focus is not the same for at least two sizes of organisations.

Human Resources Management
H₀₅: The mean of human resource management is the same for all sizes of organisations.
Hₐ₅: The mean of human resource management is not the same for at least two sizes of organisations.

Strategy
H₀₆: The mean of strategy is the same for all sizes of organisations.
Hₐ₆: The mean of strategy is not the same for at least two sizes of organisations.

Business Processes
H₀₇: The mean of business processes is the same for all sizes of organisations.
Hₐ₇: The mean of business processes is not the same for at least two sizes of organisations.

Information, Knowledge, Communication
H₀₈: The mean of information/knowledge/communication is the same for all sizes of organisations.
$H_{a8}$: The mean of information/knowledge/communication is not the same for at least two sizes of organisations.

**Business Outcomes**

$H_{09}$: The mean of business outcomes is the same for all sizes of organisations

$H_{a9}$: The mean of business outcomes is not the same for at least two sizes of organisations.

These hypotheses are tested in Chapter 5.

### 3.6.2 Hypotheses of the Comparison of the QMAF Categories by ANZSIC Codes

Below are the hypotheses of the comparison of the QMAF categories by ANZSIC codes.

**Leadership**

$H_{010}$: The mean of leadership is the same for all ANZSIC codes.

$H_{a10}$: The mean of leadership is not the same for at least two ANZSIC codes.

**Quality Culture**

$H_{011}$: The mean of quality culture is the same for all ANZSIC codes.

$H_{a11}$: The mean of quality culture is not the same for at least two ANZSIC codes.

**Improvement Methods**

$H_{012}$: The mean of improvement methods is the same for all ANZSIC codes.

$H_{a12}$: The mean of improvement methods is not the same for at least two ANZSIC codes.

**Partnering Focus**

$H_{013}$: The mean of partnering focus is the same for all ANZSIC codes.

$H_{a13}$: The mean of partnering focus is not the same for at least two ANZSIC codes.

**Human Resources Management**

$H_{014}$: The mean of human resource management is the same for all ANZSIC codes.
H_{a14}: The mean of human resource management is not the same for at least two ANZSIC codes.

**Strategy**

H_{015}: The mean of strategy is the same for all ANZSIC codes.

H_{a15}: The mean of strategy is not the same for at least two ANZSIC codes.

**Business Processes**

H_{016}: The mean of business processes is the same for all ANZSIC codes.

H_{a16}: The mean of business processes is not the same for at least two ANZSIC codes.

**Information, Knowledge, Communication**

H_{017}: The mean of information/ knowledge/ communication is the same for all ANZSIC codes.

H_{a17}: The mean of information/ knowledge/ communication is not the same for at least two ANZSIC codes.

**Business Outcomes**

H_{018}: The mean of business outcomes is the same for all ANZSIC codes.

H_{a18}: The mean of business outcomes is not the same for at least two ANZSIC codes.

These hypotheses are tested in Chapter 5.

### 3.6.3 Hypotheses for the SEM Analysis of the QMAF Model

The following are a group of hypotheses developed to test the direct and indirect effects of the combination of the variables in the QMAF model. The exogenous constructs in the model are Leadership (L), Quality Culture (QC) and Information/Knowledge/Communication (IKC). The endogenous constructs are Strategy (S), Human Resources Management (HRM), Partnering Focus (PF), Improvement Methods (IM), Business Processes (BP) and Business Outcomes (BO). The hypotheses tested are outlined in three subsets.

H1: Hypotheses when IKC is considered and included in the model.

H1a: Leadership directly has a significant positive effect on strategy.
H1b: Strategy directly has a significant positive effect on human resources management.

H1c: Human resources management directly has a significant positive effect on business processes.

H1d: Business processes directly have a significant positive effect on business outcomes.

H1e: Quality culture directly has a significant positive effect on improvement methods.

H1f: Improvement methods directly has a significant positive effect on business processes.

H1g: Quality culture directly has a significant positive effect on partnering focus.

H1h: Partnering focus directly has a significant positive effect on strategy.

H1i: Quality culture directly has a significant positive effect on human resources management.

H1j: Quality culture indirectly has a significant positive effect on strategy through partnering focus.

H1k: Quality culture indirectly has a significant positive effect on human resources management through partnering focus followed by strategy.

H1l: Quality culture indirectly has a significant positive effect on business processes through improvement methods.

H1m: Quality culture indirectly has a significant positive effect on business processes through human resources management.

H1n: Quality culture indirectly has a significant positive effect on business processes through partnering focus followed by strategy and human resources management.

H1o: Quality culture indirectly has a significant positive effect on business outcomes through improvement methods followed by business processes.

H1p: Quality culture indirectly has a significant positive effect on business outcomes through human resources management followed by business processes.

H1q: Quality culture indirectly has a significant positive effect on business outcomes through partnering focus followed by strategy, human resources management and business processes.
H1r: Leadership indirectly has a significant positive effect on human resources management through strategy.

H1s: Leadership indirectly has a significant positive effect on business processes through strategy followed by human resources management.

H1t: Leadership indirectly has a significant positive effect on business outcomes through strategy followed by human resources management and business processes.

H1u: Partnering focus indirectly has a significant positive effect on human resources management through strategy.

H1v: Partnering focus indirectly has a significant positive effect on business processes through strategy followed by human resources management.

H1w: Partnering focus indirectly has a significant positive effect on business outcomes through strategy followed by human resources management and business processes.

H1x: Strategy indirectly has a significant positive effect on business processes through human resources management.

H1y: Strategy indirectly has a significant positive effect on business outcomes through human resources management followed by business processes.

H1z: Improvement methods indirectly has a significant positive effect on business outcomes through business processes.

H1aa: Human resources management has a significant positive effect on business outcomes indirectly through business processes.

H1ab: IKC directly has a significant positive effect on strategy.

H1ac: IKC directly has a significant positive effect on business processes.

H1ad: IKC indirectly has a significant positive effect on human resources management through good strategy.

H1ae: IKC indirectly has a significant positive effect on business processes through strategy followed by human resources management.

H1af: IKC indirectly has a significant positive effect on business outcomes through strategy followed by human resources management and good business processes.

H2: Hypotheses without considering IKC
The hypotheses H1a, H1b, H1c, H1d, H1e, H1f, H1g, H1h, H1i, H1j, H1k, H1l, H1m, H1n, H1o, H1p, H1q, H1r, H1s, H1t, H1u, H1v, H1w, H1x, H1y, H1z and H1aa were proposed without considering IKC.

H3: Hypotheses with IKC having a one to one relationship with the other constructs

H1ab and H1ac are proposed; in addition the following hypotheses are also proposed:
H2a: IKC directly has a significant positive affect on leadership.
H2b: IKC directly has a significant positive affect on quality culture.
H2c: IKC directly has a significant positive affect on human resources management.
H2d: IKC directly has a significant positive affect on partnering focus.
H2e: IKC directly has a significant positive affect on improvement methods.
H2f: IKC directly has a significant positive affect on business outcomes.

These hypotheses are tested in Chapter 6.

3.7 Summary

This section draws upon the extensive literature that is available in the vast and important field of quality management and, through a synthesis of important contributions, presents a framework for assessing quality management practices in an organisation. The QMAF delineates the major elements that influence quality management and outcomes in an organisation. This framework, as depicted in Figure 3.2, suggests that “core driver” elements such as leadership, quality culture, information/knowledge/communication propel effective development and deployment of planning approaches, coupled with a strong partnering focus and employee development and empowerment program. The partnering focus encompasses both customers and suppliers. The value chain, as expressed in the quality value-based push approach in Figure 3.3, is further fuelled by a continuous improvement program supported by tools and techniques, so that operational and infrastructure business processes can be designed, implemented, monitored, and
improved with a view towards creating customer value and achieving business excellence. Finally a set of hypotheses have been proposed and are tested in Chapters 5 and 6 respectively.
4.1 Introduction

This study aims at understanding quality management problems, mentioned and extensively discussed in chapter 2 and 5, in large, medium and small sized organisations in the Western Sydney region with a view towards developing measures to overcome these problems. Evidence exists to show that many industries in Australia manage their quality systems using traditional methods and many do not have effective continual improvement systems (Eisen et al. 1992; Beattie and Sohal, 1999). Based on the surveyed literature, a conceptual model for assessing quality management practices in relation to optimum business outcomes has been developed. This model also incorporates the role that Information communication technology can play in strengthening these practices. A comprehensive survey was carried out on large, medium and small firms in the Western Sydney region to identify their critical quality problems. Pathways towards achieving optimum business outcomes will be determined and guidelines for managers to manage their quality systems will be developed.

The more specific objectives of this research as covered in Chapter 1 are:

i) Conduct a comprehensive review of TQM.

ii) Develop a conceptual model for understanding factors promoting and hindering TQM in manufacturing enterprises.

iii) Based on the model, conduct a comprehensive survey to identify the major weaknesses of quality systems in manufacturing organisations in the Western Sydney region.

iv) Provide an assessment of the quality management capabilities of manufacturing organisations in the Western Sydney Region.

v) Determine pathways to achieving optimum business outcomes through the various TQM categories in the proposed quality model using structural equation modelling (SEM), specifically SEM path analysis.
The following sections explain the research methodology starting with operationalisation of the QMAF variables, namely measures used to assess the different categories in the QMAF, research method adopted in the study which is the survey method, data collection, analysis procedures, statistical terms and techniques and software used in the research. Some of the basic statistical terms have been further explained in order to serve as guidelines to quality practitioners and managers. The procedure to verify reliability of the data is also outlined. This chapter concludes with a brief summary.

4.2 Operationalisation of the QMAF variables

The organisation’s performance output and the expected theoretical relationships among variables appearing in the model have already been defined in the previous chapter – namely, leadership, quality culture, information/knowledge/communication are independent variables; strategy, human resources management, partnering focus, improvement methods, business processes and business outcomes (business results, customer and stakeholder value and feedback) are the dependant variables. The issue to be discussed here is how to operationalise these variables. All variables in the model are observed and are measured directly. The approach employed in the process of operationalisation is to generate multiple scale items intended at measuring these variables in quantitative terms. Most questions have been scored using the Likert scale.

4.3 Research Method

This section provides a detailed description of the research method applied in this work. The nature of the research is explained first, followed by the methodology used in developing the questionnaire. It further outlines the selection of the population used in the study, followed by the methodology used in determining the sample size and data collection details are given below.
4.3.1 Nature of Research

This research is based on the survey method. A comprehensive postal survey was carried out with a preliminary mail out of 300 firms in the Western Sydney Region to identify their critical quality problems. These firms were a combination of large, medium and small organisations. Since it was hard to achieve complete responses, from the first mail out, additional three lists of the remaining population were made in the same ratios as the first list. The complete population was used up trying to get the companies participation as best as we can as this was a major limitation not only for this project but for other similar research.

The mailing list and contacts were obtained from The Business Who’s Who of Australia, Dun and Bradstreet (D&B) Australia, which was available in University of Western Sydney Electronic Resources, to identify a list of potential firms from the Western Sydney area. D&B has 2.8 million company records in Australasia. It is the Australian leader in credit reporting, debt collection and sales and marketing data. The global database is updated more than one million times daily.

A letter (Appendix 1) along with the survey questionnaire (Appendix 2) was sent to the CEOs of the identified firms making a formal request to undertake a survey in their firm. As a follow-up, the CEOs were contacted by telephone to ascertain whether they needed further clarifications.

If an affirmative response was received from a CEO, the manager(s) assigned by the CEO were contacted and agreement to complete the survey questionnaire was obtained. Follow-up telephone calls were made to ensure completed surveys were returned to the principal investigator.

In the postal surveys no classified information was sought and firms were assured of confidentiality of the information provided. The firms were able to opt out of the study at any time if they so desired.

The chief investigator and the supervisor retained the completed survey questionnaires, information and analysis. It was to be used to prepare scholarly
publications. Confidentiality of all participants was maintained for ethical reasons by taking necessary precautions such as not mentioning any names of companies surveyed to ensure that the identity of the firms is disguised in the publications.

4.3.2 Questionnaire - the Research Instrument

A questionnaire, whether it is called a schedule, interview form or measurement instrument, is a prescribed set of questions for obtaining information from respondents (Malhotra, 2004). In order to gather quantitative primary data, a questionnaire must transform the information required into a set of specific questions, which encourages respondents to complete the questionnaire and minimises response error.

The questionnaire has been designed to obtain information on managers’ views of leadership, quality culture and information/knowledge and communication, strategy, employee development, employee empowerment, benchmarking, total quality tools and continuous improvement, business processes, business results, customer and stakeholder value. As discussed later in this section, the construct item measures used in this study are objective and are established on the survey scores. Although responses to such measures are likely to be prejudiced by selection bias, there is evidence sustaining the general reliability of self-reported and subjective measures (Dess and Robinson, 1984).

As a rule of thumb, using the scaling technique that will acquiesce the maximum level of information possible in a given situation will allow the use of a great variety of statistical analysis. The widely used Likert rating scale has been used for this study. A Likert scale requires a respondent to specify a degree of agreement or disagreement with an array of statements associated to the phenomenon (Aaker and Day, 1990). The Likert scale has several advantages. It is easy to construct and implement. Respondents readily comprehend how to apply the scale, making it appropriate for mail, telephone, or personal interviews. The main drawback of the Likert scale is that it takes longer to complete than other itemised ranking scales, as respondents have to read each statement. Hence the statements used in the questionnaire were short and to the point. The ranking scale could vary between two
to any higher numbers, but most researchers favour between five and nine ranking scales (Cox, 1980; Reynolds and Neter, 1982). The correlation coefficient diminishes with a reduction in the number of scale classes, impacting all statistical analyses based on the correlation coefficient (Givon and Shapira, 1984).

In this research a five-point scale has been used to capture respondents’ evaluation. The scores were then standardised to a percentage scale (the range being 0 minimum to 100 maximum). The higher the score the better is the performance of the organisation with regard to the respective survey question. This higher score will also be used as a comparison level to further differentiate and test with respect to different organisation sizes and ANZSIC codes.

4.3.3 Development of the Research Questionnaire

Preparation of the research instrument has been steered by the relevant literature and expert opinion in the field of research. The questionnaires were pre-tested to determine the readiness and ability of respondents to complete them and to unearth any defects in their design or in specific questions. The questionnaire developed for this study was conducted at two stages. First, the preliminary questionnaire was reviewed to assess the questionnaire items for subject matter and expression validity of the constructs. After this reviewing process, the comments and suggestions were included in a revised questionnaire.

The next stage was to pilot the questionnaire in the field to check whether the revised questionnaire is effortlessly understood and whether it is likely to get cooperation from the prospective respondents when the questionnaires were finally mailed. To achieve these objectives, a small sample of five organisations was selected for personal interview. All facets of the questionnaire were assessed, inclusion or exclusion of any items, question content, phrasing, sequence, form, layout, question complexity, instructions and time to complete the questionnaire. Only minor adjustments were made to improve questions in need of clarification. So, all necessary revision was made in the questionnaire before mail out.
Following the amendments noted in the preceding section, the final questionnaire was produced in the form shown in Appendix 2. The survey instrument was organised in two parts. Part I (questions 1 to 3) related to the general information such as Name of Company, Business Category ([a] manufacturing, service [b] public company, listed company [c] multinational, Australian owned), brief details of business. Part II (questions 1 to 138) included Leadership, Quality Culture, Continuous Improvement, Customer Focus, Supplier Focus, Strategy, Employee Development, Employee Empowerment, Benchmarking, Total Quality Tools, Business Processes, Information/Knowledge/Communication, Business Results, Customer and Stakeholder Value.

4.3.4 Population and Sample Selection

Several factors were brought into consideration in determining the population for this research.

1. The population was limited to only organisations engaged in manufacturing in the Western Sydney region. This selection was for several reasons:
   a. It controls for heterogeneity of quality systems across NSW.
   b. The Western Sydney region is the centre of industries for NSW and provides a wide variety of both industries by size and Australian and New Zealand Standard Industrial Classification (ANZSIC) category.
   c. The University of Western Sydney is based in the Western Sydney region and the researcher was familiar with the region’s context which assisted in collecting valuable information for the study.

2. The following were the conditions taken into account in identifying the sample size. First, the limitation of time and financial resources. Additionally, since it was hard to obtain respondents to the survey, all the four lists generated from the population were used in order to generate the maximum number of respondents.

Regression analysis, analysis of variance (ANOVA) and path analysis- structural equation model (SEM), with maximum likelihood chi square (ML) $\chi^2$ goodness of fit method (available in both the AMOS and LISEREL computer software) were used in this study. The literature reveals that there are no generally accepted criteria for
determining a precise sample size using maximum likelihood estimation or comparable structural modelling techniques (Hair et al. 1998; Hayduk, 1996). Although a specific sample size formula is not available, general guidelines have been suggested and used in the majority of studies sighted. In terms of a bare minimum, valid results can be obtained with a sample as little as 50, taking into consideration the number of categories (variables) used in the models. It is accepted, however, that 100 is the realistic minimum for ensuring the aptness of maximum likelihood estimation in structural equation modelling (Hair et al. 1998). However, Boomsma (1983) recommends that, as a general rule over a number of model categories, samples of 200 were needed to deliver parameter estimates with any degree of confidence.

Basically the role of sample size in SEM - path analysis and all other SEM techniques is the same as for other kinds of statistical methods: results obtained within larger samples have less sampling error than within smaller samples. Some guidelines about absolute sample size in estimation methods are: small, N < 100; medium, N between 100 and 200; large, N > 200 (Kline, 2005). Another factor is model complexity. Essentially, more complex models - those with more parameters - require larger samples than more parsimonious models in order for the estimates to be comparably stable. Thus, a sample size of 200 or even much larger may be necessary for a very complicated path model. Although there are no complete standards in the literature about the association between sample size and path model complexity, the following recommendations are offered: a desirable goal is to have the ratio of the number of cases to the number of free parameters be 20:1; a 10:1 ratio, however, may be a more realistic ratio. Thus, a path model with 20 parameters should have a minimum sample size of 200 cases. If the cases/parameter ratio is less than 5:1, the statistical precision of the results may be doubtful (Kline, 2005). All of the above regarding the sample size, can be smoother when using recursive path analysis without latent variables which is the case in this thesis.

A stratified sampling method was used by stratifying the total population into the ANZSIC codes under consideration. In order to ensure that the sampling process covered a selection of representative organisations, the following protocol was applied:
The post code ranges of the area under study was determined using the *Universal Business Directory (UBD) Street Directory*, Sydney 2000, produced and published by UBD a division of Universal Press Pty. Ltd., Australia.

- The search was conducted for the identified post code ranges.
- The addresses of the organisations and their corresponding ANZSICs, Revenues and Employee Numbers were downloaded from the website.
- Organisations with ANZSICs for manufacturing were selected. The ones which did not have details of employee numbers were filtered out. The final database consisted of 1236 organisations.
- The organisations were then sorted into the following categories:
  - Small 1—19 employees
  - Medium 20—199 employees
  - Large 200 and above employees.

The above categorisation of the organisation’s size by employee numbers is based on organisation size defined by the *Australian Bureau of Statistics* (Australian Bureau of Statistics, 2002).

- The ratio of each category was determined and used to compute number of samples needed in each category to achieve a total of 300 samples. Table 4.1 summarises the sample distribution used in this study.

<table>
<thead>
<tr>
<th></th>
<th>Population Size</th>
<th>Percentage</th>
<th>Computed Sample Size for each list</th>
<th>Sample Size Rounded up to integers for each list</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>1236</td>
<td></td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>Small</td>
<td>497</td>
<td>40.21%</td>
<td>120.63</td>
<td>121</td>
</tr>
<tr>
<td>Medium</td>
<td>613</td>
<td>49.60%</td>
<td>148.79</td>
<td>149</td>
</tr>
<tr>
<td>Large</td>
<td>126</td>
<td>10.19%</td>
<td>30.58</td>
<td>30</td>
</tr>
</tbody>
</table>

**Table 4.1: Summary of sample distribution**
• Each category was then sorted into the type of industry.
• The ratio of each industry type up to the first two ANZSIC digits in each category was determined.
• The ratio of each industry type in each category was used to determine the sample size for each individual industry type and category as outlined in Table 4.2.

Table 4.2: Summary of sample distribution by ANZSIC codes and size

<table>
<thead>
<tr>
<th>Two Digit ANZSIC</th>
<th>Sample Size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Small</td>
</tr>
<tr>
<td>20</td>
<td>5</td>
</tr>
<tr>
<td>21</td>
<td>0</td>
</tr>
<tr>
<td>22</td>
<td>1</td>
</tr>
<tr>
<td>23</td>
<td>4</td>
</tr>
<tr>
<td>24</td>
<td>7</td>
</tr>
<tr>
<td>25</td>
<td>12</td>
</tr>
<tr>
<td>26</td>
<td>2</td>
</tr>
<tr>
<td>27</td>
<td>7</td>
</tr>
<tr>
<td>28</td>
<td>8</td>
</tr>
<tr>
<td>29</td>
<td>0</td>
</tr>
<tr>
<td>30</td>
<td>6</td>
</tr>
<tr>
<td>31</td>
<td>0</td>
</tr>
<tr>
<td>32</td>
<td>1</td>
</tr>
<tr>
<td>33</td>
<td>4</td>
</tr>
<tr>
<td>34</td>
<td>17</td>
</tr>
<tr>
<td>35</td>
<td>19</td>
</tr>
<tr>
<td>36</td>
<td>13</td>
</tr>
<tr>
<td>37</td>
<td>4</td>
</tr>
<tr>
<td>38</td>
<td>5</td>
</tr>
<tr>
<td>39</td>
<td>6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>121</strong></td>
</tr>
</tbody>
</table>

The samples were selected using random sampling technique for each category, namely small, medium and large size organisations (MINITAB software). Three additional lists were prepared using the above mentioned methodology as a standby to replace companies selected in the first list who decided not to participate. Since it was very hard getting respondents, all the remaining lists were used in an effort to obtain replacements for the companies that did not wish to participate.
4.3.5 Data Collection

A mail survey with telephone follow up was used to gather the data. The self-administered mail survey approach was considered suitable for this research for administrative and chronological reasons, given the nature of the study, and the number and range of respondents throughout the Western Sydney region. A standardised questionnaire, with appropriately framed questions, is simple to administer in the data collection stage and consequently permits for proficient coding and analysis, and will enhance the ability to draw inferences. All this contributes to greater dependability of the overall results (Malhotra, 2004). The self-administration feature of the survey has the benefit of being low cost, motivating respondents to provide more sensitive information because of the anonymity of the method and eliminating potential interviewer bias (Malhotra 2004). However, mail surveys have been criticised because of low response rates and the implied probable of non-response bias (Churchill, 1979).

A cover letter from the researcher, and a self-addressed, postage paid envelope, were sent to the senior executives. One week after the mail out, telephone contacts were made with the firms in order to remind them to reply. All responses were checked for completeness. Out of the total questionnaires that were mailed out, only 60 completed questionnaires were returned. If a response was received indicating that the organisation opted not to participate, a replacement survey questionnaire was mailed out from the next list for the respective ANZSIC code and organisation size. Due to the poor response, eventually all four lists were used in the survey. The complete responses were 60 questionnaires. Hence the completed responses of 60 were a limitation in this study. This also restricted us from extending the analysis beyond the Path Analysis. Table 4.3 shows the total population, sample drawn and response rate in each industry size (i.e. large, medium and small). Initially all data collected were coded and entered into MINITAB which was previously constructed and tested. Strict controls were imposed to guarantee integrity of the data.
### Table 4.3: Summary population, sample drawn and responses received

<table>
<thead>
<tr>
<th>Size of Organisation</th>
<th>Total Population</th>
<th>Sample Drawn in each of the four lists</th>
<th>Total Response Received</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>% of Total Population</td>
<td>No.</td>
</tr>
<tr>
<td>Large</td>
<td>126</td>
<td>2.43%</td>
<td>16</td>
</tr>
<tr>
<td>Medium</td>
<td>613</td>
<td>12.06%</td>
<td>37</td>
</tr>
<tr>
<td>Small</td>
<td>497</td>
<td>9.79%</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td>1236</td>
<td>24.27%</td>
<td>60</td>
</tr>
</tbody>
</table>

### 4.4 Data Analysis Procedures

#### 4.4.1 Basic Descriptive Statistics of the TQM Elements in the QMAF

The descriptive statistical analysis was applied to study the quality profile of the organisations surveyed. It should be noted that the scores obtained for all the questions in the questionnaire were used to form the categories and the statistical analysis. In order to make this thesis self-contained, a full description of all descriptive statistics applied in the initial analysis is discussed below. (Some of the description/introduction given below can be skipped if familiar with the statistical terminologies).

**Measures of Central Tendency**

Measures of central tendency, also referred to measures of location, are valuable in identifying where the bulk of the data lie in the distribution. They assist the researcher in determining where the most frequent or typical cases are most probable to lie (Sprinthall, 2003).

The mode is a helpful measure of central tendency when a variable is measured on a normal scale. The median is generally the best indicator for central tendency for ordinal data. The median is not influenced by the value of even the most extreme scores. The mean is a very strong measure of central tendency.

Difficulty of extreme scores: extreme scores have a significant impact on the mean when the sample size is small. Scores can be an issue still in a fairly large sample if a
number of scores are very extreme. In a skewed distribution, wide differences between the mean, median, and mode are quite possible.

In summary, measures of central tendency must be chosen and applied carefully in order that the test used gives the most accurate illustration of the most representative cases in the distribution. Ordinal measures most characteristically use the median but, if normally distributed, may use the mean. Interval and ratio measures most usually need the mean. If there is a severe skewness, though, a variable estimated at the interval or ratio levels may be better signified by the median or even the mode.

**Variance and Standard Deviation**

The standard deviation is a very valuable statistic which gives a dependable estimate of the degree to which the numbers in the variable deviate from the mean. Thus the standard deviation is a standard measure of variability that relates to any distribution, regardless of the unit of measure used (Larson and Farber, 2003). If the standard deviation is very small, scores are not scattered far from the mean. The larger the standard deviation, the more widely scattered are values in the distribution.

**Percentile and Quartile Measures**

It is advantageous to discern where a particular subject’s score lies relative to the entire distribution. A good statistic for this purpose is the percentile. A percentile orders all the scores from highest to lowest and computes the percentage of scores that lie below each of the individual scores (Loether and McTavish, 1974).

A quartile is basically the entire percentile chart divided into four equal sections. Scores from the 75th to the 99th percentile form the top quartile. The 50th to the 74th percentile form the second highest quartile. Scores from the 26th to the 49th percentile form the third highest quartile, and scores from the 1st to the 25th percentile form the lowest quartile. One method to explain central tendency for such a distribution is to describe the scores in the second and third quartile, which is called the interquartile range (Glass and Hopkins, 1996). This interquarile range is the box, of a box and whisker plot.
The Anderson-Darling Normality Test

The Anderson-Darling test, named after Theodore Wilbur Anderson, Jr. and Donald A. Darling who invented it in 1952, is one of the most powerful statistics for detecting normality. The Anderson-Darling test (Stephens, 1974) is applied to verify if a sample of data came from a population with a specific distribution. It is a modification of the Kolmogorov-Smirnov (K-S) test and provides more weight to the tails than does the K-S test. The Anderson-Darling uses a specific distribution in calculating critical values. This has the advantage of allowing a more sensitive test (NIST/SEMATECH, 2009).

4.4.2 Regression Analysis

As all variables are observed, simple regression was used to determine one-to-one relationships between the information/knowledge/communication (IKC) category and the other remaining categories in the QMAF. Multiple regression together with path analysis structural equation modeling (SEM) was also used and is discussed later in section 4.4.5.

To conduct regression analysis (simple/multiple) one must check if the sampling and the following assumptions are considered:

1. Outliers – these are extreme data points that have substantial influence on the regression solution and should be deleted or modified to reduce their impact (Tabachnick and Fidell, 1989). Coakes and Steed (2001) observed that the judgment to remove outliers from the data set must be made with caution since their removal frequently results in the generation of further outlying cases.

2. Multicollinearity – multicollinearity occurs due to high correlations among the independent variables. Coakes and Steed (2001) noted that this issue affects how a researcher interprets any relationship between the independent variables and the dependent variable, and multicollinearity can be established by examining the correlation matrix.

3. Normality, linearity, homoscedasticity and independence of residuals – an inspection of residual scatterplots allows a researcher to assess these assumptions. It is assumed that the differences between the obtained and predicted dependent variable scores are normally distributed. It is also assumed
that the residuals have a linear relationship with the predicted dependent variable scores, and that the variance of the residuals is the same for all predicted scores. Coakes and Steed (2001) stated that mild deviations from linearity are not serious, but moderate to extreme deviations may lead to a serious underestimation of a relationship.

4.4.3 ANOVA

In analysis of variance (ANOVA), a continuous response variable, known as a *dependent variable*, is measured under experimental conditions identified by classification variables, known as *independent variables*. The variation in the response is assumed to be due to effects in the classification, with random error accounting for the remaining variation (Hair et al. 1998).

ANOVA technique will be used to explore the variance between the means of groups based on the size of the organisation (i.e. large, medium small) and the ANZSIC categories under study for each element of the QMAF model. For example, we might be interested in comparing the variance between the means of different groups (large, medium and small organisations) of questions about leadership in the QMAF. This would either confirm or reject the proposition that leadership in different organisations with respect to size, i.e. large, medium and small is the same.

Hsu's Multiple Comparisons with the Best (MCB) provides a confidence interval for the difference between each level mean and the best of the other level means. Hsu's MCB test uses a family error rate. Hsu's MCB is used if you want to eliminate levels that are not the best and to identify those that are best or close to the best (Hsu, 1996; Minitab, 2000).

Hsu’s MCB is designed specifically to provide sharp statistical inference for deciding which treatments are close to the true best treatment and which are not. The current range of applications includes single-stage balanced and unbalanced one-way and certain higher-way designs, under the normality and equal-but-unknown variance assumptions (Gupta and Hsu, 1985).
Hsu’s MCB method was selected for this study in order to compare the best mean of the groups (e.g. organisation size) with the means of the other organisation sizes. The best is largest value for each case of this study which used Hsu’s MCB. Additionally though the theoretical ideal standardised maximum score for each category in the model is 100, the maximum standardised score for the population is unknown in some categories of the QMAF model as the data obtained is a sample of the population this further supports the choice of Hsu’s MCB method for the study. The higher mean in an ANOVA is the best to compare with when trying to find the significant pair, rather than comparing the pairs together without one considering this higher situation. The means for other groups will always be compared with the remaining largest through the whole analysis in chapter 5. The determination of the best mean through Hsu’s MCB will enable the identification of the best management practices in the group with the best mean. The application of Hsu’s MCB for the above mentioned purpose has been demonstrated in comparative studies of groups with the best mean (Zadnik et al. 1999; Chan et al. 2000).

4.4.4 Reliability of the Research Instrument

Content validity is an evaluation of the degree to which the measurement scale encapsulates the theoretical foundation of the construct (Churchill, 1979; Malhotra, 2004). Churchill (1979) points out that measures would have content validity if the scale development method incorporated the following: specifying the sphere of the construct, producing a sample of items from this sphere, and refining the scales through initial data collection. As the existing scales have been established from literature and have been refined using pre-test responses from sample respondents, content validity can be assumed. However, measuring content validity is a subjective
check and not a sufficient measure of the validity of the scale. A more formal
evaluation of the validity of each of the measures was tested by examining the
construct validity in Chapter 5.

Reliability is a characteristic of scores in a particular sample, not measures. A
measure is not reliable versus unreliable or valid versus not valid over all
conceivable uses of it (Thompson, 2003). It is vital that the scores analysed in SEM
(or any other type of statistical method for behavioural data) are reliable (Kline,
2005). These principles are reviewed below. Bryant (2000), Strube (2000), and
Nunnally and Bernstein (1994) provide more information on this subject.

Since there are various types of random error, it is often necessary to assess different
aspects of score reliability. The most universally accepted estimate of reliability is
Cronbach's coefficient alpha (\(\alpha\)). This statistic measures internal consistency
reliability, the degree to which responses are consistent across the items within a
single measure. If internal consistency reliability is low, the content of the items may
be so heterogeneous that the total score is not the best possible unit of analysis for the
measure. Estimation of other kinds of score reliability may require multiple
measurement occasions, test forms, or examiners.

Although there is no standard as to how high coefficients should be in order to
consider score reliability as "good," some rough guidelines are offered: generally,
reliability coefficients around .90 are considered "excellent," values around .80 are
"very good," and values around .70 are "adequate." One can either evaluate the
reliability of scores in one’s own samples or rely on published sources (test manuals,
journal articles, etc.). Note that published reliability coefficients may not generalise
to a researcher's particular sample.

4.4.5 Structural Equation Modelling-Path Analysis

The term structural equation modelling (SEM) does not refer to a single statistical
technique but instead encompasses a family of related procedures. Other terms such
as covariance structure analysis, covariance structure modelling or analysis of
covariance structures are also used in the literature to classify these various
techniques under the same label. Another term used is causal modelling which is used mainly in associations with the technique of SEM path analysis (Kline, 2005).

According to Kline (2005), summarised below are some things that most SEM methods have in common:

1. SEM is *a priori* and requires researchers to think in terms of models. But being *a priori* does not mean that it is exclusively confirmatory. Many applications of SEM are a blend of exploratory and confirmatory analysis.

2. The explicit representation of the distinction between observed and latent variables is characteristic of many structural equation models. The distinction makes it possible for researchers to test a wide variety of hypotheses.

3. The basic statistic in SEM is covariance. It is possible to analyse other types of data, such as means.

4. The technique of SEM is not just for non experimental (correlational) data. Instead it is a very flexible analytical tool that can be applied to data from experiments too.

5. Many standard statistical procedures, including multiple regression, canonical correlation, and analysis of variance (ANOVA) can be viewed as special cases of SEM.

6. SEM is still a large-sample technique. That is, although there is some recent suggestions in the literature about the analysis of structural equation models in smaller samples, most applications still require large samples.

7. It is possible to test many different types of effects for statistical significance in SEM but the role of statistical tests in the overall analysis is often less important compared with more traditional techniques.

The six basic steps of SEM are listed below. These steps are iterative as problems at a later step may require a return to an earlier one (Kline, 2005).

1. Stipulate the model, i.e. the researcher’s hypotheses are expressed in the form of a structure equation model. Although many researchers begin the process of specification by drawing a diagram of a model using a set of more-or-less standard symbols, however, the model can alternatively be described as a series of equations. These equations define the model’s parameters which correspond
to presumed relations among observed or latent variables that the computer eventually estimates with sample data.

2. Establish whether the model is identified, which means that it is theoretically possible for the computer to derive a unique estimate of every model parameter. Different types of structural equation models must meet certain requirements in order to be identified. If a model fails to meet the relevant identification requirements, attempts to estimate it may be unsuccessful.

3. Select measures of the variables denoted in the model (i.e. operationalise the constructs) and collect, prepare, and screen the data.

4. Use a computer program to estimate the model (i.e. conduct analysis). The following things take place at this step:
   a. Evaluate model fit, which means determine how well the model as a whole explains the data. If the model does not fit the data well, go to step 5.
   b. Infer the parameter estimates once it is established that the fit of a structural equation model to the data is adequate (Kaplan, 2000).
   c. Consider equivalent models. An equivalent model explains the data just as well as the researcher’s preferred model but does so with a different configuration of hypothesised relations. An equivalent model thus provides a competing account of the data. It expects the researcher to explain how his or her preferred model should not be rejected in favour of statistically equivalent ones.

5. If necessary, re-specify the model and evaluate the fit of the revised model to the same data. As with a model, initial specification, its re-specification should be steered by the researcher’s hypotheses.

6. Given a satisfactory model, accurately and completely describe the analysis in a written report.

7. Replicate the results. Replication is rare in SEM. Nevertheless, it is critical to eventually replicate a structural equation model if it is ever to represent anything beyond a mere statistical exercise.

8. Apply the results.

The main objective of structural equation modelling is to map and examine hypothetically postulated causal relationships among variables (Homburg, 1991). In
contrast to conventional methods, structural equation modelling allows testing of an entire model simultaneously instead of testing each hypothesis step by step (Schumacker and Lomax, 1996). Regardless of whether the variables of concern are observable (obvious) or unobservable (latent), their assumed relations are determined in structural linear equations (Fornell et al. 1990). The structural equation model approach entails developing measurement models to define latent variables and then ascertaining relationships or structural equations among the latent variables. So the SEM consists of two parts, the measurement model and the structural model:

- The measurement model outlines how latent variables or hypothetical constructs depend upon or are specified by the observed variables. It explains the measurement properties (reliabilities and validities) of the observed variables.
- The structural model specifies the causal relationships among the latent variables, describes the causal effects, and allocates the explained and unexplained variance.

The structural component of the model investigates relationships among a set of independent variables and the dependent variables that are hypothesised based on theoretical deduction. This method varies from traditional regression analysis, as it carries out multiple regression analysis concurrently, and permits the direct and indirect effects of variables to be simultaneously estimated (Schumacker and Lomax, 1996). Direct effects are measured by a structure coefficient, specifically a path coefficient, represented as $\beta_1$ (beta) in Figure 4.1 (A-C). Path coefficients were computed on the hypothesised relationships between the independent variables and the dependent variable. Presented in standardised form, as they emerge in the analysis chapter, these $\beta$ (beta) values characterise a standardised partial regression coefficient. The value of this standardised parameter shows the resultant change in a dependent variable as a result of a one-unit change in an independent variable ascribed to this direct relationship.

A dependent variable may also be indirectly impacted by an independent variable through another mediating variable. Indirect effects exist when the dependent variable may be reached from the independent variable via the paths connecting each to one or more other variables. (See, for example, A-B-C in Figure 4.1) the indirect
effects were estimated as a product of the structure coefficients involved, represented as $\beta_2$ and $\beta_3$ in Figure 4.1. This value corresponds to the resultant change in the dependent variable as a result of a one-unit increase in an independent variable; the indirect and direct effects were summed together (Schumacker and Lomax, 1996).

