ASSESSING THE PRESENCE OF TOTAL QUALITY UTILISING A NOVEL EXAMINATION OF SELECTED PERFORMANCE FACTORS

AN INNOVATIVE METHOD FOR DIFFERENTIATING BETWEEN COMPANIES POSSESSING EFFECTIVE TOTAL QUALITY PROGRAMMES AND THOSE ERRONEOUSLY CLAIMING THEY DO

ANTHONY RICHARD DAVIDSON

Thesis submitted for the degree of Doctor of Philosophy

City University Business School
Department of Management Systems and Information
London EC1V 0HB

August 1998

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

DEDICATION

This thesis is dedicated to the memory of my late father, Benjamin Davidson, to whom the advancement of education was of paramount importance. The pride he would have taken from completion of this work will, I hope, be counted as a partial payment towards the eternal debt of gratitude I owe him for the opportunity and encouragement he afforded me to pursue an education.

ACKNOWLEDGEMENTS

I would like to acknowledge the following people who have helped me with this work.

My supervisors at City University were Professor John V. Chelsom and Dr. Ross Janes. Professor Chelsom's invaluable advice and considerable expertise ensured that the research incorporated best practices. His zero tolerance for defects proved demanding but ultimately rewarding. Dr. Janes' persistent encouragement prompting and checking were vital to the completion of this work.

My external supervisor, Dr. Louis W. Stern of the Bernard M. Baruch College, City University of New York provided me with the benefit of countless hours of assistance, years of experience and many practical solutions to seemingly insurmountable obstacles.

The Department at City University, London, especially Fred Charlewood, Roman Hovorka and Lawrie Reavill who lent me support and advice both in London and New York, and Graham Clewer who shared my passion for the applied.

Finally, my wife Linda for her contributions, support and tolerance, my children Nechama, Leah and Benjamin for their help, patience and concern, and my mother, brothers and parents-in-law for their understanding.

DECLARATION

I grant powers of discretion to the University Librarian to allow this thesis to be copied in whole or in part without further reference to me. This permission covers only single copies made for study purposes subject to the normal conditions of acknowledgement.

ABSTRACT

As the debate over the success of total quality management continues, the number of attempts to measure the effectiveness of total quality programmes increases. Almost all of these methods have been based on either surveys or questionnaires, or some other subjective way of evaluating customer satisfaction. Furthermore, many companies perceive themselves as practitioners of total quality management, when in fact all they are doing is engaging in the peripheral highlights of the initiative adopted. This not only forestalls success of the programme it actually proves to be counterproductive. True total quality requires total commitment, total integration and total system-wide adoption of the quality concept.

As a result of the special, interwoven relationship that just-in-time inventory management and total quality enjoys, research was conducted to determine whether the presence of superior inventory performance indicates the presence of total quality in manufacturing organisations.

An objective, two-tier quantitative model has been developed for assessing the presence of total quality in an organisation and for determining the level of effectiveness of a company's total quality management initiatives. The model utilised inventory performance as a stand-alone indicator of the presence of total quality and then combined it with return on capital employed and employee value to create a multifactor model for a more detailed evaluation.

Both rating methods were tested on a population of 48 companies including reputed TQ and non-TQ organisations and the results were compared and contrasted. Detailed analysis revealed that some companies claiming the presence of total quality did not meet the performance criteria established by the benchmark TQ companies.

Statistical tests showed that the inventory performance rating method developed through this research is a reliable stand-alone indicator of a total quality organisation. Further analysis determined that the multifactor rating method is useful in assessing the exact areas of success or failure for any given company.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background and Purpose of Research

A car owner recently experienced a problem with his 1991 automobile. The motor of the electric rear window fell apart. The car was covered by a bumper-to-bumper 5 year/50,000 miles warranty so he returned to his dealer only to be told that since the car had more than 50,000 miles on it the repairs were not covered under the warranty. Puzzled by the fact that the rear window is, quite possibly, the least used feature on a car rarely driven with more than two occupants, and failing to see the correlation between mileage and window operation, he confronted the technician. "It's just terribly designed," said the mechanic and armed with that information the customer contacted the Customer Service division. Customer Service listened attentively and was able to put an end to the matter by telling the customer that the mileage exceeded the warranty limit and he would have to pay for the repairs.

The situation described above is a perfect example of the problem with the traditional approach to quality control where the main focus is on mass inspection and corrective controls as opposed to preventive measures and customer satisfaction. However, this interchange occurred at a company that professed to be customer driven and had a reputation for practising Total Quality Management.

Since the adoption of total quality management became a pursuit of companies in search of a remedy to declining sales and an eroding competitive position there has been a plethora of articles evaluating the success or lack thereof of total quality programmes. Furthermore, there have been numerous attempts to assess the presence of total quality in any given organisation. More often than not, the companies themselves have conducted these measurements in order to gauge the success of their own quality initiatives.

Most of these measurements revolved around surveys, questionnaires or other subjective instruments that for the most part evaluated customer satisfaction which was only one aspect, albeit an important one, of total quality management.

The establishment of a standardised measure has also met with mixed results. The use of criteria such as winning quality awards or receiving quality standards certification has proved unreliable. A number of companies won awards only to meet with severe financial setbacks within a short period of time. Conversely, many companies have succeeded in using the awards as a stepping stone to even greater excellence and a subsequent competitive advantage.

It became apparent that total quality management was not being inculcated into the company philosophy or integrated into the strategic planning. Rather, total quality was being used as a quick-fix technique in a manner that was consistent with the popular trend of thought. One slogan was discarded in favour of another; TQM (total quality management) was replaced by CQI (continuous quality improvement) which was in turn supplanted by BPR (business process re-engineering) and/or other buzzwords. The inability to appreciate that the success of all of these total quality initiatives is dependent upon a system-wide adoption resulted in inevitable failure. Different organisations have succeeded using each of the aforementioned techniques and the common denominator enabling that success has been the integration of the components of the specific initiative into all facets of the system.

The concept of understanding production as a system was introduced by none other than Deming himself, (Neave, 1995) and the fourteen points that he recommended for achieving quality were, in essence, consequences of his philosophy not merely a summary. A complete adoption of Deming's approach requires the understanding that system components generate and drive quality.

Such system-wide commitment involves the participation and co-operation of suppliers, customers, employees and management in the manufacturing, technology and co-ordination stages of the production and marketing process. Creation of a quality department is inimical to the concept of total quality, which requires that everyone and everything be involved in creating and maintaining quality.

The purpose of the research is to identify quantifiable, system-wide factors that can be used to indicate the presence of total quality. Since previous literature and fieldwork utilised subjective measures, the problem of erroneous perceptions of the presence of quality was prevalent. Companies professed to have total quality when it was evident they did not and in some cases the reverse was true. More importantly, without quantifiable measures it was difficult for an organisation to verify the success of its quality initiatives.

To that end it was decided to research whether inventory performance, which is readily quantifiable, is a dependable gauge of the presence of total quality. In the event it was discovered that inventory performance alone was not sufficiently reliable as an indicator of total quality, two additional factors, R.O.C.E. (return on capital employed) and EVF (employee value factor), which have system-wide effects, would be considered. These factors would then be combined with inventory performance into a multifactor model.

Since total quality is an ever-changing dynamic concept it was decided to distribute a questionnaire that could identify current practices of total quality companies and simultaneously assess the managerial attitude of those adopting total quality initiatives. It was hoped that this would help facilitate making a differentiation between companies practising total quality management and those erroneously claiming that they do.

1.2 Goals and Objectives

This thesis describes the design, development and testing of a non-subjective, quantitative model that can be used to indicate the presence and evaluate the effectiveness of a total quality management programme in manufacturing organisations. It will employ the novel approach of utilising inventory performance as a measure of total quality. Additional factors that are intertwined with total quality are also explored with a view to combining them with inventory performance into a "supermodel." The supermodel could then be used to definitively determine the presence of total quality management and the success of any programmes implemented.

More specifically, the research identified three objectives:

- to determine whether inventory performance is a valid measurement tool for assessing TQ levels

- to determine whether other factors should be combined with inventory performance to form a multifactor measurement method

- to determine through testing a model on a sampling of TQ and traditional companies whether a multifactor rating system provides significantly better evaluations of total quality management than just inventory performance alone.

1.2.1 Why Inventory Performance?

As described earlier in this chapter, the focus of Deming's principles keyed on the understanding that production is a dynamic system, which requires the commitment, co-operation and integration of suppliers, customers, employees and management. Superior inventory performance cannot be achieved without these same criteria.

The TQ organisation must have the quality concept ingrained in all facets of its philosophy and that in turn must be reflected in the tangible elements of the production process. For the system to operate flawlessly quality must exist at every stage from design to customer post-purchase satisfaction. The initial infusion of quality into the product requires first-class incoming raw materials. Defective raw materials will render all future inputs of quality pointless. Total quality, therefore, cannot and does not simply rely on the inspection of incoming raw materials but it seeks to establish and promote long-term relationships with suppliers. The modern-day TQ company embellishes upon those relationships by encouraging suppliers and customers to participate in the design of the product and to provide input into the technology and the production process to be used. This ensures 100% quality, and the meeting of customer expectations throughout the entire system from design to finished goods. These partnerships and inherent generators of quality are also basic requirements for a company wishing to operate on a JIT or lean manufacturing basis.

The current consumer market entails rapidly changing customer expectations. A TQ organisation, if it wishes to be responsive to customer needs and thus ensure customer satisfaction, must avoid having large inventories of finished goods. Additionally, this means not only providing a superior quality product but also delivering it in a timely manner. Thomas Stallkamp, President of Chrysler Corporation has been seeking to establish participatory relationships with the railroads (Fuller, 1998) in order to reduce the amount of time cars spend on the railways between the factory and the dealership.

JIT facilitates total quality in that it has a flexible manufacturing process and it allows for little or no finished goods inventory. Furthermore, for a JIT or lean manufacturing system to be fully operative it must have reliable equipment, committed and dedicated employees, and a process by which raw materials can be converted into finished goods in an expeditious manner.

JIT is dependent on the use of superior technology and electronic data interchange, which facilitates the development of information technology skills and technologically advanced manufacturing equipment and facilities. As previously mentioned, these technological factors are equally mandated for successful total quality.

Superior inventory performance as indicated by low inventories and manifested through JIT or lean-manufacturing systems can only be implemented effectively when there is a commitment to:

- quality design
- non-defective incoming supplies
- 100% reliable equipment
- best-practice production processes
- flexibility
- responsive and rapid manufacturing
- technological superiority
- supplier participation
- employee integration

These criteria also represent the fundamental precepts by which total quality is attained. Simply put, JIT forces an organisation to be externally focused (Harari, 1997). Without inventory stocks from which to choose, the company has to anticipate what customers expect and want, and this breeds total quality.

1.2.2 Why R.O.C.E.

True total quality management must inevitably result in improved financial performance. A key measure of financial performance is R.O.C.E., return on capital employed. Since the journey toward total quality calls for the elimination of waste, R.O.C.E. is a particularly relevant financial measure in that it penalises inefficient use of assets.

1.2.3 Why Employee Value

Similarly, in order for total quality management to be effective, employees must be more productive and more quality conscious. "Getting it right the first time" means that employees should be able to generate more units, more sales and more profits in the same amount of production time. Furthermore, empowerment and employee involvement in strategy formulation and implementation facilitates greater co-operation and as a result improved employee efficiency. The integration of employees has system-wide implications and, as such, an employee value factor (EVF) was calculated for inclusion into a multifactor model.

1.2.4 Limitations of Model

Historically, most models that were developed to measure total quality management focused on service organisations or the purchase and ownership experience for manufactured products. Consequently, the attributes considered were subjective in nature and included such items as customer satisfaction, repeat business, the meeting of customer expectations and overall experience during the processing of the transaction. The model developed in this thesis concentrates on more concrete and objective measurement techniques. The use of inventory performance, however, necessarily limits the models usage to firms in the manufacturing industries. Clearly, JIT is not relevant in non-manufacturing situations. However, although the inventory component of JIT is not present in service organisations, the concept driving JIT may well be there. The use of the JIT approach in a variety of industries ranging from hospitality and leisure to health care and financial services has already been documented (Haag et al., 1998) and is covered in Section 4.5.1. in Chapter 4. Accordingly, it is not unreasonable to foresee the potential of being ultimately able to either combine this model with other models or to integrate other measurement methods of customer service attributes in order to expand the scope of applicability of this model. The scope of this thesis is limited, however, to testing the model only in manufacturing industries.

Another caveat that should be noted is that there could be a subtle difference between firms in process industries with a long and complex production system versus firms in a traditional manufacturing setting. In the former, it is possible that the customers are also continuous processors and minimising finished goods inventories may well jeopardise continuous production at the client company (Chelsom 1998b) resulting in a cost far greater than any potential savings generated by lean inventories. Obviously, a blood bank cannot maintain low finished goods inventories because the cost of a stock-out is too great.

In such situations it is more appropriate to consider the finished goods as part-processed inputs to the next phase rather than just simply finished goods (Chelsom 1998b). Whether it is blood being provided for surgery or petro-chemicals being supplied for fertiliser producers, the finished good is not really finished in that it will still be used as part of another process even if that process happens to take place in another organisation.

A number of manufacturing organisations which sell both work-in-process items and finished goods include the partly finished items in the finished goods total on the grounds that as far as the manufacturing process in the company is concerned they <u>are</u>, indeed, finished. Similarly, in processing companies there is a more acute need to examine how items in inventory should be classified. As a result, an absolute inventory performance standard applicable to both manufacturing and processing industries may not be entirely suitable but certainly, a comparative analysis within each industry respectively should provide equally valid indications of the presence of total quality.

1.3 Research Hypotheses

All logical conclusions and a review of the literature indicate that for total quality management to be effective there must be superior inventory performance. This thesis seeks to establish that the identification of superior inventory performance within an organisation is sufficient to establish the presence of total quality.

The null hypothesis, therefore, is that inventory performance is a reliable indicator of the presence of total quality.

In the event that the null hypothesis is either rejected or unable to be confirmed, an alternative hypothesis was formulated postulating that a multifactor model consisting of a combination of inventory performance, return on capital employed and employee value is a reliable indicator of the presence of total quality.

1.3.1 Synopsis of Methodology to be Used

Ten companies with sterling reputations for total quality will be selected in order to compile a benchmark group. An inventory rating system will be developed and tested on the benchmark group in order to establish the inventory performance ratings of known TQ organisations.

An additional number of companies with no particular reputation for total quality will be selected for inclusion into what has been termed a control group. The term control group is not used in its strict empirical sense but rather as the nomenclature for the group of companies for which there was no recognisable total quality programme in existence. The purpose of creating the control group is to establish inventory performance ratings for non-TQ organisations.

A comparison of the inventory ratings for the benchmark and control group companies will be calculated. Thereafter, a multifactor rating for the benchmark and control group companies will be performed. An analysis of the two rating methods will be conducted in order to detect any similarities or differences between them.

Finally, both methods will be tested on the entire population of 48 companies and an analysis and discussion of the results will be presented. Conclusions will be formulated and the hypotheses will either be accepted or rejected.

1.4 Outline of Thesis

In order to fully understand the special relationship that exists between inventory performance and total quality, it is first necessary to comprehend the intrinsic composition of each partner in the relationship. Chapter Two seeks to define quality and to trace its evolution into total quality management. Total quality is examined and a comprehensive insight and evaluation of current philosophies is presented.

Chapter Three seeks to help the reader understand the concept of inventory management and to appreciate the differences between traditional inventory policies such as economic order quantity and current best practices that lean toward minimal inventories and just-in-time inventory management. The importance of supplier partnerships and co-operation is detailed and the relationship between superior inventory performance and total quality is explored.

Chapter Four introduces the importance of a systems approach toward both total quality management and inventory management. Their success is dependent upon an appreciation of the integral role each plays as their underlying philosophies permeate throughout the organisation. In addition, two other system-wide factors, R.O.C.E. and employee value, are examined with a view to combining them with inventory performance in a multifactor model.

Chapter Five discusses the steps and processes undertaken in the research design. It describes the details of the collection of data and the methodology employed for ultimate testing and analysis of the data.

Chapter Six outlines the procedures used for analysing and testing the data. An overview and explanation of the mathematical tools used to combine factors in a multiple objective decision scenario are provided and methods for data normalisation are discussed. Analysis and testing of the benchmark and control group companies using both inventory and multifactor ratings are reviewed, and ultimately both rating methodologies for the entire population of 48 companies are presented.

Chapter Seven reports the findings and results from the various stages of analysis conducted in Chapter Six. Observations are noted and commented upon and the implications of the research and the findings are discussed.

Chapter Eight lists the conclusions that can be drawn from the research, analysis and testing of data. It discusses the hypotheses in light of the findings and proposes the areas which merit further research.

The Appendices contain the raw data and incidental analysis or findings either not germane to the purpose and direction of the research or which had insufficient value to warrant their inclusion in the main body of the thesis.

CHAPTER TWO

2.0 THE PHILOSOPHY OF TOTAL QUALITY

2.1 Introduction

This chapter traces the evolution and development of quality from its initial role to its current standing representing a management theory, which regards quality as a pervasive, all-encompassing strategic tool. Traditional quality control and a philosophy of total quality are compared and contrasted in the context of a review of existing literature. Where appropriate, a critique of current thinking is included in order to help the reader understand why a different approach might be utilised. The key to a more comprehensive investigation can only be obtained through a compilation of authoritative definitions of total quality and traditional quality as well as the methods used for implementation of the respective programmes. Of paramount importance is an examination of the successes, or lack thereof, of Total Quality Management initiatives and, perhaps, more importantly the underlying reasons behind the results. The above elements are contained in this chapter in an effort to lay the groundwork for further understanding of what makes quality the catalyst of success. This will enable the research to identify possible indicators of successful quality programmes.

2.2 Understanding Quality

As quality has evolved, so have its definitions. Whereas, formerly the quality of a product was a direct result of its manufacturer, (apprentice, craftsman, master craftsman), today quality is viewed as either an ingredient in the manufacturing process (traditional quality control) or a component of the strategic plan (total quality control). In either case, a need to define quality has arisen and there have been plenty of contributors. This section defines and elaborates upon the various dimensions of quality and total quality management. It compares and contrasts traditional quality control with a total quality control philosophy.

2.2.1 What is Quality?

A frequent answer given is "excellence," but venturing a little deeper into the realm of quality a number of definitions surface; performance, features, meeting customer preferences, reliability, durability, serviceability, response, appearance, accuracy, timeliness and reputation. One can even go so far as to say, " I don't know how to exactly define what quality is but I know quality when I see it." The problem with these definitions is that they are relative and, therefore, do not readily lend themselves to measurement. Garvin (1984) maintained that most definitions fall into one of five categories: transcendent, product-based, user-based, manufacturing-based and value-based. He argued that firms must adopt alternative definitions of quality as their products progress from the design stage through production and ultimately to the end user.

From a more analytical perspective, quality has been defined, at one time or another, as *value* by Abbott (1955) and Feigenbaum, (1951) *conformance to specifications* by Gilmore, (1974) *conformance to requirements* by Crosby, (1979) *fitness for use* by Juran, (1988) *loss avoidance* by Taguchi (1989) and *meeting and/or exceeding customers' expectations* by Parasuraman et al., (1985).

The level of quality a product possesses can be attained through two different channels: a quality level that is required and a quality level that is generated.

Quality can be generated as a result of better:

- design
- manufacturing facilities
- tools and machinery
- raw materials
- product testing
- management
- training

A firm is <u>required</u> to manufacture at a quality level that will:

- meet government regulations
- be acceptable to the marketplace
- be competitive
- be consistent with its organisational policy (reputation)

It was recently established (Tamimi and Sebastianelli, 1996) that definitions of quality vary between manufacturing and service firms and between TQM and non-TQM companies. Furthermore, definitions could be elicited from various perspectives, among them customer-orientated, non-customer-orientated and literature-based. The study served to confirm the complexities inherent in defining and measuring the quality construct.