Figure 4.1: A-B-C path diagram model

$$\text{Direct effect} = \beta_1$$
$$\text{Indirect effect} = \beta_2 \cdot \beta_3$$
$$\text{Total effects} = \beta_1 + \beta_2 \cdot \beta_3$$

A path analysis is from the SEM family. The starting point is the specification of a structural model that represents all causal hypotheses (Kline, 2005). A path model is a structural model for observed variables.

The technique of structural equation model (SEM) path analysis entails the estimation of presumed causal relations among observed variables. Correlation does not imply causation. It is also true that an observed correlation of zero does not rule out a true causal relation.

The path analytic approach to the study of causality with correlations is as follows. The overall goal of a SEM path analysis is to assess causal versus non-causal aspects of observed correlations. Part of the estimation of a path model involves assessing how well it accounts for the data - that is, the observed correlations or covariances. If the model is not rejected, one cannot automatically deduce that the hypotheses about causality are correct, since the failure to reject a path model (or any type of structural equation model) does not prove that it is correct.
The statistical measures concerned with SEM path analysis are basically methods of testing the appropriateness of a causal model with the use of standardised multiple regression equations (Leclair, 1981). One of the major limitations is lack of control and resulting inability to deal with all variables in a given system. The results can only be used as an estimate to causality, so expectations for confirmed causal explanations should not be considered at this phase (Miller, 1977). Confidence in the power of the method is increasing, and its use is on the rise considerably.

SEM path analysis in combination with traditional correlation and multiple regression techniques has made it feasible to establish causal relationships and hypothesise causal linkages among a set of variables, while testing a theoretical model (Leclair, 1981).

Kerlinger and Pedhazur (1973) suggest that the following four assumptions must be met: (a) relations among variables are linear, additive, and causal (curvilinear and multiplicative relationships and interactions are excluded); (b) residuals are not correlated; (c) a one-way causal flow exists; and (d) variables are measured on an interval scale.

Miller (1977) has established a six-step process in the application of SEM path analysis that will serve to demonstrate its use.
1. Develop a causal scheme or model.
2. Establish a pattern of associations between the variables in the sequence.
3. Depict a path diagram.
4. Calculate path coefficients for the basic model.
5. Test for "goodness of fit" with the basic model.
6. Interpret the result.

There are two basic types of path models. **Recursive** models are the most straightforward and have two basic features: their disturbances are uncorrelated, and all causal effects are unidirectional. **Nonrecursive** models have feedback loops or may have correlated disturbances (Kline, 2005). Consider the path models in Figure 4.2. The model of Figure 4.2(a) is recursive because its disturbances are independent
and no variable is both a cause and an effect of another variable, directly or indirectly. For example, \( X_1, X_2, \) and \( Y_1 \), are specified as direct or indirect causes of \( Y_2 \), but \( Y_2 \) has no effect back onto one of its presumed causes. In contrast, the model of Figure 4.2(b) is nonrecursive because it has a direct feed-back loop in which \( Y_1 \) and \( Y_2 \) are specified as both causes and effects of each other (\( Y_1 \rightarrow Y_2 \)). The model of Figure 4.2(b) also has a disturbance correlation. Note that models with indirect feedback loops, such as \( Y_1 \rightarrow Y_2 \rightarrow Y_3 \rightarrow Y_1 \), are also nonrecursive.

Figure 4.2: Examples of recursive, nonrecursive, and partially recursive path models.

There is another type of path model, one that has directional effects and correlated disturbances, two examples of which are presented in Figures 4.2(c) and 4.2(d) sourced from Kline (2005). Unfortunately, the categorisation of such models in the SEM literature is not consistent. Kline (2005) states that some authors refer to these models as nonrecursive, whereas others use the expression partially recursive. But more significant than the label for these models is the feature made in the figure.

Partially recursive models with a bow-free pattern of disturbance correlations can be considered in the analysis just like recursive models. A bow-free pattern means that correlated disturbances are limited to pairs of endogenous variables without direct effects between them (see Figure 4.2(c)). In comparison, partially recursive models with a bow pattern of disturbance correlations must be treated in the analysis as nonrecursive models. A bow pattern indicates that a disturbance correlation occurs
with a direct effect between the endogenous variables (see Figure 4.2(d); Brito & Pearl, 2003; Kenny, 1979). Recursive and nonrecursive models comprise of, partially recursive models without and with direct effects among the endogenous variables (Kline, 2005).

The difference between recursive and nonrecursive path models has several consequences. The assumptions of recursive models that all causal effects are unidirectional and that the disturbances are independent when there are direct effects among the endogenous variables simplify the statistical requirements for their analysis. For example, multiple regression can be used to assess path coefficients for direct effects and disturbance variances in recursive models. Computer programs with regression modules are widely available. The same suppositions of recursive models that ease the analytical burden are also very restrictive, however. For example, causal effects that are not unidirectional or disturbances that are correlated in a model with direct effects between the corresponding endogenous variables (e.g. Figure 4.2(d)) cannot be represented in a recursive model. Although these effects can be represented in nonrecursive models, such models cannot be analysed with standard multiple regression. Nonrecursive models require more complicated methods and may also require additional assumptions. The likelihood of a problem in the analysis of a nonrecursive model is also greater than for a recursive model. One of these problems is that of identification (Kline, 2005).

Advantages of Structural Equation Modelling

Multiple regression analysis, factor analysis, multivariate analysis of variance and discriminant analysis grant the researcher powerful tools for addressing a wide range of managerial and theoretical questions. However, they all have one common constraint: each technique can study only a single relationship at a time (Hair et al. 1998). Regression techniques cannot be used to test multiple dependence relationships of the theoretical model where some of the variables are concurrently dependent and independent.

Research on success factors in business performance outputs is often symbolised by multiple variables; some of these variables are not directly evident, and sometimes
there are possible high levels of multicolinearity (Fornell, 1987). Such data are rarely free of noise or measurement errors, so standard statistical methods are difficult to apply. It is, therefore, prudent to employ a second generation of multivariate analysis, i.e. structural equation modelling (Fornell, 1987). Structural equation modelling provides for the unambiguous illustration of measurement error, which exists in the vast majority of measures used in behavioural, social and educational sciences, and produces parameter estimates acquiring desirable optimal properties, such as preciseness and efficiency (Bollen, 1989; Joreskog and Sorbom, 1988). Structural equation modelling allows for examining causal hypotheses about studied phenomena and their advancement across time at the construct level allows devising and testing a wide range of theoretically pertinent models, and can provide in vital ways to theory development and construct validation. Structural equation modelling approaches also sanction the study of empirically relevant properties of measurement tools and adequacy of observed measures, and can aid in improving the explanatory power of non-experimental data that are often collected in behavioural, social and educational research (Schaie and Hertzog, 1982, 1985). The above mentioned applications will aid in establishing the direct and indirect effects and strengths of the causal relationships between the various categories in the QMAF model.

**Characteristics of Structural Equation Modelling Application**

Bollen and Long (1993) explained five steps that describe most of the structural equation modelling applications. These include: (a) model specification, referring to the preliminary theoretical model the researcher devises on the basis of a review of the literature in a concrete area or hypothesising on the basis of a theory; (b) identification, which is to query if unique values can be established for the parameters to be estimated in the theoretical model. In some cases, the analysis may not converge or arrive at a solution, i.e. find unique parameter values, even after 100 iterations, because the model is misidentified; (c) estimation, which needs knowledge of the different estimation techniques that are used depending on the variable scales and/or distributional function of the variable(s) used in the model such as least squares, maximum likelihood etc.; (d) testing fit, which involves inferring model fit or comparing fit indices for alternative or nested models. The researcher is confronted with having to make a choice among numerous fit indices that subjectively specify if the data fit the theoretical model; (e) re-specification, which
generally transpires when the model fit indices imply a poor fit. In this occasion, one has to arrive at a decision with regard to deleting, adding, or modifying paths in the model, and then eventually returning to the analysis. Model alteration indices and/or tests of paths from the preliminary model steer the researcher in this effort.

Identification. An essential consideration when specifying models in SEM is identification. Model identification addresses if the information supplied by the data is adequate to permit a unique solution to be established for the system of equations containing the model parameters as proposed in the theoretical model (Schumacker and Lomax, 1996). The parameters of a particular model are combined to form one model-implied variance covariance matrix (E). If two or more sets of parameter values produce the same matrix, E, then they are deemed equivalent. If a parameter has the same value in all equivalent sets than that parameter is considered identified.

Structural models may be just-identified, overidentified, or underidentified. A just-identified model is one in which there is a one-to-one correspondence between the data and structural parameters - namely, the number of data variances and covariances equals the number of parameters to be estimated. However, in spite of the capability of the model to provide a unique solution for all parameters, the just-identified model is not scientifically appealing as it has no degrees of freedom and therefore can never be rejected. An overidentified model is one in which the number of estimable parameters is less than the number of data points (i.e., variances, covariances of the observed variables). This condition results in positive degrees of freedom that permit rejection of the model, therefore making it of scientific use. The aim in structural equation modelling is to specify a model that achieves the criterion of overidentification. Finally, an underidentified model is one in which the number of parameters to be estimated surpasses the number of variances and covariances (i.e., data point). Thus the model contains insufficient information (from the input data) for the purpose of achieving a determinate solution of parameter estimation; that is, an infinite number of solutions are feasible. Thus a constraint on model specification is that for any model to be estimated it ought to be either just-identified or overidentified. This condition was achieved in this study.

Estimation. The overall rationale in estimating the factor model is to find estimates of the parameters that reproduce the sample matrix of variance and covariances of
the observed variables as closely as possible in some well-defined sense. The estimation of the model parameters can be attained by three statistical methods: a) initial estimates (IE), b) maximum likelihood estimates (ML), and c) the unweighted least squares (ULS). All three methods give a consistent estimate. This means that they are very close to the true parameter values in large samples, based on the assumption that the model is correct. Nevertheless, the three estimates vary in a number of ways. The preliminary estimates are based on an ad hoc procedure, which is non-iterative and hence very fast. The maximum likelihood estimates and the unweighted least squares estimates are determined by an iterative procedure designed to minimise a definite fitting function by successively enhancing the parameter estimates beginning with the initial estimates (Shamsuddoha, 2004).

The ML method is pertinent only to rather large samples. The ULS method can be applied even to small samples. The ML method not only provides the parameter estimates, but also gives the standard errors for the estimates. These are computations for the precision of such an estimate. Standard errors are not available in the program for the ULS method. Moreover, Hoyle (1995) states that a growing body of research indicates that ML performs reasonably well under a variety of less-than-optimal investigative conditions such as small sample size and disproportionate kurtosis (Hoyle, 1995), and ML is extensively available and is the most widely researched estimator among the ones otherwise offered (the unweighted least squares, ordinary least squares). Hence, the analyses that are presented were all conducted by use of the ML method, as the sample also allowed this (Boomsma, 1983; Hair et al. 1998).

**Indirect and total effects.** **Indirect effects** are computed statistically as the product of direct effects, either standardised or unstandardised, that comprise them. They are also interpreted just as path coefficients (Kline, 2005).

The sum of all direct and indirect effects of one variable on another is **total effects.** Some SEM computer programs compute effects decomposition, i.e. a summary of estimated direct, indirect, and total effects. The AMOS program provides both total effects and total indirect effects. Total indirect effect is the sum of all indirect effects of a causally prior variable on a subsequent one.
In standard ML estimation, AMOS does not provide standard errors for total effects or total indirect effects. However, AMOS applies the method of bootstrapping to evaluate the standard error for unstandardised or standardised total effects and total indirect effects (Kline, 2005).

The AMOS program does not calculate standard errors for individual indirect effects of variables with multiple indirect effects on other variables. However, Baron and Kenny (1986) illustrate some hand-calculable statistical tests for unstandardised indirect effects in recursive path models that involve only one mediator. The best known of these tests is established on an estimated standard error developed by Sobel (1986).

**Assessment of overall model fit.** Overidentified path models with more observations than parameters usually do not perfectly fit the data. Hence there is a need to measure the degree of fit of such models. There are several model fit indexes outlined in the SEM literature, and new indexes are being developed regularly.

Outlined below is a minimal set of fit indexes that should be reported and interpreted when reporting the results of SEM analyses. This specific set depicts the contemporary practices in reporting summaries of the analysis (Boomsma, 2000; McDonald & Ho, 2002). These are (1) the model chi-square, (2) the Steiger-Lind root mean square error of approximation (RMSEA) (Steiger, 1990) with its 90% confidence interval, (3) the Bentler comparative fit index (CFI) (Bentler, 1990), and (4) the standardised root mean square residual (SRMR). It is helpful to note the following limitations of basically all fit indexes in SEM (Kline, 2005): Values of fit indexes signify only the average or overall fit of a model.

Because a single index reflects only a particular aspect of model fit, a supportive value of that index does not by itself indicate good fit. Therefore model fit is usually estimated based in part on the values of more than one index.
Fit indexes do not specify whether the results are theoretically meaningful. Even if values of fit indexes appear to be supportive, results that are uncharacteristic require explanation.

Values of fit indexes that suggest satisfactory fit do not necessarily suggest that the predictive power of the model is also high.

The sampling distributions of many fit indexes used in SEM are unknown (the RMSEA may be an exception).

The main purpose in analysing structural equation models is the degree to which the hypothesised model “fits”, or in other words sufficiently describes, the samples data. However, model assessment is one of the most disconcerted and complex issues associated with structural equation modelling. Bollen and Long (1993), MacCallum (1995), Mulaik et al. (1989), and Steiger (1990) display a range of viewpoints and recommendations on this topic. The AMOS program also supplies powerful tools to estimate the fit and the determination of the lack of fit of the model. The following quantities are used:

- parameter estimates;
- standard errors (for ML only);
- the coefficient of determination;
- overall goodness-of-fit (GOF) measures.

The first three quantities give reasonable estimates to assess the goodness of fit of the model. If any of these quantities has an unrealistic value it is a sign that the model is basically wrong, and that it is not appropriate for the data. Negative variances and correlations larger than one in magnitude are illustrations of a bad model.

The determination of overall model fit in structural equation modelling is not as clear-cut as it is in other statistical approaches in multivariable procedures such as the analysis of variance, multiple regression, SEM path analysis, discriminant analysis, and canonical analysis. These multivariable methods use observed variables that are believed to be measured without error, and they have statistical tests with known distributions. Structural equation modelling fit indices have no single
A statistical test of significance that identifies a correct model given the sample data. Overall, the fit indices are in the class of model fit, model comparison, or model parsimony fit indices.

The model fit can be assessed by testing the chi-square statistic relative to the degree of freedom, the goodness-of-fit index (GFI), the adjusted-goodness-of-fit index (AGFI), and the root-mean-square error of approximation (RMSEA). These criteria are computed by comparing the observed covariance matrix with the model implied covariance matrix (Schumacker and Lomax, 1996). A non-significant chi-square value, goodness-of-fit indices close to one, and a RMSEA less than 0.05 infers that the observed and implied covariance matrices are not different and therefore the data can be assumed to fit the model. However, the chi-square measure is sensitive to sample size and very sensitive to departures from multivariate normality of the observed variables. Joreskog (1996) proposed that the chi-square be adjusted by the degree of freedom to assess model fit. $\chi^2/df$ (chi-square/degree of freedom), called the normed chi square (NC) measure, can detect two kinds of inappropriate models: (a) a model that is overidentified and capitalises on chance, or (b) models that do not fit the observed data and require improvement. Carmines and McIver (1981) indicate chi-square to degrees of freedom ratios in the range of 2 to 1 or 3 to 1 are suggestive of an acceptable fit between the hypothetical model and the sample data. The Tucker-Lewis index (TLI), the normal fit index (NFI), and comparative fit index (CFI) can estimate the model comparison. These criteria typically compare the proposed model with a null model; a value close to one infers a perfect fit. (Schumacker and Lomax, 1996; Arbuckle and Wothke, 1999; Arbuckle, 1997; Kline, 2005).

The goodness-of-fit criteria used to estimate the measurement models and their acceptable fit inferences are presented in Table 4.4. Some indices are more dependant on sample size than others, and there is ongoing discussion regarding the aptness of some of the measures, hence a range of criteria were evaluated (Schumacker and Lomax, 1996; Arbuckle, 1997; Kline, 2005).
Table 4.4: Goodness of fit criteria and acceptable fit interpretations

<table>
<thead>
<tr>
<th>Goodness-of-Fit Criterion</th>
<th>Acceptable Level</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chi-square ((\chi^2))</td>
<td>Tabled chi-square value</td>
<td>Compares obtained chi-square value with tabled value for given degrees of freedom</td>
</tr>
<tr>
<td>Normed Chi-square ((\chi^2/df))</td>
<td>1.0 to 5.0</td>
<td>Less than 1.00 is a poor model fit. Higher than 5.00 reflects a need for improvement.</td>
</tr>
<tr>
<td>Root-Mean-Square Error of Approximation (RMSEA)</td>
<td>0 to 1</td>
<td>Value less than .05 indicates a good model fit</td>
</tr>
<tr>
<td>Root Mean Square Residual (RMR)</td>
<td>Researcher defines level</td>
<td>Indicates the closeness of (\Sigma) to (S) matrix</td>
</tr>
<tr>
<td>Incremental Fit Index (IFI)</td>
<td>Values close to 1 indicate a very good fit.</td>
<td></td>
</tr>
<tr>
<td>Goodness-of-fit Index (GFI)</td>
<td>0 (no fit) to 1 (perfect fit)</td>
<td>Value close to .90 reflects a good fit</td>
</tr>
<tr>
<td>Adjusted GFI (AGFI)</td>
<td>0 (no fit) to 1 (perfect fit)</td>
<td>Value adjusted for df, with .90 a good model fit</td>
</tr>
<tr>
<td>Normed Fit Index (NFI)</td>
<td>0 (no fit) to 1 (perfect fit)</td>
<td>Value adjusted for df, with .90 a good model fit</td>
</tr>
<tr>
<td>Tucker-Lewis Index (TLI)</td>
<td>0 (no fit) to 1 (perfect fit)</td>
<td>Value adjusted for df, with .90 a good model fit</td>
</tr>
<tr>
<td>Comparative Fit Index (CFI)</td>
<td>0 (no fit) to 1 (perfect fit)</td>
<td>Value adjusted for df, with .90 a good model fit</td>
</tr>
</tbody>
</table>

Source: Schumacker and Lomax (1996); Arbuckle (1997); Kline (2005).

Since the sample size of 60 respondents is small, attempts were made to increase the sample size but it was extremely hard to get more participants - hence the SEM analysis and the estimation of the goodness of fit parameters, though acceptable, would be limited by the sample size.

### 4.5 Statistical Software

Statistical software packages such as Minitab, AMOS (Analysis of Moment Structures) Version 7, SPSS and LISREL were used in different aspects of the statistical analysis of the data. Minitab was used for stepwise regression and ANOVA. AMOS was used for SEM analysis and LISREL was used to check some of the results of the other software. SPSS was used to compute the Cronbach \(\alpha\) reliability analysis of the data.

AMOS is a Microsoft Windows program comprising of two core modules, AMOS Graphics and AMOS Basic (Kline, 2005). AMOS Graphics offers a GUI through which the user can specify the model by drawing it on the screen. All other features
of the analysis are also controlled through this GUI. A full set of tools is offered under AMOS Graphics for drawing, modifying, or aligning graphical elements of model diagrams. AMOS Graphics attempts to prevent errors in model specification.

Other unique features of AMOS include the capability to compute bootstrapped estimates of standard errors and confidence intervals for all parameter estimates. Both nonparametric bootstrapping (when a raw data file is analysed) and parametric bootstrapping that assumes multivariate normality (when a matrix summary of the data is analysed) are offered in AMOS. The program also provides a special maximum likelihood method for raw data files where some observations are missing at random (Kline, 2005).

4.6 Summary

This chapter dealt with the research methodology used in gathering data to test the hypothesised model. It explored the design and structure of the questionnaire and established the measurement instrument to be reliable and valid. Operational definitions and measurements of the variables and analysis procedure of the data were explained. The sampling method used to select the participants in the survey is also discussed. Previous chapters have concentrated on describing the background of the research and the theoretical basis for the hypotheses.

The analysis procedures used in Chapters 5 and 6 are comprehensively explained which included descriptive statistics, ANOVA, Regression and SEM - paths analysis (specifically recursive SEM path analysis) and the respective software packages used in the analysis.

The statistical techniques such as descriptive statistics, ANOVA (including Hsu’s MCB) will be used in assessing the quality management practices of the organisations in the Western Sydney Region. The statistical Structural Equation Modeling SEM path analysis will be used test the whole model and to determine the direct and indirect effects of the categories in the QMAF model.
The following Chapter 5 provides an overall quality management profile of the surveyed organisations. The descriptive statistics highlights the strengths and weaknesses of the organisations surveyed with regard to the various TQM elements in the QMAF model. The ANOVA and Hsu’s MCB analysis provides a comparative analysis of various categories in the QMAF model by organisation size and ANZSIC codes used in the study.
5.1 Introduction

The previous chapter explained the research methodology used in gathering data to test the QMAF model. The design and structure of the questionnaire was also established together with its reliability. Additionally operational definitions and measurements of the variables and analysis procedure of the data were explained.

The data of the questionnaire was used to conduct the statistical analysis as outlined in this chapter and the next Chapter 6.

This chapter provides an overall assessment of the quality management capabilities of the sample of the manufacturing organisations surveyed in the Western Sydney region. Section 5.2 uses descriptive statistics to analyse the various quality elements considered in the model. The practical implications of the findings the descriptive statistics are also discussed. Section 5.3 uses ANOVA and Hsu’s MCB to compare the organisations by size and ANZSIC codes - the findings and practical implications of the ANOVA and Hsu’s MCB are also outlined.

5.2 Basic Descriptive Statistics of the TQM Elements in the QMAF

This section determines the basic descriptive statistics of the TQM elements in the QMAF model followed by the analysis of the results; finally, the conclusions and practical implications of the findings are discussed.

A copy of the survey questionnaire used in the mail-out is in Appendix 3. Appendix 4 is the questionnaire which includes the sub-categories.
5.2.1 Analysis and Results

Below are the results of the descriptive statistics of the TQM elements in the QMAF. The TQM elements have been grouped under the categories used in the QMAF model. The mean, standard error, median, mode, standard deviation, sample variation and Anderson-Darling normality test is computed for each category with a view to assessing the quality management capabilities of the sample studied with regard to the respective categories in the QMAF model and to derive the practical implications associated with the findings. Table 5.1 summarises the descriptive statistics of the QMAF categories.

Table 5.1: Descriptive statistics of the categories in the QMAF model

<table>
<thead>
<tr>
<th>QMAF Categories</th>
<th>Mean</th>
<th>Standard Error</th>
<th>Median</th>
<th>Mode</th>
<th>Standard Deviation</th>
<th>Sample Variance</th>
<th>Anderson-Darling Normality Test</th>
<th>A-Squared:</th>
<th>P-Value:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leadership (L)</td>
<td>47.10</td>
<td>2.82</td>
<td>44.38</td>
<td>37.50</td>
<td>21.84</td>
<td>477.09</td>
<td>0.321</td>
<td>0.522</td>
<td></td>
</tr>
<tr>
<td>Quality Culture (QC)</td>
<td>45.78</td>
<td>2.95</td>
<td>49.17</td>
<td>56.67</td>
<td>22.86</td>
<td>522.74</td>
<td>0.504</td>
<td>0.196</td>
<td></td>
</tr>
<tr>
<td>Improvement Methods (IM)</td>
<td>27.74</td>
<td>2.20</td>
<td>27.44</td>
<td>39.63</td>
<td>17.03</td>
<td>290.07</td>
<td>0.341</td>
<td>0.485</td>
<td></td>
</tr>
<tr>
<td>Partnering Focus (PF)</td>
<td>39.36</td>
<td>2.56</td>
<td>42.14</td>
<td>45.00</td>
<td>19.83</td>
<td>393.30</td>
<td>0.293</td>
<td>0.593</td>
<td></td>
</tr>
<tr>
<td>Human Resources Management (HRM)</td>
<td>35.36</td>
<td>2.54</td>
<td>34.89</td>
<td>34.67</td>
<td>19.68</td>
<td>387.12</td>
<td>0.243</td>
<td>0.757</td>
<td></td>
</tr>
<tr>
<td>Strategy (S)</td>
<td>41.78</td>
<td>3.49</td>
<td>45.29</td>
<td>0.00</td>
<td>27.04</td>
<td>730.96</td>
<td>1.138</td>
<td>0.005**</td>
<td></td>
</tr>
<tr>
<td>Business Processes (BP)</td>
<td>33.96</td>
<td>2.81</td>
<td>37.78</td>
<td>0.00</td>
<td>21.79</td>
<td>474.76</td>
<td>0.728</td>
<td>0.055</td>
<td></td>
</tr>
<tr>
<td>Information/ Knowledge/ Communication (IKC)</td>
<td>31.72</td>
<td>2.63</td>
<td>31.00</td>
<td>23.50</td>
<td>20.40</td>
<td>416.12</td>
<td>0.387</td>
<td>0.377</td>
<td></td>
</tr>
<tr>
<td>Business Outcomes (BO)</td>
<td>36.26</td>
<td>2.70</td>
<td>37.25</td>
<td>25.50</td>
<td>20.92</td>
<td>437.64</td>
<td>0.328</td>
<td>0.512</td>
<td></td>
</tr>
</tbody>
</table>

p<5%**

Additionally Appendix 5 provides the graphical distribution of the scores as histograms and the relevant descriptive statistics of the categories and sub-categories of the QMAF model in Figures 5.1 to 5.48. Below are also detailed statistical description showing the profiles for each category.

Leadership (L)
The mean value is 47.10 close to the 50% mark of the score. The median is 44.38 which indicates that the middle data is below the 50% of the score. The most frequently occurring score is 37.50, the mode. Standard deviation is 21.84.
The Anderson-Darling normality test has a p-value = 0.522 supporting a normal distribution.

Half of the companies surveyed have a score below 44.38 with regard to leadership, 25% had a score above 60.94 and 25% had a score below 35.00.

Leadership has two sub-categories, namely Organisational Leadership and Public Responsibility and Citizenship. The findings with respect to these are presented below.

- **Organisational Leadership (L1)**
  More than 50% of the companies surveyed are below average with regard to leadership, 50% are below 44.38 with regard to leadership, 25% had a score above 65.45, 25% had a score below 35.00.

- **Responsibility and Citizenship (L2)**
  More than 50% of the companies surveyed are above average with regard to leadership, 25% had a score above 68.00 and 25% had a score below 24.00.

**Quality Culture (QC)**
The mean value is 45.78 lower than the 50% mark. The median is 49.17 indicating that the middle data point is close to the 50% mark. The mode is 56.67 which supports the most frequently occurring score is approximately 7% above the 50% mark. The standard deviation is 22.86. The p-values =0.196 in the Anderson-Darling normality test supporting a normal distribution.

The companies surveyed are above average for 50% of the companies with regard to quality culture. One fourth had a score below 28.75 and 25% had a score above 61.67.

The sub-categories of quality culture are Employee Attitudes, Organisational Structure and Internal Partnering. The findings with respect to these are presented below.
• **Employee Attitudes (QC1)**
  More than 50% had a score that was above average, 50% had a score above 60.00, 25% had a score above 80.00 but 25% also were poor and had a score below 20.00.

• **Organisational Structure (QC2)**
  More than 50% have a score that is above average and 50% have a score above 53.33, 25% have a score above 73.33 and another 25% have a score below 26.67 which falls in the poor category.

• **Internal Partnering (QC3)**
  More than 50% of the companies surveyed are below average and 50% of the companies had a score below 42.5, 25% had a score below 28.13 and 25% had a score above 65.00.

**Improvement Methods (IM)**

The mean score is 27.74 which is quite low. The median 27.44 is close to the mean. The mode 39.63 is higher than the mean and median and is the most frequently occurring score. The standard deviation is 17.03. The p-value is 0.485 in the Anderson-Darling normality test supporting a normal distribution.

More than 75% of the companies surveyed were below average with regard to applying improvement methods. 75% had a score below 39.48, 25% had a score between 39.48 and 27.44, 25% had a score between 14.23 and 0.91 - hence more than 25% could be categorised as poor with regard to applying improvement methods. Another 25% had a score between 39.48 and 85.98.

The sub-categories of Improvement Methods are Benchmarking, Total Quality Tools and Continuous Improvement. The findings with respect to these are presented below.
Benchmarking

Benchmarking is further classified into Planning for Benchmarking, Conducting Benchmarking, Analysis of Benchmarks and Action Steps Post-Analysis.

- **Planning for Benchmarks (IM1)**
  
  More than 50% of the companies surveyed were below average with regard to planning for benchmarking, 50% had a score below 37.50. 25% had a score of zero which means 25% did not plan for benchmarking and clearly more than 25% could be classified as poor with regard to planning for benchmarking. Twenty five percent had a score greater than 71.88.

- **Conducting Benchmarking (IM2)**
  
  More than 50% of the companies surveyed were above average with regard to conducting benchmarking, 50% had a score above 60.00. Twenty five percent had a score above 80.00 and 25% had a score below 30.00.

- **Analysis of Benchmarks (IM3)**
  
  More than 50% of the companies surveyed were poor with regard to analysis of benchmarks, 50% had a score below 25.00 and 25% had a score equal to 0.00. A quarter had a score above 60.00.

- **Action Steps Post-Analysis (IM4)**
  
  More than 50% of the companies surveyed had a score below 27.50 with regard to action steps post analysis of benchmarks, 25% had a score above 53.75, 25% had a score between 53.75 and 27.50, 25% had a score between 27.50 and 0.00 and 25% had a score equal to 0.00.

Total Quality Tools

- **Total Quality Tools (IM5)**
  
  Approximately 75% of the companies surveyed were poor with regard to using TQ tools, 25% had a score between 25.45 and 75.45, 25% had a score between 25.45 to 10.91, another 25% had a score between 10.91 and 2.05 and the remaining 25% had a score equal to 0.00 indicating that they did not use any TQ tools.
Continuous Improvement

Continuous Improvement is made up of Initiatives for Continuous Improvement, Supportive Infrastructure Available and Rewards Systems.

- **Initiatives for Continuous Improvement (IM6)**
  More than 50% of the companies surveyed are below average with regard to implementing initiatives for continuous improvement, 50% had a score below 38.57, 25% had a score below 11.43, 25% had a score between 54.29 and 97.14.

- **Supportive Infrastructure Available (IM7)**
  Three-fourths of the companies surveyed were below average with regard to supportive infrastructure available, 75% having a score below 47.83. More than 25% were poor with regard to supportive infrastructure available, 25% had a score between 19.35 and 1.74 and 25% had a score between 88.70 and 47.83.

- **Reward Systems (IM8)**
  More than 75% could be categorised as poor with regard to rewards systems, 75% having a score below 17.50, and 50% of the companies surveyed had a score of 0.00 indicating that they had no rewards system. Only 25% had a score between 17.50 and 100.00.

Partnering Focus (PF)

The mean score is 39.36, similar to quality culture. The median 42.14 is close to the mean. The mode is 45.00 and is significantly lower than the mean and median and is the most frequently occurring score. The standard deviation is 19.83.

Partnering Focus has two sub-categories Customer Focus and Supplier Focus. The findings with respect to these are presented below.

**Customer Focus**

More than 50% of the companies surveyed are below average and 50% have a score below 44.21, 25% have a score below 26.32 and another 25% have a score above 56.84. This suggests that quite a few companies need to work toward a higher customer focus.

• **Understanding Customer Needs (PF1)**
  More than 75% of the companies surveyed scored below average in identifying customer needs, and 25% had a score below 13.33. The distribution is strongly skewed towards the lower score side. This showed a high deficiency in companies' capability of identifying customers' needs.

• **Customer Relationship Management (PF2)**
  More than 50% of the companies surveyed have an above average score for customer relationship management, 25% have a score below 35.00 and 25% have a score greater than 62.50.

• **Customer Satisfaction Determination (PF3)**
  More than 50% of the companies surveyed had a below average score and 50% had a score below 40.00, 25% had a score below 24.00 and 25% had a score above 60.00.

**Supplier Focus**

• **Supplier Focus (PF4)**
  More than 50% of the companies surveyed had a below average score and 50% had a score below 28.89, 25% had a score below 13.89 and another 25% had a score above 50.56.

**Human Resources Management (HRM)**

The mean is 35.36 and the median is close 34.89. The mode is lower than the mean 34.67. The standard deviation is 19.68. The p-value is 0.757, hence it passes the normality test.

Nearly 75% of the companies surveyed were below average with regard to human resource management, 50% had a score below 47.89, 25% had a score below 22.00 and 25% had a score above 47.89.
Human Resources Management consists of the following sub-categories: Employee Development and Employee Empowerment. The findings with respect to these are presented below.

**Employee Development**


- **Recruitment (HRM1)**
  
  More than 50% of the companies surveyed were poor with regard to recruitment practices, 50% had a score below 20.00 and 25% had a score of zero. More than 75% were below average and 25% had a score between 20.00 and 40.00.

- **Training Needs Identification (HRM2)**
  
  More than 50% of the companies surveyed were below average in training needs identification, 25% had a score below 26.67 and 25% had a score between 46.67 and 26.67. Another 25% had a score above 60.00.

- **Training Design (HRM3)**
  
  More than 75% of the companies surveyed were below average with regard to training design, 25% had a score between 27.00 and 42.00. More than 25% could be categorised as poor with regard to training design as 25% had a score below 14.00.

- **Training Delivery (HRM4)**
  
  More than 50% of the companies surveyed were below average. 25% had a score above 60.00 and 25% had a below 22.00 score.

- **Training Evaluation (HRM5)**
  
  More than 25% were above average with regard to training evaluation and 25% had a score above 55.00, 50% had a score below 35.00 and 25% had a score below 15.00.
**Employee Empowerment**

Employee Empowerment is made up of Employee Involvement, Development of Employee Commitment, Support for Team Building and Recognition and Rewards.

- **Employee Involvement (HRM6)**
  More than 50% of the companies surveyed were below average with regard to employee involvement and 50% had a score below 40.00, 25% had a score below 15.00 - therefore more than 25% could be categorised as poor with regard to employee development, and another 25% had a score above 55.00.

- **Developing Employee Commitment (HRM7)**
  More than 50% of the companies surveyed were below average with regard to employee involvement and 50% had a score below 40.00, 25% had a score below 18.13, hence more than 25% could be categorised as poor with regard to employee involvement, and another 25% had a score above 59.38.

- **Support for Team Building (HRM8)**
  More than 50% of the companies surveyed were below average with regard to employee involvement and 50% had a score below 40.00, 25% had a score below 17.00 and hence more than 25% could be categorised as poor with regard to employee involvement while 25% had a score above 55.00.

- **Recognition and Reward Systems (HRM9)**
  More than 50% of the companies surveyed could be classified as poor with regard to recognition and rewards for employees, 50% scoring below 25.00 and 25% getting a score of 5.00. Another 25% had a score above 53.75.

**Strategy (S)**

The mean value is 41.78, the median is 45.29, which is higher than the mean. The mode is 0.00 and the standard deviation is 27.04. The p-value 0.005 suggests that the distribution is not normal.

Half of the companies surveyed are below average with regard to strategy, 25% have a score above 62.35. More than 25% would be classified as poor with regard to strategy management with 25% having a score below 13.24. There appears to be two sets of data with two peaks in the distribution.
Strategy has two sub-categories: Strategy Development and Strategy Deployment. Below are the findings related to these two sub-categories.

- **Strategy Development (S1)**
  Almost 50% of the companies surveyed are below average with regard to strategy development with 50% having a score above 47.86, 25% have a score above 62.86. More than 25% would be classified as poor with regard to strategy development, with 25% below 14.65.

- **Strategy Deployment (S2)**
  Half the companies have a score below average with regard to strategy deployment, 25% have a score above 60.00. More than 25% can be categorised as poor with regard to strategy deployment and 25% have a score equal to zero.

**Business Processes (BP)**

The mean value is 33.96 and the median is close to the mean 37.78. The mode is 0.00. The p-value is 0.055, thus marginally meeting the normal distribution criteria.

More than 75% of the companies surveyed were below average on business processes, 75% had a score below 48.89, 25% had a score below 17.23, hence more than 25% could be categorised as poor with regard to business processes. Twenty five percent had a score between 48.89 and 100.00. There appears to be two sets of data with two peaks.

Business Processes is made up of two sub-categories: Approaches for Redesign of Processes and Measures used for Rating Performance of Business Processes. The findings of these sub-categories are presented below.

- **Approaches for Re-design of Processes (BP1)**
  More than 50% of the companies surveyed were below average on approaches to re-design of business processes, 50% had a score below 35.00, 25% had a score below 17.50, hence more than 25% could be categorised as poor with regard to approaches for re-design of business processes. Another 25% had a score between 52.50 and 100.00.
Measures used for Rating Performance of Business Processes (BP2)

More than 25% of the companies surveyed were above average on measures used to rate performance of business processes, 25% had above 53.33, 25% had a score below 6.67, hence more than 25% could be categorised as poor with regard to measures used to rate performance of business processes.

Information, Knowledge, Communication (IKC)
The mean and median are close- 31.72 and 31.00 respectively. The mode is 23.50 and the standard deviation is 20.40. The p-value is 0.377, hence it passes the normality test.

More than 75% of the companies surveyed were below average with regard to information, knowledge and communication management, 75% had a score below 44.50, 25% had a score between 31.00 and 18.00 and more than 25% could be classified as poor with regard to information, knowledge and communication management as 25% had a score below 18.00.

The sub-categories of Information, Knowledge, Communication are Information Management, Knowledge Management and Communication. Below are the findings of these sub-categories.

- **Information Management (IKC1)**
  More than 50% of the companies surveyed were below average with regard to information management, 25% scoring between 32.00 and 18.25. More than 25% could be categorised as poor with regard to information management, 25% scoring below 18.25 and another 25% scored above 52.75.