2.2.2 What is "Total" Quality?

The philosophy of total quality involves a constant, continual improvement in quality and it recognises that employees bear a major responsibility for quality improvement. Shepard (1991) felt that although several definitions have been offered for total quality they all basically converge on one issue - customer satisfaction - which is essentially the accepted cornerstone of Total Quality Management. However, Grossman (1994) opined that expressing goals in terms of customer satisfaction led to the failure of total quality programmes simply because there has never been a clear or unanimous definition of the term. Organisations have reshaped themselves under the guidance of the marketing concept; in other words, they have adopted a customer-orientated philosophy, (Ghoshal & Bartlett, 1994). However, accurate measurement of the success of these initiatives can be precarious since surveys are the predominant measurement technique used and while surveys measure how the customer has been satisfied in the past they, states Hermel (1997) "say little on what needs to be done in the future."

2.2.3 Pioneers of Total Quality Management

Over the years since the inception of the total quality philosophy there have been many gurus who have led the way in establishing total quality theories for the formulation, adoption and implementation of total quality programmes. This section presents five of the more prominent experts who have influenced the development of Total Quality Management and whose ideologies have formed a basis for the research undertaken in this thesis.

2.2.3.1 Armand V. Feigenbaum

The main thrust of Feigenbaum's (1961; 1983; 1991) theories on quality was to insist on the involvement of every employee in the company leading to a consolidated effort to prevent defects. A system that is designed to build in quality rather than facilitate corrective controls *post facto* requires the total, synergised involvement of all departments in the prevention of defects and the maintenance and improvement of quality. This integrated approach seems to be the precursor to what is now called a "Total Quality Control Philosophy."

2.2.3.2 W. Edwards Deming

After World War II Japan's infrastructure lay in ruins. The phrase "Made in Japan" was indicative of inferior workmanship and it was generally accepted among industrial analysts that Japan's economy would be a drain on international resources for many years to come. Although there are several versions of how Dr. Deming, an American, arrived in Japan, a popular account is that he was invited by *JUSE*, the Union of Japanese Scientists and Engineers. It was there that he was able to successfully convey his theories as to the importance of quality and the use of statistical techniques to improve quality. He told them that if they would adopt his principles they would be able to capture world markets within a few years. They listened, and he was right, for now the label "Made in Japan" is synonymous with the highest quality standards and it is able to attract consumers world wide.

His return to the U.S. was highlighted by the now famous roundtable discussion hosted by the U.S. General Accounting Office in August, 1980 entitled "Product Quality—Japan vs. United States." He subsequently developed his Universal Fourteen Points (Deming, 1981/2; 1985; 1986) which, despite minor revisions throughout the years, remain the backbone for implementing quality improvement. The crux of his message is that everyone in the organisation should accept the doctrine that poor quality, defective products or service will not be tolerated. He insisted that companies rely on suppliers that have historically provided quality materials rather than emphasising sampling inspections in order to ensure the quality of each delivery. This would involve using a few reliable suppliers providing consistent quality as opposed to dealing with many suppliers. Deming also stressed the importance of using statistical techniques to detect the sources of poor quality and advocated the use of statistical quality control during the process rather than solely at the end.

As stated by Neave, (1995) Deming's Fourteen Points, rather than being mistakenly regarded as a summary of his whole management philosophy, are in reality but fourteen consequences of the philosophy. His recommendations for incorporating total quality are based on his belief that production and, later, any organisation, must be viewed as a system. This, in turn, meant that the components of the system are essentially the generators and the drivers of quality. Although Deming's philosophy was clearly system orientated, many of his followers incorrectly focused simply on statistical process control and/or his fourteen points.

2.2.3.3 Joseph M. Juran

Juran (1991) concentrated on a concept that involved top-down management and featured the customer more prominently. In his legendary Quality Control Handbook, (Juran, 1951) and subsequent lectures he introduced the classic functions of management, planning, controlling and organising into the quality mix. Further works (Juran, 1986; 1989; 1991a; 1991b) elaborated on the idea of integrating management into the overall responsibility for quality and the idea of determining quality objectives.

2.2.3.4 Philip Crosby

In his book Quality is Free, Crosby (1979) supplants "goodness," as a definition of quality with "conformance to requirements." His emphasis on the motivational and strategic aspects of quality and the insistence on zero defects are the fundamentals of his approach. The underlying theme of his book is that the costs of inspection, rework and failure will always be greater than the costs of prevention. Hence...quality is free.

2.2.3.5 Henry Ford Sr.

Not usually thought of as a quality guru, Henry Ford (Stuelpnagel, 1993) "developed a management process using the same principles as today's Total Quality Management." His book, My Life and Work, (Ford et al., 1926) describes his management process and it bears a remarkable resemblance to what we now call TQM. The main tenets of the management process delineated in his book and restated (Stuelpnagel, 1993) in today's TQM terminology are:

- Quality
- Customer Focus
- Continuous Improvement
- Hands-on Leadership
- Statistical Thinking
- Job Satisfaction
- Just-in-time Manufacturing

His vision of building a car, the Ford Model T, that everyone could afford, and his innovative production techniques was indicative of his inherent understanding of the ingredients required for TQM. In fact, Ford thought of his management process as common sense. Stuelpnagel (1993) feels that Total Quality Management is 90% common sense plus the discipline to implement it.

2.2.3.6 Evaluation and Summary

In an effort to regain a competitive edge companies turned toward a total quality management philosophy and invariably selected one of the aforementioned gurus as a mentor. Unfortunately, many organisations, instead of seeking to understand and promulgate the philosophies behind Deming's 14 points, Juran's 10 steps or Crosby's 14 steps, simply followed each item as they would a set of instructions.

Peters (1987) wrote that successful implementation of TQM is predicated upon the adoption of a quality system or ideology. He declined to endorse any particular system but rather he emphasised the importance of adhering completely to whichever approach is selected, even if it is one newly created by the organisation. He contended that most quality programmes fail because they either have a system without passion or passion without a system and success requires both. This thesis will outline in Chapter 4 the importance of a systems approach.

It is apparent that Deming, Juran and Crosby agree on many concepts relating to total quality management. Pike's (1994) summary of these common elements includes high levels of education and training, a constant search for improvement and an awareness of opportunity, a philosophy of prevention, the use of self-defined measurement, the use of statistical process control especially with regard to suppliers, non-financial rewarding of employees, substantial and open levels of communication, a focus on the management of processes and the concept of the “internal customer.”

It is true that each has different opinions on how to tackle quality but most of those occur in the specifics rather than the general philosophy. For example, Crosby is against the use of quality circles and is in favour of establishing a “zero defects day” with plenty of fanfare to visibly celebrate the attainment of the prevailing performance standard. Juran and Crosby suggest setting individual goals, which Deming opposes along with the tactic of pay linked to output. Nonetheless, it is possible that while each proposes a unique approach in how to inculcate quality throughout the organisation agreement upon the basic concept of total quality management is unanimous.

As this thesis will demonstrate, the most important part of adopting a successful total quality philosophy is the process by which it is undertaken. Arriving at zero defects is not nearly as important as the attempt to get there, so it is arguable that one or more of the gurus were concerned that setting certain goals may actually distract the organisation from the real purpose of engendering quality throughout the system. This is often a point raised by detractors of the Baldrige award.

In conclusion, it is evident that although the pioneers may have had specific differences as far as the implementation of a total quality programme is concerned, they would have agreed that their points and/or steps should not be taken as a sequential plan of attack. Rather they should be viewed as contemporaneous guidelines for the purposes of establishing and ensuring a system-wide adoption of the quality construct. It is also clear that just as the definition of quality is constantly evolving so too is the implementation process. It may well be argued (Chelsom 1998b) that Crosby and Juran tended to take a more introspective view of the organisation ignoring the role of suppliers and customers in the current inter-organisational system approach to quality. In their defence, it should be added that information technology that was not available to them has now progressed substantially. Therefore, the inclusion of suppliers and customers into the system has been greatly facilitated. Given this knowledge they may well now adopt a more expanded approach. Even Deming, who already viewed production as a system, was not immune to change. This resulted in an update to his model as detailed in Chapter 4 and illustrated in Figure 4-6.

2.3 Quality Control Circles

Quality control circles originated in Japan as a cost-effective way to increase both productivity and quality. While the first Quality Control circles were formed in about 1962 as a result of a magazine article appearing in “Genba to QC” exhorting workers to organise at a workshop level, (JUSE, 1980) they only really became popular because of the adverse effects of the 1970's oil crises. In a quality control circle, employees meet regularly to solve quality-related problems. A facilitator runs the meeting wherein all aspects of quality control are discussed. This meeting normally takes place after work once a week or else for a cumulative four hours a month. Essentially there is no pay but employees receive company recognition for their contributions.

As a result of cultural differences and a general misapplication of what was seen in Japanese plants, some American firms have soured on quality control circles and have replaced them with their own versions. It is interesting to note that while some companies found quality control circles to be too rigid others found them to be too unfocused (Naj, 1993)

Ten years after their introduction by Lockheed Aircraft to the United States the development of quality circles tapered off and they were replaced by more value-based approaches which were starting to become popular in Europe. Although the attributes of quality circles were recognised as important, many US companies felt they were not sufficient for effective implementation of Total Quality Management and thus they abandoned the concept. The choice that could have been made was to have integrated quality circle characteristics into a more comprehensive and holistic instrument for diffusing quality. The failure to select this more preferable approach constituted a regrettable balancing move (Kano 1993) on the part of these US companies.

2.4 The Conceptual Evolution Of Total Quality

Although, as this paper will demonstrate, there are several important differences between traditional quality control and total quality control, it is important to understand at this juncture that the concept of total quality is constantly being revised. In fact, total quality should be viewed as an evolutionary process into which additional factors are introduced as and when their applicability to the total quality concept becomes evident.

Hermel (1997) contends that the evolution of the quality movement can be divided into two distinct eras, pre- and post- 1980s each having its own paradigms, conceptualisation and trends.

As stated earlier in this paper, the quest for quality has been ever present, it is simply the approach and/or the willingness to invest in it that has changed. The first era was comprised of four periods, each of which had its own identifiable approach, methodology and techniques: inspection, quality control, quality assurance and total quality. The development of quality with respect to each period can be linked to a parallel evolution of four principal trends:

2.4.1.1 1900-1930s

Although initial approaches to quality were highly quantitative, an introduction of qualitative factors steadily gaining in significance took place. By the end of this period both quantitative and qualitative factors played a role when establishing performance criteria of companies.

2.4.1.2 1930s-1950s

As the realisation that quality involves a proactive stance not just a reactive one became apparent, inspection evolved from a uni-dimensional task with essentially remedial purposes to being a part of a multi-dimensional preventative process.