- **Knowledge Management (IKC2)**
  More than 75% of the companies surveyed are below average with regard to knowledge management, 75% having a score below 35.36. More than 50% could be classified as poor with regard to knowledge management with 50% having a score below 21.43 and 25% had a score below 4.29.
• **Communication (IKC3)**
  More than 50% of the companies surveyed were below average with regard to communication: 50% had a score below 43.33, 25% had a score below 20.00 hence more than 25% could be classified as poor with regard to communication. Another 25% had a score above 56.67.

**Business Outcomes (BO)**

The mean 36.26 and the median 37.25 are close. The mode 25.50 is higher than the mean and median. The standard deviation is 20.92. The p-value is 0.512 supporting a normal distribution.

Almost 75% of the companies surveyed had below average business outcomes with 75% having a score below 49.63. More than 25% were poor with regard to business results with 25% having a score below 21.63.

The sub-categories of Business Outcomes are Business results and Customer and Stakeholder Value. Below are the findings of these sub-categories.

*Business Results*

Business results further consists of Measures used for Evaluating Overall Company Performance and Approaches used to link Performance Measures with Quality Improvement.

• **Measures used for Evaluating Overall Company Performance (BO1)**
  More than 50% of the companies surveyed were below average with regard to measures used for evaluating overall company performance, with 50% scoring below 41.16. More than 25% could be considered to be poor in this area with 25% scoring below 21.73. Only 25% score above 55.38.

• **Approaches Used to Link Performance Measures with Quality Improvement (BO2)**
  Almost 75% of the companies surveyed were below average with regard to approaches used to link performance measure with quality improvement. More than 25% could be categorised as poor.
**Customer and Stakeholder Value**

Customer and Stakeholder Value comprises of Measures used for Assessing Customer Value, Measures used for Assessing Contribution to the Environment and Measures used for Assessing Contribution to the Community.

- **Measures used for Assessing Customer Value (BO3)**
  More than 50% of the companies surveyed were below average with regard to measures used for assessing customer value, with 50% scoring below 40.00. A significant number could be considered to be poor in this area with 25% scoring below 30.00. Only 25% score above 60.00.

- **Measures used for Assessing Contribution to the Environment (BO4)**
  More than 75% scored below average in measures used for assessing contributions to the environment and more than 50% could be categorised as poor in this area with 25% getting a score of zero.

- **Measures used for Assessing Contribution to the Community (BO5)**
  Half of the companies surveyed scored zero in measures used for assessing contribution to the community, 25% scored between 0.00 and 40.00 and another 25% scored above 40.00.

### 5.2.2 Conclusions and Practical Implications

The inferences drawn from the descriptive statistical analysis are outlined below:

**Leadership (L)**

The results of the survey indicate that there is a fair amount of awareness with regard to leadership. Approximately a quarter of the subjects demonstrated strong leadership and half could be classified as below average.

The trend in organisational leadership and public responsibility and citizenship was very similar to overall leadership.

Organisations performing below average in leadership could learn from those with a higher score as to how:
• their senior managers communicate effectively values that their organisation stands for; short and long term directions of the organisation; expectations related to organisational and individual performance;
• their manager’s are able to translate performance review into priorities for improvement and innovation;
• the organisation have well established procedures to encourage suppliers/partners to improve and innovate and thereby ensure organisational alignment;
• the senior managers use performance review findings to improve their own leadership effectiveness and their leadership systems;
• managers in the organisation understand how the overall performance measures compare to major competitors;
• the orientation of the organisation shifts from managing functions to managing key business processes;
• middle managers in the organisation are empowered to use their own discretion within broad guidelines to make decisions;
• management in the company create a total quality organisation through a well trained and empowered workforce;
• managers make employees aware of the link between their specific jobs and its impact on the quality of the organisation’s output;
• the organisation assesses the impacts on society of their products, services an operations through addressing regulatory and legal requirements of processes, measures and targets; address risks associated with products, services and operations; anticipate public concerns with current and future products, services and operations; accomplish ethical business practices in all stakeholders transactions and interactions;
• the organisation, its senior managers, and employees actively support community involvement and enthusiastically determine ways in which the organisation could support community projects and activities.

(MBQP 2001; MSU Logistics SCM Research)
Quality Culture (QC)
There was an appreciable amount of awareness among the subjects with regard to quality culture with a quarter showing existence of strong quality culture with another quarter being below average. Similar observations were made with regard to employee attitude, organisational structure, and internal partnering. However internal partnering appeared to have three clusters of data.

Organisations performing below average in quality culture could learn from those with a higher score as to how:

- employees individually and collectively accept responsibility for quality;
- the specialised quality department is viewed as facilitating quality improvement and not being solely responsible for quality improvement;
- the organisation ensures that there are formal quality management practices in all functional areas;
- the organisation acknowledge the importance of functional excellence but focuses on performance achievement;
- teams have the following objectives setup namely achieve specified quality standards; teams share work within the team on an equitable and efficient basis; teams work effectively with other team members; teams apply the next customer concept; teams reach production targets; teams perform routine maintenance; improve work area layout; look for improvement possibilities continuously.

(Tan, 1997; Anderson and Sohal 1999)

Improvement Methods (IM)
Most of the companies surveyed were quite weak with regard to using improvement methods.

A quarter of the companies did not even have a plan for benchmarking; most of the others had an awareness of planning for benchmarking but were well below optimum. However, the results with regard to conducting benchmarking were a lot better compared to planning for benchmarking, indicating that most companies did conduct some form of benchmarking. As far as analysis of benchmarking goes, the concept was non-existent with a quarter of the companies the others showing a weak
effort towards conducting any analysis. Performance of the companies with regard to action steps post-analysis was comparable to analysis for benchmarking.

The companies demonstrated a dismal result with regard to usage of total quality tools. A quarter did not use any TQ tools at all, most of the remaining participants demonstrated a very minimal attempt to use TQ tools, with a small minority demonstrating appreciable usage of TQ tools.

The results with regard to initiatives for continuous improvement were mildly better than the performance with regard to usage of TQ tools. The results on initiatives for continuous improvement appear to form two clusters. The results on supportive infrastructure available share some similarities with those of initiatives for continuous improvements. The companies surveyed leave a lot to be desired in the area of reward systems.

Organisations need to strongly consider benchmarking as an improvement method tool. Benchmarks must align with the organisation’s strategic plans, ensure the quality of data for performance measurement is high; analysis of benchmarks are used to determine the current competitive gap; project future performance levels; establish functional goals; implement specific actions and monitor progress; factors critical for improved performances must be identified post-analysis of benchmarks; findings of analysis must be communicated to the relevant people to plan and implement change. and that periodic follow-ups are conducted to verify outcomes of implemented change in relation to benchmark target. The organisation must share benchmarking and information on best practices/processes results with suppliers.

Organisations must effectively apply total quality tools. Organisations which scored highly and demonstrated a high degree of application of TQ tools could serve as a model as to how TQ applications can be used appropriately to deliver strong performance improvements. The TQ tools to be considered are flowcharts, cause and effect diagrams, multi voting, affinity diagrams, process action teams, election grids, task lists, Deming cycle (PDCA), sampling techniques, scatter diagrams, Pareto charts, run charts, control charts, histograms, process mapping tools, FMEA (Failure Mode and Effect Analysis), QFD (Quality Function Development), creativity tools/
idea generation tools, display/visualisation tools, standardisation tools, 5S and Taguchi methodology of experimental design.

The cluster of organisations which performed better with regard to continuous improvement could provide know-how with regard to the following:

- how an organisation successfully utilises time-based logistics with customers and/or suppliers such as continuous replenishment, quick response, just-in-time, defect reduction and waste evaluation;
- how the organisation significantly reduces the number of suppliers to improve operational integration;
- how the quality department initiates, plans and implements quality initiatives with various departments; facilitates and conducts quality enhancement efforts under the leadership of top management; provides training for quality and inspection;
- how organisations use team processes such as quality circles, quality problem-solving team (Multi-departmental teams brought together to solve specific management-directed problems), Quality improvement team (Multi-departmental teams that generate their own projects from broad management briefs);
- how supporting infrastructure for quality improvement is provided by a body of senior managers who regularly meet to steer continuous improvement activities;
- how continuous improvement (CI) processes are strengthened through training of personnel, monitoring of CI process, top management support for CI programs, CI project leaders, suggestion schemes, application of PDCA, promotions through notice boards, internal media, face-to-face communication, use of ISO 9000, total productive maintenance regimes, formal policy deployment protocols and time studies;
- how the organisation must actively encourage best practice implementation;
- how CI processes are supported by incentive schemes and through competitions and awards.

(Anderson and Sohal 1999; Adam, 1997; MSU Logistics SCM Research; Camp 1989; Tan, 1997; Cook and Dale, 1995; Hyland et al. 2000; Bunney and Dale, 1997)
Partnering Focus (PF)

The results indicate that many companies are not good at understanding customer needs, though they are average with having systems for customer relationship management and are below average when it involves customer satisfaction determination.

Though awareness exists with regard to customer focus, there is a lot more to be done by companies toward building customer focus. There are major deficiencies observed in the areas of understanding customer needs. The results with regard to customer relationship management were reasonable, though there exists a lot of room for improvement. Customer satisfaction determination was marginally lower when compared to customer relationship management, demonstrating the need to put efforts toward upgrading this area.

The results indicate that a fair bit needs to be done in building strong supplier partnering by most of the companies surveyed. There appears to be two clusters of data, one with higher supplier focus compared to the other.

Most organisations need to upgrade their customer focus processes and ensure that the following are effectively implemented:

• Customer needs are determined by the following means: telephone surveys, feedback from sales personnel, formal customer surveys, focus groups, competitor analysis, data-mining approaches.

• It should be easy for customers to seek information about the organisation’s products and services; to comment about the organisation’s products and services; to complain about the company’s products and/or services.

• There should be company toll free number, and a website with a section to log customer complaints and to request for information.

• Research must be conducted to project future customers and predict what their key requirements are likely to be.

• Accommodate a wide range of unique customer requests by implementing pre-planned solutions.
• The organisation must have supply chain arrangements with customers that operate under principles of shared rewards and risks.
• There should be systems which identify customer’s current needs, future needs, level of satisfaction and customer loyalty.
• Customer satisfaction results must be used in decision making of marketing and sales initiatives.

The organisations lying in the higher cluster of scores for supplier focus could provide useful insights with regard to:
• willingness to share strategic information with selected suppliers;
• supplier selection based on formal evaluations and assessments;
• the practice of supplier contracts for key raw materials/suppliers;
• the practice of not working with suppliers who lack environmental awareness;
• the practice of considering strategic direction, role and performance of their supply chain partners being critical to achieving success;
• the practice of helping suppliers finance capital equipment;
• considering helping suppliers finance capital equipment;
• sharing research and development costs and results with primary suppliers;
• sharing responsibility with suppliers in new product/service development and commercialization;
• facilitating a strong supply network fostering cooperation with entire chain of primary and secondary suppliers

(MBQP, 2001; Anderson and Sohal 1999; Tan, 1997; MSU Logistics SCM Research; Lagorsen, 2001; Standards Australia, 2008)

**Human Resources Management (HRM)**

Almost three-fourths of the companies surveyed could be classified as being below average with regard to human resources management.

The human resources management results could be attributed to poor recruitment practices, below average with regard to training needs identification of employees, and lack of good training designs. Though training delivery methods were also below
average for about half the companies surveyed, methods for training evaluation was very inferior for most companies.

There was below average evidence of employee involvement and developing employee commitment with roughly half the companies surveyed. Support for team building performed comparably with employee involvement and developing commitment. Recognition and reward systems were virtually non-existent for a very significant number of companies surveyed.

Organisations with below average scores could enhance their employee development and involvement by applying the processes used by organisations with higher scores in the human resources management area. Special attention should be paid to the following:

- In the selection of staff, organisations must look for ‘Critical to Quality’ attributes in the biographical data of candidates and use pre-employment testing in employee selection.
- Training needs require to be identified based on: performance appraisals, business requirements and staff profiles.
- Human resource department providing advice and researching the market to identify good quality external training resources, products and courses.
- Application of various modes of training such as lectures and presentations, coaching/mentoring, self-directed learning, discussion formats, instructional simulations, role-plays, interactive multimedia training, other training technologies (satellite broadcasts, cable broadcasts, video-conferencing, virtual classrooms, video tapes, narrated slide presentations, audio tapes).
- The perspective of all stakeholders being considered and being met in designing training programs.
- Trainers must be capable to focus and build on learners’ strengths and weaknesses, create an accepting and encouraging mood for learners, give learners verbal cues about their performance, be generous with sincere compliments and positive constructive criticism, encourage learners to ask questions.
• The organization must have active programs to capture the experience and expertise of individuals and transfer this knowledge throughout the organisation.

• Training programs should be evaluated based on the following success criteria: there are costs benefits and maximum utility of the training program; the training programs achieve their key objectives; the net effects of training programs are benchmarked; the training programs are ethical.

• The organization must have processes in place to foster the following in employee involvement: educating, enabling and encouraging.

• The organization must implement a number of innovative approaches to job and work design such as self-directed teams throughout all areas of the organisation.

• The organization must implement a reliable performance assessment system that is linked to a reward system.

• Design human resources systems to promote flexibility among members of the workforce, cooperation among members of the workforce, and open communication among members of the workforce.

• Encourage suggestions for business improvements to permeate from the bottom of the organisational hierarchy.

• Tailor employee involvement activities to change attitudes of employees resisting change.

• Adopt a through prevention-based approach to employee safety and well-being.

• Use a wide variety of methods to measure and improve employee satisfaction, to enable teams to be autonomous.

• Ensure that there are processes to identify employee/team competency; training requirements in order to deliver skills to employees/team members; training requirements in order to build commitment among employees/teams.

• The organisation must utilise cross-functional work teams for managing day-to-day operations.

• Employees must feel well recognized for their accomplishments.

• Link a significant portion of employee performance and productivity.
• The organisation’s compensation and reward system must encourage adherence to stated policies and procedures.
• The organisation’s compensation, incentive and reward systems must encourage integration and harmonisation of activities and processes.
(MBQP, 2001; Vinten, 2000; Truelove, 1992; MSU Logistics SCM Research; Newby, 1992; Adam et al. 1997; Tan, 1997; Anderson and Sohal 1999; Martinez Lorente et. al., 1999; MBQP, 1997; Honold, 1997; Briggs and Koegh, 1999)

Strategy (S)
There is evidence that there is awareness of the concept of strategy among most companies; however, there appears to be two clusters in the data collected in the survey. Strategy development and deployment seems to follow closely with the trend observed in overall strategy scores. A significant part of the companies surveyed, strategy deployment was not existent.

Since most companies surveyed are weak with regard to strategy development and deployment, it would be essential to review their quality systems and implement the following and additionally reapplication of systems implemented by those companies with high scores would be helpful:
• Ensure their overall strategic planning process contains key steps; key participants; short-term planning time horizons and long-term planning time horizons.
• The strategic planning process must address the objectives and challenges related to the following: customer and market needs/expectations/opportunities; competitive environment and capabilities relative to competitors; technological and other changes that might affect product/services/operations; strengths and weaknesses, including human and other resources; supplier/partner strengths and weaknesses; financial societal, and other potential risks and environmental issues.
• have key objectives and timetables for accomplishing its strategic plans.
• collaborate with key customers and suppliers in developing it’s strategic plans.
• have well established procedures to develop and deploy action plans, based on the strategic plan, to achieve key objectives.
• have key performance measures/indicators for tracking progress relative to their action plans and stakeholders.

• have procedures to feedback differences in comparative information to modify the action plans.

( MBQP, 2001; MSU Logistics SCM Research; Anderson and Sohal, 1999)

Business Processes (BP)

More than three-fourths of the companies surveyed were below average with regard to business processes and a very significant number of these could be categorised as poor in business processes. There appears to be two sets of companies among the companies surveyed. The reasons for the level of performance of companies are clearly reflected in the fact that they have rather limited approaches for redesign of processes and measures used for rating performance of business processes.

Since most companies surveyed are weak with regard to having effective business processes, it would be essential to review their quality systems and implement the following, and additionally reapplication of systems implemented by those companies with high scores would be helpful:

• Methodologies for product design processes need to involve getting inputs from all departments.

• employing a systematic process for incorporating new and changing customer requirements into product/service design.

• demonstrating substantially reduced facility and operational complexity over time.

• redesigning the logistic system for greater environmental efficiency.

• logistical capability must be significantly more responsive (pull) as compared to predetermined (push) over time.

• Active involvement in initiatives to standardise supply-chain practices and operations.

• Data on key process measures must be collected on a regular basis.

• The organisation must have valid control strategies to keep all process measures within standards or acceptable levels.
• The organisation must use activity-based costing.
(Anderson and Sohal, 1999; MSU Logistics SCM Research)

**Information, Knowledge, Communication (IKC)**

More than 75% of the companies were below average with regard to information, knowledge and communication management, with a large proportion showing very inferior systems. A significant number of companies demonstrated that they had no knowledge management systems at all.

Organisations can improve their Information, Knowledge and Communication systems by:

• using software packages to facilitate the administrative work associated with the development of quality management systems to meet ISO 9000 standards;
• using ICT to manage reporting systems, data collection and analysis of data and decision making process;
• ensuring the organisation’s information systems capture and maintain information on changes in customer needs;
• ensuring that the information systems capture and maintain information on changes in customer needs;
• ensuring the information available in the organisation is accurate, timely and formatted to facilitate easy use;
• ensuring the firm obtains information directly from customers to facilitate operational plans and reduce reliance on forecasting;
• ensuring logistics operating and planning databases are integrated across applications within the organisation;
• ensuring the organisation maintains an integrated database and access method to facilitate information sharing;
• ensuring the organisation actively utilises industry standards for data exchange
• ensuring the ICT systems are designed to facilitate cross-organisational data exchange;
• ensuring information systems in the organisation are being expanded to reflect more enterprise wide integrated processes (ERP), facilitate electronic commerce using internet capability;
• ensuring the organisation shares technical resources with key suppliers to facilitate operations;
• ensuring the organisation has developed information linkages with customers that permit substantial last minute accommodation without loss of planned efficiencies;
• ensuring that the organisation has increased the use of integrated inventory, transportation and warehousing planning systems and EDI standards;
• collecting comparative and competitor data on product and service quality, supplier performance, employee data, internal operations and support functions and other appropriate processes and functions;
• verifying if the comparative and competitor data on benchmarking is reliable for product and service quality, customer satisfaction, supplier performance, HR practices, internal operations and support functions and other appropriate processes and functions;
• ensuring the organisation has designed data collection and reporting systems around the needs of the managers and employees who use the data to plan and make decisions;
• ensuring the organisation has knowledge management systems that collect state of the art information on best practices in business, innovative quality systems;
• ensuring the organisation effectively shares operational information between departments;
• building adequate capability to share externally standardised information and customised information;
• ensuring performance measurement data is available on a more timely basis over time.

(Martinez Lorente et al. 1999; MSU Logistics SCM Research; Anderson and Sohal 1999; Bhatt, 2001; Howe et al., 2000; Ngai and Cheng, 1998)

**Business Outcomes (BO)**
Almost one-fourth of the companies surveyed were above average with regard to business outcomes and another one-fourth could be classified as poor in this area. The composite score in business outcomes is comparable to scores on measures used for evaluating overall company performance and measures used for assessing
customer value. However, approaches used to link performance measures with quality improvement performed were lower than the above mentioned characteristics. Measures for assessing contribution to the environment had even poorer scores, with one-fourth of the companies surveyed having no measures at all in this area. Measures used for assessing contribution to the community were the poorest with half the number of companies surveyed making no measures at all in this area.

- Organisations deficient in achieving good business outcomes - namely business results, customer and stakeholder value - could gain from learning about the practices of those who scored above average in business outcomes. The organisation must use ‘balanced scorecard’ approach to measurement.
- The categories used for measuring organisation performance must be customer satisfaction, employee satisfaction, financial performance, product/service quality, supplier performance, operational performance and each should have 2—3 measures all showing improvement trends internally and compared to competitors.
- The organisation must demonstrate gains in market share relative to major competitors’ market share.
- All key business decisions and plans must be based upon an analysis of performance data.
- The implementation of change based on gaps identified through benchmarking must lead to improvement in performance levels.
- There must be evidence of continuous improvements in the education/training as a result of training evaluations.
- Employee participation leads to improved communication with employees, involvement of employees in decision-making resulting in successful attaining of organisational objectives.
- The organisation must thoroughly understand the link between different types of measures such as the relationship between customer satisfaction and quality, with financial performance.
- The organisation must increase operational flexibility through supply-chain collaboration.
The organisation must evaluate and make many major improvements in its measures and data collection and reporting methods.

Performance in business outcomes can be monitored for the following:

- Trends in gaining and avoiding losses of customers.
- Customer’s estimation of the organisation’s quality of products and services.
- Environmental performance and measures of environmental performance when compared to other organisations in the same industry.
- Public health performance and measures of public health performance compared to other organisations in the same industry

(Anderson and Sohal, 1999; MBQP, 1997; Camp, 1989; Lindsay and Preston, 2000; MSU Logistics SCM Research)

5.3 ANOVA

As mentioned in the previous chapter ANOVA and Hsu’s MCB were applied to the different categories in the QMAF model in order to compare the organisations by size and ANZSIC codes. In the completely randomised design, subjects under study are allocated randomly to treatments. The completely randomised design is made up of only one independent variable, with two or more treatment levels or classifications (Black, 2008).

Analysis of Variance (ANOVA) and Hsu’s MCB (Gupta and Hsu, 1985 and Minitab, 2000) techniques were used to explore the variance between the means of large, medium and small organisations for the categories in the QMAF model. The ANOVA technique was also applied to examine the variance between the means of the various ANZSIC codes of industries for the categories of the QMAF model considered in this study. For example, in comparing the variance between the means of scores of different groups (large, medium and small organisations) on leadership in the QMAF, the analysis would either confirm or reject the proposition that leadership in large organisations is the same as in medium or small organisations.

Only 56 of the 60 cases were used in this analysis since four subjects did not disclose their size and ANZSIC codes. In the ANOVA of the ANZSIC codes only 51 of the
56 cases were used since five cases of ANZSIC codes - namely 20, 22, 24, 31 and 38 - had only one data point each.

5.3.1 Analysis and Results of the Comparison of the QMAF Categories by Size

Below are the results and analysis of the comparison of the QMAF categories by size.

Leadership (L)

$H_{01}$: The mean of leadership is the same for all sizes of organisations is rejected as $(p = 0.006)$. Hsu’s MCB shows that the mean of leadership scores for large organisations is the best and is significantly higher than medium and small organisations (which are not significantly different) (family error rate 0.100). Figure 5.49 provides the box plot in Appendix 5.

Practical Implications

Medium and small size organisations have a lot to gain from reapplying leadership practices used by the large organisations that were surveyed.

Quality Culture (QC)

$H_{02}$: The mean of quality culture is the same for all sizes of organisations is rejected as $(p=0.036)$.

Hsu’s MCB shows that the mean of quality culture scores for large organisations is the best and is significantly higher than medium organisations. (family error rate 0.100). The mean of the small size is also significantly higher than the medium size mean since its corresponding confidence interval is positive and since the upper interval endpoint of the medium size is zero, the smallest it can be. Figure 5.50 provides the box plot in Appendix 5. The box plots indicate that there is a significant difference between large and small size as well though not as large as between large and medium.
Practical Implications

Medium organisations have a lot to gain from reapplying quality culture practices used by the large organisations that were surveyed. Small size organisations can also benefit from the quality culture practices of large organisations.

**Improvement Methods (IM)**

$H_{03}$: The mean of improvement methods is the same for all sizes of organisations is rejected as ($p=0.002$).

Hsu’s MCB shows that the mean of improvement methods scores for large organisations is the best and is significantly higher than medium and small organisations. (family error rate 0.100). Figure 5.51 provides the box plot in Appendix 5.

Practical Implications

Medium and small size organisations have a lot to gain from reapplying improvement methods practices used by the large organisations that were surveyed.

**Partnering Focus (PF)**

$H_{04}$: The mean of partnering focus is the same for all sizes of organisations is rejected as ($p=0.012$).

Hsu’s MCB shows that the mean of partnering focus scores for large organisations is the best and is significantly higher than medium and small organisations. (family error rate 0.100). Figure 5.52 provides the box plot in Appendix 5.

Practical Implications

Medium and small size organisations have a lot to gain from reapplying partnering focus practices used by the large organisations that were surveyed.

**Human Resources Management (HRM)**

$H_{05}$: The mean of human resource management is the same for all sizes of organisations is rejected as ($p=0.016$).
Hsu’s MCB shows that the mean of human resources management scores for large organisations is the best and is significantly higher than medium organisations. (family error rate 0.100). The mean of the small size is also significantly higher than the medium size mean since its corresponding confidence interval is positive and since the upper interval endpoint of the medium size is zero, the smallest it can be. Figure 5.53 provides the box plot in Appendix 5. The box plots indicate that there is a significant difference between large and small size as well, though not as large as between large and medium.

Practical Implications
Medium organisations have a lot to gain from reapplying human resources management practices used by the large organisations that were surveyed. Small size organisations can also benefit from the human resources management practices of large organisations.

Strategy (S)
H06: The mean of strategy is the same for all sizes of organisations is accepted as (p=0.321). Figure 5.54 provides the box plot in Appendix 5.

Business Processes (BP)
H07: The mean of business processes is the same for all sizes of organisations is accepted as (p=0.275). Figure 5.55 provides the box plot in Appendix 5.

Information/Knowledge/Communication (IKC)
H08: The mean of information/knowledge/communication is the same for all sizes of organisations is accepted as (p=0.173). Figure 5.56 provides the box plot in Appendix 5.

Business Outcomes (BO)
H09: The mean of information/knowledge/communication is the same for all sizes of organisations is rejected as (p=0.099).

Hsu’s MCB shows that the mean of business outcomes scores for large organisations is the best and is significantly higher than medium organisations. The mean of the
small size is also significantly higher than the medium size mean since its corresponding confidence interval is positive and since the upper interval endpoint of the medium size is zero, the smallest it can be. (family error rate 0.100). Figure 5.57 provides the box plot in Appendix 5. The box plots indicate that there is a significant difference between large and small size as well, though not as large as between large and medium.

Practical Implications

Medium organisations have a lot to gain from reapplying business outcomes practices used by the large organisations that were surveyed. Small size organisations can also benefit from the business outcomes practices of large organisations.

All the above null hypotheses were rejected at 10% and lower level of significance except strategy, business processes and information, knowledge, communication. The results of the one way ANOVA and Hsu’s MCB between large, medium and small organisations are summarised in Table 5.2.
Table 5.2: Means and One Way ANOVA and Hsu’s MCB test between large, medium and small organizations for the categories in the QMAF

<table>
<thead>
<tr>
<th>Categories</th>
<th>Size</th>
<th>Number (N)</th>
<th>Mean</th>
<th>F-values (p-value)</th>
<th>Hsu's MCB (Multiple Comparisons with the Best)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lower</td>
<td>Centre</td>
</tr>
<tr>
<td>Leadership (L)</td>
<td>Large</td>
<td>16</td>
<td>60.70</td>
<td>5.69 (0.006****)</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>33</td>
<td>39.77</td>
<td></td>
<td>-31.13</td>
</tr>
<tr>
<td></td>
<td>Small</td>
<td>7</td>
<td>44.46</td>
<td></td>
<td>-31.41</td>
</tr>
<tr>
<td>Quality Culture (QC)</td>
<td>Large</td>
<td>16</td>
<td>57.71</td>
<td>3.55 (0.036**)</td>
<td>-3.37</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>33</td>
<td>39.65</td>
<td></td>
<td>-29.20</td>
</tr>
<tr>
<td></td>
<td>Small</td>
<td>7</td>
<td>44.53</td>
<td></td>
<td>-29.74</td>
</tr>
<tr>
<td>Improvement Methods (IM)</td>
<td>Large</td>
<td>16</td>
<td>39.43</td>
<td>7.15 (0.002***)</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>33</td>
<td>22.12</td>
<td></td>
<td>-25.01</td>
</tr>
<tr>
<td></td>
<td>Small</td>
<td>7</td>
<td>22.56</td>
<td></td>
<td>-28.32</td>
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<tr>
<td>Partnering Focus (PF)</td>
<td>Large</td>
<td>16</td>
<td>50.81</td>
<td>4.81 (0.012**)</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>33</td>
<td>33.03</td>
<td></td>
<td>-26.26</td>
</tr>
<tr>
<td></td>
<td>Small</td>
<td>7</td>
<td>36.22</td>
<td></td>
<td>-27.51</td>
</tr>
<tr>
<td>Human Resources Management (HRM)</td>
<td>Large</td>
<td>16</td>
<td>45.39</td>
<td>4.45 (0.016**)</td>
<td>-5.45</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>33</td>
<td>28.71</td>
<td></td>
<td>-25.92</td>
</tr>
<tr>
<td></td>
<td>Small</td>
<td>7</td>
<td>37.08</td>
<td></td>
<td>-22.07</td>
</tr>
<tr>
<td>Strategy (S)</td>
<td>Large</td>
<td>16</td>
<td>47.87</td>
<td>1.16 (0.321)</td>
<td>Since p-value is high there is no difference between the means of large, medium and small sizes.</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>33</td>
<td>35.61</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Small</td>
<td>7</td>
<td>42.69</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Business Processes (BP)</td>
<td>Large</td>
<td>16</td>
<td>40.42</td>
<td>1.32 (0.275)</td>
<td>Since p-value is high there is no difference between the means of large, medium and small sizes.</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>33</td>
<td>30.71</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Small</td>
<td>7</td>
<td>27.30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Information/Knowledge/Communication (IKC)</td>
<td>Large</td>
<td>16</td>
<td>40.09</td>
<td>1.81 (0.173)</td>
<td>Since p-value is high there is no difference between the means of large, medium and small sizes.</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>33</td>
<td>28.17</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Small</td>
<td>7</td>
<td>30.64</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Business Outcomes (BO)</td>
<td>Large</td>
<td>16</td>
<td>45.22</td>
<td>2.42 (0.099*)</td>
<td>-4.83</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>33</td>
<td>31.24</td>
<td></td>
<td>-24.43</td>
</tr>
<tr>
<td></td>
<td>Small</td>
<td>7</td>
<td>34.50</td>
<td></td>
<td>-26.26</td>
</tr>
</tbody>
</table>

p<1%***; p<5%**; p<10%*
5.3.2 Analysis and Results of the QMAF Categories by ANZSIC Codes

The description of the ANZSIC codes considered in this study is tabled in Table 5.3.

Leadership (L)

$H_{010}$: The mean of leadership is the same for all ANZSIC codes is accepted as $(p=0.282)$. Figure 5.58 provides the box plot in Appendix 5.

Quality Culture (QC)

$H_{011}$: The mean of quality culture is the same for all ANZSIC codes is rejected as $(p=0.075)$.

Hsu’s MCB indicates that the mean score of quality culture for ANZSIC code 28 (Chemicals and Allied Products) is the best and significantly higher than the mean score of quality culture for ANZSIC codes 34 (Fabricated Metal Products, Except Machinery and Transportation Equipment), 35 (Industrial and Commercial Machinery and Computer Equipment) and 37 (Transportation Equipment) organisations. Additionally ANZSIC codes 25 (Furniture and Fixtures), 30 (Fabricated Metal Products, Except Machinery and Transportation Equipment), 36 (Electronic and other Electrical Equipment and Components, except Computer Equipment) and 39 (Miscellaneous Manufacturing Industries) are also significantly higher than ANZSIC codes 34, 35 and 37. Hsu’s MCB analysis was used at family error rate 0.100. Figure 5.59 provides the box plot in Appendix 5.

Practical Implications

ANZSIC codes 34 (Fabricated Metal Products, Except Machinery and Transportation Equipment), 35 (Industrial and Commercial Machinery and Computer Equipment) and 37 (Transportation Equipment) organisations can gain considerably from reapplying the quality culture practices of ANZSIC code 28 (Chemicals and Allied Products). ANZSIC codes 34, 35 and 37 can also benefit from the quality culture practices of ANZSIC codes 25 (Furniture and Fixtures), 30 (Fabricated Metal Products, Except Machinery and Transportation Equipment), 36 (Electronic and other Electrical
Equipment and Components, except Computer Equipment) and 39 (Miscellaneous Manufacturing Industries).

**Improvement Methods (IM)**

$H_{012}$: The mean of improvement methods is the same for all ANZSIC codes is accepted as ($p=0.343$). Figure 5.60 provides the box plot in Appendix 5.

**Partnering Focus (PF)**

$H_{013}$: The mean of partnering focus is the same for all ANZSIC codes is accepted as ($p=0.174$). Figure 5.61 provides the box plot in Appendix 5.

**Human Resources Management (HRM)**

$H_{014}$: The mean of human resources management is the same for all ANZSIC codes is rejected as ($p=0.096$).

Hsu’s MCB shows that the mean score of human resources management for ANZSIC code 28 (Chemicals and Allied Products) is the best mean score and that the mean of ANZSIC code 39 score is comparable to 28. Hence the means of ANZSIC codes 28 and 39 are significantly higher than the mean scores of human resources management for ANZSIC codes 30 (Rubber and Miscellaneous Plastics Products), 34 (Fabricated Metal Products, Except Machinery and Transportation Equipment) and 35 (Industrial and Commercial Machinery and Computer Equipment) organisations. Additionally the means of ANZSIC codes 25 (Furniture and Fixtures), 36 (Electronic and other Electrical Equipment and Components, except Computer Equipment) and 37 (Transportation Equipment) are also significantly higher than means of ANZSIC codes 30, 34 and 35.

Hsu’s MCB analysis was used at family error rate 0.100. Figure 5.62 provides the box plot in Appendix 5.

**Practical Implications**

ANZSIC codes 30 (Rubber and Miscellaneous Plastics Products), 34 (Fabricated Metal Products, Except Machinery and Transportation Equipment) and 35 (Industrial and Commercial Machinery and Computer Equipment) organisations can gain
considerably from reapplying the human resources management practices of ANZSIC codes 28 (Chemicals and Allied Products) and 39 (Miscellaneous Manufacturing Industries). ANZSIC codes 30, 34 and 35 can also benefit from the human resources management practices of ANZSIC codes 25 (Furniture and Fixtures), 36 (Electronic and other Electrical Equipment and Components, except Computer Equipment) and 37 (Transportation Equipment).

**Strategy (S)**

H$_{015}$: The mean of strategy is the same for all ANZSIC codes is accepted as (P=0.542). Figure 5.63 provides the box plot in Appendix 5.

**Business Processes (BP)**

H$_{016}$: The mean of business processes is the same for all ANZSIC codes is accepted as (p=0.506). Figure 5.64 provides the box plot in Appendix 5.

**Information/Knowledge/Communication (IKC)**

H$_{017}$: The mean of information/ knowledge/ communication is the same for all ANZSIC codes is accepted as (p=0.306). Figure 5.65 provides the box plot in Appendix 5.

**Business Outcomes (BO)**

H$_{018}$: The mean of business outcomes is the same for all ANZSIC codes is accepted as (p=0.363). Figure 5.66 provides the box plot in Appendix 5.