2.4.1.3 1950s-1970s

This period oversaw an expansion of quality into different and original areas extending beyond just the final product. The quality of routine activities and processes were examined.

2.4.1.4 1970s-1980s

The integration of all functions that have an impact on quality was the primary focus. It was further enhanced to include economic, social and organisational aspects in an effort to develop a "total" perspective of the company.

The trends developed in this last period formed the basis for the current approach to quality and the way in which integration should be conducted is continually changing.

Hence, whether one;

> substitutes one of the buzzword terms (TQM) with another (CQI, BPR) or whether one:
>
> elects to implement programmes that search for excellence, pursue customer satisfaction and grant empowerment or whether one;
>
> seeks, instead, to pursue awards or the attainment of a particular certification,

the desired goal is the same, to find a way of integrating all quality related aspects of the organisation in a way so as to establish and maintain a competitive advantage.

TQM is an eclectic model (Guillen, 1994) with a variety of influences. Quality has been analysed based on a fixed set of quantifiable factors, as indicated by the current trend toward Business Process Reengineering or by a set of qualitative evaluations as has been done under Total Quality Management. However, the examination of total quality should, in reality, be conducted from a systems standpoint. This would currently require the integration of any and all components in the system, tangible or intangible, that might influence the ultimate level of quality. Include in the above system are supplier relationships, customer relationships, technology, employees, employers, labour relations, business performance and managerial attitude.

2.5 Ramifications of Total Quality Management

An examination of the impact of the Total Quality concept at four companies which profess a strong commitment to a total quality control philosophy best illustrates how TQM has infiltrated the American workplace in terms of philosophy and approach. These specific companies were selected to represent four different industries, service, manufacturing, retail and commodities, illustrating that TQM can be applied across the board. Each company identified its own relevant area in which to inculcate Total Quality Management principles.

2.5.1.1 Whirlpool, USA

When Whirlpool wanted to put in a new assembly line at its Clyde, Ohio plant it allocated a budget of $150 million and solicited vendors' proposals. However, instead of asking management to analyse these proposals it entrusted the evaluation to the hourly workers who would be using the assembly line. They in turn made several suggestions such as building an elevated assembly line to eliminate constant stooping and/or bending over thus avoiding injuries and lost labour hours. These same workers now visit the equipment makers to inspect the machinery before it is purchased. Newly hired product engineers spend a week on the assembly line at Clyde before they move into their offices at HQ. If a quality problem is detected the worker involved goes to an inspection area where it is discussed. Since workers are being trained in statistical process control they can take measurements and make adjustments before the problem gets too serious (Hampton, 1987).

2.5.1.2 L.L. Bean Inc.

As a mail order company based out of Freeport, Maine, L.L. Bean is renowned for its commitment to quality and its policy of always honouring its lifetime guarantees. When a customer in New York didn't receive his canoe in time for a weekend trip, an L.L. Bean sales representative strapped one on his car and drove it to the purchaser.

Despite this obvious display of dedication to customer satisfaction, management were concerned as to why the canoe had not been delivered on time in the first place. Upon further review L.L. Bean discovered that while the employees were in a quality frame of mind they were not empowered to act upon it. Furthermore, they were not knowledgeable enough about processes elsewhere in the organisation to prevent defects before they occurred.

L.L. Bean decided to adopt a Total Quality Management system but instead of focusing on improving the manufacturing process they concentrated on employee development. Now in its fifth year since implementation and after much process redesign, the Total Quality Management system has helped boost profits, increase customer satisfaction, improve conformance and enhance safety. The company claims that its successes are due to the way the process was managed (Halerow, 1994).

2.5.1.3 Perdue Farms

Frank Perdue took over the chicken farm business from his father. The industry essentially traded as a commodity, with each farm possessing the same level of quality. This meant that competition was strictly on a price basis. Perdue engaged in research, which revealed that customers preferred plump and yellow chickens. Using careful breeding and feed additives to produce meatier, more yellow chickens than his competitors he was able to produce a chicken with a higher, more consistent meat-to-bone ratio.

To prevent wet pinfeathers from escaping the torching process that burns them off he purchased a turbine engine to blow-dry the chickens. This did not result in zero defects but far fewer pinfeathers ended up in people's homes. This capital investment did not expand capacity or reduce labour costs, as is normally the case, but it improved the real and perceived quality of Perdue chickens.

Perdue used aggressive television and billboard advertisements to advise and remind consumers of quality improvements and he now gets a premium price for a “commodity”. He emphasises product and service quality - no pinfeathers, plump and yellow, high meat/bone ratio and brand image - not price (Gale, 1987).

2.5.1.4 Grand Union

The Grand Union is a large retail grocery operation with the majority of stores located in well-established neighbourhoods. Since the evolution of the new super store ranging from 100,000 to 260,000 square feet, Grand Union, a traditional, discount-driven, 40,000 square foot grocery store, decided that it could not compete on that level. In order to meet its new strategic business needs, Grand Union decided to redefine itself from being an undifferentiated, price-based business to a high quality, customer-driven business.

Aside from changing some of the product lines to incorporate only the best quality products, the culture of the firm changed to emphasise listening to and serving customers. In response to the question of how to become a customer-driven operation they developed a list of organisational characteristics. Based upon these characteristics they concluded that several changes were in order. The before and after observations are listed below.

EMPLOYEES	BEHAVIOURS BEFORE THE CHANGE	BEHAVIOURS AFTER THE CHANGE
BAG PACKERS	Ignore Customers Lack of packing standards	Greet customers Respond to customers Ask for customer's preference
CASHIERS	Ignore Customers Lack of eye contact	Greet customers Respond to customers Assist customers Speak clearly Call customers by name
SHELF STOCKERS	Ignore Customers Don't know store	Respond to customers Help customers with correct product/location information Knowledgeable about product location
DEPARTMENT WORKERS	Ignore Customers Limited knowledge	Respond to customers Know Products Know store
DEPARTMENT MANAGERS	Ignore Customers Ignore workers	Respond to customers Reward employees for responding to customers
STORE MANAGERS	Ignore Customers Stay in booth	Respond to customers Reward employees for service Appraise employees on customers service

Figure 2-1: Customer-Driven Employee Behaviours

Source: (Schuler, 1992)

2.6 Traditional Versus Total Quality Control

Traditionally, quality control referred mainly to inspections during or at the end of the transformation process. The responsibility for quality was assigned to a separate department in order to:

- Increase the overall average level of quality
- Better ensure interchangeability/standardisation
- Enable the grading of output
- Facilitate the synergism of multi-dimension criteria so that two "bad" lots could be ultimately combined to form one large "good" lot
- Make it easier to conform to regulations
- Have better control over incoming raw materials

Total Quality Management implies that the organisation as a whole assumes responsibility for quality, which must come first, before short-term profits. This means planning and designing for quality, preventing and correcting defects and continuously striving to increase quality. Traditionally, the focus was on corrective controls as opposed to getting it right the first time. A table delineating the major differences between traditional and total quality control has been compiled and is shown in Figure 2-2 below.

TRADITIONAL QUALITY	TOTAL QUALITY
♦ Screen for Quality	♦ Plan for Quality
♦ Quality is the responsibility of the quality control department	♦ Quality is everybody's responsibility
♦ Some mistakes are inevitable	♦ Strive for zero defects
♦ Quality means inspection	♦ Quality means conformance to requirements
♦ Rejects are the major costs of poor quality	♦ Rejects are only a small part of the costs of non-conformance
♦ Quality is a tactical issue	♦ Quality is a strategic issue
♦ Quality focuses on just the product and/or service	♦ Quality permeates throughout the entire system

Figure 2-2: Differences Between Traditional and Total Quality

However one chooses to define Total Quality Management, be it a singular phrase or a combination of the above, research has shown that to try and pin a label on TQM may not do justice to its role in business. Later, this report demonstrates that there are different angles from which to approach, implement, measure and evaluate Total Quality Management, each with its own merits and each warranting appropriate circumstances. Total Quality Management is not a technique but a philosophy, one that must drive the quality and not just accompany it.

2.7 Evaluating the Success of TQM

There continues to be an increasing amount of evidence of quality initiatives that are defective or have failed completely. Baldrige award winners have found themselves entrenched in financial difficulties not long after victory, perhaps because of the overwhelming concentration of company resources required for successful participation which meant diverting attention from improving quality to winning the award. Since the explosion of the concept of total quality onto the business scene, some twenty-five years ago, there have been numerous attempts to implement various total quality control philosophies and discover the ways to measure their respective success.

Ranganath Nayak, who heads the world-wide operations management practice at Arthur D. Little Inc., a consulting firm out of Boston, Massachusetts, estimates that in the last decade over $800 billion has been spent in capital investment and about $150 billion in worker training resulting in only paltry returns (Naj, 1993). Two surveys by the American Electronics Association (Pittiglio et al., 1992a; 1992b) revealed that the percentage of members with Total Quality Management programmes dropped from 86% in 1988 to 73% in 1991. A reduction of internal defects by more than 10% could not be achieved by 63% of companies with Total Quality Management programmes and 80% of them failed to reduce supplier defects by 10% or more.

Electronic Business Magazine (Baatz, 1993) reported that only 16% of their executives said their quality programmes brought them a higher market share and a mere 13% said their quality programmes brought higher operating income and profits.

Arthur D. Little, summarised findings from 500 executives of U.S. manufacturing and service organisations (Poe and Courter, 1992) by stating that "only one-third believe their Total Quality Management efforts made them more competitive." Since Deming's assertion was that quality paves the road to being more competitive one can hardly call these programmes a success even if quality and productivity were improved.

How would Total Quality Management perform if it were to be graded? A report card (Romano, 1994) was issued by Management Review and the results follow:

> "The trouble with Total Quality Management – failure of Total Quality Management, you call it – is that there is no such thing. It is a buzzword. I have never used the term, as it carries no meaning."
>
> *W. Edwards Deming, Ph.D*

> "Sometimes people talk about quality as if it is some kind of abstraction, something different from the normal job."
>
> *Lewis E. Platt, CEO*
> *Hewlett-Packard Company*

"TQM is not a destination it is a journey. It is a cycle of constantly changing yourself to respond to internal conditions and these are natural cycles we are not paying attention to."

Michele Hunt, Director
Federal Quality Institute

"The most frequent reason for the failure [of quality programmes] is the failure of upper management to have personal involvement, as Robert Galvin [of Motorola] and Roger Milliken [CEO of Milliken & Co.] did."

Joseph M. Juran, J.D.

"When Total Quality Management programmes fail, it is because they are mounted as programmes, unconnected to business strategy, rigidly and narrowly applied, and expected to bring about miraculous transformations in the short term without top management lifting much of a finger."

Rosabeth Moss Kanter
Professor, Harvard University

Many of the aforementioned problems result from cultural and work ethic differences from Japanese counterparts. Furthermore, even those companies desirous of practising Total Quality Management are not aware of the framework under which Total Quality Management operates and how it relates to the company in question.

Of particular importance is the realisation that it is necessary to ensure that each managerial technique becomes the driving force that propels quality into the forefront. All too often, good ideas are introduced and are doomed to failure because they are appendages to, rather than driving forces behind, quality.

Initial research indicates that much of the blame for the failure of Total Quality Management programmes lies with the managers who possess

- a very limited understanding as to what Total Quality Management really implies,
- invariably flawed implementation procedures and,
- an inability to measure performance in a manner consistent with the Total Quality Management objective.

Furthermore, the establishment of a Director of Quality or even a Quality Department is inimical to the idea that total quality involves quality infiltrating into all aspects of the organisation, becoming everyone's responsibility and, ultimately, quality taking its place as the cornerstone of strategy and operations (Harari 1997). It has even been shown (Tatikonda and Tatikonda, 1996b) that the bureaucracy created by the establishment of a TQM unit and/or a Manager in charge of quality has been the very reason why Total Quality Management has failed to improve profits.

This classic mistake is best illustrated by the attempt to establish a total quality department at Smith Barney. The person appointed as supervisor of the new programme and responsible for its implementation had, by his own admission, “not much idea of what [he was] doing,” and wanted to know how to “get everyone to do it.” This recipe for failure was further confirmed by his responses to the survey he was asked to fill out.

The use of buzzwords and other clichés such as empowerment, continuous quality improvement, customer focus, benchmarking, downsizing or rightsizing, has served only to foster a feel-good spirit without instilling the fully-fledged commitment required to make the initiative a success. Very little, if any, effort has been made to establish appropriate criteria (Schmahl et al, 1997) for measuring the cost of quality nor has there necessarily been an earnest attempt to measure or even report the cost of quality (Tatikonda and Tatikonda, 1996a). The result has been to adversely affect corporate profits thus damaging TQM's credibility. This has, in turn, led to the abandonment of Total Quality Management. Since “programmes” can simply be replaced, new ones such as Continuous Quality Improvement, Business Process Reengineering or whatever is currently popular, have surfaced as alternatives. It is crucial that Total Quality Management not be treated as a program containing a methodology but rather as an organisational initiative to be adopted and practised, totally, by all constituents of the organisation (Jocou, 1996).

Other recent surveys have demonstrated that, of the individuals and/or companies practising what they believe to be TQM, many do so without really knowing or understanding the dynamics. Additionally, ignoring the presence of intangibles and embarking on quality initiatives that receive only a lukewarm commitment from top management (Powell, 1995) have been crucial factors which have led in many cases to the failure of Total Quality Management programmes. As such, the inevitable failure of the quality system cannot be deemed a vilification of Total Quality Management.

As a result of a survey conducted by A.T. Kearney (1993) in association with The TQM Magazine, it was discovered that companies that have been successful at Total Quality Management share four common characteristics:

- An emphasis on tangible results
- An insistence on performance measurement
- An integrated programme
- A clear commitment from top management

Harari (1997) asserts that the conclusion to be drawn from independent research conducted by Arthur D. Little, Ernst & Young, Rath & Strong, McKinsey & Co, and A.T. Kearney is that, at best, only one-third of Total Quality Management programmes in the United States and Europe have achieved significant or even tangible improvements in any of the major areas in which business performance is measured.

2.7.1 Measurement of Quality

It is difficult to manage that which cannot be measured and it is almost impossible to measure that which cannot be defined. Various definitions have been offered earlier in this chapter culminating in a suggestion (Tamimi and Sebastianelli, 1996) that quality must be defined, and thus measured, from different perspectives depending on what stage in the raw materials to end user process one is examining. This would seem to concur with the premise of this thesis, which seeks to establish inventory management and performance as a prime indicator of quality. Inventory performance affects not only the raw material stage and work in process but also it has a profound impact on the firm's ability to deliver acceptable products to the consumer in a timely fashion.

Inventory performance is clearly measurable and sound process measures provide an indication of where continuous improvements can be made (Owen et al., 1993). Erroneous measurement or lack of measurement has been linked (Tatikonda and Tatikonda, 1996b) to the failure of Total Quality Management programmes to generate increased profits. It is, therefore, appropriate that future research should specifically concentrate on quantifiable ways of measuring the level at which Total Quality Management initiatives function.

Accepting the fact that performance measurement can be defined as "the process of quantifying the efficiency and effectiveness of action," (Neely et al., 1995) it is appropriate to consider various other approaches taken in an attempt to use more than just traditional financial measures of performance.

Several methods for measuring quality have been developed since the Develin and Partners report in 1989, which revealed that there was no means of identifying and certainly not measuring tangible results. Since then, measurement attributes have ranged from strict financial performance ("hard") to people satisfaction ("soft"). Stone (1997) traces the progression of key studies on the hard and soft issues starting with the GAO study in 1991, which focused on objective results ultimately spawning the Bradford Study (Oakland et al., 1993), along with the A.T. Kearney (1993) study that emphasised tangible results to the 1994 Vauxhall and Management Today Study (Heller 1994) that used soft measures but not employee-related ones and finally the Wilkinson, McCabe and Knights (1995, 1996) survey that included employee related factors.

2.7.1.1 The Balanced Scorecard

Perhaps the most influential attempt to integrate soft and hard issues into a combined measurement technique was the introduction in 1992 of the Balanced Scorecard. Having found that senior executives tend not to rely on one set of measures to the exclusion of the others, Kaplan and Norton (1992) devised a balanced scorecard, which provides managers with a "fast but comprehensive view of the business."

As depicted below, the scorecard looks at four important elements of the business in an effort to answer four basic questions that provide the manger with four key perspectives. Much as a pilot cannot afford to rely on one instrument alone but must use all the detailed information provided to him by the various instruments, so too must the manager use a holistic approach in an attempt to benefit from indicators that are not traditionally combined.

Although it has achieved some popularity, the balanced scorecard has been criticised for being too simplistic (Brignall, 1992) and inadequate (Ballantine and Brignall, 1994) in terms of meeting the criteria for a performance measurement system. Of particular concern to this thesis' perspective of total quality management in the current business climate, is its failure to incorporate external perspectives as confirmed by Neely et al., (1995).

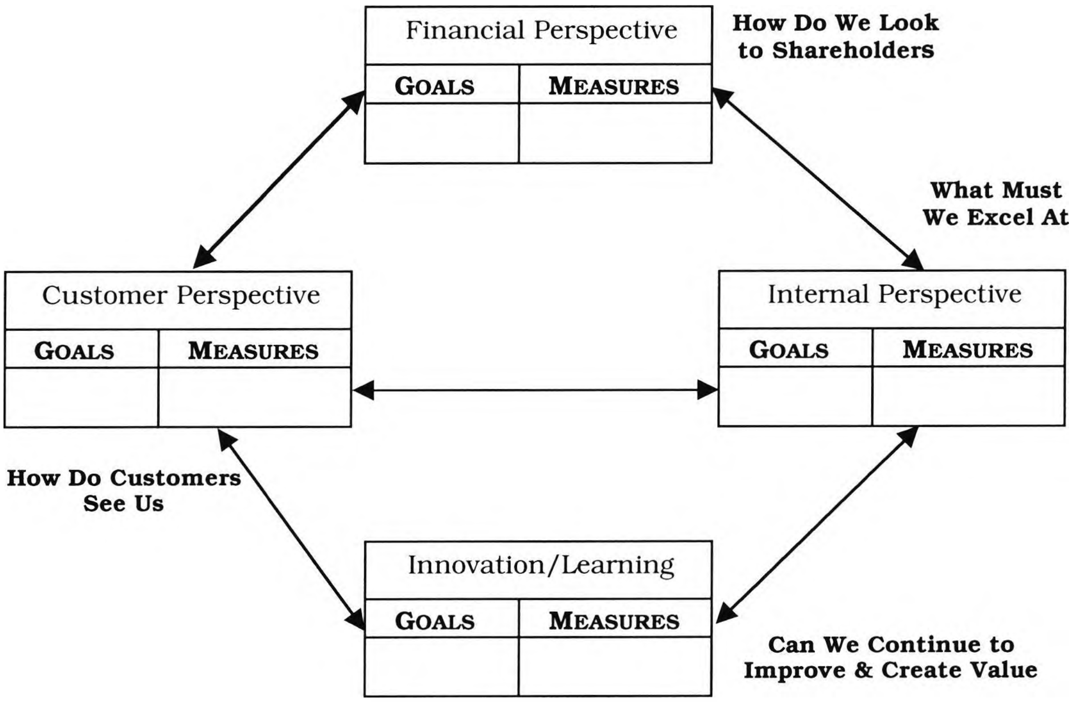

Figure 2-3: The Balanced Scorecard

Source: (Kaplan and Norton 1992)

2.7.1.2 Quality Models

As the need to assuage both the forces requesting more "hard" measurement attributes and the ones insisting on the inclusion of "soft" issues became more urgent (Wilkinson, 1992) quality models evolved. Their purpose was to offer a means by which organisations could evaluate their quality management performance using a self-appraisal methodology. The European Foundation for Quality Management Self-Assessment framework also known as the European Business Excellence Model measures success by examining nine key components in the organisation which are divided into two groups, "enablers" and "results." The enablers on the left side of the model are driven by the leaders and they will, in turn, produce results. By using benchmarks of published best practices a company can measure itself and determine where its strengths and weaknesses lie.