Only quality culture and human resources management of above null hypotheses were rejected at 10% and lower level of significance. The one way ANOVA analysis and the Hsu’s MCB analysis of organisations by ANZSIC codes is summarised in Tables 5.4 and 5.5 respectively.
Table 5.3: Description of ANZSIC codes

<table>
<thead>
<tr>
<th>ANZSIC Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>Furniture and Fixtures</td>
</tr>
<tr>
<td>28</td>
<td>Chemicals and Allied Products</td>
</tr>
<tr>
<td>30</td>
<td>Rubber and Miscellaneous Plastics Products</td>
</tr>
<tr>
<td>34</td>
<td>Fabricated Metal Products, Except Machinery and Transportation Equipment</td>
</tr>
<tr>
<td>35</td>
<td>Industrial and Commercial Machinery and Computer Equipment</td>
</tr>
<tr>
<td>36</td>
<td>Electronic and other Electrical Equipment and Components, except Computer Equipment</td>
</tr>
<tr>
<td>37</td>
<td>Transportation Equipment</td>
</tr>
<tr>
<td>39</td>
<td>Miscellaneous Manufacturing Industries</td>
</tr>
</tbody>
</table>
Table 5.4: Means and One Way ANOVA of organisations by ANZSIC codes for the categories of the QMAF

<table>
<thead>
<tr>
<th>Categories</th>
<th>Leadership (L)</th>
<th>Quality Culture (QC)</th>
<th>Improvement Methods (IM)</th>
<th>Partnering Focus (PF)</th>
<th>Human Resources Management (HRM)</th>
<th>Strategy (S)</th>
<th>Business Processes (BP)</th>
<th>Information/ Knowledge/ Communication (IKC)</th>
<th>Business Outcomes (BO)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANZSIC Code</td>
<td>Number (N)</td>
<td>Means</td>
<td>One Way ANOVA</td>
<td>F-value</td>
<td>p-value</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>6</td>
<td>52.92</td>
<td>54.45</td>
<td>32.47</td>
<td>51.55</td>
<td>39.63</td>
<td>32.94</td>
<td>33.71</td>
<td>25.08</td>
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<tr>
<td>28</td>
<td>7</td>
<td>59.64</td>
<td>58.57</td>
<td>41.03</td>
<td>49.90</td>
<td>48.26</td>
<td>50.76</td>
<td>46.35</td>
<td>47.57</td>
</tr>
<tr>
<td>30</td>
<td>5</td>
<td>31.00</td>
<td>43.00</td>
<td>18.97</td>
<td>29.14</td>
<td>20.36</td>
<td>23.30</td>
<td>20.45</td>
<td>22.10</td>
</tr>
<tr>
<td>34</td>
<td>7</td>
<td>39.29</td>
<td>28.57</td>
<td>20.60</td>
<td>29.29</td>
<td>25.65</td>
<td>29.58</td>
<td>24.76</td>
<td>27.86</td>
</tr>
<tr>
<td>35</td>
<td>9</td>
<td>39.44</td>
<td>35.56</td>
<td>24.22</td>
<td>32.86</td>
<td>25.58</td>
<td>40.13</td>
<td>31.11</td>
<td>32.39</td>
</tr>
<tr>
<td>36</td>
<td>8</td>
<td>44.84</td>
<td>51.25</td>
<td>27.63</td>
<td>36.25</td>
<td>35.50</td>
<td>37.79</td>
<td>26.94</td>
<td>30.75</td>
</tr>
<tr>
<td>37</td>
<td>4</td>
<td>40.31</td>
<td>25.00</td>
<td>22.41</td>
<td>26.97</td>
<td>31.89</td>
<td>40.88</td>
<td>32.22</td>
<td>20.75</td>
</tr>
<tr>
<td>39</td>
<td>5</td>
<td>54.75</td>
<td>49.67</td>
<td>24.70</td>
<td>43.28</td>
<td>47.38</td>
<td>55.06</td>
<td>40.89</td>
<td>43.60</td>
</tr>
</tbody>
</table>

One Way ANOVA:

<table>
<thead>
<tr>
<th>ANZSIC Code</th>
<th>Number (N)</th>
<th>F-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>6</td>
<td>1.28</td>
<td>0.282</td>
</tr>
<tr>
<td>28</td>
<td>7</td>
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<tr>
<td>30</td>
<td>5</td>
<td>1.17</td>
<td>0.343</td>
</tr>
<tr>
<td>34</td>
<td>7</td>
<td>1.56</td>
<td>0.174</td>
</tr>
<tr>
<td>35</td>
<td>9</td>
<td>1.89</td>
<td>0.096*</td>
</tr>
<tr>
<td>36</td>
<td>8</td>
<td>0.86</td>
<td>0.542</td>
</tr>
<tr>
<td>37</td>
<td>4</td>
<td>0.91</td>
<td>0.506</td>
</tr>
<tr>
<td>39</td>
<td>5</td>
<td>1.23</td>
<td>0.306</td>
</tr>
</tbody>
</table>

p<10%*
Table 5.5: Hsu’s MCB (multiple comparison with the best) for ANZSIC codes

<table>
<thead>
<tr>
<th>ANZSIC Code</th>
<th>Number (N)</th>
<th>Quality Culture</th>
<th>Human Resources Management</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean (p-value = 0.075)</td>
<td>Lower</td>
</tr>
<tr>
<td>28</td>
<td>7</td>
<td>58.57</td>
<td>-21.24</td>
</tr>
<tr>
<td>30</td>
<td>5</td>
<td>43.00</td>
<td>-42.27</td>
</tr>
<tr>
<td>34</td>
<td>7</td>
<td>28.57</td>
<td>-54.38</td>
</tr>
<tr>
<td>35</td>
<td>9</td>
<td>35.56</td>
<td>-46.00</td>
</tr>
<tr>
<td>36</td>
<td>8</td>
<td>51.25</td>
<td>-30.92</td>
</tr>
<tr>
<td>37</td>
<td>4</td>
<td>25.00</td>
<td>-62.16</td>
</tr>
<tr>
<td>39</td>
<td>5</td>
<td>49.67</td>
<td>-35.60</td>
</tr>
</tbody>
</table>

5.4 Summary

This chapter established the overall profile of the quality management capabilities of the organisations surveyed. Descriptive statistics, ANOVA and Hsu’s MCB were applied in the analysis. The results and interpretation of the statistical analysis of the data have been reported. The descriptive statistical analysis of all the TQM elements in the QMAF have highlighted significant deficiencies in all categories considered in the QMAF model for the industries in the Western Sydney region. Further, certain sections of the population performed better than the others. The conclusion and practical implications of these findings have determined useful managerial guidelines in each QMAF category. Additionally recommendations of reapplying the practices of the sections of the population that performed better than those with weaker results have been outlined.

The ANOVA and MCB analysis have provided useful insights into the various categories in the QMAF model between large, medium and small organisations and also among the ANZSIC codes considered in the study (Tables 5.1, 5.3, and 5.4). The ANOVA analysis of the mean has identified some significant differences between large, medium and small industries and between the ANZSIC codes. These differences could provide useful benchmarks and insights which could be reapplied in the other organisation sizes and the relevant ANZSIC codes.
In order to determine the direct and indirect effects on each of the categories considered in the QMAF model and their final impact on the business outcome category, further statistical analysis was undertaken in Chapter 6 using SEM - recursive pathway analysis.

Chapter 6 provides the study’s analysis and results, and comments on the findings in relation to testing the direct and indirect effects hypotheses and their impact on providing further managerial guidelines on quality management practices.
Chapter 6  
Further Statistical Analysis and Discussion

6.1 Introduction

The previous chapter presented the overall profile of the quality management capabilities of the organisations surveyed. Descriptive statistics, ANOVA and multiple comparison with the best (MCB) were used in the analysis. The descriptive statistical analysis of all the TQM elements in the QMAF have highlighted significant deficiencies in the industries in the Western Sydney region for all the categories considered in the QMAF model.

The ANOVA and MCB analyses have provided valuable managerial implications between large, medium and small organisations and also among the ANZSIC codes for the categories of QMAF considered in the study. The findings inferred significant managerial guidelines and practical implications to quality management practices.

The main objective of this chapter is to glean deeper insights and managerial implications from the direct and indirect effects of the categories in the QMAF and the overall impact of these effects on the business outcome category, further statistical analysis using structural equation modelling (SEM) - recursive path analysis is conducted in this chapter.

This chapter begins with explaining the (SEM) recursive path analysis conducted on the QMAF model in section 6.2, followed by postulating the hypotheses in section 6.2.1. Cronbach’s alpha is used to measure the reliability of the scales to examine how well these items explain the constructs in the QMAF. These results are presented in section 6.2.2. Sections 6.2.3 and 6.2.4 describe the results of SEM recursive path analysis with and without considering the IKC construct respectively. Section 6.2.5 provides the regression analysis of the one to one relationship between IKC and the other QMAF categories.
All in all, the statistical analysis in this chapter tests the \textit{a priori} QMAF model that has been developed in Chapter 3 and addresses the two research questions:

1. Are the proposed relationships between the categories in the QMAF valid?
2. What is the strength of the relationships between the different quality management constructs prescribed by the QMAF criteria?

\subsection{Analysis of the QMAF Model}

Many frameworks to measure organisational quality have been discussed in the quality management literature (Saraph et al. 1989; Flynn et al. 1994; Ahire et al. 1996). Organisational factors related to infrastructural elements such as information management and human resources management have also been studied (Anderson et al. 1995; Flynn et al. 1995; Chen et al. 1997; Poister and Harris, 1997; Lengnick-Hall and Sanders, 1997; Li, 1997; Rungtusanatham et al. 1998; Dow et al. 1999). Dow et al. (1999) surveyed a large, random sample of manufacturing sites to establish the primary dimensions of quality management and examine the relationship between quality practices and quality outcomes. The results revealed that the practices can be divided into nine categories. The workforce commitment, shared vision and customer focus categories combine to yield a positive correlation with quality outcomes. However the other categories benchmarking, use of teams, personnel training, advanced manufacturing systems, just-in-time principles and co-operative supplier relations did not relate to quality outcomes.

Pannirselvam and Ferguson (2001) established the measurement validity of the Baldrige Criteria for Performance Excellence (CPE) by testing a confirmatory factor analysis (CFA) model using 1993 Arizona Governor’s Quality Award (AGQA) applicant data. Samson and Terziiovski (1999) also confirmed the measurement validity of the CPE. They analysed data obtained from a large Australasian manufacturing sample, using a survey instrument based on the 1994 CPE. (Dellana and Hauser, 1999; Dow et al. 1999) through their studies have arrived at similar conclusions with regard to the validity of the CPE.

Flynn and Saladin (2001) used path analysis to assess the hypothesised linkages of the CPE framework. The data was obtained from a sample of manufacturing plants in
the USA and elsewhere. They also inferred that the path models that related to the 1992 and 1997 Baldrige criteria were a better fit to data, in comparison to the path model that corresponded to the 1988 criteria; concluding that the frameworks have improved upon the base established by the original 1988 framework.

A recursive path analytic model determines the observed correlations among the variables to estimate the path coefficients in the model. The QMAF characterises the causal relationships between the quality management systems and organisation results. Therefore, this methodology is suitable for measuring such a relationship. A correlation structure model merges the factor analytic and path analytic models and simultaneously estimates the strength of the relationships between the variables.

This study attempts to validate the QMAF model. Eight constructs - Leadership (L), Quality Culture (QC), Information/Knowledge/ Communication (IKC), Strategy (S), Human Resources Management (HRM), Improvement Methods (IM), Partnering Focus (PF) and Business Processes (BP) -were considered. The strength of the relationships between the constructs and their effects on Business Outcomes (BO) were estimated using (SEM) recursive path analysis. (SEM) recursive path analysis is a type of multivariate method that inspects sets of relationships in linear causal models that are unidirectional. The statistical techniques used with (SEM) path analysis test the appropriateness of a causal model with the use of standardised multiple regression equations. The major limitation is lack of control and inability to deal with all variables in a given model.

AMOS 7 and (LISREL when needed) were used to estimate the factor loadings for each item in the eight construct and the strength of the path coefficients; the adequacy of the whole model was rechecked through manual calculations. A correlation structure model was analysed using AMOS 7 for each direct effect between the eight constructs and Business Outcomes (BO), and the adequacy of the whole model, while the path coefficients for the indirect effects were calculated manually. Since the objective of this research is to establish the validity of the QMAF three configurations of the model’s path diagrams were examined, Figure 6.1 to Figure 6.3. These were supported by the literature and the project.
The standardised path coefficients for the set of causal relationships are presented in Tables 6.2, 6.3 and 6.4. The p-values associated with each path coefficient estimates the statistical significance of the coefficient.

Figures 6.1, 6.2 and 6.3 establish the direct effect of one construct on another by the arrow connecting the two constructs. Indirect effects of constructs can be established by following a set of forward pointing arrows. For example, though there is no direct effect of quality culture on business processes in Figures 6.1 and 6.2, an indirect effect can be established by assessing the direct effects of quality culture on human resources management and improvement methods and the direct effects of these two constructs on business processes.

For example the indirect effect of quality culture on business processes in Figure 6.1 can be calculated as follows:

\[(\text{Direct effect of QC on HRM} \times \text{direct effect of HRM on BP}) + (\text{direct effect of QC on PF} \times \text{direct effect of PF on S} \times \text{direct effect of S on HRM} \times \text{direct effect of HRM on BP}) + (\text{direct effect of QC on IM} \times \text{direct effect of IM on BP}) = (0.533 \times 0.178) + (0.836 \times 0.132 \times 0.139 \times 0.178) + (0.763 \times 0.425) = 0.427^{***}\]

All the other indirect effects of the other constructs were calculated using the same method and reported in Tables 6.2 and 6.3.

6.2.2 The Cronbach’s Alpha Test of Reliability

The internal consistency method was used to test the reliability of the research constructs. As outlined by Nunnally (1967), the coefficient alpha developed by Cronbach (1951) was used to test for internal consistency. A Cronbach alpha value of 0.70 or more is accepted for internal consistency for established scales (Nunnally, 1967). Tables 6.1a and b provide the Cronbach alpha test results. The overall internal consistency of the nine variables is 0.959. The Cronbach alpha was also computed by excluding each of the category in the QMAF respectively and the value ranged from 0.905 to 0.924. Namely the Cronbach alpha when one of the respective categories in the QMAF are excluded i.e. leadership 0.916, Quality Culture 0.920, Improvement
Methods 0.917, Human Resources Management 0.905, Strategy 0.917, Business Processes 0.924, Information/Knowledge/Communication 0.906, Business Outcomes 0.907 and Partnering Focus 0.905. Since the Cronbach alpha is higher than 0.900 in all cases excellent reliability of the score data is confirmed.
### Table 6.1a: Cronbach’s alpha Covariance Matrix

<table>
<thead>
<tr>
<th>Categories</th>
<th>Leadership</th>
<th>Quality Culture</th>
<th>Improvement Methods</th>
<th>Human Resources Management</th>
<th>Strategy</th>
<th>Business Processes</th>
<th>Information, Knowledge, Communication</th>
<th>Business Outcomes</th>
<th>Partnering Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leadership</td>
<td>305.34</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Quality Culture</td>
<td>172.13</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Improvement Methods</td>
<td>706.86</td>
<td>584.75</td>
<td>3120.73</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Human Resources Management</td>
<td>648.06</td>
<td>465.29</td>
<td>1724.48</td>
<td>1959.78</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strategy</td>
<td>275.69</td>
<td>185.65</td>
<td>725.03</td>
<td>722.58</td>
<td>528.12</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Business Processes</td>
<td>118.45</td>
<td>93.09</td>
<td>422.28</td>
<td>299.50</td>
<td>164.55</td>
<td>96.14</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Information/ Knowledge/ Communication</td>
<td>483.26</td>
<td>399.59</td>
<td>1722.13</td>
<td>1311.46</td>
<td>612.04</td>
<td>302.25</td>
<td>1664.49</td>
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</tr>
<tr>
<td>Business Outcomes</td>
<td>479.12</td>
<td>399.82</td>
<td>1722.48</td>
<td>1431.63</td>
<td>547.68</td>
<td>299.17</td>
<td>1272.20</td>
<td>1750.56</td>
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</tr>
<tr>
<td>Partnering Focus</td>
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<td>318.46</td>
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<td>1029.49</td>
<td>416.17</td>
<td>204.72</td>
<td>851.36</td>
<td>902.08</td>
<td>770.87</td>
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</table>

Overall Cronbach’s Alpha = 0.959

### Table 6.1b: Cronbach’s Alpha after excluding one of the respective categories

<table>
<thead>
<tr>
<th>Excluded Category</th>
<th>Cronbach’s Alpha</th>
<th>Excluded Category</th>
<th>Cronbach’s Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leadership</td>
<td>0.916</td>
<td>Business Processes</td>
<td>0.924</td>
</tr>
<tr>
<td>Quality Culture</td>
<td>0.920</td>
<td>Information/ Knowledge/ Communication</td>
<td>0.906</td>
</tr>
<tr>
<td>Improvement Methods</td>
<td>0.917</td>
<td>Business Outcomes</td>
<td>0.907</td>
</tr>
<tr>
<td>Human Resources Management</td>
<td>0.905</td>
<td>Partnering Focus</td>
<td>0.905</td>
</tr>
<tr>
<td>Strategy</td>
<td>0.917</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
6.2.3 The Analysis of the QMAF model when IKC is Considered and Included in the Model

Different models were considered involving all the nine categories, the path directions were considered and the path coefficients calculated and all models were tested against a set criteria. The model in Figure 6.1 was considered to be most appropriate based on the set criteria.

The fitted model was considered reasonably acceptable based on most of the SEM goodness of fit measurements, such as the normed Chi-square (Joreskog, 1969) which was 5.39 indicating an acceptable ratio: Schumacker and Lomax (1996); Arbuckle (1997) and Kline (2005); IFI (Incremental Fit Index) was good 0.820 (Hair et al. 1998); NFI (Normed Fit Index) was 0.788 which was good (Bentler and Bonnett, 1980); CFI (Comparative Fit Index) 0.816 was close to the recommended value of a good fit 0.90 Bentler (1990); TLI (Tucker-Lewis Index) discussed by Bentler and Bonnett (1980) was 0.698 which was acceptable, GFI (Goodness-of-fit) was also acceptable 0.683 (Hair et al. 1998). The fit indices indicate an acceptable fit between the model and the data (Bollen, 1989 and Schumacker and Lomax, 1996). These results suggest that the model is confirmed by the sample data. Pannirselvam
and Ferguson (2001) in his SEM study of the relationships between the Baldridge categories reported similar results.

The standardised path coefficients are for the set of causal relationships are presented in Figure 6.1. Table 6.2 outlines the direct, indirect and total effects of the constructs of the QMAF when IKC is considered and included in the model. H1a Leadership has a significant direct effect on strategy with p<1%. H1b was supported by significant path coefficients with p<1%. Strategy has a significant direct effect on human resources management. H1c produced moderately significant results with p<10%. Human resources management has a direct effect on business processes. H1d was validated by the significant path coefficient; therefore business processes have a direct effect on business outcomes. The test of H1e, H1g and H1i provided well supported statistical analysis. Hence quality culture has a direct effect on improvement methods, partnering focus and human resources management. H1f also had significant supporting path coefficients, confirming that improvement methods have direct effect on business processes. H1h was not significant p>25%. There were two reasons for this result, first the distribution of strategy scores is not a normal distribution for the sample size of 60 companies. This was due to eight companies having a score of zero which skewed the distribution. When the SEM path analysis was rerun with 52 data points i.e. without the eight data points with zero strategy score H1h was very significant p<1% concluding that partnering focus has a direct effect on strategy.

The following indirect effects were also found to be very significant (p<1%). The hypotheses related to the indirect effects of quality culture namely - H1, Hm, Hn, H1o, H1p and H1q - have significant path coefficients accentuating the following inferences. Quality culture has an indirect effect on business processes and business outcomes.

Leadership has an indirect effect on human resources management through strategy H1r (p<1%). H1z is statistically significant, supporting that improvement methods has an indirect effect on business outcomes through business processes. H1ab (p<5%) and H1ac (p<1%) were significant indicating that IKC has a direct significant effect on strategy and business processes respectively.
H1ad and H1ae are significant at p<5%, therefore a strong IKC program indirectly supports good human resources management through good strategy and indirectly supports good business processes through good strategy followed by good human resources management. H1af was found to be significant at p<5%. The significant path coefficient confirms that a strong IKC program indirectly supports good business outcomes through good strategy followed by good human resources management and good business processes.

Hypotheses H1j, H1k, H1s, H1t, H1u, H1v, H1w, H1x, H1y and H1aa did not have significant p-values and were rejected when IKC was considered in the model. However these were significant and accepted when IKC is not considered in the model as discussed in section 6.2.4.

Table 6.2: Direct, indirect and total effects of the QMAF model when IKC is considered and included.

<table>
<thead>
<tr>
<th>Hypotheses</th>
<th>Path</th>
<th>Direct Effect</th>
<th>Indirect Effect</th>
<th>Total Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1a</td>
<td>Leadership-strategy</td>
<td>0.392***</td>
<td>0.392**</td>
<td></td>
</tr>
<tr>
<td>H1b</td>
<td>Strategy-human resources management</td>
<td>0.391***</td>
<td>0.391***</td>
<td></td>
</tr>
<tr>
<td>H1c</td>
<td>Human resources management-business processes</td>
<td>0.178*</td>
<td>0.178</td>
<td></td>
</tr>
<tr>
<td>H1d</td>
<td>Business processes-business outcomes</td>
<td>0.715***</td>
<td>0.715***</td>
<td></td>
</tr>
<tr>
<td>H1e</td>
<td>Quality culture-improvement methods</td>
<td>0.763***</td>
<td>0.763***</td>
<td></td>
</tr>
<tr>
<td>H1f</td>
<td>Improvement methods-business processes</td>
<td>0.425***</td>
<td>0.425***</td>
<td></td>
</tr>
<tr>
<td>H1g</td>
<td>Quality culture-partnering focus</td>
<td>0.836***</td>
<td>0.836***</td>
<td></td>
</tr>
<tr>
<td>H1h</td>
<td>Partnering focus-strategy</td>
<td>0.132</td>
<td>0.132</td>
<td></td>
</tr>
<tr>
<td>H1i, H1k</td>
<td>Quality culture-human resources management</td>
<td>0.533***</td>
<td>0.043</td>
<td>0.576***</td>
</tr>
<tr>
<td>H1i, H1j</td>
<td>Quality culture-strategy</td>
<td>0.110</td>
<td>0.110</td>
<td></td>
</tr>
<tr>
<td>H1l, H1m, H1n</td>
<td>Quality culture-business processes</td>
<td>0.427***</td>
<td>0.427***</td>
<td></td>
</tr>
<tr>
<td>H1o, H1p, H1q</td>
<td>Quality culture-business outcomes</td>
<td>0.232***</td>
<td>0.232***</td>
<td></td>
</tr>
<tr>
<td>H1r</td>
<td>Leadership-human resources management</td>
<td>0.153***</td>
<td>0.153***</td>
<td></td>
</tr>
<tr>
<td>H1s</td>
<td>Leadership-business processes</td>
<td>0.027</td>
<td>0.027</td>
<td></td>
</tr>
<tr>
<td>H1t</td>
<td>Leadership-business outcomes</td>
<td>0.020</td>
<td>0.020</td>
<td></td>
</tr>
<tr>
<td>H1u</td>
<td>Partnering focus-human resources management</td>
<td>0.052</td>
<td>0.052</td>
<td></td>
</tr>
<tr>
<td>H1v</td>
<td>Partnering focus-business processes</td>
<td>0.009</td>
<td>0.009</td>
<td></td>
</tr>
<tr>
<td>H1w</td>
<td>Partnering focus-business outcomes</td>
<td>0.007</td>
<td>0.007</td>
<td></td>
</tr>
<tr>
<td>H1x</td>
<td>Strategy-business processes</td>
<td>0.070</td>
<td>0.070</td>
<td></td>
</tr>
<tr>
<td>H1y</td>
<td>Strategy-business outcomes</td>
<td>0.050</td>
<td>0.050</td>
<td></td>
</tr>
<tr>
<td>H1z</td>
<td>Improvement methods-business outcomes</td>
<td>0.304***</td>
<td>0.304***</td>
<td></td>
</tr>
<tr>
<td>H1aa</td>
<td>Human resources management-business outcomes</td>
<td>0.127</td>
<td>0.127</td>
<td></td>
</tr>
<tr>
<td>H1ab</td>
<td>IKC-strategy</td>
<td>0.298***</td>
<td>0.298***</td>
<td></td>
</tr>
<tr>
<td>H1ac, H1ae</td>
<td>IKC-business processes</td>
<td>0.338***</td>
<td>0.021</td>
<td>0.359***</td>
</tr>
<tr>
<td>H1ad</td>
<td>IKC-Human resources management</td>
<td>0.117**</td>
<td>0.117**</td>
<td></td>
</tr>
<tr>
<td>H1af</td>
<td>IKC-business outcomes</td>
<td>0.256**</td>
<td>0.256**</td>
<td></td>
</tr>
</tbody>
</table>

p<1%***; p<5%**; p<10%*
6.2.4 The Analysis of the QMAF Model without Considering IKC

Figure 6.2: Path diagram of the QMAF without considering IKC.

The fitted model was considered reasonably acceptable based on most of the SEM goodness of fit measurements, such as the normed Chi-square (Joreskog, 1969) which was 5.89 indicating an acceptable ratio: Schumacker and Lomax (1996); Arbuckle (1997) and Kline (2005); IFI (Incremental Fit Index) was good 0.859 (Hair et al. 1998); NFI (Normed Fit Index) was 0.820 which was good (Bentler and Bonnett, 1980); CFI (Comparative Fit Index) 0.855 was close to the recommended value of a good fit 0.90 Bentler (1990); TLI (Tucker-Lewis Index) discussed by Bentler and Bonnett (1980) was 0.775 which was acceptable, GFI (Goodness-of-fit) was also acceptable 0.727 (Hair et al. 1998). The fit indices indicate an acceptable fit between the model and the data (Bollen, 1989 and Schumacker and Lomax, 1996). These results suggest that the model is confirmed by the sample data. Pannirselvam and Ferguson (2001) in his SEM study of the relationships between the Baldridge categories reported similar results.
The standardised path coefficients for the set of causal relationships are presented in Figure 6.2. Table 6.3 outlines the direct, indirect and total effects of the constructs that were calculated for the model without IKC.

The direct effects were found to be very significant the level of significance being $p<1\%$. $H1_a$ Leadership has a significant direct effect on strategy. $H1_b$ was supported by significant path coefficients. Strategy has a significant direct effect on human resources management. $H1_c$ produced similar results. Human resources management has a direct effect on business processes. $H1_d$ was validated by the significant path coefficient; therefore business processes have a direct effect on business outcomes.

The test of $H1_e$, $H1_g$ and $H1_i$ provided well supported statistical analysis. Hence quality culture has a direct effect on improvement methods, partnering focus and human resources management. $H1_f$ also had significant supporting path coefficients confirming that improvement methods have direct effect on business processes. $H1_h$ was affirmed by the significant statistical inferences concluding that partnering focus has a direct effect on strategy.

The following indirect effects were also found to be significant. The hypotheses related to the indirect effects of quality culture -namely $H1_j$ and $H1_k$ ($p<5\%$) respectively; $H1_l$, $H1_m$, $H1_n$, $H1_o$, $H1_p$, and $H1_q$ ($p<1\%$) respectively - have comparable results and significant path coefficients accentuating the following inferences. Quality culture has an indirect effect on strategy, human resources management, business processes and business outcomes.

Leadership has an indirect effect on human resources management through strategy. Similar statistical results were obtained for hypotheses $H1_r$, $H1_s$ each had ($p<1\%$) and $H1_t$ ($p<5\%$). Leadership has an indirect effect on human resources management, business processes and business outcomes. Hypotheses $H1_u$ ($p<5\%$); $H1_v$ and $H1_w$ ($p<10\%$) respectively have significant path coefficients which support partnering focus having an indirect effect on human resources management, business processes and business outcomes. Strategy has an indirect effect on business processes and business outcomes since hypotheses $H1_x$ and $H1_y$ ($p<5\%$) respectively have significant path coefficients. $H1_z$ ($p<1\%$) and $H1_{aa}$ ($p<5\%$) are statistically
significant, supporting that improvement methods and human resources management have an indirect effect on business outcomes through business processes.

Table 6.3: Direct, indirect and total effects of the QMAF model without considering IKC

<table>
<thead>
<tr>
<th>Hypotheses</th>
<th>Path</th>
<th>Direct Effect</th>
<th>Indirect Effect</th>
<th>Total Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1a</td>
<td>Leadership-strategy</td>
<td>0.466***</td>
<td>0.466***</td>
<td></td>
</tr>
<tr>
<td>H1b</td>
<td>Strategy-human resources management</td>
<td>0.389***</td>
<td>0.389***</td>
<td></td>
</tr>
<tr>
<td>H1c</td>
<td>Human resources management-business processes</td>
<td>0.301***</td>
<td>0.301**</td>
<td></td>
</tr>
<tr>
<td>H1d</td>
<td>Business processes-business outcomes</td>
<td>0.722***</td>
<td>0.722***</td>
<td></td>
</tr>
<tr>
<td>H1e</td>
<td>Quality culture-improvement methods</td>
<td>0.763***</td>
<td>0.763***</td>
<td></td>
</tr>
<tr>
<td>H1f</td>
<td>Improvement methods-business processes</td>
<td>0.576***</td>
<td>0.576***</td>
<td></td>
</tr>
<tr>
<td>H1g</td>
<td>Quality culture-partnering focus</td>
<td>0.836***</td>
<td>0.836***</td>
<td></td>
</tr>
<tr>
<td>H1h</td>
<td>Partnering focus-strategy</td>
<td>0.305**</td>
<td>0.305**</td>
<td></td>
</tr>
<tr>
<td>H1i, H1k</td>
<td>Quality culture-human resources management</td>
<td>0.536***</td>
<td>0.099**</td>
<td>0.635***</td>
</tr>
<tr>
<td>H1j</td>
<td>Quality culture-strategy</td>
<td>0.255**</td>
<td>0.255**</td>
<td></td>
</tr>
<tr>
<td>H1l, H1m, H1n</td>
<td>Quality culture-business processes</td>
<td>0.631***</td>
<td>0.631***</td>
<td></td>
</tr>
<tr>
<td>H1o, H1p, H1q</td>
<td>Quality culture-business outcomes</td>
<td>0.455***</td>
<td>0.455***</td>
<td></td>
</tr>
<tr>
<td>H1r</td>
<td>Leadership-human resources management</td>
<td>0.181***</td>
<td>0.181***</td>
<td></td>
</tr>
<tr>
<td>H1s</td>
<td>Leadership-business processes</td>
<td>0.055**</td>
<td>0.055**</td>
<td></td>
</tr>
<tr>
<td>H1t</td>
<td>Leadership-business outcomes</td>
<td>0.039**</td>
<td>0.039**</td>
<td></td>
</tr>
<tr>
<td>H1u</td>
<td>Partnering focus-human resources management</td>
<td>0.119**</td>
<td>0.119**</td>
<td></td>
</tr>
<tr>
<td>H1v</td>
<td>Partnering focus-business processes</td>
<td>0.036*</td>
<td>0.036*</td>
<td></td>
</tr>
<tr>
<td>H1w</td>
<td>Partnering focus-business outcomes</td>
<td>0.026*</td>
<td>0.026*</td>
<td></td>
</tr>
<tr>
<td>H1x</td>
<td>Strategy-business processes</td>
<td>0.117**</td>
<td>0.117**</td>
<td></td>
</tr>
<tr>
<td>H1y</td>
<td>Strategy-business outcomes</td>
<td>0.085**</td>
<td>0.085**</td>
<td></td>
</tr>
<tr>
<td>H1z</td>
<td>Improvement methods-business outcomes</td>
<td>0.416***</td>
<td>0.416***</td>
<td></td>
</tr>
<tr>
<td>H1aa</td>
<td>Human resources management-business outcomes</td>
<td>0.217**</td>
<td>0.217**</td>
<td></td>
</tr>
</tbody>
</table>

p<1%***; p<5%**; p<10%*
6.2.5 The Analysis of the QMAF with IKC having a One to One Relationship with the Other QMAF Categories

Figure 6.3: Path diagram of the QMAF with IKC having a one to one relationship with the other categories

Figure 6.3 depicts the path diagram of the QMAF with IKC having a one to one relationship with the other QMAF categories. Table 6.4 summarises the direct effects and $R^2$ when IKC is considered to have a one to one relationship with the other QMAF categories. Simple linear regression was used to determine these direct effects. The direct effects were very significant with $p=0.000$. All the hypotheses H1a, H1c, H2a, H2b, H2c, H2d, H2e and H2f had significant path coefficients. A strong IKC program directly supports good leadership, quality culture, strategy development and deployment, human resources management, partnering focus, improvement methods, business processes and business outcomes respectively.
Table 6.4: Direct effects of the QMAF model with IKC having a one to one relationship with the other QMAF categories

<table>
<thead>
<tr>
<th>Hypotheses</th>
<th>Path</th>
<th>Direct effect (β coefficient)</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1ab</td>
<td>IKC - strategy.</td>
<td>0.368****</td>
<td>42.6%</td>
</tr>
<tr>
<td>H1ac</td>
<td>IKC - business processes.</td>
<td>0.182****</td>
<td>57.1%</td>
</tr>
<tr>
<td>H2a</td>
<td>IKC - leadership.</td>
<td>0.290****</td>
<td>46.0%</td>
</tr>
<tr>
<td>H2b</td>
<td>IKC - quality culture.</td>
<td>0.240****</td>
<td>51.0%</td>
</tr>
<tr>
<td>H2c</td>
<td>IKC - human resources management.</td>
<td>0.788****</td>
<td>52.7%</td>
</tr>
<tr>
<td>H2d</td>
<td>IKC - partnering focus.</td>
<td>0.511****</td>
<td>56.5%</td>
</tr>
<tr>
<td>H2e</td>
<td>IKC - improvement methods.</td>
<td>1.035****</td>
<td>57.1%</td>
</tr>
<tr>
<td>H2f</td>
<td>IKC - business outcomes.</td>
<td>0.764****</td>
<td>55.5%</td>
</tr>
</tbody>
</table>

p = 0.000%****

6.3 Discussion of Results

The findings have led to the development of important guidelines for managers involved in the planning and management of quality. The (SEM) recursive path analysis has strongly supported the QMAF model in Figure 3.2 and the quality value-based push approach graphically outlined in Figure 3.4 for manufacturing organisations in the Western Sydney Region. The study can be extended to other populations to test the replication of the findings.

The QMAF criteria represent leadership, quality culture and information/knowledge and communication as the core drivers that influence all other elements of quality management. These results are similar to the findings of previous research which studied quality – performance relationships. Pannirselvam and Ferguson (2001) in their study of the relationships between the Baldrige categories using SEM path analysis confirmed the validity of the MBQNA framework. Additionally their results ascertain that leadership significantly directly and indirectly impacts human resources management, product and process management, customer focus and relationship management, business results and customer satisfaction, except for strategic quality planning and information management as it was not tested in the model. Panirselvam and Ferguson have determined that human resources management has a significant
indirect influence on an organisation’s performance through product and process management and customer focus and relationship management efforts. Their research also established that information management is vital to effectively plan and to also execute those plans. The customer focus construct in Pannirselvam and Ferguson’s model had the most significant impact on business and customer satisfaction results.

Flynn et al. (1995) used (SEM) path analysis to study a quality framework which focused on both core quality management practices and on the infrastructure that creates an environment supporting their use. Flynn et al. (1995) determined that top management support has a significant effect on human resources management. Flynn also established that perceived quality market outcomes were chiefly related to statistical control/feedback and the product design process. He also determined that the percent of product that passed final inspection without needing rework was strongly related to process flow management and to a lesser extent to statistical control/feedback. Adam et al. (1997) used factor analysis on their survey data - their results suggest that an organisation’s approach to quality has a stronger association with actual quality and a lesser extent to financial performance. They further determined that the major factors found to impact actual quality were the organisation’s knowledge of quality management, the extent of customer focus and management participation. Winn and Cameron’s (1998) model, based on exploratory factor analysis, also concluded that the main effect of leadership was on the system dimensions, not on the outcome dimensions.

Therefore, validating the model provides useful guidelines to managers in deciding which pathways to choose in order to devote resources towards achieving business outcomes. Leadership has shown to have a direct impact on strategy development and deployment and significant indirect effects on human resources management, business processes and business outcomes. Quality culture has demonstrated to have a strong influence on improvement methods, partnering focus (customers and suppliers) and indirect effects on strategy, human resources management, business processes and business outcomes. Information/knowledge/communication has shown to have direct influence on all the constructs, namely leadership, quality culture, partnering focus, improvement methods, human resources management, business processes and business
outcomes. Significant indirect effects of IKC were also noted on human resources management, business processes and business outcomes. Indirect effects of improvement methods on business outcomes through business processes have also been inferred.

The results of the analysis of the QMAF model without considering ICT affirm the importance of the pathways towards meeting business outcomes with the traditional TQM constructs, namely leadership, quality culture, strategy, partnering focus, human resources management, improvement methods and business processes. This is reinforced by the increased strengths of the path coefficients and the significance with in all the cases of the (SEM) path analysis both direct and indirect when IKC is not considered in the analysis. This is a further assertion of the vitality of traditional TQM constructs in the QMAF.

Leadership has shown to have a direct impact on strategy development and deployment and significant indirect effects on human resources management, business processes and business outcomes. Quality culture has demonstrated to have a strong influence on improvement methods, partnering focus (customers and suppliers) and indirect effects on strategy, human resources management, business processes and business outcomes. The impact of good strategy on business processes and business outcomes has been validated through indirect effects. Similar links have been inferred by indirect effects of improvement methods and human resources management on business outcomes through business processes.

These findings do not in any way diminish the role that ICT plays in delivering optimum business outcomes. Instead it clarifies that fundamental traditional TQM principles must be a precursor to effectively utilise ICT as an enabler in delivering excellent business outcomes.

The one to one direct effect of IKC on the other elements of the QMAF model provides a more holistic picture of the important role ICT plays in obtaining optimum business outcomes.
Guidelines for Managers

The analysis has demonstrated direct and indirect relationships between the categories of the QMAF model with pathways to achieving optimum business outcomes. The interplay with ICT and its strong significance as an enabler has also been established through the analysis. Manager’s can further enhance their quality systems by developing and deploying the following as in Table 6.5.
Table 6.5: Guidelines for Managers

<table>
<thead>
<tr>
<th>QMAF Categories</th>
<th>Guidelines for Managers</th>
<th>References</th>
</tr>
</thead>
</table>
| Leadership (L)  | • The organisation’s senior managers must communicate effectively values that their organisation stands for; short and long term directions of the organisation; expectations related to organisational and individual performance.  
• The manager’s must be able to translate performance review into priorities for improvement and innovation.  
• The organisation must have well established procedures to encourage suppliers/partners to improve and innovate and thereby ensure organisational alignment.  
• Senior managers must use performance review findings to improve their own leadership effectiveness and their leadership systems.  
• Managers in the organisation must understand how the overall performance measures compare to major competitors.  
• The orientation of the organisation must shift from managing functions to managing key business processes.  
• Middle managers in the organisation must be empowered to use their own discretion within broad guidelines to make decisions.  
• Management in the company must understand that creating a total quality organisation requires a well trained and empowered workforce.  
• Managers must be able to make employees aware of the link between their specific jobs and its impact on the quality of the organisation’s output.  
• The organisation must assess the impacts on society of their products, services and operations through addressing regulatory and legal requirements of processes, measures and targets; addressing risks associated with products, services and operations; anticipate public concerns with current and future products, services and operations; accomplish ethical business practices in all stakeholders transactions and interactions.  
• The organisation, its senior managers, and employees must actively support community involvement and enthusiastically determine ways in which the organisation could support community projects and activities. | (MBQP 2001; MSU Logistics SCM Research)                                      |
| Quality Culture (QC) | • Employees individually and collectively must accept responsibility for quality.  
• The specialised quality department must be viewed as facilitating quality improvement and not being solely responsible for quality improvement.  
• The organisation must ensure that there are formal quality management practices in all functional areas.  
• The organisation must acknowledge the importance of functional excellence but focuses on performance achievement.  
• Teams must have the following objectives setup namely achieve specified quality standards; share work within the team on an equitable and efficient basis; work effectively with other team members; apply the next customer concept; reach production targets; perform routine maintenance; improve work area layout; look for improvement possibilities continuously. | (Tan, 1997); Anderson and Sohal 1999)                                        |
| Improvement Methods (IM) | • Organisations require to strongly consider benchmarking as an improvement method tool.  
• Benchmarks must align with the organisation’s strategic plans, ensure the quality of data for performance measurement is high; analysis of benchmarks must be used to determine the current competitive gap; project future performance levels; establish functional goals; implement specific actions and monitor progress; factors critical for improved performances must be identified post-analysis of benchmarks; findings of analysis must be communicated to the relevant people to plan and implement change.  
• Periodic follow-ups must be conducted to verify outcomes of implemented change in relation to benchmark target.  
• The organisation must share benchmarking and information on best practices/processes results with suppliers. | (Anderson and Sohal 1999; Adam, 1997; MSU Logistics SCM Research; Camp 1989; Tan, 1997; Cook and Dale, 1995; Hyland et al. 2000; Bunney and Dale, 1997) |
### Table 6.5: Guidelines for Managers Cont’d

<table>
<thead>
<tr>
<th>QMAF Categories</th>
<th>Guidelines for Managers</th>
<th>References</th>
</tr>
</thead>
</table>
| **Improvement Methods (IM)** Cont’d | - Organisations must effectively apply total quality tools. The TQ tools to be considered are flowcharts, cause and effect diagrams, multi voting, affinity diagrams, process action teams, election grids, task lists, Deming cycle (PDCA), sampling techniques, scatter diagrams, Pareto charts, run charts, control charts, histograms, process mapping tools, FMEA (Failure Mode and Effect Analysis), QFD (Quality Function Development), Creativity tools/ Idea generation tools, display/ visualisation tools, standardisation tools, 5S and Taguchi methodology of experimental design.  
- The organisation must successfully utilise time-based logistics with customers and/or suppliers such as continuous replenishment, quick response, just-in-time, defect reduction and waste evaluation.  
- The organisation must significantly reduced the number of suppliers to improve operational integration.  
- The quality department must initiate, plan and implements quality initiatives with various departments; facilitate and conduct quality enhancement efforts under the leadership of top management; provide training for quality and inspection.  
- Organisations must use team processes such as quality circles, quality problem-solving team (Multi-departmental teams brought together to solve specific management-directed problems), Quality improvement team (Multi-departmental teams that generate their own projects from broad management briefs).  
- Supporting infrastructure for quality improvement must be provided by a body of senior managers who regularly meet to steer continuous improvement activities.  
- Continuous improvement (CI) processes must be strengthened through training of personnel, monitoring of CI process, top management support for CI programs, CI project leaders, suggestion scheme, application of PDCA, promotions through notice boards, internal media, face to face communication; use of ISO 9000, total productive maintenance regimes, formal policy deployment protocols and time studies.  
- The organisation must actively encourage best practice implementation.  
- CI processes must be supported by incentive schemes and through completions and awards. | (MBQP, 2001; Anderson and Sohal 1999; Tan, 1997; MSU Logistics SCM Research; Lagorsen, 2001; ISO 9001:2000 Standard) |
| **Partnering Focus (PF)** | - Customer needs must be determined by the following means telephone surveys, feedback from sales personnel, formal customer surveys, focus groups, competitor analysis, data mining approaches.  
- It must be easy for customers to seek information about the organisation’s products and services; to complain about the company’s products and/or services.  
- The organisation must have a company’s toll free number, a website to with a section to log customer’s complaints and to request for information.  
- Research must be conducted to project future customers and predict what their key requirements are likely to be.  
- The organisation must accommodate a wide range of unique customer requests by implementing pre planned solutions.  
- The organisation must have supply chain arrangements with customers that operate under principles of shared rewards and risks.  
- The organisation must have systems which identify customer’s current needs, future needs, level of satisfaction and customer’s loyalty.  
- Customer satisfaction results must be used in decision making of marketing and sales initiatives.  
- The organisation must be willing to share strategic information with selected suppliers.  
- The organisation must select suppliers based on formal evaluations and assessments.  
- The organisation must have supplier contracts for key raw materials/ suppliers.  
- The organisation must not work with suppliers who lack environmental awareness.  
- The organisation must believe that the strategic direction, role and performance of their supply chain partners are critical to achieving success. | (MBQP, 2001; Anderson and Sohal 1999; MSU Logistics SCM Research; Lagorsen, 2001; ISO 9001:2000 Standard) |
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| Partnering Focus (PF) Cont’d | • The organisation should consider helping suppliers finance capital equipment.  
• The organisation must share research and development costs and results with primary suppliers.  
• The organisation must be committed to sharing responsibility with suppliers in new product/service development and commercialisation.  
• The organisation must facilitate a strong supply network fostering cooperation with entire chain of primary and secondary suppliers. | (MBQP, 2001; Vinten, 2000; Truelove, 1992; MSU Logistics SCM Research; Newby, 1992; Adam et al. 1997; Tan, 1997; Anderson and Sohal 1999; Martinez Lorente et. al., 1999; MBQP, 1997; Honold, 1997; Briggs and Koegh, 1999) |
| Human Resources Management (HRM) | • In the selection of staff organisation’s must look for ‘Critical to Quality’ attributes in the biographical data of candidates and use pre-employment testing in employee selection.  
• Training needs require to be identified based on: performance appraisals, business requirements and staff profiles.  
• Human resource department must provide advice and must research the market to identify good quality external training resources, products and courses.  
• The organisation must apply various modes of training such as lectures and presentations, coaching/mentoring, self-directed learning, discussion formats, instructional simulations, role-plays, interactive multimedia training, other training technologies (satellite broadcasts, cable broadcasts, video-conferencing, virtual classrooms, video tapes, narrated slide presentations, audio tapes).  
• The perspective of all stakeholders must be considered and met in designing training programs.  
• Trainers must be capable to focus and build on learner’s strengths and weaknesses, create an accepting and encouraging mood for learners, give learners verbal cues about their performance, generous with sincere compliments and positive constructive criticism, encourage learners to ask questions.  
• The company must have active programs to capture the experience and expertise of individuals and transfer this knowledge throughout the organisation.  
• Training programs should be evaluated based on the following success criteria: there are costs benefits and maximum utility of the training program; the training programs achieve their key objectives; the net effects of training programs are benchmarked; the training programs are ethical.  
• Organisations must have processes in place to foster the following in employee involvement: educating, enabling and encouraging.  
• The organisation must implement a number of innovative approaches to job and work design such as self-directed teams throughout all areas of the organisation.  
• The organisation must implement a reliable performance assessment system that is linked to a reward system.  
• The organisation must:  
  o design human resources systems to promote flexibility among members of the workforce; cooperation among members of the workforce; open communication among members of the workforce;  
  o encourage suggestions for business improvements to permeate from the bottom of the organisational hierarchy;  
  o tailor employee involvement activities to change attitudes of employees resisting change;  
  o adopt a through prevention based approach to employee safety and well being;  
  o use a wide variety of methods to measure and improve employee satisfaction, to enable teams to be autonomous;  
  o ensure that there are processes to identify employee/team competency; training requirements in order to deliver skills to employees/team members; training requirements in order to build commitment among employees/team.  
• The organisation must utilise cross-functional work teams for managing day-to-day operations. The organisation must link significant portion of employee performance to productivity.  
• Employees must feel well recognised for their accomplishments.  
• The organisation’s compensation and reward system must encourage adherence to stated policies and procedures.  
• The organisation’s compensation, incentive and reward systems must encourage integration and harmonisation of activities and processes. |
Table 6.5: Guidelines for Managers Cont’d

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| Strategy (S)    | • Ensure that the organisation’s overall strategic planning process contains key steps; key participants; short term planning time horizons and long term planning time horizons.  
• The strategic planning process must address the objectives and challenges related to the following: customer and market needs/expectations/opportunities; competitive environment and capabilities relative to competitors; technological and other changes that might affect product/services/operations; strengths and weaknesses, including human and other resources; supplier/partner strengths and weaknesses; financial, societal, and other potential risks and environmental issues.  
• The organisation must have key objectives and timetables for accomplishing its strategic plans.  
• The organisation must collaborate with key customers and suppliers in developing its strategic plans.  
• The organisation must have well established procedures to develop and deploy action plans, based on the strategic plan, to achieve key objectives.  
• The organisation must have key performance measures/indicators for tracking progress relative to their action plans and stakeholders.  
• The organisation must have procedures to feedback differences in comparative information to modify the action plans. | (MBQP, 2001; MSU Logistics SCM Research; Anderson and Sohal, 1999) |
| Business Processes (BP) | • Methodologies for product design processes require to involve getting inputs from all departments.  
• The organisation must employ a systematic process for incorporating new and changing customer requirements into product/service design.  
• Organisations require to demonstrate substantially reduced facility and operational complexity over time.  
• The organisation must redesign the logistic system for greater environmental efficiency.  
• The organisation’s logistical capability must be significantly more responsive (pull) as compared to predetermined (push) over time.  
• The organisation must actively be involved in initiatives to standardise supply chain practices and operations.  
• Data on key process measures must be collected on a regular basis.  
• The organisation must have valid control strategies to keep all process measures within standards or acceptable levels.  
• The organisation must use activity based costing. | (Anderson and Sohal, 1999; MSU Logistics SCM Research) |
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| **Information, Knowledge, Communication (IKC)** | Organisations can improve their Information, Knowledge and Communication systems by:  
- using software packages to facilitate the administrative work associated with the development of quality management systems to meet ISO 9000 standards;  
- using ICT to manage its reporting systems, data collection and analysis of data and decision making process;  
- ensuring the information available in the organisation is accurate, timely and formatted to facilitate easy use;  
- ensuring that the information systems capture and maintain information on changes in customer needs;  
- ensuring the organisation’s information systems capture and maintain information on changes in customer needs;  
- ensuring the firm obtains information directly from customers to facilitate operational plans and reduce reliance on forecasting;  
- ensuring logistics operating and planning databases are integrated across applications within the organisation;  
- ensuring the organisation maintains an integrated database and access method to facilitate information sharing;  
- ensuring the organisation actively utilises industry standards for data exchange;  
- ensuring the organisation has invested in technology designed to facilitate cross-organisational data exchange;  
- ensuring information systems in the organisation are being expanded to reflect more enterprise wide integrated processes (ERP), facilitate electronic commerce using internet capability;  
- ensuring the organisation shares technical resources with key suppliers to facilitate operations;  
- ensuring the organisation has developed information linkages with customers that permit substantial last minute accommodation without loss of planned efficiencies;  
- ensuring that the organisation has increased the use of integrated inventory, transportation and warehousing planning systems and EDI standards;  
- collecting comparative and competitor data on product and service quality, supplier performance, employee data, internal operations and support functions and other appropriate processes and functions;  
- verifying if the comparative and competitor data on benchmarking is reliable for product and service quality, customer satisfaction, supplier performance, HR practices, internal operations and support functions and other appropriate processes and functions;  
- ensuring the organisation has designed data collection and reporting systems around the needs of the managers and employees who use the data to plan and make decisions;  
- ensuring the organisation has knowledge management systems that collect state of the art information on best practices in business, innovative quality systems;  
- ensuring the organisation effectively shares operational information between departments;  
- building adequate capability to share internally and externally standardised information and customised information;  
- ensuring performance measurement data is available on a more timely basis over time. | (Martinez Lorente et. al., 1999; MSU Logistics SCM Research; Anderson and Sohal 1999; Bhatt, 2001; Howe et.al., 2000; Ngai and Cheng, 1998) |
| **Business Outcomes (BO)** | The organisation must use “balanced scorecard” approach to measurement.  
- The categories used for measuring organisation performance must be customer satisfaction, employee satisfaction, financial performance, product/service quality, supplier performance, operational performance and each should have 2—3 measures all showing improvement trends internally and compared to competitors.  
- All key business decisions and plans must be based upon an analysis of performance data.  
- The implementation of change based on gaps identified through benchmarking must lead to improvement in performance levels.  
- There must be evidence of continuous improvements in the education/training as a result of training evaluations.  
- Employee participation leads to improved communication with employees, involvement of employees in decision-making resulting in | (Anderson and Sohal, 1999; MBQP, 1997; Camp, 1989; Lindsay and Preston, 2000; MSU Logistics SCM Research) |
Table 6.5: Guidelines for Managers Cont’d

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| Business Outcomes (BO) Cont’d | successful attaining of organisational objectives.  
• The organisation must thoroughly understand the link between different types of measures such as the relationship between customer satisfaction and quality, with financial performance.  
• The organisation must increase operational flexibility through supply-chain collaboration.  
• The organisation must evaluate and make many major improvements in its measures and data collection and reporting methods.  
• The organisation must demonstrate gains in market share relative to major competitors’ market share.  
Performance in business outcomes can be monitored for the following:  
• Trends in gaining and avoiding losses of customers.  
• Customer’s estimation of the organisation’s quality of products and services.  
• Environmental performance and measures of environmental performance when compared to other organisations in the same industry.  
• Public health performance and measures of public health performance compared to other organisations in the same industry. | (Anderson and Sohal, 1999; MBQP, 1997; Camp, 1989; Lindsay and Preston, 2000; MSU Logistics SCM Research) |
6.4 Summary

This chapter provided the (SEM) recursive path analysis of the constructs in QMAF in order to deliver optimum business outcomes using structural equation modelling.

The (SEM) recursive path analysis results of the model presented in this chapter provide empirical evidence that establish the pathways through the various elements of TQM considered in the model. All these pathways ultimately lead to delivering optimum business outcomes. Further, ICT as an enabler is confirmed as it is found to have direct one-to-one influence on all the elements of the model including business outcomes. The indirect effects of ICT on business processes, human resources management and business outcomes were also demonstrated. The vitality of the traditional elements of TQM is reinforced by the increased strengths of the path coefficients and the significance with p<1% in all cases of the SEM recursive path analysis both direct and indirect in the QMAF model when ICT is not considered.

The findings have led to the development of important guidelines for managers involved in the planning and management of quality. The next and final chapter presents conclusions, implications, strengths and limitations of the study, and recommendations for further research.

The sample size of 60 was a limitation to the SEM analysis of the data and correspondingly impacted the values of the goodness of fit indices criteria. A larger sample size would definitely result in better goodness of fit indices criteria values.
Chapter 7
Conclusions and Recommendations

7.1 Introduction

The research has developed a holistic approach of pathways to achieving optimum business outcomes using a Quality Management Assessment Framework (QMAF) with information communication technology (ICT) as an enabler and has formulated guidelines for managers with regard to quality management practices.

The theoretical QMAF model was developed and tested using primary data obtained from a sample survey of organisations drawn from large, medium and small organisations in the Western Sydney Region.

An assessment of the quality management capabilities of the industries in the Western Sydney Region of New South Wales (NSW), Australia was carried out using descriptive statistical analysis, ANOVA and Hsu’s MCB.

Structural equation modelling techniques, specifically Recursive path analysis, were used to test the validity of the overall QMAF model and the relationships between the categories hypothesised in the model.

Hence multiple regression and SEM recursive path analysis were used to study the strengths and the relationships between the QMAF constructs and their impact on the business outcome category with and without the Information/Knowledge/Communication (IKC) category. Thus an investigation of the direct and indirect effects of the QMAF categories on business outcomes of organisations was carried out. Finally the one to one direct effect of IKC on the other categories of the QMAF model was determined using regression analysis. This is particularly helpful in developing a clear and more complete explanation of the impact of the QMAF categories on an organisation’s business outcomes.
This chapter presents a summary and conclusion of the study as well as its implications and limitations. Finally, the strengths and limitations of the study and suggestions for future research are provided. Thus the chapter begins with an overview of the study and a brief summary of the results.

### 7.2 Overview of Research

The present research effort was conducted in four phases. First, the TQM literature was reviewed in the areas of theoretical background, determinants and measurement of business outcomes. The TQM literature was also reviewed to understand the relationship between TQM elements and business outcomes. Second, drawing on the literature a proposed model of Quality Management Assessment Framework (QMAF) was formulated for empirical testing. Third, a questionnaire was developed and administered to obtain the primary data necessary to test the model. Finally, the proposed model was tested on the primary data gathered.

#### 7.2.1 Previous Research

**Theoretical Background of the Study**

The evolution of total quality is explained in a chronological order. The major elements of TQM Leadership, Quality Culture, Customer Focus, Partnering, Empowerment, Education and Training, Communication, Total Quality Tools, Benchmarking and Continuous Improvement, were reviewed.

The theoretical aspects and literature on organisational factors and TQM implementation, certification and quality awards, information communication technology in TQM, future trends in TQM, best practices in large organisations, emerging models of TQM, paradigm Shift in quality management, the impact of ICT on quality management were discussed.
7.2.2 Proposed Model

The primary purpose of the study was to develop and test a comprehensive model of quality management assessment framework (QMAF) that investigates how TQM constructs directly and indirectly influence an organisation’s business outcomes. The theories of quality and literature suggest that an organisation’s business outcomes are correlated with key elements such as leadership, quality culture, customer focus and continuous improvement. The proposed model integrates the use of ICT, leadership, quality culture, strategy, partnering focus, human resources management, improvement methods and business processes to influence business outcomes. This study conceptualised the direct and indirect impact of Leadership, Quality Culture, Information/Knowledge/Communication, Strategy, Partnering Focus, Human Resources Management, Business Processes, Improvement Methods on the organisations’ Business Outcomes and i.e. Business Results and Customer and Stakeholder value.

7.2.3 Questionnaire Development and Administration

The questionnaire was developed and administered and the collected data was used to test the model. Drawing on the literature and expert opinion in the field of research, measures were developed for assessing an organisation’s leadership, quality culture and information/knowledge and communication, strategy management, human resources management (employee development and employee empowerment), partnering focus (customer and supplier focus), improvement methods (benchmarking, total quality tools and continuous improvement), business processes, business outcomes (business results, customer and stakeholder value and the relevant feedback systems) using the Likert scale. The questionnaire was then constructed using these operational scales. However, several other criteria were also used in developing the questionnaire. Chiefly, an effort was made to ensure clarity, readability, and continuity to maintain respondent interest and motivation. D&B Business Who’s Who of Australia Database [http://www.dnb.com.au/] was used to determine the population from which the sample was obtained. The questionnaire was then pre-tested, and mailed to a preliminary sample of 300 firms in the Western Sydney region. These firms were a combination of large, medium and small organisations.
and limited to manufacturing organisations only. Since it was hard to achieve complete responses, three additional lists were prepared. Getting companies to participate was a major limitation as a result, the research was limited to a small sample of data for testing the proposed model. Eventually all the other lists were used to replace companies that did not respond.

The Western Sydney region was selected as the context of this research to control for heterogeneity of quality systems across NSW. A telephone follow-up was also used to solicit participation and remind CEOs to participate in the survey. A total of 60 usable responses were returned.

### 7.2.4 Model Testing and Research Findings

All the scores of the questions in the survey questionnaire were used in the statistical analysis. An overall assessment of the quality management capabilities of the sample of the manufacturing organisations surveyed in the Western Sydney Region was conducted. This assessment was conducted using descriptive statistics to analyse the various quality elements considered in the model. The descriptive statistical analysis of all the TQM elements in the QMAF have highlighted significant deficiencies in all categories considered in the QMAF model for the industries in the Western Sydney Region. Further, certain sections of the population performed better than the others. The conclusion and practical implications of these findings have determined useful managerial guidelines in each QMAF category. Additionally, recommendations of re-applying the practices of the sections of the population that performed better than those with weaker results have been outlined.

ANOVA and multiple comparison with the best (MCB) were used to compare the organisations by size and ANZSIC codes for all categories considered in the QMAF model; the findings and practical implications were also outlined. The ANOVA analysis of the mean has identified some significant differences between large, medium and small industries and between the ANZSIC codes. These differences could provide useful benchmarks and insights which could be re-applied in the other organisation sizes and the relevant ANZSIC codes. A significant difference exists between large and medium size industries with regard to leadership and quality
culture - large organisations performing better than medium size organisations. Large organisations are significantly better with respect to improvement methods and partnering focus from both medium and small organisations. Large organisations are markedly superior in human resources management compared to medium size organisations; the mean of the small size is also significantly higher than the medium size; there is also a significant difference between large and small size though not as big as large and medium size. The means of strategy, business processes and information/knowledge/communication respectively are the same for all sizes of organisations.

The mean score of quality culture for ANZSIC code 28 (Chemicals and Allied Products) is the best and significantly higher than the mean score of quality culture for ANZSIC codes 34 (Fabricated Metal Products, Except Machinery and Transportation Equipment), 35 (Industrial and Commercial Machinery and Computer Equipment) and 37 (Transportation Equipment) organisations. Additionally ANZSIC codes 25 (Furniture and Fixtures), 30 (Fabricated Metal Products, Except Machinery and Transportation Equipment), 36 (Electronic and other Electrical Equipment and Components, except Computer Equipment) and 39 (Miscellaneous Manufacturing Industries) are also significantly higher than ANZSIC codes 34, 35 and 37.

The mean score of human resources management for ANZSIC code 28 (Chemicals and Allied Products) is the best mean score and that the mean of ANZSIC code 39 score is comparable to 28. Hence the means of ANZSIC codes 28 and 39 are significantly higher than the mean scores of human resources management for ANZSIC codes 30 (Rubber and Miscellaneous Plastics Products), 34 (Fabricated Metal Products, Except Machinery and Transportation Equipment) and 35 (Industrial and Commercial Machinery and Computer Equipment) organisations. Additionally the means of ANZSIC codes 25 (Furniture and Fixtures), 36 (Electronic and other Electrical Equipment and Components, except Computer Equipment) and 37 (Transportation Equipment) are also significantly higher than means of ANZSIC codes 30, 34 and 35.
The relationships hypothesised in the proposed model were through the use of structural equation modelling, specifically recursive path analysis. The exogenous variables were Leadership (L), Quality Culture (QC) and Information/Knowledge/Communication (IKC) and the endogenous variables were strategy (S), Human Resources Management (HRM), Partnering Focus (PF), Improvement Methods (IM), Business Processes (BP) and Business Outcomes (BO). Multivariate regression, univariate regression and structural equation model (SEM) with maximum likelihood chi square (ML) $\chi^2$ goodness of fit method were used. A total of nine variables were specified in the conceptual model. After the reliability of the measurement model was demonstrated, the structural relationships were then tested for the QMAF model when IKC is considered; the QMAF without considering IKC and the QMAF with IKC having a one-to-one relationship with the other variables.

The model results provided pathways to achieving optimum business outcomes with the QMAF constructs using IKC as an enabler. The recursive path analysis indicated that H1a leadership has a significant direct effect on strategy. H1b strategy has a significant direct effect on human resources management. H1c human resources management has a direct effect on business processes. H1d business processes have a direct effect on business outcomes. The test of the hypotheses H1e, H1g and H1i respectively supports the following: quality culture has a direct effect on improvement methods, partnering focus and human resources management. H1f was confirmed, i.e. improvement methods have direct effect on business processes. H1h was affirmed concluding that partnering focus has a direct effect on strategy.

The hypotheses related to the indirect effects of quality culture, namely H1, Hm, Hn, H1o, H1p, and H1q, were inferred - quality culture has an indirect effect on business processes and business outcomes. Leadership has an indirect effect on human resources management through strategy H1r  H1z is statistically significant, supporting that improvement methods has an indirect effect on business outcomes through business processes. H1lab and H1lac were statistically significant, indicating that IKC has a direct significant effect on strategy and business processes respectively.
A strong IKC program indirectly supports good human resources management through good strategy and indirectly supports good business processes through good strategy followed by good human resources management was apparent from the analysis, substantiating H1ad and H1ae. H1af was also supported and therefore a strong IKC program indirectly supports good business outcomes through good strategy followed by good human resources management and good business processes.

Though hypotheses H1j, H1k, H1s, H1t, H1u, H1v, H1w, H1x, H1y and H1aa did not have significant p-values and were rejected when IKC was considered in the model, these were found to be significant and accepted when IKC is not considered in the model.

The results of the analysis of the QMAF model without considering IKC affirm the importance of the pathways towards meeting business outcomes with the traditional TQM constructs, namely Leadership, Quality Culture, Strategy, Partnering Focus, Human Resources Management, Improvement Methods and Business Processes. This was reinforced by the increased strengths of the path coefficients in the QMAF model without considering IKC as compared to the QMAF model with considering IKC. The increased significance in all the cases of the path analysis both direct and indirect is a further assertion of the vitality of traditional TQM constructs in the QMAF. These findings do not in any way diminish the role that ICT plays in delivering optimum business outcomes. Instead it clarifies that fundamental traditional TQM principles must be a precursor to effectively utilise ICT as an enabler in delivering business excellence.

In the case of the QMAF with IKC having a one to one relationship with the other constructs, the hypotheses H1ab, H1ac, H2a, H2b, H2c, H2d, H2e and H2f had significant path coefficients. Therefore a strong IKC program directly supports good leadership, quality culture, strategy development and deployment, human resources management, partnering focus, improvement methods, business processes and business outcomes respectively.
7.3 Contributions of the Study

Assessment of quality management system effectiveness is an important aspect of business. Quality management academics have identified the importance of quality management systems and have presented various models to evaluate these systems. However, most of these models are propositions. This work represents an empirical investigation to examine the direct and indirect impact of TQM constructs with ICT as an enabler on business outcomes (business results and customer and stakeholder value) using more rigorous statistical techniques (SEM). As such, the research makes contributions from different perspectives which are summarised below.

7.3.1 Theoretical Perspective

First, our knowledge of the impact of TQM elements on business outcomes of a firm is mainly anecdotal. Pannirselvam and Ferguson (2001) applied path analysis to data from the Arizona Governor's Quality Award, which is based on the MBNQA. They confirmed the validity of the MBNQA framework. This study has established the pathways that should be taken through the TQM categories with ICT as an enabler in order to achieve optimum business outcomes. It lends valuable empirical support to a few studies on this issue. Therefore, this study contributes to the literature by validating the direct and indirect efforts that the TQM elements have on business outcomes with regard to business results, and customer and stakeholder value, and providing empirical support through rigorously testing the model using SEM.

Through non recursive path analysis the QMAF model with and without considering IKC have established significant direct and indirect effects of the traditional TQM elements and IKC with unidirectional pathways towards business outcomes. Additionally the one to one direct effects of IKC on each of the QMAF categories have holistically confirmed the vitality of IKC as an enabler.
7.3.2 Managerial Perspective

The descriptive statistical analysis of all the constructs have highlighted significant deficiencies in all constructs considered in the QMAF model for the manufacturing industries in the Western Sydney region. The practical implications of the data analysis have also been explained.

The ANOVA analysis of the mean has identified some significant differences between large, medium and small industries. These differences could provide useful benchmarks and insights which could be re-applied in the organisation sizes that had corresponding lower scores when compared with those that had higher scores.

Medium and small size organisations have a lot to gain from reapplying leadership, quality culture, improvement methods and partnering focus practices used by the large organisations that were surveyed. Small size organisations can also benefit from the quality culture practices of large organisations.

Medium organisations have a lot to gain from reapplying human resources management and business outcomes practices used by the large organisations that were surveyed. Small size organisations can also benefit from the human resources management and business outcome practices of large organisations.

ANZSIC codes 34 (Fabricated Metal Products, Except Machinery and Transportation Equipment), 35 (Industrial and Commercial Machinery and Computer Equipment) and 37 (Transportation Equipment) organisations can gain considerably from reapplying the quality culture practices of ANZSIC code 28 (Chemicals and Allied Products). ANZSIC codes 34, 35 and 37 can also benefit from the quality culture practices of ANZSIC codes 25 (Furniture and Fixtures), 30 (Fabricated Metal Products, Except Machinery and Transportation Equipment), 36 (Electronic and other Electrical Equipment and Components, except Computer Equipment) and 39 (Miscellaneous Manufacturing Industries).

ANZSIC codes 30 (Rubber and Miscellaneous Plastics Products), 34 (Fabricated Metal Products, Except Machinery and Transportation Equipment) and 35 (Industrial and
Commercial Machinery and Computer Equipment) organisations can gain considerably from reapplying the human resources management practices of ANZSIC codes 28 (Chemicals and Allied Products) and 39 (Miscellaneous Manufacturing Industries). ANZSIC codes 30, 34 and 35 can also benefit from the human resources management practices of ANZSIC codes 25 (Furniture and Fixtures), 36 (Electronic and other Electrical Equipment and Components, except Computer Equipment) and 37 (Transportation Equipment).

These findings, coupled with the recursive path analysis study which provided vital guidelines in formulating strategies towards achieving business excellence through TQM (Lobo et al, 2008), can be used to foster continual improvement supported by the QMAF assessment tool.

The QMAF delineates the major elements that influence quality management and outcomes in an organisation. This framework, suggests that “core driver” elements such as leadership, quality culture, information/ knowledge/ communication propel effective development and deployment of planning approaches, coupled with strong partnering focus and human resources management (employee development and empowerment) programs. The partnering focus encompasses both customers and suppliers. The value chain is further fuelled by a continuous improvement program supported by improvement methods (tools and techniques), so that operational and infrastructure business processes can be designed, implemented, monitored, and improved with a view towards creating customer and stakeholder value and achieving business results with excellence.

The findings have led to the development of important guidelines for managers involved in the planning and management of quality. One of the significant features of the QMAF is that it helps to draw explicit attention to the role that can be played by information and communication technology (ICT) in promoting quality. The improvements that can be symbiotically achieved with all the QMAF elements due to the enabling influence of ICT has been illustrated in the comprehensive review of the literature and further reinforced by the path analysis. The clever use of ICT in creating a quality culture, employee development, empowerment, and strategy formulation could facilitate speedy creation of these core competencies. Additionally
the results confirm the findings in the literature. Leadership and support of top management is needed to get all the functions to work together, share information, and maintain a reliable and secure ICT operating system (Madu and Madu, 2003).

The QMAF criteria represent leadership, quality culture and information/knowledge and communication as the core drivers that influence all other elements of quality management. These results are similar to the findings of previous research which studied quality-performance relationships. Flynn et al. (1995) determined that top management support has a significant effect on human resources management. Adam et al. (1997) illustrate through their research that leadership has a significant effect on training and product quality. Winn and Cameron’s (1998) model, based on exploratory factor analysis, also concluded that the main effect of leadership was on the system dimensions, not on the outcome dimensions.

Therefore, validating the model provides useful guidelines to managers in deciding which pathways to choose in order to devote resources towards achieving business outcomes. Leadership has shown to have a direct impact on strategy development and deployment and significant indirect effects on human resources management, business processes and business outcomes. Quality culture has demonstrated to have a strong influence on improvement methods, partnering focus (customers and suppliers) and indirect effects on strategy, human resources management, business processes and business outcomes. Information/knowledge/communication has shown to have direct influence on all the constructs - namely leadership, quality culture, partnering focus, improvement methods, human resources management, business processes and business outcomes. Significant indirect effects of IKC were also noted on human resources management, business processes and business outcomes. The impact of good strategy on business processes and business outcomes has been validated through indirect effects. Similar links have been inferred by indirect effects of improvement methods and human resources management on business outcomes through business processes.

**Application of the Litmus Tests for the Baldrige Categories**

A drill down investigation of an organisation’s management system in order to score its management system using the Likert scale in the QMAF reduced questionnaire as
in Appendix 4 can be well supported by the application of the litmus tests for the Baldrige categories as outlined below:

Baldrige judges and examiners provide the following recommendations to identify strengths and weaknesses in every category of the Baldrige criteria (Garvin, 1991):

Category #1: Leadership
• Review logbooks and calendars.
• Ask CEO and senior managers
  □ How much time did they spend
    − talking with customers
    − meeting with employees
    − Leading quality improvement teams
    − Reviewing the progress of the quality program
  □ What percentage of their total time was spent on quality-related activities?

Category #2: Information and Analysis
• Fact-based Management - a reliance of hard data not assumptions, when making decisions.
• Information base must be comprehensive, accessible, and well validated.
• Information must cover critical areas, customers, competitors, employees, suppliers, and internal processes.
• Assure the data’s consistency and correctness.
• The data must be easy to find and use.
• Benchmarking- how information on other organisations’ performance and practices are used as a catalyst of change, a learning process rather than a score card.
• A targeted approach to benchmarking superior companies by identifying a business need, what needs to be benchmarked, target the company that is best-in-class, conduct the benchmark visit, and include findings immediately into the strategic planning process.
Category #3: Strategic Quality Planning

- Strategic Quality Plans must be concrete, focused, aligned, integrated, and aggressive.
- Strategic Quality Plans must include findings of benchmarking visits, use customer data to drive goal-setting and improvement activities and be closely linked with the business planning process and have stretching goals.

Category #4: Human Resource Utilisation

- Empowerment of employees is evaluated by the ability of frontline employees to act in the interest of customers without getting prior approval.
- Are employees punished, or do they receive coaching and support when things go wrong?
- Is personal initiative valued or feared?
- Number of employee teams.
- Number of employee suggestions, number used.
- Amount of education and training and application of training (quality awareness, problem solving tools, group process skills, job-specific skills).
- Attitude surveys, informal meetings between managers and lower-level employees.

Category #5: Quality Assurance of Products and Services

- Companies have mapped their core and support processes.
- Measured, controlled and improved the processes through statistical methods.

Category #6: Quality Results

- Measures must be objective, with strategic significance.
- Timely data reporting, covering at least three years, show sustained improvements on critical measures, achieve high levels of performance relative to competitors and best-in-class benchmarks, and have evidence that quality initiatives, not serendipity, drove their trends.
- Statistical methods used to correlate their objective quality results with measures of customer satisfaction.
Category #7: Customer Satisfaction

- Evidence of customer understanding and commitment and excellent results.
- Wide range of sources of customer information - focus groups, surveys, one-on-one meetings, letters to the chairman, sales visits, telephone hot lines - measures that are objective and validated not anecdotal.
- Analysis of customer information to prevent future problems.
- Systems to collect customer information to determine what they are looking for, aiming at customer delight.

As stated in clause 8.2.2 of the ISO 9001:2008 standard, ‘Internal audits must be conducted at planned intervals, selection of auditors and conduct of audits shall ensure objectivity and impartiality of the audit process, auditors shall not audit their own work. The management responsible for the area being audited shall ensure that actions for the area being audited are taken without undue delay to eliminate detected non-conformities and their causes. Follow-up activities shall include the verification of the actions taken and the reporting of verification results.’ Hence if these audits were conducted in frequencies of quarterly periods and if financial reporting was done in the same frequencies, correlations could be established between financial dimensions and the elements in the QMAF framework. Additionally, longitudinal studies using factor analysis and multivariate analysis techniques can be used to determine relationships between respective dimensions in the framework.

7.3.3 Public Policy-maker Perspective

The findings of this study have demonstrated the important role of management’s support and leadership in following pathways towards achieving optimum business outcomes through business results and customer and stakeholder value. The findings have further comprehensively established the direct and indirect effects of the elements in the QMAF, namely ICT, leadership, quality culture, strategy, partnering focus, human resources management, that influence business outcomes. Therefore, this study suggests that policy-makers should develop effective national quality promotion programs to ensure favourable impacts upon business results and customer and stakeholder value creation. Such programs can use the QMAF model and the survey questionnaire to assess organisations with regard to their performance.
and reward successful organisations through tax incentives and grants for further research and development and innovation. The program could have a positive and long-term sustainable impact on the national economy.

7.4 Strengths and Limitations of the Study

The research has several key strengths. The conceptual research model for this study is based upon the extensive review of the literature. Primary data were gathered specifically for the study and sophisticated statistical techniques such as (SEM) were also used to analyse the data.

However, this research has some limitations which must be taken into consideration in evaluating the above results and their implications. A basic limitation of this study is that the data analysed for this study are cross-sectional rather than longitudinal to review quality programs over time. A longitudinal study can provide an in-depth view of the situation and the changes that take place over time. Finally, sample size of 60 used in this study is enough for SEM analysis, since the case/parameter ratio is 7.5:1 which is within the acceptable limit for statistical precision of the results (Kline, 2005); however, it should be noted that the limitation of the sample size did impact some of the goodness of fit criteria of the SEM analysis correspondingly. Hence a larger sample to augment validation of the findings could have been better. Therefore further validation of these findings is needed in future research.

7.5 Future Research Direction

Study results and limitations provide the basis for future research. There are a number of areas to which further research into the evaluations of the QMAF could be directed. Two general areas of future research are highlighted here for future researchers. First, future research can be directed at the limitations of this study and second, future research can be conducted on a larger population such as a national basis as compared to just the Western Sydney Region as in this study. This study has developed a model that contributes to measure the direct and indirect impact of the QMAF elements on business outcomes. It is particularly important to validate the model with another sample in another region, and confirm its
applicability in a different business environment. Moreover, attention should be
given to investigating the universal applicability of the findings in this study.
Interesting insights could be gained by looking into comparative studies by
replicating the research design with other samples of firms such as primary industries
and services. The impact of quality promotion on such industries may be different
from that of manufacturing, especially in terms of business outcomes. As such, cross-
industry comparisons would enhance the universality of the findings reported in this
study.

The government could promote a quality program to fuel the economy on a national
level using the QMAF. Impetus to the the total quality movement in Australia can be
delivered by a more equitable reward system and a mechanism that dynamically
uses optimum resources in a continual improvement process. Thus providing a
PDCA cycle for quality improvement on a national scale which is sustainable and
result oriented. Below is a proposed conceptual model to initiate such a program.

Figure 7.1 maps out the process flowchart to promote quality improvement at a
national level using the QMAF model.

Figure 7.1: A process flowchart to promote quality improvement at a national level using the QMAF model
7.6 Conclusion

The contribution of this research is the establishment of a clearer and more complete explanation of the impact the categories in the QMAF - namely ICT, leadership, quality culture, strategy, partnering focus, human resources management, - have on business outcomes. This kind of contribution can only be generalised if the additional insights offered by the research stand the tests of time and replication. If future researchers test this model across industries and other regions, then it may be said that this study has made a contribution to the understanding of the effectiveness of quality programs. It is hoped that other research will seek to establish the validity of the findings in this study by replicating the research design with other samples of firms.