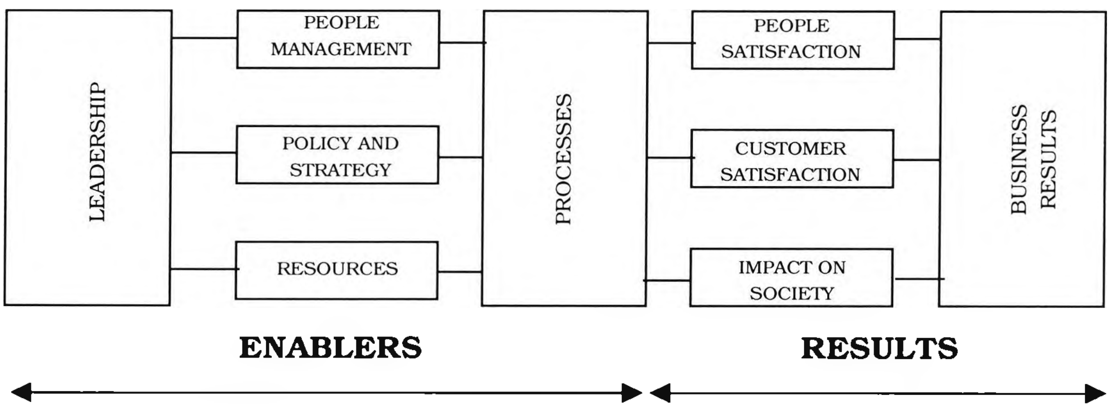

Figure 2-4: The EFQM Model

Source: (Chelsom, 1998a)

The EFQM model is commendable in that it finally provides a formal technique for measuring an organisation's progress toward total quality. Moreover, it seeks to encourage a quantitative evaluation of employee's views and attitudes. However, "there is little mention of the supply base and the external customer, and the interactions between them," state Chelsom et al., (1998). Any feedback from customers and/or suppliers is lumped into the policy and strategy component, which is clearly insufficient when considering the significant role that they play in the inter- and intra-organisational information partnership.

As Chelsom et al., (1998) comment, "...[this model] fails to recognise the full potential of the supply base as an enabler to provide current results...or future benefits through the feedforward of new knowledge."

2.7.1.3 Conclusion

This thesis analyses inventory performance, a criterion discovered to have significant potential and which has heretofore been relatively unexplored in its capacity as a possible predictor of a strong and effective total quality programme. It is representative of the previously established necessity of analysing, evaluating and measuring aspects that are affected by the system as a whole since total quality itself is only truly present and effective if it infiltrates all facets of the organisation. In contrast to the EFQM model and the balanced scorecard it does address external factors and it will reflect the presence of feedforward and anticipation in the system. Evidence of superior inventory performance will be found in participants external to the organisation such as suppliers and customers. If the hypothesis proves successful, the conclusions would also meet the criteria of successful Total Quality Management companies as outlined above in the A.T. Kearney (1993) survey. Moreover, the use of inventory performance as a measurement model is a novel approach designed to encourage an organisation to try new, more effective methods as opposed to simply improving existing ones.

2.8 Discussion and Summary

This chapter examined the roots of quality control from the turn of the century until the modern day in order to better define and understand the primary factors that generate quality. Tracing the development of quality control from an isolated input into the production model to its current position as an integrative philosophy that permeates throughout all facets of the organisation has served to confirm the need for a more comprehensive approach to the quality function. Techniques suggested by the leading quality gurus such as, Feigenbaum, Crosby, Deming and Juran have been adopted and applied, yet the results have been far from the outstanding successes predicted. Most programmes were ineffective and in many cases financial and/or business performance at best showed no significant improvement and often deteriorated.

Much of the blame for the lack of success can be attributed to an inability to appreciate the true meaning of total quality and a failure to understand what the implementation of a total quality programme really entails. Simply adopting the trimmings of a total quality technique through the creation of slogans or cliché such as TQM, CQI, BPR or Benchmarking while ignoring the essence of the philosophy have led to failures which, in turn, generated serious criticism of quality initiatives. A review of the literature indicates that the criticism of the initiatives may indeed be legitimate but that the initiatives in question have not met the criteria, as this thesis defines them, for being called total quality programmes. As such, the condemnation is of the <u>initiative</u> and <u>not</u> of the <u>quality</u>. This would also help explain why there continues to be a vilification of innovative ways of improving manufacturing and service quality. The exchange of one buzzword for another, one executive title for another or one department label for another not only does not address the underlying problem - a misunderstanding and misapplication of the quality concept - but it actually impedes its correction.

A further problem discovered in the literature and in some exploratory research was the discrepancy between a company's self-image regarding its commitment to quality and what was actually taking place. This was best illustrated by the surveys distributed to Aurora International and Smith Barney & Co. The desire of Smith Barney's Director of Quality to involve outside consultants, something which was clearly inimical to the Japanese firm's philosophy, indicated neglect of the "total" element of quality: all the employees have to be involved all of the time. His primary day-to-day concern being fear of a sexual harassment suit as opposed to failing to meet a customer's expectation as stated by Aurora's CEO was indicative of his misunderstanding of how total quality infiltrates and dominates all operations, including day-to-day activities. It is ironic to note that shortly after this questionnaire was conducted, Smith Barney were the defendants in a major sexual harassment lawsuit which, reported Barry Wigmore in an article in the London Times (1997) culminated in a $162,000 award to the plaintiff in December 1996.

Smith Barney perceived itself as having a strong and aggressive total quality programme using a variety of Japanese quality management techniques. Aurora International, by contrast, was not familiar with the buzzword terms and therefore claimed not to practice them. It was quite evident, however, that the company had inculcated all the concepts and operational aspects of a total quality philosophy in the way the firm conducted its business. The literature is replete (e.g. Nyerges, 1996; Genasci, 1994; Buzzell and Gale, 1987;) with cases of decision makers who do not comprehend the principles of total quality and are not sufficiently familiar with the processes required to implement an effective programme. At least the Smith Barney representative was able to admit that he was out of his depth.

Another attempt at disseminating quality was the establishment of Quality Awards such as Malcolm Baldrige, and the European Quality Award which have motivated corporations to adopt quality programmes. While theses awards have received mixed reviews it seems clear that business performance has not improved significantly as a result of victory. Quite often the resources expended in the pursuit of the award exceed the benefits and the focus on winning diverts attention from the real goal – enhancing quality. Given research findings to date, it would be extremely difficult to equate the winning of awards with the presence of a comprehensive total quality programme. At best, it would seem that the winning of awards merely indicates that one component, albeit an important one, of the quality process is present, namely management commitment.

A review of the literature and current methodologies in use suggested that it would be beneficial to develop quantifiable performance measures that will clearly indicate the existence of a superior quality programme. It is evident that factors which are currently considered as influences on the systems perspective way in which total quality is now viewed, are being ignored or under-represented by traditional measures of quality. Accordingly, the research will be directed in a manner such as to harness new technologies and insert them as an ingredient in the system. This will facilitate the development of a measure of quality that can accommodate current system components and newly developed components in the future. Additionally, it is apparent that unless the company can demonstrate a measure of financial success and positive tangible results then the implementation of a rigorous and costly quality programme may not be warranted.

From the foregoing assessment of total quality initiatives it can be deduced that it is necessary to look for other determinants of total quality and this has motivated the further research undertaken in this thesis. The objective of the research is to find performance factors that indicate the presence of a total quality programme that is system-wide, yields superior financial performance and is quantifiable. To that end, this thesis explores a number of factors but primarily focuses on inventory performance. The next chapter presents an overview of inventory management, its relationship to the total quality concept and the reasons why it is likely to be an excellent candidate as an indicator of total quality.

CHAPTER THREE

3.0 INVENTORY MANAGEMENT

3.1 Introduction

The previous chapter established the need for more reliable indicators of the presence of total quality and a more effective technique for measurement. In an effort to better understand inventory performance and its potential relationship to total quality a review and analysis of the existing literature is provided. This chapter explores the area of inventory control, its relationship to quality and productivity, and some approaches to performance measurement. Inventory Performance and Total Quality are explored as interdependent components in a system approach which is required to have an effective and successful total quality programme. Traditional inventory control is examined and particular attention is paid to Japanese inventory control systems, such as JIT, that seek to minimise or eliminate inventory because successful operation at low levels of inventory requires an unwavering commitment to zero defects, the cornerstone of a total quality programme. Moreover, previous attempts to affiliate inventory performance and total quality are discussed in as much as they have provided an initial basis for the development of the research.

3.2 Understanding Inventory

Inventory may be said to be the stock of any item or stored resource that is used to satisfy a current or future need. Some of the primary purposes for keeping inventory are to promote:

- Customer service
- Manufacturing flexibility
- Certainty in production/operations
- Production smoothing
- Profits through price speculation

There are four kinds of physical inventories:

- Raw materials
- Work-in-process
- Finished goods
- Maintenance, repair and operating supplies

Inventory control models assume that demand is either dependent or independent. Dependent demand means that the demand for Item A is related to and dependent on the demand for Item B. When the demand for an item is unrelated to any other items it is said to be independent. The major issues addressed by inventory control so as to minimise total costs are: how much to order, how often to order and when to order.

3.2.1 Traditional Inventory Systems

While holding inventory serves to protect companies against the potential hazards enumerated above it nonetheless costs money to carry the inventory. These costs are known as *holding costs* and they are made up of a combination of insurance premiums, opportunity costs of money tied up in inventory, warehousing costs, taxes, obsolescence and spoilage. Carrying costs are expressed either as a percentage of the average dollar value of inventory in stock or as a fixed cost per unit depending on what is appropriate for a given situation. In addition to holding costs there are also *ordering costs*, which are essentially the costs of processing the order. These may involve the costs of forms, clerical time and handling supplies. If the items are to be manufactured then ordering costs are termed *set-up costs* and include the costs of preparing the plant, machinery and tools for production.

By reducing ordering or set-up costs a manager can develop a more cost-efficient inventory policy. Furthermore, there is very often a strong correlation between *set-up time* and *set-up costs.* A reduction in set-up time will, in such cases, improve the performance of the inventory control system.

3.2.2 Just-In-Time Inventory Systems

Just-in-time inventory is the smallest amount of inventory that is required to keep the process operational. The JIT approach regards any levels of equipment, materials, labour, space or other resources in excess of what is needed to produce the goods and services as being waste (Dar-El, 1997) and therefore, a goal of JIT would be (Hernandez, 1989) to eliminate waste. Instead of having stock on hand, the materials/work-in-process/finished goods arrive just when they are needed, in exactly the right quantity and, states Schniederjans (1993) at the minimum cost. In most traditional cases inventory is accumulated in order to protect against variability in the system. Variability is caused by several different internal or external factors and traditionally manufacturers stockpiled work-in-process inventories so that production would be able to continue even if there were no raw materials delivered or there was some other down-time in the manufacturing process. The major characteristics of JIT are that it is demand driven and it minimises both production lead-time and all types of inventory holdings

3.2.3 Roots of JIT

It was common belief that variability in the system would be caused by the production of inferior units, incorrect quantities, untimely deliveries, poor forecasts of customer demand, inaccurate specifications or technical data provided by engineers, or an attempt to produce without the complete set of information required. Since inventory provides a buffer against these unexpected variations it was traditionally accepted to keep sufficient inventory and try to economise by balancing set-up and holding costs.

Japanese managerial analysis discovered that inventory tends to either hide problems (variability) that keep recurring or, at best, minimise the severity of those problems. The excess inventory required to maintain the buffer presented an enormous increase in holding costs. The need to try to reduce or eliminate this variability, which, in turn, would obviate the need for inventory became increasingly important. Since it was apparent that most variability was caused by either poor management or waste, they proceeded to develop programmes for curtailing that waste and improving management. One such programme is the concept of JIT.

As was stated earlier, the expanded concept of total quality requires examination of factors from a systems perspective. Accordingly, all components of the general, internal and operating environments should be considered since they all will, ultimately, have an effect on the final quality level. This should include an analysis of labour relations, skill level of personnel, reliability and/or failure rates of equipment, inbound/outbound logistics, communication channels, flow of information and congruity in capacity.

In actuality, successful operation of JIT inventory system will depend on a strong presence of total quality, not only inherent in the traditional factors but in all aspects of the system. It is precisely this premise which forms a basis for the research to determine that superior inventory performance will be a definitive indicator of the presence of a successful total quality programme.

3.2.4 Implementing JIT

In order to obtain raw materials on a just-in-time basis it is crucial to minimise the variability factor. This means that suppliers must meet certain criteria. Since JIT relies upon frequent deliveries it is essential to have suppliers located nearby who have the ability to deliver often. Additionally, those suppliers must produce and deliver only first class quality materials because there is no inventory to fall back on should an item be defective. Furthermore, the suppliers must have the capacity to produce the required quantities in the allotted time frame. It is a common misconception that Just-in-time involves merely the elimination of raw material inventories from the user plant. If these actions necessitate that the supplier holds the extra inventory in order to meet user quantity requirements then the total system cost incurred is unchanged. The objective is to train suppliers in Just-in-time concepts so that every supplier, in turn, may be able to operate on a Just-in-time basis thus removing the inventory from the flow of materials. If the inventory is truly eliminated then no holding costs are present for anyone in the chain to pay.

Work-in-process inventories accumulate due to production time. At each stage in the process there may be some lead-time before production can continue. This in turn can create some bottlenecks, which are alleviated by using stock as opposed to waiting for the item to arrive from the previous stage. Closer analysis reveals, however, that a majority of the process time is, in fact, spent idle waiting to enter the production run. Accordingly, if one were to shorten the cycle time and the set-up time, one could reduce work-in-process inventories.

3.2.4.1 JIT at General Motors

It is very common to see JIT at work in auto manufacturing. Entire rooms, which were used to store foam, fabric, nuts and bolts, frames, and motors for car seats now, lie totally empty. Lear Siegler, located in Romulus, Michigan is the sole supplier of seats for General Motors' Willow Run plant fifteen miles away. When GM ascertains that it will require seats it notifies Lear Siegler electronically about four hours before assembly as to the colour, style, options and quantity it will need. Lear Siegler then assembles the seats and loads them onto special trucks in reverse order so that when they arrive at Willow Run the seats are unloaded in the exact sequence they are needed for assembly. As a result of this relationship GM has all but eliminated its seating inventories and has a dependable supplier nearby. Although Lear Siegler has to dispatch a truck every hour and has a very narrow time frame it has, in GM, secured a valuable customer that places steady orders. Consequently, Lear Siegler has been able to trim its inventory by 80%. Another important feature of this JIT relationship is the use of electronic notification. This significantly reduces the set-up costs that would otherwise make frequent deliveries prohibitive (Raia, 1988).

3.3 Impact of JIT on Quality

Finished goods inventories are items which have been completed and are awaiting shipping to the next stop in the distribution channel be it a wholesaler, distributor, retailer or an end-user. It is equally important for the company to be able to deliver to its customers (the next entity in the channel of distribution), on a just-in-time basis thus avoiding the accumulation of finished goods inventory. Customer satisfaction, however, can only be achieved if JIT operations integrate their production processes with their quality control processes to ensure that there are no defective items. Successful accomplishment of supplying one's goods on a just-in-time basis is also dependent on the development of enhanced relationships with one's customers coupled with an acute understanding that JIT only works if it is approached from a systems perspective. It is vital to appreciate that company A's customer is company B's supplier. Consequently, unless everyone in the system applies JIT concepts, operates on a just-in-time basis and works in harmony to reduce or eliminate the inventory in the entire system, then the ability for any firm in the system to operate on a just-in-time basis is severely compromised.

Ideally, problems can be identified by analysis and resolved by asking why inventory is being held at a particular point in the system. However, on occasion, a diminution of inventory, intentional or not, will cause problems (variability) in the system to manifest themselves. Only when each layer's problems are eventually dispensed with can a JIT system be implemented. JIT typically requires a good deal of time, effort and investment to decrease set-ups, ensure a balanced line and deal with random fluctuations (Giauque and Sawaya, 1992), so not all companies are suited for JIT.

Scrap, rework, investment and damage costs comprise much of the total expenditure required to maintain and upgrade quality. These factors are directly related to inventory on hand and, therefore, JIT can cut the costs of quality. Furthermore, JIT can help improve quality. As JIT reduces lead-time it can provide indications of new problems as well as limit the number of potential sources of errors. Moreover, since having reliable and/or certified suppliers within close proximity is a prerequisite for JIT, the respective co-operation between the suppliers' and manufacturers' quality control personnel serves to increase the overall quality infused into the production process. Reciprocally, world class quality throughout the system is essential for running an efficient JIT system. This reciprocal relationship means that suppliers, and indeed all participants, must be involved in the design and development of JIT and TQM and their related concepts. JIT, by definition, does not allow for the extra inventory often held to protect the company from variability in quality. Consistent system-wide quality, therefore, enables a JIT system to operate efficiently and can allow for the elimination of physical inventory.

3.4 Inventory Performance and Quality

All too often, companies stress performance in areas that are counterproductive to the TQM strategy they espouse. US Air achieved high customer satisfaction due to their timeliness but continuously stressing on-time performance has led to serious safety concerns. Certainly, it did not emphasise zero-defects. A study by Daniel and Reitsberger (1994) found that U.S. electronics managers have adopted zero-defect philosophies more fervently than the Japanese, however, they do not receive much management control information to support those strategies. Japanese managers are provided with goal setting and feedback information about quality performance regardless of the strategy, thus focusing workers' attention on CQI.

3.4.1 Performance Measurement

The A.T. Kearney (1993) study cited previously, discovered that companies which practise Total Quality successfully share four common characteristics, one of them being an insistence on performance measurement. However, it has not been easy to quantify data that decisively reflects on quality since much of the research has been based on executive perceptions or has been descriptive in nature. Typical objective measures of quality have included an analysis of the percentage of products that pass final inspection without rework but a study (Schroeder et al., 1992) clearly revealed that there was no statistically significant difference in the percent of products requiring rework between the participants. The Olsten Forum (1994) concluded that there are various types of quality programmes, customer service, product, internal staff and vendor quality each of which warrants independent goals and different measurements of performance.

3.5 Suppliers and Quality

Successful implementation of JIT or even operating with low inventory levels requires a relationship with several quality suppliers. Dependence on incoming raw material inspections, as is the case traditionally, is not adequate since rejections or defects, even if detected immediately, will halt the production process since there is no inventory from which to find a replacement. Many companies adopting JIT have instituted rigorous procedures for the certification of qualified suppliers. The basis for granting certification is not price but rather quality and reliability. The advantage to suppliers in achieving a dependable customer warrants them investing more money in the pursuit of quality and zero defects. This quality is, of course, transferred to the manufacturer product through the raw materials and ultimately injects more quality into the final product.

Current analysis concludes that suppliers must be regarded as much more than providers of incoming materials. It is argued, (Chelsom, 1998a, Chelsom et al., 1998) that suppliers need to be involved in the design of the product, the various strategic stages of the firm's production process, and the provision of innovative, technological tools. The extent of the suppliers' involvement and their interest in the clients' success ensures that only first class materials are despatched which eliminates the need for the inspection and testing of incoming materials. These concepts are discussed in greater detail in the next chapter and are illustrated in Figure 4-6 on page 106.

A key error in failing to understand the expanded role of suppliers was made by Boeing. Having established a working relationship with a group of quality suppliers, Boeing proceeded to try to impose onerous terms on them, which led to production problems. The Times (April 10, 1998) reported that Boeing announced it will be taking a $350 million charge in the first quarter of 1998 after having posted a 1997 loss of $178 million.

General Motors, which managed to establish an extremely successful Just-In-Time relationship with its supplier Lear Siegler, subsequently demonstrated that it failed to understand the integrative role of its suppliers. Recently it disclosed sensitive information obtained from its suppliers to other competing suppliers in a move to lower prices. The result, says Harari, (1997) will likely be manifested in inferior quality of future GM products.

In early 1998, GM succeeded in undermining its own employees by taking away business from subsidiary plants and outsourcing it to independent plants. These capricious attitudes created distrust and alienation among GM's suppliers and employees. Section 4.4.2 elaborates on GM's shortsightedness and the resulting industrial action taken by the union.

3.6 Inventory, Productivity and Quality

As mentioned previously, inventory was used primarily as a buffer to protect against variability in the system. Since the manufacturing system is essentially configured in series, a failure at any point in the production line would cause the entire system to stop functioning. In order to ensure that production could continue in the event of a breakdown early in the system, significant amounts of work-in-process inventory would be accumulated. It has been shown that this only serves to hide the real problem, which is the fact that failures occur. A firm can expose these problems and correct them thus eliminating the need for inventory.