The National PDCA model could be a roadmap to improving quality at the national level.
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Appendix 1: An inventory of management concepts which was used to aid in the formulation of the survey questionnaire

Table 3.2: An Inventory of management concepts which was used to aid in the formulation of the survey questionnaire

<table>
<thead>
<tr>
<th>ELEMENTS OF QMAF</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Leadership</strong></td>
<td></td>
</tr>
<tr>
<td><strong>1.1 Organisational Leadership</strong></td>
<td>MBQP 2001; MSU Logistics SCM Research</td>
</tr>
<tr>
<td>• Senior managers must be able to effectively communicate the organisation’s values and the organisation’s short and long term directions and have systems in place that will relate organisational and individual performance.</td>
<td></td>
</tr>
<tr>
<td>• The organisation must have procedures to promote mechanisms for translating organisational performance review into priorities for improvement and innovation; to encourage suppliers/partners to improve and innovate that ensures organisational alignment.</td>
<td></td>
</tr>
<tr>
<td>• Senior managers must use performance review findings to improve their own leadership effectiveness and systems.</td>
<td></td>
</tr>
<tr>
<td>• Managers in the organisation must understand how the overall performance measures compare to major competitors.</td>
<td></td>
</tr>
<tr>
<td>• Managers must put mechanisms in place that will cause a shift from managing functions to managing key business processes.</td>
<td></td>
</tr>
<tr>
<td>• Middle managers must be empowered to use their own discretion within broad guidelines to make decisions.</td>
<td></td>
</tr>
<tr>
<td>• Management must comprehend that a total quality organisation requires a well trained and empowered workforce.</td>
<td></td>
</tr>
<tr>
<td>• Employees must be made aware of the link between their specific job and its impact on the quality of the organisation’s output.</td>
<td></td>
</tr>
<tr>
<td><strong>1.2 Public Responsibility and Citizenship</strong></td>
<td></td>
</tr>
<tr>
<td>• The organisation must systematically assess, at regular intervals, the impacts on society of their products, services and operations by:</td>
<td></td>
</tr>
<tr>
<td>o addressing regulatory and legal requirements of processes, measures and targets;</td>
<td></td>
</tr>
<tr>
<td>o addressing risks associated with products, services and operations;</td>
<td></td>
</tr>
<tr>
<td>o anticipating public concerns with current and future products, services and operations;</td>
<td></td>
</tr>
<tr>
<td>o anticipating public concerns with current and future products, services and operations;</td>
<td></td>
</tr>
<tr>
<td>o accomplishing ethical business practices in all stakeholders transactions and interactions,</td>
<td></td>
</tr>
<tr>
<td>• The organisation, its senior managers, and employees must actively support community involvement and enthusiastically determine ways in which the organisation could support community projects and activities.</td>
<td></td>
</tr>
</tbody>
</table>
Table 3.2: An Inventory of management concepts which was used to aid in the formulation of the survey questionnaire (cont’d)

<table>
<thead>
<tr>
<th>2. Quality Culture</th>
<th>(Tan 1997); (Anderson and Sohal 1999)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1 Employee Attitudes</td>
<td></td>
</tr>
<tr>
<td>• Managers must make it conducive for employees to feel that they are individually and collectively responsible for quality.</td>
<td></td>
</tr>
<tr>
<td>2.2 Organisational Structure</td>
<td></td>
</tr>
<tr>
<td>• The role of the specialised quality department must be seen as facilitating quality improvement and not being solely responsible for quality improvement.</td>
<td></td>
</tr>
<tr>
<td>• The quality department plays the following roles:</td>
<td></td>
</tr>
<tr>
<td>o initiating, planning and implementing quality initiatives with the various departments;</td>
<td></td>
</tr>
<tr>
<td>o facilitating and conducting quality enhancement efforts under the leadership of top management;</td>
<td></td>
</tr>
<tr>
<td>o training for quality and inspection;</td>
<td></td>
</tr>
<tr>
<td>o not inspection only.</td>
<td></td>
</tr>
<tr>
<td>• Managers must ensure that the organisation has formal quality management practices in all functional areas.</td>
<td></td>
</tr>
<tr>
<td>• Management must acknowledge the importance of functional excellence but focus on performance achievement.</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>ELEMENTS OF QMAF</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Benchmarking</td>
<td>(Anderson and Sohal 1999); (Adam 1997)</td>
</tr>
<tr>
<td>3.1 Planning for Benchmarks</td>
<td>MSU Logistics SCM Research ; (Camp 1989)</td>
</tr>
<tr>
<td>• Benchmarks must align with the organisation’s strategic plans.</td>
<td></td>
</tr>
<tr>
<td>3.2 Conducting Benchmarking</td>
<td></td>
</tr>
<tr>
<td>• The quality of data available for performance measurement in the organisation must demonstrate a significant improvement over the years.</td>
<td></td>
</tr>
<tr>
<td>• The number of performance measures regularly used by the organisation should have increased over the years.</td>
<td></td>
</tr>
<tr>
<td>3.3 Analysis of Benchmarks</td>
<td></td>
</tr>
<tr>
<td>• Analysis of benchmarks must be used to determine the current competitive gap.</td>
<td></td>
</tr>
<tr>
<td>• Analysis of benchmarks must be used to project future performance levels.</td>
<td></td>
</tr>
<tr>
<td>• Analysis of benchmarks must be used to establish functional goals.</td>
<td></td>
</tr>
<tr>
<td>• Analysis of benchmarks must be used to implement specific actions and monitor progress.</td>
<td></td>
</tr>
<tr>
<td>3.4 Action Steps Post-analysis</td>
<td></td>
</tr>
<tr>
<td>• Factors critical for improved performance must be identified post-analysis of benchmarks.</td>
<td></td>
</tr>
<tr>
<td>• Findings of analysis must be communicated to the relevant people to plan and implement change.</td>
<td></td>
</tr>
<tr>
<td>• Periodic follow-ups must be conducted to verify outcomes of implemented change in relation to benchmark target.</td>
<td></td>
</tr>
<tr>
<td>• The organisation must share benchmarking and information on best practices/processes results with suppliers.</td>
<td></td>
</tr>
</tbody>
</table>
Table 3.2: An Inventory of management concepts which was used to aid in the formulation of the survey questionnaire (cont’d)

<table>
<thead>
<tr>
<th>4. Customer Focus</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1 Understanding Customer Needs</td>
<td>MBQP 2001; (Anderson and Sohal 1999); MSU Logistics SCM Research; (Tan 1997)</td>
</tr>
<tr>
<td>• Customer must be determined by: telephone surveys; feedback from sales personnel; formal customer questionnaire surveys; focus groups; competitor analysis; data mining approaches.</td>
<td></td>
</tr>
<tr>
<td>4.2 Customer Relationship Management (includes commitment)</td>
<td>MSU Logistics SCM Research; (Lagrosen 2001)</td>
</tr>
<tr>
<td>• Systems must be in place for customers:</td>
<td></td>
</tr>
<tr>
<td>o to seek information about the firm’s products and services;</td>
<td></td>
</tr>
<tr>
<td>o to comment about the firm’s products and services;</td>
<td></td>
</tr>
<tr>
<td>o to complain about the organisation’s products and/or services.</td>
<td></td>
</tr>
<tr>
<td>• The organisation must have:</td>
<td></td>
</tr>
<tr>
<td>o a customer service toll free number;</td>
<td></td>
</tr>
<tr>
<td>o a website with a section to log customer complaints and to request for information.</td>
<td></td>
</tr>
<tr>
<td>• Research must be conducted to project future customers and predict what their key requirements are likely to be.</td>
<td></td>
</tr>
<tr>
<td>• The organisation must be able to accommodate a wide range of unique customer requests by implementing preplanned solutions.</td>
<td></td>
</tr>
<tr>
<td>• The organisation must have supply chain arrangements with customers that operate under principles of shared rewards and risks.</td>
<td></td>
</tr>
<tr>
<td>4.3 Customer Satisfaction Determination</td>
<td>References</td>
</tr>
<tr>
<td>• The organisation must have systems which identify a customer’s current needs, future needs, level of satisfaction &amp; loyalty.</td>
<td></td>
</tr>
<tr>
<td>• Customer satisfaction results must be used in decision making of marketing and sales initiatives.</td>
<td></td>
</tr>
</tbody>
</table>

ELEMENTS OF QMAF

5. Supplier Focus

<table>
<thead>
<tr>
<th>5. Supplier Focus</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1 Supplier Partnering</td>
<td>MSU Logistics SCM Research; ISO 9001:2000 Standard; (Anderson and Sohal 1999)</td>
</tr>
<tr>
<td>• The organisation must be willing to share strategic information with selected suppliers.</td>
<td></td>
</tr>
<tr>
<td>• The organisation must select and monitor suppliers based on formal evaluations and assessments.</td>
<td></td>
</tr>
<tr>
<td>• Supplier contracts must be established for key raw materials/suppliers.</td>
<td></td>
</tr>
<tr>
<td>• The organisation must avoid working with suppliers who lack environmental awareness.</td>
<td></td>
</tr>
<tr>
<td>• The organisation must understand that the strategic direction, role and performance of their supply chain partners are critical to achieving success.</td>
<td></td>
</tr>
<tr>
<td>• The organisation must be willing to help suppliers finance capital equipment.</td>
<td></td>
</tr>
<tr>
<td>• The organisation must be willing to share research and development costs and results with primary suppliers.</td>
<td></td>
</tr>
<tr>
<td>• The organisation must be committed to sharing responsibility with suppliers in new product/service development and commercialisation.</td>
<td></td>
</tr>
<tr>
<td>• The organisation must facilitate a strong supply network fostering cooperation with entire chain of primary and secondary suppliers.</td>
<td></td>
</tr>
</tbody>
</table>

6. Employee Development

<table>
<thead>
<tr>
<th>6. Employee Development</th>
<th>MBQP 2001; (Vinten 2000); (Truelove 1992); MSU Logistics SCM Research; (Newby 1992)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1 Recruitment</td>
<td></td>
</tr>
<tr>
<td>• The firm must look for “Critical To Quality” attributes in employee biographical data.</td>
<td></td>
</tr>
<tr>
<td>• Pre-employment testing must be used in employee selection.</td>
<td></td>
</tr>
<tr>
<td>6.2 Training Needs Identification</td>
<td></td>
</tr>
<tr>
<td>• Training needs must be identified based on performance appraisals, business requirements, staff profiles.</td>
<td></td>
</tr>
</tbody>
</table>
Table 3.2: An Inventory of management concepts which was used to aid in the formulation of the survey questionnaire (cont’d)

<table>
<thead>
<tr>
<th>6.3 Training Design</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Human resource department must provide advice and research the market to identify good quality external training resources, products and courses.</td>
<td></td>
</tr>
<tr>
<td>• A variety of forms of training must be used such as lectures and presentations, coaching/mentoring, self-directed learning, discussion format, instructional simulations, role-plays, interactive multimedia training (audiovisual and computer based training), other training technology (satellite broadcasts, cable broadcasts, video-conferencing and virtual classrooms, videotapes, narrated slide presentations, audio tapes).</td>
<td></td>
</tr>
<tr>
<td>• The perspective of all stakeholders must be considered and met in designing training programs.</td>
<td></td>
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</table>

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<thead>
<tr>
<th>6.4 Training Delivery</th>
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</thead>
<tbody>
<tr>
<td>• The trainers must exhibit the following:</td>
<td></td>
</tr>
<tr>
<td>o Focus and build on learners strengths, not weaknesses.</td>
<td></td>
</tr>
<tr>
<td>o Set an accepting and encouraging mood for learners.</td>
<td></td>
</tr>
<tr>
<td>o Give learners verbal cues about their performance, generous with sincere compliments and positive constructive criticism.</td>
<td></td>
</tr>
<tr>
<td>o Encourage learners to ask questions.</td>
<td></td>
</tr>
<tr>
<td>• The organisation must have active programs to capture the experience and expertise of individuals and transfer this knowledge throughout the organisation.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ELEMENTS OF QMAF</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.5 Training Evaluation</td>
<td></td>
</tr>
<tr>
<td>• Training programs must be evaluated based on the following success criteria:</td>
<td></td>
</tr>
<tr>
<td>o There are cost benefits and maximum utility of the training programs.</td>
<td></td>
</tr>
<tr>
<td>o The training programs achieve their key objectives.</td>
<td></td>
</tr>
<tr>
<td>o The net effect of training programs is benchmarked.</td>
<td></td>
</tr>
<tr>
<td>o The training programs are ethical.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>7. Empowerment</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>7.1 Employee Involvement</td>
<td></td>
</tr>
<tr>
<td>• Processes must be in place to foster educating, enabling and encouraging in employee involvement.</td>
<td></td>
</tr>
<tr>
<td>• The organisation must implement a number of innovative approaches to job and work design such as self-directed teams throughout all areas of the organisation.</td>
<td></td>
</tr>
<tr>
<td>7.2 Developing Employee Commitment</td>
<td></td>
</tr>
<tr>
<td>• The performance assessment system must be linked to a reward system.</td>
<td></td>
</tr>
<tr>
<td>• Human resource systems must be designed to promote:</td>
<td></td>
</tr>
<tr>
<td>o flexibility among members of the workforce;</td>
<td></td>
</tr>
<tr>
<td>o cooperation among members of the workforce;</td>
<td></td>
</tr>
<tr>
<td>• Suggestions for business improvements must permeate from the bottom of the organisational hierarchy.</td>
<td></td>
</tr>
<tr>
<td>• Employee involvement activities must be aimed at changing attitudes of employees resisting change.</td>
<td></td>
</tr>
<tr>
<td>• The organisation must employ a thorough and prevention-based approach to employee safety and well being.</td>
<td></td>
</tr>
<tr>
<td>• A wide variety of methods must be used to measure and improve employee satisfaction.</td>
<td></td>
</tr>
</tbody>
</table>

(Adam et al. 1997); (Tan 1997); (Anderson and Sohal 1999); MBQP 2001; Martinez Lorente et. al. 1999); MBQP 1997; (Honold 1997); MSU Logistics SCM Research; Briggs & Keogh 1999)
### Table 3.2: An Inventory of management concepts which was used to aid in the formulation of the survey questionnaire (cont’d)

#### 7.3 Support for Team Building

- Processes must be in place to identify:
  - employee/team competency;
  - training requirements in order to deliver skills to employees/team members;
  - training requirements in order to build commitment among employees/team.
- Processes must be in place to enable teams to be autonomous.
- The organisation must utilise cross-functional work teams for managing day-to-day operations.

#### 7.4 Recognition and Reward Systems

- Employees must feel well recognised for their accomplishments.
- Employees at all levels must have a significant portion of their compensation linked to performance and productivity.
- The organisation’s compensation and reward systems must encourage adherence to stated policies and procedures.
- The organisation’s compensation, incentive and reward systems must encourage integration and harmonisation of activities and processes.

#### 7.5 Internal Partnering

- Teams must have the following objectives set up:
  - achieve specified quality standards;
  - share work within the team on an equitable and efficient basis;
  - work effectively with other team members;
  - apply the next customer concept.
  - reach production targets;
  - perform routine maintenance;
  - improve work area layout;
  - look for improvement possibilities continuously.

#### 8. Strategy

#### 8.1 Strategy Development

- The overall strategic planning process must contain key steps, key participants, short-term planning time horizons, long-term planning time horizons.
- The strategic planning process must address the objectives and challenges related to the following:
  - customer and market needs/expectations/opportunities;
  - competitive environment and capabilities relative to competitors;
  - technological and other changes that might affect product/services/operations;
  - strengths and weaknesses, including human and other resources;
  - supplier/partner strengths and weaknesses;
  - financial, societal, and other potential risks;
  - environmental issues.
- The organisation must have key objectives and timetables for accomplishing its strategic plans.
- The organisation must collaborate with key customers in developing its strategic plans.
- The organisation must collaborate with suppliers in developing strategic plans.

**References**

- MBQP 2001; MSU Logistics SCM Research;
- (Anderson and Sohal, 1999)
Table 3.2: An Inventory of management concepts which was used to aid in the formulation of the survey questionnaire (cont’d)

8.2 Strategy Deployment

- The organisation must have well established procedures to develop and deploy action plans, based on the strategic plan, to achieve key objectives.
- The organisation must have key performance measures/indicators for tracking progress relative to their action plans and stakeholders.
- Procedures must be available to feedback differences in comparative information to modify the action plans.

9. Continuous Improvement

9.1 Initiatives for Continuous Improvement

- The organisation must have extensively redesigned work routines and processes over the past three years.
- The organisation must successfully utilise time-based logistics with customers and/or suppliers like continuous replenishment, quick response, Just-in-Time, defect reduction, waste evaluation.
- The organisation must significantly reduce the number of suppliers to improve operational integration.

9.2 Supportive Infrastructure Available

- The continuous improvement team processes used must be quality circles (teams made up from one department or work area, identifying their own projects to tackle), quality problem-solving team (multi-departmental teams brought together to solve specific management-directed problems), quality improvement team (multi-departmental teams that generate their own projects from broad management briefs).
- Supporting infrastructure for quality improvement must be provided by a body of senior managers who regularly meet to steer continuous improvement activities.
- Continuous improvement (CI) processes must be strengthened through training of personnel, monitoring of CI process, top management support for CI programs, CI project leaders, a suggestion scheme, PDCA-cycle, promoting on notice boards, promoting through internal media (magazines, newsletters), face to face communication, regular shop-floor visits by management, use of ISO 9000, total productive maintenance regimes, formal policy deployment protocols, time studies.
- The organisation must actively encourage best practice implementation.

9.3 Reward Systems

- Continuous improvement processes must be supported by incentive systems, promoting through competitions and awards.

10. Total Quality Tools

- The following tools must be used: flow charts, cause and effect diagrams, multi voting, affinity diagrams, process action teams, election grids, task lists, Deming cycle (PDCA), control charts, scatter diagrams, Pareto charts, sampling techniques, run charts, histograms, process mapping tools, FMEA, QFD, creativity tools/idea generation tools, display/visualisation tools, standardisation tools, SS, Taguchi methodology of experimental design.

11. Business Processes

11.1 Approaches for Redesign of Processes

- Methodologies which involve getting inputs from all departments must be used for product design processes.
- The organisation must employ a systematic process for incorporating new and changing customer requirements into product/service design.
- The organisation must reduce facility and operational complexity.
- The organisation must redesign the logistic system for greater environmental efficiency.
- The organisation’s logistical capability must be significantly more responsive (pull) as compared to predetermined (push).
- The organisation must be actively involved in initiatives to standardise supply chain practices and operations.
### Table 3.2: An Inventory of management concepts which was used to aid in the formulation of the survey questionnaire (cont’d)

#### 11.2 Measures used for Rating Performance of Business Processes

<table>
<thead>
<tr>
<th>Measures</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data on key process measures must be collected on a regular basis.</td>
<td></td>
</tr>
<tr>
<td>The organisation must employ valid control strategies to keep all process measures within standards or acceptable levels.</td>
<td></td>
</tr>
<tr>
<td>The organisation uses activity-based costing.</td>
<td></td>
</tr>
</tbody>
</table>

#### ELEMENTS OF QMAF

**12. Information, Knowledge, Communication**

<table>
<thead>
<tr>
<th>12.1 Information Management</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Software packages must be used to facilitate the administrative work associated with the development of quality management systems to meet ISO 9000 standards.</td>
<td>Martinez Lorente et. al. 1999; MSU Logistics SCM Research; (Anderson and Sohal 1999); (Bhatt 2001); (Howe et.al. 2000, Ngai and Cheng 1998)</td>
</tr>
<tr>
<td>The organisation must use IT to manage its reporting systems, data collection, analysis of data, decision-making process.</td>
<td></td>
</tr>
<tr>
<td>The information available in the organisation must be accurate, timely, formatted to facilitate easy use.</td>
<td></td>
</tr>
<tr>
<td>The organisation’s information systems must capture and maintain information on changes in customer needs.</td>
<td></td>
</tr>
<tr>
<td>The firm must obtain information directly from customers to facilitate operational plans and reduce reliance on forecasting.</td>
<td></td>
</tr>
<tr>
<td>Logistics operating and planning databases must be integrated across applications within the organisation.</td>
<td></td>
</tr>
<tr>
<td>The organisation must maintain an integrated database and access method to facilitate information sharing.</td>
<td></td>
</tr>
<tr>
<td>The organisation must actively utilise industry standards for data exchange.</td>
<td></td>
</tr>
<tr>
<td>The organisation must invest in technology designed to facilitate cross-organisational data exchange.</td>
<td></td>
</tr>
<tr>
<td>Information systems in the organisation must be expanded to reflect more enterprise-wide integrated processes (ERP).</td>
<td></td>
</tr>
<tr>
<td>The organisation’s information systems must facilitate electronic commerce using internet capability.</td>
<td></td>
</tr>
<tr>
<td>The organisation must share technical resources with key suppliers to facilitate operations.</td>
<td></td>
</tr>
<tr>
<td>The organisation must develop information linkages with customers that permit substantial last minute accommodation without loss of planned efficiencies.</td>
<td></td>
</tr>
<tr>
<td>The organisation must increase the use of integrated inventory, transportation and warehousing planning systems.</td>
<td></td>
</tr>
<tr>
<td>The organisation must increase the use of EDI standards.</td>
<td></td>
</tr>
</tbody>
</table>

**12.2 Knowledge Management**

<table>
<thead>
<tr>
<th>Measures</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>The organisation must collect comparative and competitor data on product and service quality, supplier performance, employee data, internal operations and support functions, other appropriate processes and functions.</td>
<td></td>
</tr>
<tr>
<td>The comparative and competitor data on benchmarking must be reliable for product and service quality, customer satisfaction, supplier performance, HR practices, internal operations and support functions, other appropriate processes and functions.</td>
<td></td>
</tr>
<tr>
<td>The organisation must design data collection and reporting systems around the needs of the managers and employees who use the data to plan and make decisions.</td>
<td></td>
</tr>
<tr>
<td>The organisation must have knowledge management systems that collect state of the art information on best practices in business, innovative quality systems.</td>
<td></td>
</tr>
</tbody>
</table>

**12.3 Communication**

<table>
<thead>
<tr>
<th>Measures</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>The organisation must effectively share operational information between departments.</td>
<td></td>
</tr>
<tr>
<td>The organisation must have adequate ability to share internally and externally standardised and customised information.</td>
<td></td>
</tr>
<tr>
<td>Performance measurement data must be available on a timely basis.</td>
<td></td>
</tr>
</tbody>
</table>
Table 3.2: An Inventory of management concepts which was used to aid in the formulation of the survey questionnaire (cont’d)

<table>
<thead>
<tr>
<th>ELEMENTS OF QMAF</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>12. Business Results + (Feedback)</strong></td>
<td>(Anderson and Sohal 1999); MBQP 1997; (Camp 1989); (Lindsay and Preston 2000); MSU Logistics SCM Research</td>
</tr>
<tr>
<td><strong>13.1 Measures used for Evaluating Overall Organisation Performance</strong></td>
<td></td>
</tr>
<tr>
<td>• The organisation must use “balanced scorecard” approach to measurement.</td>
<td></td>
</tr>
<tr>
<td>• The categories used for measuring organisation performance must be customer satisfaction, employee satisfaction, financial performance, product/service quality, supplier performance, operational performance and each should have 2—3 measures all showing improvement trends internally and compared to competitors..</td>
<td></td>
</tr>
<tr>
<td>• The organisation must demonstrate gains in market share relative to major competitors’ market share.</td>
<td></td>
</tr>
<tr>
<td><strong>13.2 Approaches used to Link Performance Measures with Quality Improvement</strong></td>
<td></td>
</tr>
<tr>
<td>• All key business decisions and plans must be based upon an analysis of performance data.</td>
<td></td>
</tr>
<tr>
<td>• The implementation of change based on gaps identified through benchmarking must lead to improvement in performance levels.</td>
<td></td>
</tr>
<tr>
<td>• There must be evidence of continuous improvements in the education/training as a result of training evaluations.</td>
<td></td>
</tr>
<tr>
<td>• Employee participation leads to improved communication with employees, involvement of employees in decision-making resulting in successful attaining of organisational objectives.</td>
<td></td>
</tr>
<tr>
<td>• The organisation must thoroughly understand the link between different types of measures such as the relationship between customer satisfaction and quality, with financial performance.</td>
<td></td>
</tr>
<tr>
<td>• The organisation must increase operational flexibility through supply-chain collaboration.</td>
<td></td>
</tr>
<tr>
<td>• The organisation must evaluate and make many major improvements in its measures and data collection and reporting methods.</td>
<td></td>
</tr>
<tr>
<td><strong>13. Customer &amp; Stakeholder Value + (Feedback)</strong></td>
<td>MBQP 1997; MSU Logistics SCM Research; MBQP 2001</td>
</tr>
<tr>
<td><strong>14.1 Measures used for Assessing Customer Value</strong></td>
<td></td>
</tr>
<tr>
<td>• The organisation has data to demonstrate positive trends in gaining and avoiding losses of customers.</td>
<td></td>
</tr>
<tr>
<td>• Customers view quality of the organisation’s products and services as quality that exceeds expectations and delights.</td>
<td></td>
</tr>
<tr>
<td><strong>14.2 Measures used for Assessing Contribution to the Environment</strong></td>
<td></td>
</tr>
<tr>
<td>• Measures of environmental performance must show continued improvement trends.</td>
<td></td>
</tr>
<tr>
<td>• Measures of environmental performance must be clearly superior to other organisations in the same industry.</td>
<td></td>
</tr>
<tr>
<td><strong>14.3 Measures used for Assessing Contribution to the Community</strong></td>
<td></td>
</tr>
<tr>
<td>• Measures of environmental/public health performance must show continued improvement trends and levels of performance.</td>
<td></td>
</tr>
<tr>
<td>• Measures of environmental/public health performance must be clearly superior to other organisations in the same industry.</td>
<td></td>
</tr>
</tbody>
</table>
Appendix 2: Sample Letter for Conducting the Survey

Stan Lobo  
School of Management  
EMG 30, Parramatta Campus  
University of Western Sydney  
Locked Bag 1797  
Penrith South DC NSW 1797

August, 2003

Mr. Xxxxxxxx  
Managing Director  
Xxxxx  
Xxxxxxxx  
Xxxxxxxxxx

Dear Mr. Xxxxxx

I am a PhD student at the School of Management of the University of Western Sydney. My research is currently being undertaken under the supervision of Dr. K. Ramanathan, Senior Lecturer at the School of Management.

My PhD research title is “A holistic approach of pathways to achieving optimum business outcomes using a Quality Management Assessment Framework (QMAF) with Information Communication Technology (ICT) as an enabler”. My work involves developing a comprehensive model for assessing quality management practices. The model illustrates the role of Information communication technology in customer value creation through quality at the firm level.

I have now completed the conceptual part of my thesis and will be publishing a paper on it shortly in a reputed international journal. I am now at a stage where I need to conduct a survey of business organisations with a view to identifying their critical quality problems. In this context I am looking for firms in the manufacturing/service sector who are willing to take part in the survey.

I would be very grateful if your organisation would participate in this survey. This would involve your quality/technical managers complete a survey questionnaire. I shall be grateful if you would provide me with the contact details of senior managers in operations/quality so that I could contact them to ascertain their willingness to complete the survey questionnaire. I would also be available to visit your organisation if any further clarification is needed.

I assure you that your personal identity or that of your organisation will not be recorded in the questionnaire or revealed in any form at a later date. Should you feel uncomfortable at any stage that you wish to discontinue your participation in the research study, you will be able to do so without any reservations or problems.
Thank you for your cooperation. We believe that, with your assistance, this study can help clarify a number of issues pertaining to quality management practices in industries in the Western Sydney Region.

If you would like to receive a copy of the summary report, please provide your name and address or a business card for mailing the same at a later date.

Many thanks for your kind consideration and cooperation.

Best regards,

Yours truly,

Stan Lobo
Doctoral Candidate
Appendix 3: Sample of Survey Questionnaire

A holistic approach of pathways to achieving optimum business outcomes using a Quality Management Assessment Framework (QMAF) with Information Communication Technology (ICT) as an enabler

Ph.D. Research Project Questionnaire

On

By

Stanislaus Lobo
Ph.D. candidate
School of Management
University of Western Sydney
Email: 10187656@studentmail.uws.edu.au
stanlobo@optusnet.com.au
Mobile: 0404045093
Tel. No. (02) 9630 6196

The questionnaire comprises of the following sections:

<table>
<thead>
<tr>
<th>General Questions</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Leadership</td>
<td>3-4</td>
</tr>
<tr>
<td>2 Quality Culture</td>
<td>3-4</td>
</tr>
<tr>
<td>3 Benchmarking</td>
<td>4</td>
</tr>
<tr>
<td>4 Customer Focus</td>
<td>4-5</td>
</tr>
<tr>
<td>5 Supplier Focus</td>
<td>5</td>
</tr>
<tr>
<td>6 Employee Development</td>
<td>5-6</td>
</tr>
<tr>
<td>7 Employee Empowerment</td>
<td>6-7</td>
</tr>
<tr>
<td>8 Strategy</td>
<td>7-8</td>
</tr>
<tr>
<td>9 Continuous Improvement</td>
<td>8-9</td>
</tr>
<tr>
<td>10 Total Quality Tools</td>
<td>9</td>
</tr>
<tr>
<td>11 Business Processes</td>
<td>9</td>
</tr>
<tr>
<td>12 Information, Knowledge, Communication</td>
<td>10-11</td>
</tr>
<tr>
<td>13 Business Results + (Feedback)</td>
<td>11-12</td>
</tr>
<tr>
<td>14 Customer &amp; Stakeholder Value + (Feedback)</td>
<td>12-13</td>
</tr>
</tbody>
</table>
## GENERAL QUESTIONS

### Company Description

1. **Name of Company:**
   - **Business Category:**
     - (a) Manufacturing
     - (b) Public Company
     - (c) Multinational

   **Brief Details of Business:**
   
<p>| | | | |</p>
<table>
<thead>
<tr>
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</tr>
</tbody>
</table>

2. **No. of Employees** ________________

3. **Overall Performance Measures**

<table>
<thead>
<tr>
<th>Year</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Sales A$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gross Profit A$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net Profit (Before Tax) A$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Assets A$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current Assets A$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current Liabilities A$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inventories A$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accounts Receivable A$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost of Goods Sold A$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### QUESTIONS

#### Leadership
1. Senior managers are able to communicate effectively
   a) values that the organisation stands for
   b) short and long term directions of the organisation
   c) expectations related to organisational and individual performance

2. The organisation has well established procedures for translating organisational performance review into priorities for improvement and innovation
3. The organisation has well established procedures to encourage suppliers/partners to improve and innovate and thereby ensure organisational alignment
4. Senior managers use performance review findings to improve their own leadership effectiveness and their leadership systems
5. Managers in the organisation understand how the overall performance measures compare to major competitors
6. The orientation of the organisation has shifted from managing functions to managing key business processes
7. Middle managers in the organisation are empowered to use their own discretion within broad guidelines to make decisions
8. Management in the company understand that creating a total quality organisation requires a well trained and empowered workforce
9. Employees are made aware of the link between their specific jobs and its impact on the quality of the organisation’s output
10. The organisation systematically assesses, at regular intervals, the impacts on society of their products, services and operations by:
    a) addressing regulatory and legal requirements of processes, measures and targets
    b) addressing risks associated with products, services and operations
    c) anticipating public concerns with current and future products, services and operations
    d) accomplishing ethical business practices in all stakeholders transactions and interactions
11. The organisation, its senior managers, and employees actively support community involvement and enthusiastically determine ways in which the organisation could support community projects and activities

#### Quality Culture
12. Employees feel that they are individually and collectively responsible for quality
13. The role of the specialised quality department is seen as facilitating quality improvement and not being solely responsible for quality improvement
14. The organisation has formal quality management practices in all functional areas
15. The organisation acknowledges the importance of functional excellence but focuses on performance achievement
16. Teams are required to have the following objectives set up:
    a) achieve specified quality standards
    b) share work within the team on an equitable and efficient basis
    c) work effectively with other team members
    d) apply the next customer concept
    e) reach production targets
    f) perform routine maintenance
    g) look for improvement possibilities continuously

#### Benchmarking
17. Benchmarks align with the organisation’s strategic plans
18. Please list three of the most important areas of benchmarking
### QUESTIONS

<table>
<thead>
<tr>
<th></th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>19. The quality of data available for performance measurement in the organisation is better today than three years ago</td>
<td></td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>20. The number of performance measures regularly used by the organisation has increased over the past three years</td>
<td></td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>21. Analysis of benchmarks are used to determine the current competitive gap</td>
<td></td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>22. Analysis of benchmarks are used to project future performance levels</td>
<td></td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>23. Analysis of benchmarks is used to establish functional goals</td>
<td></td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>24. Analysis of benchmarks is used to implement specific actions and monitor progress</td>
<td></td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>25. Factors critical for improved performance are identified post-analysis of benchmarks.</td>
<td></td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>26. Findings of analysis are communicated to the relevant people to plan and implement change</td>
<td></td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>27. Periodic follow-ups are conducted to verify outcomes of implemented change in relation to benchmark target</td>
<td></td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>28. The organisation shares benchmarking and information on best practices/processes results with suppliers</td>
<td></td>
<td>1 2 3 4 5</td>
</tr>
</tbody>
</table>

#### 4. Customer Focus

29. Customer needs are determined by:

<table>
<thead>
<tr>
<th></th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Telephone surveys</td>
<td></td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>b) Feedback from sales personnel</td>
<td></td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>c) Formal customer questionnaire surveys</td>
<td></td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>d) Focus groups</td>
<td></td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>e) Competitor analysis</td>
<td></td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>f) Data mining approaches</td>
<td></td>
<td>1 2 3 4 5</td>
</tr>
</tbody>
</table>

30. It is easy for customers:

<table>
<thead>
<tr>
<th></th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) to seek information about the firm’s products and services</td>
<td></td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>b) to comment about the firm’s products and services</td>
<td></td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>c) to complain about the company's products and/or services</td>
<td></td>
<td>1 2 3 4 5</td>
</tr>
</tbody>
</table>

31. The organisation has:

<table>
<thead>
<tr>
<th></th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) A customer service toll free number</td>
<td></td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>b) A website with a section to log customer complaints and to request for information</td>
<td></td>
<td>1 2 3 4 5</td>
</tr>
</tbody>
</table>

32. Research is conducted to project future customers and predict what their key requirements are likely to be. |   | 1 2 3 4 5 |

33. The organisation is able to accommodate a wide range of unique customer requests by implementing preplanned solutions |   | 1 2 3 4 5 |

34. The organisation has supply chain arrangements with customers that operate under principles of shared rewards and risks |   | 1 2 3 4 5 |

35. Does the company have systems which identify:

<table>
<thead>
<tr>
<th></th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>g) customer’s current needs</td>
<td></td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>h) customer’s future needs</td>
<td></td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>i) customer’s level of satisfaction</td>
<td></td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>j) customer’s loyalty</td>
<td></td>
<td>1 2 3 4 5</td>
</tr>
</tbody>
</table>

36. Customer satisfaction results are used in decision making of marketing and sales initiatives |   | 1 2 3 4 5 |

#### 5. Supplier Focus

37. The organisation is willing to share strategic information with selected suppliers |   | 1 2 3 4 5 |

38. The organisation selects and monitors suppliers based on formal evaluations and assessments |   | 1 2 3 4 5 |

39. Supplier contracts are established for key raw materials/suppliers |   | 1 2 3 4 5 |

40. The organisation does not work with suppliers who lack environmental awareness |   | 1 2 3 4 5 |
### QUESTIONS

<table>
<thead>
<tr>
<th></th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>41. The organisation believes that the strategic direction, role and performance of their supply chain partners are critical to achieving success</td>
<td></td>
<td></td>
</tr>
<tr>
<td>42. The organisation is willing to help suppliers finance capital equipment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>43. The organisation shares research and development costs and results with primary suppliers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>44. The organisation is committed to sharing responsibility with suppliers in new product/service development and commercialisation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45. The organisation has facilitated a strong supply network fostering cooperation with entire chain of primary and secondary suppliers</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**6. Employee Development**

<table>
<thead>
<tr>
<th></th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>46. The firm looks for “Critical To Quality” attributes in employee biographical data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>47. Pre-employment testing is used in employee selection</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| 48. Training needs are identified based on:  
  a) performance appraisals  
  b) business requirements  
  c) staff profiles |       |
| 49. Human resource department provides advice and researches the market to identify good quality external training resources, products and courses |       |

**50. The forms of training used are:**  
  a) lectures and presentations  
  b) coaching/mentoring  
  c) self-directed learning  
  d) discussion format  
  e) instructional simulations  
  f) role-plays  
  g) interactive multimedia training *(audiovisual and computer based training)*  
  h) Other training technology *(satellite broadcasts, cable broadcasts, video-conferencing and virtual classrooms, videotapes, narrated slide presentations, audio tapes)* |       |

**51. The perspective of all stakeholders are considered and met in designing training programs** |       |

**52. The trainers exhibit the following:**  
  a) Focus and build on learners strengths, not weaknesses  
  b) Set an accepting and encouraging mood for learners  
  c) Give learners verbal cues about their performance, generous with sincere compliments and positive constructive criticism.  
  d) Encourage learners to ask questions |       |

**53. The company has active programs to capture the experience and expertise of individuals and transfer this knowledge throughout the organisation** |       |

**54. Training programs are evaluated based on the following success criteria:**  
  a) There are cost benefits and maximum utility of the training programs.  
  b) The training programs achieve their key objectives  
  c) The net effect of training programs are benchmarked.  
  d) The training programs are ethical |       |

**7. Employee Empowerment**

<table>
<thead>
<tr>
<th></th>
<th>YES</th>
<th>NO</th>
</tr>
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</table>
| 55. Processes are in place to foster the following in employee involvement:  
  a) Educating  
  b) Enabling  
  c) Encouraging |       |
| 56. The organisation has implemented a number of innovative approaches to job and work design such as self-directed teams throughout all areas of the organisation |       |
| 57. A reliable performance assessment system that is linked to the reward system is in place. |       |
### QUESTIONS

<table>
<thead>
<tr>
<th>58. Human resource systems are designed to promote:</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) flexibility among members of the workforce</td>
</tr>
<tr>
<td>b) cooperation among members of the workforce</td>
</tr>
<tr>
<td>c) open communication among members of the workforce</td>
</tr>
<tr>
<td>[ ] strongly agree = 5  [ ] very strongly agree = 5  [ ] agree = 3  [ ] slightly agree = 2  [ ] very slightly agree = 1</td>
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<table>
<thead>
<tr>
<th>59. Suggestions for business improvements permeate from the bottom of the organisational hierarchy</th>
</tr>
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<tbody>
<tr>
<td>[ ] strongly agree = 5  [ ] very strongly agree = 5  [ ] agree = 3  [ ] slightly agree = 2  [ ] very slightly agree = 1</td>
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<table>
<thead>
<tr>
<th>60. Employee involvement activities are aimed at changing attitudes of employees resisting change</th>
</tr>
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<tbody>
<tr>
<td>[ ] strongly agree = 5  [ ] very strongly agree = 5  [ ] agree = 3  [ ] slightly agree = 2  [ ] very slightly agree = 1</td>
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<table>
<thead>
<tr>
<th>61. The organisation employs a thorough and prevention-based approach to employee safety and well being</th>
</tr>
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<td>[ ] strongly agree = 5  [ ] very strongly agree = 5  [ ] agree = 3  [ ] slightly agree = 2  [ ] very slightly agree = 1</td>
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<thead>
<tr>
<th>62. A wide variety of methods are used to measure and improve employee satisfaction</th>
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<td>[ ] strongly agree = 5  [ ] very strongly agree = 5  [ ] agree = 3  [ ] slightly agree = 2  [ ] very slightly agree = 1</td>
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<table>
<thead>
<tr>
<th>63. Processes are in place to identify:</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) employee/team competency</td>
</tr>
<tr>
<td>b) training requirements in order to deliver skills to employees/team members</td>
</tr>
<tr>
<td>c) training requirements in order to build commitment among employees/team</td>
</tr>
<tr>
<td>[ ] strongly agree = 5  [ ] very strongly agree = 5  [ ] agree = 3  [ ] slightly agree = 2  [ ] very slightly agree = 1</td>
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<thead>
<tr>
<th>64. Processes are in place to enable teams to be autonomous</th>
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<tbody>
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<td>[ ] strongly agree = 5  [ ] very strongly agree = 5  [ ] agree = 3  [ ] slightly agree = 2  [ ] very slightly agree = 1</td>
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<table>
<thead>
<tr>
<th>65. The organisation utilises cross-functional work teams for managing day-to-day operations</th>
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<tbody>
<tr>
<td>[ ] strongly agree = 5  [ ] very strongly agree = 5  [ ] agree = 3  [ ] slightly agree = 2  [ ] very slightly agree = 1</td>
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<table>
<thead>
<tr>
<th>66. Employees feel well recognised for their accomplishments</th>
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</thead>
<tbody>
<tr>
<td>[ ] strongly agree = 5  [ ] very strongly agree = 5  [ ] agree = 3  [ ] slightly agree = 2  [ ] very slightly agree = 1</td>
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<table>
<thead>
<tr>
<th>67. Employees at all levels have a significant portion of their compensation linked to performance and productivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ] strongly agree = 5  [ ] very strongly agree = 5  [ ] agree = 3  [ ] slightly agree = 2  [ ] very slightly agree = 1</td>
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<table>
<thead>
<tr>
<th>68. The organisation’s compensation and reward systems encourage adherence to stated policies and procedures</th>
</tr>
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<tbody>
<tr>
<td>[ ] strongly agree = 5  [ ] very strongly agree = 5  [ ] agree = 3  [ ] slightly agree = 2  [ ] very slightly agree = 1</td>
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<table>
<thead>
<tr>
<th>69. The organisation’s compensation, incentive and reward systems encourage integration and harmonisation of activities and processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ] strongly agree = 5  [ ] very strongly agree = 5  [ ] agree = 3  [ ] slightly agree = 2  [ ] very slightly agree = 1</td>
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</table>

### 8. Strategy

<table>
<thead>
<tr>
<th>70. The overall strategic planning process contains</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) key steps</td>
</tr>
<tr>
<td>b) key participants</td>
</tr>
<tr>
<td>c) short term planning time horizons</td>
</tr>
<tr>
<td>d) long term planning time horizons</td>
</tr>
<tr>
<td>[ ] strongly agree = 5  [ ] very strongly agree = 5  [ ] agree = 3  [ ] slightly agree = 2  [ ] very slightly agree = 1</td>
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</table>

<table>
<thead>
<tr>
<th>71. The strategic planning process addresses the objectives and challenges related to the following:</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) customer and market needs/expectations/opportunities</td>
</tr>
<tr>
<td>b) competitive environment and capabilities relative to competitors</td>
</tr>
<tr>
<td>c) technological and other changes that might affect product/services/operations</td>
</tr>
<tr>
<td>d) strengths and weaknesses, including human and other resources</td>
</tr>
<tr>
<td>e) supplier/partner strengths and weaknesses</td>
</tr>
<tr>
<td>f) financial societal, and other potential risks</td>
</tr>
<tr>
<td>g) environmental issues</td>
</tr>
<tr>
<td>[ ] strongly agree = 5  [ ] very strongly agree = 5  [ ] agree = 3  [ ] slightly agree = 2  [ ] very slightly agree = 1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>72. The organisation has key objectives and timetables for accomplishing its strategic plans</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ] strongly agree = 5  [ ] very strongly agree = 5  [ ] agree = 3  [ ] slightly agree = 2  [ ] very slightly agree = 1</td>
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<table>
<thead>
<tr>
<th>73. The organisation collaborates with key customers in developing it’s strategic plans</th>
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<tbody>
<tr>
<td>[ ] strongly agree = 5  [ ] very strongly agree = 5  [ ] agree = 3  [ ] slightly agree = 2  [ ] very slightly agree = 1</td>
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<table>
<thead>
<tr>
<th>74. The organisation collaborates with suppliers in developing strategic plans</th>
</tr>
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<tbody>
<tr>
<td>[ ] strongly agree = 5  [ ] very strongly agree = 5  [ ] agree = 3  [ ] slightly agree = 2  [ ] very slightly agree = 1</td>
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</table>
### QUESTIONS

<table>
<thead>
<tr>
<th>Question</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>75. The organisation has well established procedures to develop and deploy action plans, based on the strategic plan, to achieve key objectives</td>
<td></td>
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<tr>
<td>76. The organisation has key performance measures/indicators for tracking progress relative to their action plans and stakeholders</td>
<td></td>
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<tr>
<td>77. Procedures are available to feedback differences in comparative Information to modify the action plans</td>
<td></td>
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<tr>
<td>80. The organisation has significantly reduced the number of suppliers to customers and/or suppliers like:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) Continuous replenishment</td>
<td></td>
<td></td>
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<tr>
<td>b) Quick response</td>
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<td></td>
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<tr>
<td>c) Just-in-Time</td>
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<tr>
<td>d) Defect reduction</td>
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<tr>
<td>e) Waste evaluation</td>
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<tr>
<td>81. The quality department plays the following roles:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) Initiating, planning and implementing quality initiatives with the various departments</td>
<td></td>
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<tr>
<td>b) Facilitating and conducting quality enhancement efforts under the leadership of top management</td>
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<tr>
<td>c) Training for quality and inspection</td>
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<tr>
<td>d) Inspection only</td>
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<td></td>
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<tr>
<td>82. The continuous improvement team processes used are:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) Quality Circles (Teams made up from one department or work area, identifying their own projects to tackle)</td>
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<tr>
<td>b) Quality Problem – solving team (Multi-departmental teams brought together to solve specific management-directed problems)</td>
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<tr>
<td>c) Quality improvement team (Multi-departmental teams that generate their own projects from broad management briefs)</td>
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<tr>
<td>83. Supporting infrastructure for quality improvement is provided by a body of senior managers who regularly meet to steer continuous improvement activities</td>
<td></td>
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<tr>
<td>84. Continuous improvement (CI) processes are strengthened through:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) Training of personnel</td>
<td></td>
<td></td>
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<tr>
<td>b) Monitoring of CI process</td>
<td></td>
<td></td>
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<tr>
<td>c) Top management support for CI programs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d) CI project leaders</td>
<td></td>
<td></td>
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<tr>
<td>e) Suggestion schemes</td>
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<tr>
<td>f) A general problem solving format (e.g. PDCA-cycle)</td>
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<tr>
<td>g) Promoting on notice boards</td>
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<tr>
<td>h) Promoting through internal media (magazines, newsletters)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>i) Face to face communication</td>
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<td></td>
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<tr>
<td>j) Regular shop-floor visits by management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>k) Use of ISO 9000</td>
<td></td>
<td></td>
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<tr>
<td>l) Use of total productive maintenance regimes</td>
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<td></td>
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<tr>
<td>m) Use of formal policy deployment protocols</td>
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<td></td>
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<tr>
<td>n) Use of time studies</td>
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<tr>
<td>85. The organisation actively encourages best practice implementation</td>
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</tbody>
</table>
QUESTIONS

86. Continuous improvement processes were supported by:
   a) Incentive systems
   b) Promoting through competitions and awards

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<thead>
<tr>
<th>YES</th>
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</table>

10. Total Quality Tools
87. Which of the following tools are used (tick all those used)
   a) Flow charts
   b) Cause and effect diagrams
   c) Multi voting
   d) Affinity diagrams
   e) Process action teams
   f) Election grids
   g) Task lists
   h) Deming cycle (PDCA)
   i) Control charts
   j) Scatter diagrams
   k) Pareto charts
   l) Sampling techniques
   m) Run charts
   n) Histograms
   o) Process mapping tools
   p) FMEA (Failure mode and effect analysis)
   q) QFD (Quality function deployment)
   r) Creativity tools/idea generation tools
   s) Display/visualisation tools
   t) Standardisation tools
   u) 5S (Seiri (Sorting); Seiton (Arranging); Seiso (Cleaning); Seiketsu (Maintaining); Shitsuke (Self-discipline))
   v) Taguchi methodology of experimental design

<table>
<thead>
<tr>
<th>YES</th>
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11. Business Processes
88. Methodologies are being used for product design processes, which involves getting inputs from all departments.

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<th>YES</th>
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90. The organisation has redesigned the logistic system for greater environmental efficiency

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<th>YES</th>
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92. In comparison to three years ago, the organisation’s logistical capability is significantly more responsive (pull) as compared to predetermined (push)

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</table>

12. Information, Knowledge, Communication
97. Software packages are used to facilitate the administrative work associated with the development of quality management systems to meet ISO 9000 standards

<table>
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<th>YES</th>
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<tr>
<td>QUESTIONS</td>
<td>YES</td>
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<tr>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>98. The organisation uses IT to manage its reporting systems</td>
<td>☐ ☐ ☐ ☐ ☐ 1 2 3 4 5</td>
</tr>
<tr>
<td>data collection</td>
<td>☐ ☐ ☐ ☐ ☐ 1 2 3 4 5</td>
</tr>
<tr>
<td>analysis of data</td>
<td>☐ ☐ ☐ ☐ ☐ 1 2 3 4 5</td>
</tr>
<tr>
<td>decision making process</td>
<td>☐ ☐ ☐ ☐ ☐ 1 2 3 4 5</td>
</tr>
<tr>
<td>99. The information available in the organisation is:</td>
<td>☐ ☐ ☐ ☐ ☐ 1 2 3 4 5</td>
</tr>
<tr>
<td>accurate</td>
<td>☐ ☐ ☐ ☐ ☐ 1 2 3 4 5</td>
</tr>
<tr>
<td>timely</td>
<td>☐ ☐ ☐ ☐ ☐ 1 2 3 4 5</td>
</tr>
<tr>
<td>formatted to facilitate easy use</td>
<td>☐ ☐ ☐ ☐ ☐ 1 2 3 4 5</td>
</tr>
<tr>
<td>100. The organisation’s information systems capture and maintain information on changes in customer needs</td>
<td>☐ ☐ ☐ ☐ ☐ 1 2 3 4 5</td>
</tr>
<tr>
<td>101. The firm obtains information directly from customers to facilitate operational plans and reduce reliance on forecasting</td>
<td>☐ ☐ ☐ ☐ ☐ 1 2 3 4 5</td>
</tr>
<tr>
<td>102. Logistics operating and planning databases are integrated across applications within the organisation</td>
<td>☐ ☐ ☐ ☐ ☐ 1 2 3 4 5</td>
</tr>
<tr>
<td>103. The organisation maintains an integrated database and access method to facilitate information sharing</td>
<td>☐ ☐ ☐ ☐ ☐ 1 2 3 4 5</td>
</tr>
<tr>
<td>104. The organisation actively utilises industry standards for data exchange</td>
<td>☐ ☐ ☐ ☐ ☐ 1 2 3 4 5</td>
</tr>
<tr>
<td>105. The organisation has increased the use of technology designed to facilitate cross-organisational data exchange</td>
<td>☐ ☐ ☐ ☐ ☐ 1 2 3 4 5</td>
</tr>
<tr>
<td>106. Information systems in the organisation are being expanded to reflect more enterprise wide integrated processes (ERP)</td>
<td>☐ ☐ ☐ ☐ ☐ 1 2 3 4 5</td>
</tr>
<tr>
<td>107. The organisation’s information systems facilitate electronic commerce using internet capability</td>
<td>☐ ☐ ☐ ☐ ☐ 1 2 3 4 5</td>
</tr>
<tr>
<td>108. The organisation shares technical resources with key suppliers to facilitate operations</td>
<td>☐ ☐ ☐ ☐ ☐ 1 2 3 4 5</td>
</tr>
<tr>
<td>109. The organisation has developed information linkages with customers that permit substantial last minute accommodation without loss of planned efficiencies</td>
<td>☐ ☐ ☐ ☐ ☐ 1 2 3 4 5</td>
</tr>
<tr>
<td>110. The organisation has increased the use of integrated inventory, transportation and warehousing planning systems over the past three years</td>
<td>☐ ☐ ☐ ☐ ☐ 1 2 3 4 5</td>
</tr>
<tr>
<td>111. The organisation has increased the use of EDI standards during the past three years</td>
<td>☐ ☐ ☐ ☐ ☐ 1 2 3 4 5</td>
</tr>
<tr>
<td>112. Does the organisation collect comparative and competitor data on:</td>
<td>☐ ☐ ☐ ☐ ☐ 1 2 3 4 5</td>
</tr>
<tr>
<td>a) product and service quality</td>
<td>☐ ☐ ☐ ☐ ☐ 1 2 3 4 5</td>
</tr>
<tr>
<td>b) supplier performance</td>
<td>☐ ☐ ☐ ☐ ☐ 1 2 3 4 5</td>
</tr>
<tr>
<td>c) employee data</td>
<td>☐ ☐ ☐ ☐ ☐ 1 2 3 4 5</td>
</tr>
<tr>
<td>d) internal operations and support functions</td>
<td>☐ ☐ ☐ ☐ ☐ 1 2 3 4 5</td>
</tr>
<tr>
<td>e) other appropriate processes and functions</td>
<td>☐ ☐ ☐ ☐ ☐ 1 2 3 4 5</td>
</tr>
<tr>
<td>113. The comparative and competitor data on benchmarking is reliable for:</td>
<td>☐ ☐ ☐ ☐ ☐ 1 2 3 4 5</td>
</tr>
<tr>
<td>a) product and service quality</td>
<td>☐ ☐ ☐ ☐ ☐ 1 2 3 4 5</td>
</tr>
<tr>
<td>b) customer satisfaction</td>
<td>☐ ☐ ☐ ☐ ☐ 1 2 3 4 5</td>
</tr>
<tr>
<td>c) supplier performance</td>
<td>☐ ☐ ☐ ☐ ☐ 1 2 3 4 5</td>
</tr>
<tr>
<td>d) HR practices</td>
<td>☐ ☐ ☐ ☐ ☐ 1 2 3 4 5</td>
</tr>
<tr>
<td>e) internal operations and support functions</td>
<td>☐ ☐ ☐ ☐ ☐ 1 2 3 4 5</td>
</tr>
<tr>
<td>f) other appropriate processes and functions</td>
<td>☐ ☐ ☐ ☐ ☐ 1 2 3 4 5</td>
</tr>
<tr>
<td>114. The organisation has designed data collection and reporting systems around the needs of the managers and employees who use the data to plan and make decisions</td>
<td>☐ ☐ ☐ ☐ ☐ 1 2 3 4 5</td>
</tr>
<tr>
<td>115. The organisation has knowledge management systems that collect state of the art information on:</td>
<td>☐ ☐ ☐ ☐ ☐ 1 2 3 4 5</td>
</tr>
<tr>
<td>a) Best practices in business</td>
<td>☐ ☐ ☐ ☐ ☐ 1 2 3 4 5</td>
</tr>
<tr>
<td>b) Innovative quality systems</td>
<td>☐ ☐ ☐ ☐ ☐ 1 2 3 4 5</td>
</tr>
<tr>
<td>116. The organisation effectively shares operational information between departments</td>
<td>☐ ☐ ☐ ☐ ☐ 1 2 3 4 5</td>
</tr>
</tbody>
</table>
QUESTIONS

117. The organisation has adequate ability to share internally:
   a) Standardised information
   b) Customised information

118. The organisation has adequate ability to share externally:
   a) Standardised information
   b) Customised information

119. Performance measurement data is available on a more timely basis than it was three years ago

13. Business Results + (Feedback)
120. The organisation has a ‘balanced scorecard’ approach to measurement

121. The following are the categories used for measuring organisation performance:
   a) Customer satisfaction
   b) Employee satisfaction
   c) Financial performance
   d) Product/Service quality
   e) Supplier performance
   f) Operational performance

122. The organisation has 2-3 measures in each of the following categories of company performance:
   a) Customer satisfaction
   b) Employee satisfaction
   c) Financial performance
   d) Product/Service quality
   e) Supplier performance
   f) Operational performance

123. The organisation has shown improvement trends over the last three or more years, on measures of:
   a) Customer satisfaction
   b) Employee satisfaction
   c) Financial performance
   d) Product/Service quality
   e) Supplier performance
   f) Operational performance

124. Compared to key competitors and similar companies the organisation has shown higher improvement trends over three or more years, on measures of:
   a) Customer satisfaction
   b) Employee satisfaction
   c) Financial performance
   d) Product/Service quality
   e) Supplier performance
   f) Operational performance

125. The organisation has data demonstrating gains in market share over the last three or more years, relative to major competitors’ market share

126. All key business decisions and plans are based upon an analysis of performance data

127. The implementation of change based on gaps identified through benchmarking has led to improvement in performance levels

128. There is evidence of continuous improvements in the education/ training as a result of training evaluations

129. Employee participation has led to the following:
   a) Improved communication with employees
   b) Involvement of employees in decision making resulting in successful attainment of organisational objectives

(IF “YES” on a scale of 1 to 5 very strongly agree=5, strongly agree=4, agree=3, slightly agree=2, very slightly agree=1, circle one of the scores)
130. The organisation thoroughly understands the link between different types of measures such as the relationship between customer satisfaction and quality, with financial performance. □ □ □ □ □

131. The organisation has increased operational flexibility through supply chain collaboration. □ □ □ □ □

132. The organisation has evaluated and made many major improvements in its measures and data collection and reporting methods over the last few years. □ □ □ □ □

133. The organisation has data to demonstrate positive trends over the last three or more years in gaining and avoiding losses of customers. □ □ □ □ □

134. Customers view quality of the organisation’s products and services as: [Acceptable quality (1); Expected quality (2); Good quality (3); Very good quality (4); Quality that exceeds expectations and delights (5)] each category is rated on a scale from 1 to 5. □ □ □ □ □

135. Measures of environmental performance show continued improvement trends. □ □ □ □ □

136. Measures of environmental performance are clearly superior to other organisations in the same industry. □ □ □ □ □

137. Measures of environmental/public health performance show continued improvement trends and levels of performance. □ □ □ □ □

138. Measures of environmental/public health performance are clearly superior to other organisations in the same industry. □ □ □ □ □
## Appendix 4: Sample of Survey Questionnaire with the Sub-categories

### QUESTIONNAIRE

**Company Description**

1. **Name of Company:**
   - Business Category: (a) Manufacturing □ Service □
   - (b) Public Company □ Listed Company □
   - (c) Multinational □ Australian Owned □

   **Brief Details of Business:**
   
   ____________________________________________________________________________________________
   ____________________________________________________________________________________________

2. **No. of Employees** _______________________

3. **Overall Performance Measures**

<table>
<thead>
<tr>
<th>Year</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Sales A$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gross Profit A$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net Profit (Before Tax) A$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Assets A$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current Assets A$</td>
<td></td>
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<tr>
<td>Current Liabilities A$</td>
<td></td>
<td></td>
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<tr>
<td>Inventories A$</td>
<td></td>
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<tr>
<td>Accounts Receivable A$</td>
<td></td>
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</tr>
<tr>
<td>Cost of Goods Sold A$</td>
<td></td>
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</tbody>
</table>
QUESTIONS

1. Leadership
   1.1 Organisational Leadership

   1. Senior managers are able to communicate effectively
      a) values that the organisation stands for.
      b) short and long term directions of the organisation.
      c) expectations related to organisational and individual performance.
   2. The organisation has well established procedures for translating
      organisational performance review into priorities for improvement and
      innovation.
   3. The organisation has well established procedures to encourage
      suppliers/partners to improve and innovate and thereby ensure organisational
      alignment.
   4. Senior managers use performance review findings to improve their own
      leadership effectiveness and their leadership systems.
   5. Managers in the organisation understand how our overall performance
      measures compare to major competitors.
   6. The orientation of the organisation has shifted from managing functions to
      managing key business processes.
   7. Middle managers in the organisation are empowered to use their own
      discretion within broad guidelines to make decisions.
   8. Management in the company understand that creating a total quality
      organisation requires a well trained and empowered workforce.
   9. Employees are made aware of the link between their specific jobs and its
      impact on the quality of the organisation’s output.

   (If “YES” on a scale of 1 to 5  very slightly agree=1, slightly agree=2, agree=3, strongly agree=4, very strongly agree=5 circle one of the scores)

   YES  NO
QUESTIONS

1.2 Public Responsibility and Citizenship

10. The organisation systematically assesses, at regular intervals, the impacts on society of their products, services and operations by
   a) addressing regulatory and legal requirements of processes, measures and targets
   b) addressing risks associated with products, services and operations
   c) anticipating public concerns with current and future products, services and operations
   d) accomplishing ethical business practices in all stakeholders transactions and interactions

11. The organisation, its senior managers, and employees actively support community involvement and enthusiastically determine ways in which the organisation could support community projects and activities

2. Quality Culture

2.1 Employee Attitudes

12. Employees feel that they are individually and collectively responsible for quality

2.2 Organisational Structure

13. The role of the specialised quality department is seen as facilitating quality improvement and not being solely responsible for quality improvement

14. The organisation has formal quality management practices in all functional areas

15. The organisation acknowledges the importance of functional excellence but focuses on performance achievement
QUESTIONS

2.3 Internal Partnering
16. Teams are required to have the following objectives set up:
   a) achieve specified quality standards
   b) share work within the team on an equitable and efficient basis
   c) work effectively with other team members
   d) apply the next customer concept
   e) reach production targets
   f) perform routine maintenance
   g) improve work area layout
   h) look for improvement possibilities continuously
   (If “YES” on a scale of 1 to 5 very slightly agree=1, slightly agree=2, agree=3, strongly agree=4, very strongly agree=5 circle one of the scores)

YES NO

3. Benchmarking

3.1 Planning for Benchmarks
17. Benchmarks align with the organisation’s strategic plans.
18. Please list three of the most important areas of benchmarking
   1. 
   2. 
   3.

3.2 Conducting Benchmarking
19. The quality of data available for performance measurement in the organisation is better today than three years ago
20. The number of performance measures regularly used by the organisation has increased over the past three years
QUESTIONS

3.3 Analysis of Benchmarks

21. Analysis of benchmarks are used to determine the current competitive gap
   YES  NO  1  2  3  4  5

22. Analysis of benchmarks are used to project future performance levels
   YES  NO  1  2  3  4  5

23. Analysis of benchmarks is used to establish functional goals
   YES  NO  1  2  3  4  5

24. Analysis of benchmarks is used to implement specific actions and monitor progress
   YES  NO  1  2  3  4  5

3.4 Action Steps Post-analysis

25. Factors critical for improved performance are identified post-analysis of benchmarks.
   YES  NO  1  2  3  4  5

26. Findings of analysis are communicated to the relevant people to plan and implement change
   YES  NO  1  2  3  4  5

27. Periodic follow-ups are conducted to verify outcomes of implemented change in relation to benchmark target
   YES  NO  1  2  3  4  5

28. The organisation shares benchmarking and information on best practices/processes results with suppliers
   YES  NO  1  2  3  4  5

4. Customer Focus

4.1 Understanding Customer Needs

29. Customer needs are determined by:
   YES  NO  1  2  3  4  5

   a) Telephone surveys
   b) Feedback from sales personnel
   c) Formal customer questionnaire surveys
   d) Focus groups
   e) Competitor analysis
   f) Data mining approaches
QUESTIONS

(If “YES” on a scale of 1 to 5  very slightly agree=1, slightly agree=2, agree=3, strongly agree=4, very strongly agree=5 circle one of the scores)

4.2 Customer Relationship Management (includes commitment)

30. It is easy for customers:
   a) to seek information about the firm’s products and services
   b) to comment about the firm’s products and services
   c) to complain about the company’s products and/or services

31. The organisation has:
   a) A customer service toll free number
   b) A website with a section to log customer complaints and to request information

32. Research is conducted to project future customers and predict what their key requirements are likely to be.

33. The organisation is able to accommodate a wide range of unique customer requests by implementing preplanned solutions

34. The organisation has supply chain arrangements with customers that operate under principles of shared rewards and risks

4.3 Customer Satisfaction Determination

35. Does the company have systems which identify:
   a) customer’s current needs
   b) customer’s future needs
   c) customer’s level of satisfaction
   d) customer’s loyalty

36. Customer satisfaction results are used in decision making of marketing and sales initiatives
### QUESTIONS

#### 5. Supplier Focus

5.1 Supplier Partnering

<table>
<thead>
<tr>
<th>37. The organisation is willing to share strategic information with selected suppliers</th>
<th>□</th>
<th>□</th>
<th>1</th>
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<tbody>
<tr>
<td>38. The organisation selects and monitors suppliers based on formal evaluations and assessments</td>
<td>□</td>
<td>□</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
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<tr>
<td>39. Supplier contracts are established for key raw materials/suppliers</td>
<td>□</td>
<td>□</td>
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<tr>
<td>40. The organisation does not work with suppliers who lack environmental awareness</td>
<td>□</td>
<td>□</td>
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<tr>
<td>41. The organisation believes that the strategic direction, role and performance of their supply chain partners are critical to achieving success</td>
<td>□</td>
<td>□</td>
<td>1</td>
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<tr>
<td>42. The organisation is willing to help suppliers finance capital equipment</td>
<td>□</td>
<td>□</td>
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<tr>
<td>43. The organisation shares research and development costs and results with primary suppliers</td>
<td>□</td>
<td>□</td>
<td>1</td>
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<tr>
<td>44. The organisation is committed to sharing responsibility with suppliers in new product/service development and commercialisation</td>
<td>□</td>
<td>□</td>
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<tr>
<td>45. The organisation has facilitated a strong supply network fostering cooperation with entire chain of primary and secondary suppliers</td>
<td>□</td>
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</table>

#### 6. Employee Development

6.1 Recruitment

| 46. The firm looks for “Critical To Quality” attributes in employee biographical data | □ | □ | 1 | 2 | 3 | 4 | 5 |
| 47. Pre-employment testing is used in employee selection | □ | □ | 1 | 2 | 3 | 4 | 5 |
### QUESTIONS

#### 6.2 Training Needs Identification

48. Training needs are identified based on:

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<tbody>
<tr>
<td>a) performance appraisals</td>
<td></td>
<td>□</td>
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<td>b) business requirements</td>
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<td>□</td>
<td>□</td>
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<td>c) staff profiles</td>
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<td>□</td>
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#### 6.3 Training Design

49. Human resource department provides advice and researches the market to identify good quality external training resources, products and courses

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50. The forms of training used are:

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<tbody>
<tr>
<td>a) lectures and presentations</td>
<td></td>
<td>□</td>
<td>□</td>
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<td>b) coaching /mentoring</td>
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<td>□</td>
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<td>c) self -directed learning</td>
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<td>□</td>
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<td>d) discussion format</td>
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<td>□</td>
<td>□</td>
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<tr>
<td>e) instructional simulations</td>
<td></td>
<td>□</td>
<td>□</td>
<td>1</td>
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<td>3</td>
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<tr>
<td>f) role-plays</td>
<td></td>
<td>□</td>
<td>□</td>
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<td>g) interactive multimedia training- (audiovisual and computer based training)</td>
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<td>□</td>
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<tr>
<td>h) Other training technology (satellite broadcasts, cable broadcasts, video –conferencing and virtual classrooms, videotapes, narrated slide presentations, audio tapes)</td>
<td></td>
<td>□</td>
<td>□</td>
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51. The perspective of all stakeholders are considered and met in designing training programs

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QUESTIONS

6.4 Training Delivery

52. The trainers exhibit the following:
   a) Focus and build on learners strengths, not weaknesses
   b) Set an accepting and encouraging mood for learners
   c) Give learners verbal cues about their performance, generous with sincere compliments and positive constructive criticism.
   d) Encourage learners to ask questions

53. The company has active programs to capture the experience and expertise of individuals and transfer this knowledge throughout the organisation

6.5 Training Evaluation

54. Training programs are evaluated based on the following success criteria:
   a) There are cost benefits and maximum utility of the training programs
   b) The training programs achieve their key objectives
   c) The net effect of training programs are benchmarked.
   d) The training programs are ethical

7. Employee Empowerment

7.1 Employee Involvement

55. Processes are in place to foster the following in employee involvement:
   a) Educating
   b) Enabling
   c) Encouraging

56. The organisation has implemented a number of innovative approaches to job and work design such as self-directed teams throughout all areas of the organisation
### QUESTIONS

<table>
<thead>
<tr>
<th></th>
<th>YES</th>
<th>NO</th>
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<tbody>
<tr>
<td>7.2 Developing Employee Commitment</td>
<td></td>
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<tr>
<td>57. A reliable performance assessment system that is linked to the reward system is in place.</td>
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<td>2</td>
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<tr>
<td>58. Human resource systems are designed to promote:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) flexibility among members of the workforce</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>b) cooperation among members of the workforce</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>c) open communication among members of the workforce</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>59. Suggestions for business improvements permeate from the bottom of the organisational hierarchy</td>
<td>1</td>
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<tr>
<td>60. Employee involvement activities are aimed at changing attitudes of employees resisting change</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>61. The organisation employs a thorough and prevention-based approach to employee safety and well being</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>62. A wide variety of methods are used to measure and improve employee satisfaction</td>
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<td>2</td>
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<table>
<thead>
<tr>
<th></th>
<th>YES</th>
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</thead>
<tbody>
<tr>
<td>7.3 Support for Team Building</td>
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<td></td>
</tr>
<tr>
<td>63. Processes are in place to identify:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) employee/team competency</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>b) training requirements in order to deliver skills to employees/team members</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>c) training requirements in order to build commitment among employees/team</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>64. Processes are in place to enable teams to be autonomous</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>65. The organisation utilises cross-functional work teams for managing day-to-day operations</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>
7.4 Recognition and Reward Systems

66. Employees feel well recognised for their accomplishments. □ □ 1 2 3 4 5
67. Employees at all levels have a significant portion of their compensation linked to performance and productivity □ □ 1 2 3 4 5
68. The organisation’s compensation and reward systems encourage adherence to stated policies and procedures □ □ 1 2 3 4 5
69. The organisation’s compensation, incentive and reward systems encourage integration and harmonisation of activities and processes □ □ 1 2 3 4 5

8. Strategy

8.1 Strategy Development

70. The overall strategic planning process contains
   a) key steps □ □ 1 2 3 4 5
   b) key participants □ □ 1 2 3 4 5
   c) short term planning time horizons □ □ 1 2 3 4 5
   d) long term planning time horizons □ □ 1 2 3 4 5

71. The strategic planning process addresses the objectives and challenges related to the following:
   a) customer and market needs/expectations/opportunities □ □ 1 2 3 4 5
   b) competitive environment and capabilities relative to competitors □ □ 1 2 3 4 5
   d) technological and other changes that might affect product/ services/ operations □ □ 1 2 3 4 5
   d) strengths and weaknesses, including human and other resources □ □ 1 2 3 4 5
   e) supplier/partner strengths and weaknesses □ □ 1 2 3 4 5
   f) financial societal, and other potential risks □ □ 1 2 3 4 5
   g) environmental issues □ □ 1 2 3 4 5
<table>
<thead>
<tr>
<th>Questions</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>72. The organisation has key objectives and timetables for accomplishing its strategic plans</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>73. The organisation collaborates with key customers in developing its strategic plans</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>74. The organisation collaborates with suppliers in developing strategic plans</td>
<td>1</td>
<td>2</td>
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</table>

**8.2 Strategy Deployment**

<table>
<thead>
<tr>
<th>Questions</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>75. The organisation has well established procedures to develop and deploy action plans, based on the strategic plan, to achieve key objectives</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>76. The organisation has key performance measures/indicators for tracking progress relative to their action plans and stakeholders</td>
<td>1</td>
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<tr>
<td>77. Procedures are available to feedback differences in comparative information to modify the action plans</td>
<td>1</td>
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</table>

**9. Continuous Improvement**

**9.1 Initiatives for Continuous Improvement**

<table>
<thead>
<tr>
<th>Questions</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>78. The organisation has extensively redesigned work routines and processes over the past three years</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>79. The organisation successfully utilises time-based logistics with customers and/or suppliers like: a) Continuous replenishment</td>
<td>1</td>
<td>2</td>
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<tr>
<td></td>
<td>2</td>
<td></td>
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<tr>
<td>b) Quick response</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>c) Just-in-Time</td>
<td>4</td>
<td></td>
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<tr>
<td>d) Defect reduction</td>
<td>5</td>
<td></td>
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<tr>
<td>e) Waste evaluation</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>80. The organisation has significantly reduced the number of suppliers to improve operational integration</td>
<td>1</td>
<td>2</td>
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</tbody>
</table>
### QUESTIONS

#### 9.2 Supportive Infrastructure Available

81. The quality department plays the following roles
   a) Initiating, planning and implementing quality initiatives with the various departments
   b) Facilitating and conducting quality enhancement efforts under the leadership of top management
   c) Training for quality and inspection
   d) Inspection only

82. The continuous improvement team processes used are:
   a) Quality Circles (Teams made up from one department or work area, identifying their own projects to tackle)
   b) Quality Problem-solving team (Multi-departmental teams brought together to solve specific management-directed problems)
   c) Quality improvement team (Multi-departmental teams that generate their own projects from broad management briefs)

83. Supporting infrastructure for quality improvement is provided by a body of senior managers who regularly meet to steer continuous improvement activities

84. Continuous improvement (CI) processes are strengthened through:
   a) training of personnel
   b) monitoring of CI process
   c) top management support for CI programs
   d) CI project leaders
   e) a suggestion scheme
   f) a general problem solving format (e.g. PDCA-cycle)
   g) promoting on notice boards
   h) promoting through internal media (magazines, newsletters)

(If “YES” on a scale of 1 to 5  very slightly agree=1, slightly agree=2, agree=3, strongly agree=4, very strongly agree=5 circle one of the scores)
i) face to face communication  □ □ 1 2 3 4 5
j) regular shop-floor visits by management  □ □ 1 2 3 4 5
k) use of ISO 9000  □ □ 1 2 3 4 5
l) use of total productive maintenance regimes  □ □ 1 2 3 4 5
m) use of formal policy deployment protocols  □ □ 1 2 3 4 5
n) use of time studies  □ □ 1 2 3 4 5

85. The organisation actively encourages best practice implementation

9.3 Reward Systems

86. Continuous improvement processes were supported by:

   a) incentive systems  □ □ 1 2 3 4 5
   b) promoting through competitions and awards  □ □ 1 2 3 4 5

10. Total Quality Tools

87. Which of the following tools are used (tick all those used)

   a) Flow charts  □ □ 1 2 3 4 5
   b) Cause and effect diagrams  □ □ 1 2 3 4 5
   c) Multi voting  □ □ 1 2 3 4 5
   d) Affinity diagrams  □ □ 1 2 3 4 5
   e) Process action teams  □ □ 1 2 3 4 5
   f) Election grids  □ □ 1 2 3 4 5
   g) Task lists  □ □ 1 2 3 4 5
   h) Deming cycle (PDCA)  □ □ 1 2 3 4 5
   i) Control charts  □ □ 1 2 3 4 5
   j) Scatter diagrams  □ □ 1 2 3 4 5
   k) Pareto charts  □ □ 1 2 3 4 5
   l) Sampling techniques  □ □ 1 2 3 4 5
   m) Run charts  □ □ 1 2 3 4 5
   n) Histograms  □ □ 1 2 3 4 5
   o) Process mapping tools  □ □ 1 2 3 4 5
   p) FMEA (Failure mode and effect analysis  □ □ 1 2 3 4 5
   q) QFD (Quality function deployment)  □ □ 1 2 3 4 5
   r) Creativity tools/Idea generation tools.  □ □ 1 2 3 4 5
QUESTIONS

s) Display/visualisation tools.

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t) Standardisation tools

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u) 5S [Seiri (Sorting); Seiton (Arranging); Seiso (Cleaning); Seiketsu (Maintaining); Shitsuke (Self-discipline)]

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v) Taguchi methodology of experimental design

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11. Business Processes

11.1 Approaches for Redesign of Processes

88. Methodologies are being used for product design processes, which involves getting inputs from all departments.

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89. The organisation employs a systematic process for incorporating new and changing customer requirements into product/service design.

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90. The organisation has substantially reduced facility and operational complexity over the past three years.

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91. The organisation has redesigned the logistic system for greater environmental efficiency.

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92. In comparison to three years ago, the organisation’s logistical capability is significantly more responsive (pull) as compared to predetermined (push).

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93. The organisation is actively involved in initiatives to standardise supply chain practices and operations.

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11.2 Measures used for Rating Performance of Business Processes

94. Data on key process measures is collected on a regular basis.

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95. The organisation employs valid control strategies to keep all process measures within standards or acceptable levels.

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96. The organisation uses activity based costing.
QUESTIONS

(If “YES” on a scale of 1 to 5 very slightly agree=1, slightly agree=2, agree=3, strongly agree=4, very strongly agree=5 circle one of the scores)

YES NO

Information, Knowledge, Communication

12.1 Information Management

97. Software packages are used to facilitate the administrative work associated with the development of quality management systems to meet ISO 9000 standards.

98. The organisation uses IT to manage its
   a) reporting systems
   b) data collection
   c) analysis of data
   d) decision making process

99. The information available in the organisation is:
   a) accurate
   b) timely
   c) formatted to facilitate easy use

100. The organisation’s information systems capture and maintain information on changes in customer needs.

101. The firm obtains information directly from customers to facilitate operational plans and reduce reliance on forecasting.

102. Logistics operating and planning databases are integrated across applications within the organisation.

103. The organisation maintains an integrated database and access method to facilitate information sharing.

104. The organisation actively utilises industry standards for data exchange.

105. The organisation has invested in technology designed to facilitate cross-organisational data exchange.

106. Information systems in the organisation are being expanded to reflect more enterprise wide integrated processes (ERP).

107. The organisation’s information systems facilitate electronic commerce using internet capability.
### QUESTIONS

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<th>Questions</th>
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<td>108. The organisation shares technical resources with key suppliers to</td>
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<td>facilitate operations.</td>
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<td>109. The organisation has developed information linkages with customers</td>
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<td>that permit substantial last minute accommodation without loss of planned</td>
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<td>110. The organisation has increased the use of integrated inventory,</td>
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<td>transportation and warehousing planning systems over the past three</td>
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<td>111. The organisation has increased the use of EDI standards during the</td>
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<td>past three years.</td>
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### 12.2 Knowledge Management

112. Does the organisation collect comparative and competitor data on:

- a) product and service quality  
- b) supplier performance
- c) employee data
- d) internal operations and support functions
- e) other appropriate processes and functions

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<td>c) employee data</td>
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<td>e) other appropriate processes and functions</td>
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113. The comparative and competitor data on benchmarking are reliable for:

- a) product and service quality
- b) customer satisfaction
- c) supplier performance
- d) HR practices
- e) internal operations and support functions
- f) other appropriate processes and functions

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<td>f) other appropriate processes and functions</td>
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114. The organisation has designed data collection and reporting systems   |     |    | 1  | 2  | 3  | 4  | 5  |
| around the needs of the managers and employees who use the data to plan  |     |    |    |    |    |    |    |
| and make decisions.                                                       |     |    |    |    |    |    |    |
### QUESTIONS

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<td>115. The organisation has knowledge management systems that collect state of the art information on:</td>
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<td>a) Best practices in business</td>
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<td>b) Innovative quality systems</td>
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#### 12.3 Communication

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<td>116. The organisation effectively shares operational information between departments.</td>
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<td>117. The organisation has adequate ability to share internally:</td>
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<td>a) Standardised information</td>
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<td>2</td>
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<td>b) Customised information</td>
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<tr>
<td>118. The organisation has adequate ability to share externally:</td>
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<tr>
<td>a) Standardised information</td>
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<td>b) Customised information</td>
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#### 4.1.1.2 a) Standardised information

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<td>119. Performance measurement data is available on a more timely basis than it was three years ago.</td>
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#### 12. Business Results + (Feedback)

#### 13.1 Measures used for Evaluating Overall Company Performance

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<td>120. The organisation has a 'balanced scorecard’ approach to measurement.</td>
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<td>121. The following are the categories used for measuring organisation performance:</td>
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<tr>
<td>a) Customer satisfaction</td>
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<td>b) Employee satisfaction</td>
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<td>2</td>
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<td>c) Financial performance</td>
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<tr>
<td>d) Product/Service quality</td>
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QUESTIONS

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<td>e) Supplier performance</td>
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<td>f) Operational performance</td>
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122. The organisation has 2-3 measures in each of the following categories of company performance.
   a) Customer satisfaction
   b) Employee satisfaction
   c) Financial performance
   d) Product/Service quality
   e) Supplier performance
   f) Operational performance

123. The organisation has shown improvement trends over the last three or more years, on measures of:
   a) Customer satisfaction
   b) Employee satisfaction
   c) Financial performance
   d) Product/Service quality
   e) Supplier performance
   f) Operational performance

124. Compared to key competitors and similar companies the organisation has shown higher improvement trends over three or more years, on measures of:
   a) Customer satisfaction
   b) Employee satisfaction
   c) Financial performance
   d) Product/Service quality
   e) Supplier performance
   f) Operational performance

125. The organisation has data demonstrating gains in market share over the last three or more years, relative to major competitors’ market share.
13.2 Approaches used to Link Performance Measures with Quality Improvement

126. All key business decisions and plans are based upon an analysis of performance data.
127. The implementation of change based on gaps identified through benchmarking has led to improvement in performance levels.
128. There is evidence of continuous improvements in the education/training as a result of training evaluations.
129. Employee participation has led to the following:
   a) Improved communication with employees;
   b) Involvement of employees in decision making resulting in successful attaining of organisational objectives.
130. The organisation thoroughly understands the link between different types of measures such as the relationship between customer satisfaction and quality, with financial performance.
131. The organisation has increased operational flexibility through supply chain collaboration.
132. The organisation has evaluated and made many major improvements in its measures and data collection and reporting methods over the last few years.

13. Customer & Stakeholder Value + (Feedback)

14.1 Measures used for Assessing Customer Value

133. The organisation has data to demonstrate positive trends over the last three or more years in gaining and avoiding losses of customers
134. Customers view quality of the organisation’s products and services as:
   [Acceptable quality (1); Expected quality (2); Good quality (3); Very good quality (4); Quality that exceeds expectations and delights (5)] each category is rated on a scale from 1 to 5.
### 14.2 Measures used for Assessing Contribution to the Environment

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<tr>
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<td>Measures of environmental performance show continued improvement trends.</td>
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<tr>
<td>Measures of environmental performance are clearly superior to other organisations in the same industry.</td>
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### 14.3 Measures used for Assessing Contribution to the Community

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<td>Measures of environmental/public health performance show continued improvement trends and levels of performance.</td>
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<tr>
<td>Measures of environmental/public health performance are clearly superior to other organisations in the same industry.</td>
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Appendix 5: Histograms of Descriptive Statistics and Box Plots

Histograms of the QMAF Categories

Figure 5.1: Descriptive Statistics of Leadership (L)

Descriptive Statistics

Variable: L

Anderson-Darling Normality Test
A-Squared: 0.321
P-Value: 0.522
Mean 47.1042
StdDev 21.8424
Variance 477.092
Skewness 0.556-02
Kurtosis -3.0E-01
N 60

Minimum 0.000
1st Quartile 35.000
Median 44.375
3rd Quartile 60.938
Maximum 100.000

95% Confidence Interval for Mu
95% Confidence Interval for Median

Figure 5.2: Descriptive Statistics of Organisational Leadership (L1)

Descriptive Statistics

Variable: L1

Anderson-Darling Normality Test
A-Squared: 0.466
P-Value: 0.244
Mean 47.5455
StdDev 22.6323
Variance 512.222
Skewness -5.7E-02
Kurtosis -3.2E-01
N 60

Minimum 0.000
1st Quartile 35.003
Median 46.360
3rd Quartile 65.450
Maximum 100.000

95% Confidence Interval for Mu
95% Confidence Interval for Median
Figure 5.3: Descriptive Statistics of Public Responsibility and Citizenship (L2)

Descriptive Statistics

Variable: L2

Anderson-Darling Normality Test
A-Squared: 0.752
P-Value: 0.048

Mean: 46.1333
StdDev: 28.4322
Variance: 806.389
Skewness: -1.4E-01
Kurtosis: -0.00313
N: 60

Minimum: 0.000
1st Quartile: 24.000
Median: 50.000
3rd Quartile: 68.000
Maximum: 100.000

95% Confidence Interval for Mu
38.789
95% Confidence Interval for Sigma
24.100
95% Confidence Interval for Median
39.723

Figure 5.4: Descriptive Statistics of Quality Culture (QC)

Descriptive Statistics

Variable: QC

Anderson-Darling Normality Test
A-Squared: 0.504
P-Value: 0.196

Mean: 45.7782
StdDev: 22.8643
Variance: 522.776
Skewness: -2.3E-01
Kurtosis: -4.6E-01
N: 60

Minimum: 0.0000
1st Quartile: 28.7475
Median: 49.1650
3rd Quartile: 61.6700
Maximum: 96.6700

95% Confidence Interval for Mu
39.8717
95% Confidence Interval for Sigma
19.3806
95% Confidence Interval for Median
41.5542

344
### Figure 5.5: Descriptive Statistics of Employee Attitudes (QC1)

#### Descriptive Statistics

<table>
<thead>
<tr>
<th>Variable: QC1</th>
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<th>StdDev</th>
<th>Variance</th>
<th>Skewness</th>
<th>Kurtosis</th>
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<td>95% Confidence Interval for Mu</td>
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<td>95% Confidence Interval for Median</td>
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### Figure 5.6: Descriptive Statistics of Organisational Structure (QC2)

#### Descriptive Statistics

<table>
<thead>
<tr>
<th>Variable: QC2</th>
<th>Mean</th>
<th>StdDev</th>
<th>Variance</th>
<th>Skewness</th>
<th>Kurtosis</th>
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<td>Anderson-Darling Normality Test</td>
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<td>P-Value:</td>
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<td>26.2135</td>
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<td>26.6700</td>
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<td>Minimum</td>
<td>42.4502</td>
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<td>95% Confidence Interval for Mu</td>
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<td>95% Confidence Interval for Median</td>
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</table>
Figure 5.7: Descriptive Statistics of Internal Partnering (QC3)

Descriptive Statistics

Variable: QC3

Anderson-Darling Normality Test
A-Squared: 0.469
P-Value: 0.240

Mean: 43.7500
SDDev: 26.0480
Variance: 678.496
Skewness: -7.5E-02
Kurtosis: -7.5E-01
N: 60

Minimum: 0.000
1st Quartile: 28.125
Median: 42.500
3rd Quartile: 65.000
Maximum: 100.000

95% Confidence Interval for Mu
37.021 - 50.479
95% Confidence Interval for Median
31.770 - 55.173

Figure 5.8: Descriptive Statistics of Improvement Methods (IM)

Descriptive Statistics

Variable: IM

Anderson-Darling Normality Test
A-Squared: 0.341
P-Value: 0.485

Mean: 27.7385
SDDev: 17.0321
Variance: 290.091
Skewness: 0.563103
Kurtosis: 0.936238
N: 60

Minimum: 0.9100
1st Quartile: 14.3300
Median: 27.4400
3rd Quartile: 39.4775
Maximum: 85.9800

95% Confidence Interval for Mu
23.3387 - 32.1383
95% Confidence Interval for Sigma
14.4370 - 20.7734
95% Confidence Interval for Median
22.8485 - 32.6938
Figure 5.9: Descriptive Statistics of Planning for Benchmarks (IM1)

Descriptive Statistics

Variable: IM1

Anderson-Darling Normality Test
A-Squared: 2.929
P-Value: 0.000

Mean 39.5933
SDDev 33.8371
Variance 1144.95
Skewness 7.21E-02
Kurtosis -1.45781
N 60

Minimum 0.000
1st Quartile 0.000
Median 37.500
3rd Quartile 71.875
Maximum 100.000

95% Confidence Interval for Mu
95% Confidence Interval for Median

Figure 5.10: Descriptive Statistics of Conducting Benchmarking (IM2)

Descriptive Statistics

Variable: IM2

Anderson-Darling Normality Test
A-Squared: 2.243
P-Value: 0.000

Mean 56.5000
SDDev 34.1892
Variance 1168.90
Skewness -5.25E-01
Kurtosis -1.00455
N 60

Minimum 0.000
1st Quartile 30.000
Median 60.000
3rd Quartile 80.000
Maximum 100.000

95% Confidence Interval for Mu
95% Confidence Interval for Median
Figure 5.11: Descriptive Statistics of Analysis of Benchmarks (IM3)

Descriptive Statistics

Variable: IM3

[Table of descriptive statistics for IM3]

Figure 5.12: Descriptive Statistics of Action Steps Post-Analysis (IM4)

Descriptive Statistics

Variable: IM4

[Table of descriptive statistics for IM4]
Figure 5.13: Descriptive Statistics of Total Quality Tools (IM5)

Descriptive Statistics

Variable: IM5

Anderson-Darling Normality Test
A-Squared: 2.093
P-Value: 0.000

Mean 15.6208
SDev 15.6235
Variance 244.995
Skewness 1.35998
Kurtosis 2.30768
N 60

Minimum 6.11
1st Quartile 11.5848
Median 15.6208
3rd Quartile 20.0475
Maximum 75.4500

95% Confidence Interval for Mu
11.5848 19.6568
95% Confidence Interval for Sigma
13.2430 19.0554
95% Confidence Interval for Median
7.2069 17.3331

Figure 5.14: Descriptive Statistics of Initiatives for Continuous Improvement (IM6)

Descriptive Statistics

Variable: IM6

Anderson-Darling Normality Test
A-Squared: 1.097
P-Value: 0.007

Mean 36.7618
SDev 27.6832
Variance 766.361
Skewness 0.309271
Kurtosis -9.3E-01
N 60

Minimum 0.0000
1st Quartile 11.4300
Median 38.5700
3rd Quartile 54.2900
Maximum 97.1400

95% Confidence Interval for Mu
29.6105 43.9132
95% Confidence Interval for Sigma
23.4652 33.7642
95% Confidence Interval for Median
20.0000 48.7683
Figure 5.15: Descriptive Statistics of Supportive Infrastructure Available (IM7)

Descriptive Statistics

Variable: IM7

Anderson-Darling Normality Test
A-Squared: 0.330
P-Value: 0.508

Mean 33.7535
SDev 19.9982
Variance 380.932
Skewness 0.351843
Kurtosis -1.5E-01

N 60
Minimum 1.7400
1st Quartile 19.3475
Median 34.7800
3rd Quartile 47.8300
Maximum 88.7000

95% Confidence Interval for Mu
28.8457 38.6613

95% Confidence Interval for Sigma
16.1035 23.1714

95% Confidence Interval for Median
24.3500 39.2507

Figure 5.16: Descriptive Statistics of Reward Systems (IM8)

Descriptive Statistics

Variable: IM8

Anderson-Darling Normality Test
A-Squared: 11.006
P-Value: 0.000

Mean 14.0000
SDev 26.6299
Variance 709.153
Skewness 1.90341
Kurtosis 2.53076

N 60
Minimum 0.000
1st Quartile 0.000
Median 0.000
3rd Quartile 17.500
Maximum 100.000

95% Confidence Interval for Mu
7.121 20.879

95% Confidence Interval for Sigma
22.572 32.479

95% Confidence Interval for Median
0.000 0.000
Figure 5.17: Descriptive Statistics of Partnering Focus (PF)

Descriptive Statistics

Variable: PF

Anderson-Darling Normality Test
A-Squared: 0.293
P-Value: 0.593

Mean 39.3578
SDev 19.6317
Variance 393.296
Skewness 0.212518
Kurtosis -1.1E-01
N 60

Minimum 2.1400
1st Quartile 22.6775
Median 42.1450
3rd Quartile 53.3925
Maximum 93.5700

95% Confidence Interval for Mu
34.2348 44.4809
95% Confidence Interval for Median
32.8101 45.0000

Figure 5.18: Descriptive Statistics of Customer Focus (CF)

Descriptive Statistics

Variable: CF

Anderson-Darling Normality Test
A-Squared: 0.414
P-Value: 0.325

Mean 41.7018
SDev 19.1979
Variance 368.558
Skewness -2.7E-02
Kurtosis -3.3E-01
N 60

Minimum 3.1600
1st Quartile 23.3200
Median 44.2100
3rd Quartile 58.6400
Maximum 92.6300

95% Confidence Interval for Mu
36.7425 46.6612
95% Confidence Interval for Median
35.7900 48.4928
Figure 5.19: Descriptive Statistics of Understanding Customer Needs (PF1)

Descriptive Statistics

Variable: PF1

Anderson-Darling Normality Test
A-Squared: 1.381
P-Value: 0.001

Mean: 33.2775
SDev: 21.9265
Varianve: 480.772
Skewness: 0.847910
Kurtosis: 0.393757
N: 60

Minimum: 0.000
1st Quartile: 13.330
Median: 30.000
3rd Quartile: 49.168
Maximum: 100.000

95% Confidence Interval for Mu: 27.613 - 38.942
95% Confidence Interval for Sigma: 18.586 - 28.743
95% Confidence Interval for Median: 19.769 - 40.231

Figure 5.20: Descriptive Statistics of Customer Relationship Management (PF2)

Descriptive Statistics

Variable: PF2

Anderson-Darling Normality Test
A-Squared: 0.793
P-Value: 0.038

Mean: 47.3750
SDev: 19.2245
Varianve: 369.582
Skewness: -5.2E-01
Kurtosis: -4.4E-01
N: 60

Minimum: 0.000
1st Quartile: 35.0000
Median: 50.0000
3rd Quartile: 62.5000
Maximum: 82.5000

95% Confidence Interval for Mu: 42.4088 - 52.3412
95% Confidence Interval for Sigma: 16.2953 - 23.4474
95% Confidence Interval for Median: 42.5000 - 57.6734
Figure 5.21: Descriptive Statistics of Customer Satisfaction Determination (PF3)

**Descriptive Statistics**

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<tr>
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<th>P-Value</th>
<th>Mean</th>
<th>StDev</th>
<th>Variance</th>
<th>Skewness</th>
<th>Kurtosis</th>
<th>N</th>
<th>Minimum</th>
<th>1st Quartile</th>
<th>Median</th>
<th>3rd Quartile</th>
<th>Maximum</th>
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<td>-5.5E-01</td>
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<td>0.000</td>
<td>24.000</td>
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<td></td>
<td>35.936</td>
<td>22.303</td>
<td>42.7333</td>
<td>0.564</td>
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</tbody>
</table>

95% Confidence Interval for Mu: 35.936 (23.871 - 38.001)
95% Confidence Interval for Median: 32.092 (24.000 - 52.000)

*Anderson-Darling Normality Test*

**Figure 5.22: Descriptive Statistics of Supplier Focus (PF4)**

**Descriptive Statistics**

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<th>A-Squared</th>
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<th>StDev</th>
<th>Variance</th>
<th>Skewness</th>
<th>Kurtosis</th>
<th>N</th>
<th>Minimum</th>
<th>1st Quartile</th>
<th>Median</th>
<th>3rd Quartile</th>
<th>Maximum</th>
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<td>PF4</td>
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<td>0.046</td>
<td>34.4075</td>
<td>24.9059</td>
<td>620.303</td>
<td>0.629902</td>
<td>-1.5E-01</td>
<td>60</td>
<td>0.00000</td>
<td>13.8875</td>
<td>28.8900</td>
<td>50.5550</td>
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<td>21.1111</td>
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</tbody>
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95% Confidence Interval for Mu: 27.9736 (20.8931 - 35.0540)
95% Confidence Interval for Median: 22.2200 (23.1037 - 44.4000)

*Anderson-Darling Normality Test*
Figure 5.23: Descriptive Statistics of Human Resources Management (HRM)

Descriptive Statistics

Variable: HRM

- Anderson-Darling Normality Test
  - A-Squared: 0.243
  - P-Value: 0.757
- Mean: 35.3635
- Variance: 387.126
- Skewness: 0.364537
- Kurtosis: 0.609287
- N: 60

- Minimum: 0.0000
- 1st Quartile: 22.0025
- Median: 34.8900
- 3rd Quartile: 47.8900
- Maximum: 97.7800

- 95% Confidence Interval for Mu
- 95% Confidence Interval for Median

Figure 5.24: Descriptive Statistics of Recruitment (HRM1)

Descriptive Statistics

Variable: HRM1

- Anderson-Darling Normality Test
  - A-Squared: 2.636
  - P-Value: 0.000
- Mean: 24.1667
- Variance: 621.328
- Skewness: 0.971841
- Kurtosis: 0.528706
- N: 60

- Minimum: 0.000
- 1st Quartile: 0.000
- Median: 20.000
- 3rd Quartile: 40.000
- Maximum: 100.000

- 95% Confidence Interval for Mu
- 95% Confidence Interval for Median
Figure 5.25: Descriptive Statistics of Training Needs Identification (HRM2)

Descriptive Statistics

Variable: HRM2

Anderson-Darling Normality Test
A-Squared: 0.639
P-Value: 0.091

Mean: 44.1115
SDev: 25.6028
Variance: 655.504
Skewness: 0.257207
Kurtosis: -5.5E-01
N: 60

Minimum: 0.000
1st Quartile: 26.670
Median: 46.670
3rd Quartile: 60.000
Maximum: 100.000

95% Confidence Interval for Mu: 37.498 - 53.330
95% Confidence Interval for Sigma: 21.702 - 90.000
95% Confidence Interval for Median: 25.6028 - 36.000

Figure 5.26: Descriptive Statistics of Training Design (HRM3)

Descriptive Statistics

Variable: HRM3

Anderson-Darling Normality Test
A-Squared: 0.431
P-Value: 0.297

Mean: 24.1410
SDev: 16.3809
Variance: 229.0000
Skewness: 0.499314
Kurtosis: 0.290657
N: 60

Minimum: 0.0000
1st Quartile: 14.0000
Median: 27.0000
3rd Quartile: 42.0000
Maximum: 90.0000

95% Confidence Interval for Mu: 22.0000 - 34.1256
95% Confidence Interval for Sigma: 16.3809 - 36.0000
95% Confidence Interval for Median: 25.6028 - 36.0000
Figure 5.27: Descriptive Statistics of Training Delivery (HRM4)

Descriptive Statistics

Variable: HRM4

Anderson-Darling Normality Test
A-Squared: 1.091
P-Value: 0.007

Mean 42.4667
SDiv 25.7244
Variance 661.745
Skewness -2.2E-01
Kurtosis -6.7E-01
N 60

Minimum 0.000
1st Quartile 22.000
Median 46.000
3rd Quartile 60.000
Maximum 100.000

95% Confidence Interval for Mu
35.821 49.112
95% Confidence Interval for Sigma
20.205 29.073
95% Confidence Interval for Median
28.176 45.000

Figure 5.28: Descriptive Statistics of Training Evaluation (HRM5)

Descriptive Statistics

Variable: HRM5

Anderson-Darling Normality Test
A-Squared: 0.942
P-Value: 0.016

Mean 34.3333
SDiv 23.8368
Variance 568.192
Skewness 0.227282
Kurtosis -4.2E-01
N 60

Minimum 0.000
1st Quartile 15.000
Median 35.000
3rd Quartile 55.000
Maximum 100.000

95% Confidence Interval for Mu
28.176 40.491
95% Confidence Interval for Sigma
20.205 29.073
95% Confidence Interval for Median
20.000 45.000
Figure 5.29: Descriptive Statistics of Employee Involvement (HRM6)

Descriptive Statistics

Variable: HRM6

Anderson-Darling Normality Test
A-Squared: 0.842
P-Value: 0.028

Mean: 35.833
StDev: 25.936
Variance: 670.480
Skewness: 0.177061
Kurtosis: -7.7E-01
N: 60

Minimum: 0.000
1st Quartile: 15.000
Median: 40.000
3rd Quartile: 55.000
Maximum: 100.000

95% Confidence Interval for Mu:
29.144 - 45.347

95% Confidence Interval for Median:
31.581 - 42.522

95% Confidence Interval for Sigma:
25.000 - 31.581

Figure 5.30: Descriptive Statistics of Developing Employee Commitment (HRM7)

Descriptive Statistics

Variable: HRM7

Anderson-Darling Normality Test
A-Squared: 0.537
P-Value: 0.162

Mean: 40.0417
StDev: 24.9300
Variance: 621.502
Skewness: 8.52E-02
Kurtosis: -7.9E-01
N: 60

Minimum: 0.000
1st Quartile: 18.125
Median: 40.000
3rd Quartile: 59.375
Maximum: 100.000

95% Confidence Interval for Mu:
33.602 - 46.482

95% Confidence Interval for Median:
30.406 - 52.673

95% Confidence Interval for Median:
Figure 5.31: Descriptive Statistics of Support for Team Building (HRM8)

Descriptive Statistics

Variable: HRM8

Anderson-Darling Normality Test
A-Squared: 0.653
P-Value: 0.084

Mean: 37.0677
StDev: 20.637
Variance: 434.63
Skewness: 0.10679
Kurtosis: -6.3E-01
N: 60

Minimum: 0.000
1st Quartile: 17.000
Median: 40.000
3rd Quartile: 55.000
Maximum: 100.000

95% Confidence Interval for Mu: 30.777, 43.356
95% Confidence Interval for Sigma: 22.453, 32.308
95% Confidence Interval for Median: 29.694, 35.347

Figure 5.32: Descriptive Statistics of Recognition and Reward Systems (HRM9)

Descriptive Statistics

Variable: HRM9

Anderson-Darling Normality Test
A-Squared: 1.595
P-Value: 0.000

Mean: 30.1667
StDev: 17.000
Variance: 289.0
Skewness: 0.640114
Kurtosis: -5.6E-01
N: 60

Minimum: 0.000
1st Quartile: 5.000
Median: 25.000
3rd Quartile: 53.750
Maximum: 100.000

95% Confidence Interval for Mu: 23.324, 37.009
95% Confidence Interval for Sigma: 22.453, 32.308
95% Confidence Interval for Median: 15.000, 35.347
**Figure 5.33: Descriptive Statistics of Strategy (S)**

Descriptive Statistics

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<td>Skewness</td>
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<td>Kurtosis</td>
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<tr>
<td>N</td>
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<td>Minimum</td>
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<td>1st Quartile</td>
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<td>95% Confidence Interval for Sigma</td>
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<td>95% Confidence Interval for Median</td>
<td>37.568</td>
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**Figure 5.34: Descriptive Statistics of Strategy Development (S1)**

Descriptive Statistics

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<td>33.333</td>
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<td>95% Confidence Interval for Median</td>
<td>40.000</td>
<td>55.809</td>
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Figure 5.35: Descriptive Statistics of Strategy Deployment (S2)

Descriptive Statistics

Variable: S2

Anderson-Darling Normality Test
A-Squared: 2.396
P-Value: 0.000

Mean 34.7778
SDev 30.6933
Variance 938.769
Skewness 0.29035
Kurtosis -1.18959
N 60

Minimum 0.000
1st Quartile 0.000
Median 33.330
3rd Quartile 60.000
Maximum 100.000

95% Confidence Interval for Mu
26.863 42.693
95% Confidence Interval for Sigma
25.971 37.370
95% Confidence Interval for Median
19.537 53.330

Figure 5.36: Descriptive Statistics of Business Processes (BP)

Descriptive Statistics

Variable: BP

Anderson-Darling Normality Test
A-Squared: 0.728
P-Value: 0.055

Mean 39.9633
SDev 21.7892
Variance 474.771
Skewness 0.17966
Kurtosis 0.100864
N 60

Minimum 0.000
1st Quartile 17.225
Median 37.780
3rd Quartile 48.890
Maximum 100.000

95% Confidence Interval for Mu
28.335 39.592
95% Confidence Interval for Sigma
18.469 26.576
95% Confidence Interval for Median
28.890 40.000
Figure 5.37: Descriptive Statistics of Approaches for Re-design of Processes (BP1)

Descriptive Statistics

Variable: BP1

Anderson-Darling Normality Test
A-Squared: 0.896
P-Value: 0.021

Mean 34.447
SD 22.729
Variance 516.619
Skewness 0.114736
Kurtosis -3.1E-01
N 60

Minimum 0.000
1st Quartile 17.503
Median 35.000
3rd Quartile 52.498
Maximum 100.000

95% Confidence Interval for Mu 28.573 40.316
95% Confidence Interval for Sigma 19.266 27.722
95% Confidence Interval for Median 26.670 46.670

Figure 5.38: Descriptive Statistics of Measures used for Rating Performance of Business Processes (BP2)

Descriptive Statistics

Variable: BP2

Anderson-Darling Normality Test
A-Squared: 1.149
P-Value: 0.005

Mean 33.000
SD 25.8175
Variance 668.542
Skewness 0.293663
Kurtosis -7.0E-01
N 60

Minimum 0.000
1st Quartile 6.670
Median 33.330
3rd Quartile 53.330
Maximum 100.000

95% Confidence Interval for Mu 26.331 39.669
95% Confidence Interval for Sigma 21.884 31.489
95% Confidence Interval for Median 26.670 40.463
Figure 5.39: Descriptive Statistics of Information, Knowledge, Communication (IKC)

Descriptive Statistics

Variable: IKC

Anderson-Darling Normality Test
A-Squared: 0.387
P-Value: 0.377

Mean 31.7167
SDev 20.3991
Variance 416.122
Skewness 0.681092
Kurtosis 0.792249
N 60

Minimum 0.000
1st Quartile 18.000
Median 31.000
3rd Quartile 44.500
Maximum 100.000

95% Confidence Interval for Mu 26.447 36.986
95% Confidence Interval for Sigma 17.291 24.880
95% Confidence Interval for Median 23.431 36.500

Figure 5.40: Descriptive Statistics of Information Management (IKC1)

Descriptive Statistics

Variable: IKC1

Anderson-Darling Normality Test
A-Squared: 0.631
P-Value: 0.095

Mean 34.5933
SDev 22.0825
Variance 487.637
Skewness 0.504966
Kurtosis -1.7E-01
N 60

Minimum 0.000
1st Quartile 18.250
Median 32.000
3rd Quartile 52.750
Maximum 100.000

95% Confidence Interval for Mu 28.879 40.288
95% Confidence Interval for Sigma 18.718 26.933
95% Confidence Interval for Median 22.931 41.208
Figure 5.41: Descriptive Statistics of Knowledge Management (IKC2)

Descriptive Statistics

Variable: IKC2

Anderson-Darling Normality Test
A-Squared: 1.580
P-Value: 0.000

Mean 23.2862
StdDev 21.9391
Variance 476.948
Skewness 1.13710
Kurtosis 1.42815
N 60

Minimum 0.000
1st Quartile 4.290
Median 21.430
3rd Quartile 35.355
Maximum 100.000

95% Confidence Interval for Mu
17.645 28.928
95% Confidence Interval for Sigma
18.512 26.636
95% Confidence Interval for Median
11.232 27.239

Figure 5.42: Descriptive Statistics of Communication (IKC3)

Descriptive Statistics

Variable: IKC3

Anderson-Darling Normality Test
A-Squared: 0.755
P-Value: 0.047

Mean 41.8342
StdDev 25.6257
Variance 656.675
Skewness 5.90E-02
Kurtosis -5.0E-01
N 60

Minimum 0.000
1st Quartile 20.003
Median 43.330
3rd Quartile 56.670
Maximum 100.000

95% Confidence Interval for Mu
35.214 48.454
95% Confidence Interval for Sigma
21.721 31.255
95% Confidence Interval for Median
36.670 46.670
Figure 5.43: Descriptive Statistics of Business Outcomes (BO)

Descriptive Statistics

Variable: BO

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<tr>
<td>Minimum</td>
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<tr>
<td>Median</td>
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<td>Maximum</td>
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<td>95% Confidence Interval for Mu</td>
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<td>95% Confidence Interval for Sigma</td>
<td>44.069 - 45.403</td>
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Anderson-Darling Normality Test
A-Squared: 0.328
P-Value: 0.512

Figure 5.44: Descriptive Statistics of Measures used for Evaluating Company Performance (BO1)

Descriptive Statistics

Variable: BO1

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<th>Statistic</th>
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<tbody>
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<td>N</td>
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</tr>
<tr>
<td>Minimum</td>
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<tr>
<td>1st Quartile</td>
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<td>Median</td>
<td>41.155</td>
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<td>3rd Quartile</td>
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<td>Maximum</td>
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<td>95% Confidence Interval for Median</td>
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<td>95% Confidence Interval for Sigma</td>
<td>48.513 - 52.812</td>
</tr>
</tbody>
</table>

Anderson-Darling Normality Test
A-Squared: 0.331
P-Value: 0.507
Figure 5.45: Descriptive Statistics of Approaches Used to Link Performance Measures with Quality Improvement (BO2)

Descriptive Statistics

Variable: BO2

Anderson-Darling Normality Test
A-Squared: 0.821
P-Value: 0.032

Mean 30.6250
SDev 23.8402
Variance 568.353
Skewness 0.510578
Kurtosis 2.20E-02
N 60

Minimum 0.000
1st Quartile 6.125
Median 20.000
3rd Quartile 45.000
Maximum 100.000

95% Confidence Interval for Mu
24.466 36.784
95% Confidence Interval for Sigma
20.206 29.077
95% Confidence Interval for Median
22.500 40.000

Figure 5.46: Descriptive Statistics of Measures used for Assessing Customer Value (BO3)

Descriptive Statistics

Variable: BO3

Anderson-Darling Normality Test
A-Squared: 0.635
P-Value: 0.093

Mean 44.0000
SDev 23.9491
Variance 573.559
Skewness -1.0E-02
Kurtosis -4.2E-01
N 60

Minimum 0.000
1st Quartile 30.000
Median 40.000
3rd Quartile 60.000
Maximum 100.000

95% Confidence Interval for Mu
37.813 50.187
95% Confidence Interval for Sigma
20.300 29.077
95% Confidence Interval for Median
40.000 50.000
Figure 5.47: Descriptive Statistics of Measures used for Assessing Contribution to the Environment (BO4)

Descriptive Statistics

Variable: BO4

Anderson-Darling Normality Test
A-Squared: 4.311
P-Value: 0.000

Mean 22.6667
SDev 27.5476
Variance 758.870
Skewness 1.08085
Kurtosis 0.380391
N 60

Minimum 0.000
1st Quartile 0.000
Median 10.000
3rd Quartile 40.000
Maximum 100.000

95% Confidence Interval for Mu
15.550 29.783

95% Confidence Interval for Median
0.000 30.000

95% Confidence Interval for Sigma

Figure 5.48: Descriptive Statistics of Measures used for Assessing Contribution to the Community (BO5)

Descriptive Statistics

Variable: BO5

Anderson-Darling Normality Test
A-Squared: 6.353
P-Value: 0.000

Mean 18.6667
SDev 26.5194
Variance 703.277
Skewness 1.37832
Kurtosis 1.25780
N 60

Minimum 0.000
1st Quartile 0.000
Median 0.000
3rd Quartile 40.000
Maximum 100.000

95% Confidence Interval for Mu
11.816 25.517

95% Confidence Interval for Median
0.000 20.000

95% Confidence Interval for Sigma
Boxplots for the QMAF categories by size of the organisations

Figure 5.49: Boxplot for Leadership (L) by organisation size

Figure 5.50: Boxplot for Quality Culture (QC) by organisation size
Figure 5.51: Boxplot for Improvement Methods (IM) by organisation size

Boxplots of IM by SIZE
(means are indicated by solid circles)

Figure 5.52: Boxplot for Partnering Focus (PF) by organisation size

Boxplots of PF by SIZE
(means are indicated by solid circles)
Figure 5.53: Boxplot for Human Resources Management (HRM) by organisation size

Boxplots of HRM by SIZE
(means are indicated by solid circles)

Figure 5.54: Boxplot for Strategy (S) by organisation size

Boxplots of S by SIZE
(means are indicated by solid circles)
Figure 5.55: Boxplot for Business Processes (BP) by organisation size

Figure 5.56: Boxplot for Information/Knowledge/Communication (IKC) by organisation size
Figure 5.57: Boxplot for Business Outcomes (BO) by organisation size

Boxplots of BO by SIZE
(means are indicated by solid circles)

Boxplots for the QMAF categories by ANZSIC codes of the organisations

Figure 5.58: Boxplot for Leadership (L) by organisation ANZSIC organisation codes

Boxplots of L by ANZSIC No.
(means are indicated by solid circles)
Figure 5.59: Boxplot for Quality Culture (QC) by organisation ANZSIC organisation codes

Boxplots of QC by ANZSIC No.
(means are indicated by solid circles)

Figure 5.60: Boxplot for Improvement Methods (IM) by organisation ANZSIC organisation codes

Boxplots of IM by ANZSIC No.
(means are indicated by solid circles)
Figure 5.61: Boxplot for Partnering Focus (PF) by organisation ANZSIC organisation codes

Boxplots of PF by ANZSIC No.
(means are indicated by solid circles)

Figure 5.62: Boxplot for Human Resources Management (HRM) by organization ANZSIC organisation codes

Boxplots of HRM by ANZSIC No.
(means are indicated by solid circles)
Figure 5.63: Boxplot for Strategy (S) by organisation ANZSIC organisation codes

Boxplots of S by ANZSIC No.
(means are indicated by solid circles)

Figure 5.64: Boxplot for Business Processes (BP) by organisation ANZSIC organisation codes

Boxplots of BP by ANZSIC No.
(means are indicated by solid circles)
Figure 5.65: Boxplot for Information/Knowledge/Communication (IKC) by organisation ANZSIC organisation codes

Boxplots of IKC by ANZSIC No.
(means are indicated by solid circles)

Figure 5.66: Boxplot for Business Outcomes (BO) by organisation ANZSIC organisation codes

Boxplots of BO by ANZSIC No.
(means are indicated by solid circles)
Appendix: 6: Publications by the Authors from this Thesis