For a company to operate with minimal inventories it must be able to guarantee quality for every component in the system. This includes people, materials and workmanship. As would be expected, a JIT system can only be effective if the highest standards of quality are adhered to. The by-product of minimising inventory and enhancing quality is increased productivity.

If productivity is defined as the "ability to produce abundantly,"(Random House Dictionary, 1992) then every company must certainly try to avoid waste. Inventory can be considered waste in that it wastes space, money and time. Motion that does not add value to a product is waste (Owen, 1990). An essential requirement for both lowering costs and producing at a high level of quality is the elimination of waste (Woodruff, 1996). The source of any waste can and should be identified and categorised and the cause must be determined and eliminated. Employees are an integral part of waste reduction and the knowledge that there is no buffer to fall back on encourages a worker to be more careful not to produce a defective item.

It is interesting to note that Japanese firms do <u>not</u> emphasise productivity. In fact, writes Sullivan (1992), "according to Japan Productivity Center data, U.S. manufacturing labour productivity is about 42% greater than that of Japan. [What keeps costs down is] clever inventory management." The study (Schroeder et al., 1992) cited previously confirms that productivity is highest in traditional US firms when compared to US "World Class" firms and Japanese transplants.

Having established that productivity implies eliminating waste, and waste is defined as that which cannot be sold, then the key gauge of productivity is manufacturing non-defective units. Before JIT systems, defective products would be replaced from inventory but because JIT does not allow for inventory on which to depend, it is vital to "get it right the first time." Thus, waste removal engenders quality. Perhaps we should now view productivity in terms of producing items that do not require any corrective controls. Stated succinctly, one saleable item is more "productive" than two unsaleable items.

At Mack Trucks, total quality was used to eliminate hidden waste within the company. By using personnel previously involved in sales marketing, engineering and manufacturing, they were able to cut delivery times in half. Simply put, reengineering, JIT and activity based management are all tools for eliminating waste and come under the umbrella of Total Quality Management, (Jocou 1996).

Stepping up the pressure on workers by removing inventory buffers plus affording them greater autonomy through empowerment will improve productivity. "It is agreed," as William Hakanson (1994), executive director for the Manufacturing Execution Systems Association put it, "that given greater accountability, workers will also become more productive."

Two studies (Kendrick, 1993), one by Becker and Golomski, of 30 companies that have adopted the TQM philosophy for an average of 6-1/2 years, and one by BDO Seidman involving midsize companies, were able to link an increase in productivity to TQM. Becker and Golomski noted that given the empowerment effects that Total Quality Management generates, organisations should be able to increase output with the same number or fewer people. The BDO Seidman study revealed, that quality programmes, training and management information systems were reported by middle market business owners to be the main reasons for increased productivity in the previous year. The distinctive relationship between quality and productivity, as defined by Garvin (1984), can be seen below.

The conclusion to be drawn is that the Japanese focus seems to be on quality, waste reduction, superior inventory management, flexibility and service. Once those are taken care of, productivity will take care of itself. Furthermore, the relationship between inventory management and total quality management is strong and vital. As a recent survey (Withers et al., 1997) demonstrated, the success of each is enhanced by their joint implementation.

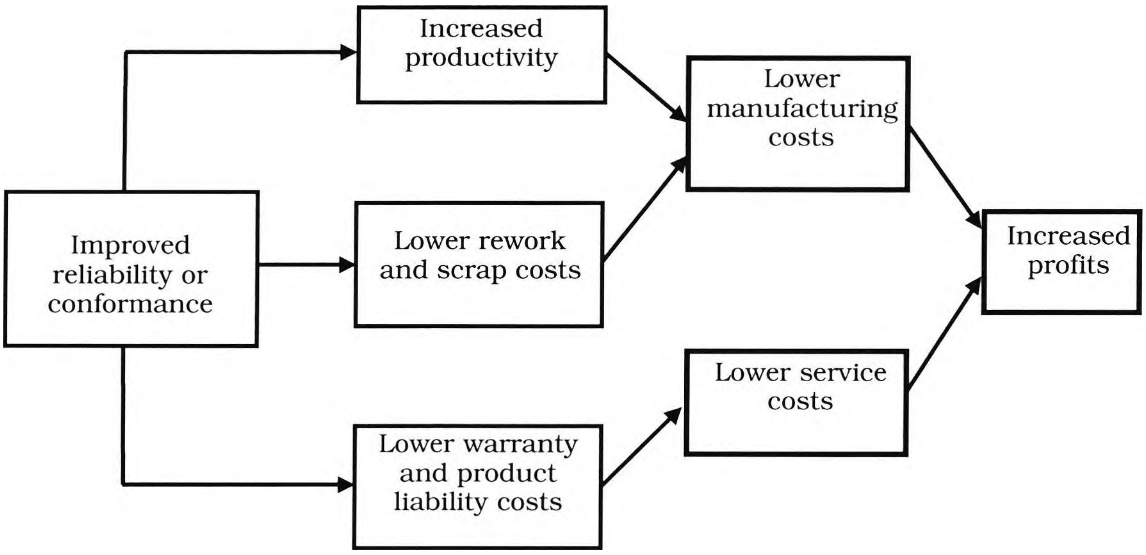

Figure 3-1: Quality and Productivity
Source: (Garvin, 1984)

3.7 Discussion

It has been established that there has been and continues to be a close relationship between effective inventory control and premium quality. A study by Mack and Jordan (1994), analysed inventory performance and clearly outlines quality problems as a reason for driving up stocks of inventory. In fact, JIT can only work efficiently if total quality is present. However, although JIT often accompanies TQM, it may not necessarily be a requirement. Accordingly, it would seem prudent to explore inventory levels, turnover and inventory turns in an effort to determine whether they are, indeed, predictors of the presence of total quality.

Inventory performance has been selected as a measurement gauge since it has already been established that the Japanese control their inventory in a decidedly better manner (Schroeder et al., 1992). Earlier in this thesis it was asserted that definitions of quality and, by implication, measurement techniques could change depending on what stage in the production model, input, transformation or output, the company was examining (Tamimi and Sebastianelli, 1996). Inventory performance can be quantifiably measured and superior inventory management must affect all phases of the production model, from raw materials to end-user delivery. Moreover, as a result of keeping low or zero inventory levels, quality suppliers must be used which in turn enhances the quality of the item manufactured. In order to develop quality suppliers, in addition to producing a quality product, they must be further educated in the principles of JIT and introduced to the system concept. Their role as a component of a total system must be clearly demonstrated to them. Functionally speaking they should be located in close proximity, be able to make frequent deliveries and have a superior communications system, preferably EDI. Thus it would appear that the corollary of the assertion "in order for JIT to work there must be total quality present," is "effective inventory control also signifies the presence of TQM."

3.8 Summary

This chapter explored the concept that there is a relationship between inventory management and quality and, more specifically, between <u>superior</u> inventory management and <u>total</u> quality.

To better understand inventory management, a background was provided. Traditional inventory control methods were reviewed followed by an introduction to the concept of a Just-In-Time inventory system. Since it will be argued that the Japanese approaches to inventory (JIT) and quality (TQM) are uniquely related, a more in-depth discussion as to the roots of JIT and the requirements for implementing JIT was presented. The subsequent section examined the impact JIT has on quality and the need for total quality to be present throughout the organisation if JIT is to be implemented successfully.

The relationships between inventory performance and quality, and suppliers and quality were reviewed and established as being significant. This, plus a further review of the literature, led to the conclusion that there is a three-way relationship between inventory, productivity and quality.

The background information and literature review provided in this chapter were designed to identify and clarify the role of inventory management in the organisation. This thesis has hypothesised that there is a special relationship between inventory and quality to the extent that it may be possible to measure the presence of total quality in the organisation by investigating its inventory performance.

Previous studies and writings have confirmed the assumption, that lean inventory and especially JIT is inextricably linked to total quality. However, it remains to be seen whether inventory performance alone is sufficient to gauge the level of Total Quality Management at which a firm is operating.

The next chapter expands upon the issues in this chapter and the previous one by linking total quality and inventory management in yet another province. The material contained in these chapters implies the theme of a system-based approach to both total quality and JIT. In keeping with the current thinking, which treats the entire organisation as a dynamic system, it has been crucial for this chapter to discuss the relationship between suppliers and quality, and inventory, productivity and quality. If it can be established that total quality and superior inventory management operate as interdependent systems within the organisation-wide system, then it can certainly be argued that inventory performance should be a good indicator of the presence of a flourishing total quality programme.

CHAPTER FOUR

4.0 THE SYSTEMS APPROACH

4.1 Introduction

This chapter deals with the increasingly apparent requirement that the organisation and its functions are viewed from a systems standpoint. In Chapter Two it was demonstrated that the failure of total quality management could be attributed to the inability of management to install the kind of programmes which ensure that quality infiltrates all aspects of the organisation. In other words, quality must be present system wide. In Chapter Three the effects of inventory management on the operations of the entire organisation were examined and it became evident that successful inventory control necessitates the implementation of superior quality techniques at each stage in the system. The relationship between inventory management and total quality management was established leading to the conclusion that Just-In-Time or superior inventory management requires the presence of total quality.

A review of current literature indicates that an organisation must be viewed as a dynamic system revolving not only around the marketing mix but also around suppliers and customers. Indeed, any efforts to achieve true success in the areas of quality control, inventory control, operations and ultimately profitability must be predicated upon this concept.

It is becoming increasingly evident that both total quality management and effective inventory management must also be considered systems in of themselves and, most importantly, that these subsystems fully integrate with all elements of the entire organisational system. This is established not only deductively but also with ample support from the prior literature. Accordingly, this section continues with an examination, from a systems perspective, of total quality and inventory management and seeks to establish their profound impact on the organisation-wide system respectively.

4.2 The Organisation as a System

4.2.1 Introduction

The nerve centre of any business is its marketing mix. It is indisputable that all components of the marketing mix must work in conjunction with one another and must be consistent with the strategic objectives of the firm if a company is to be profitable. In other words, the marketing mix and its related activities must function as an integrated, dynamic system. The business as a system is shown below in Figure 4-1.

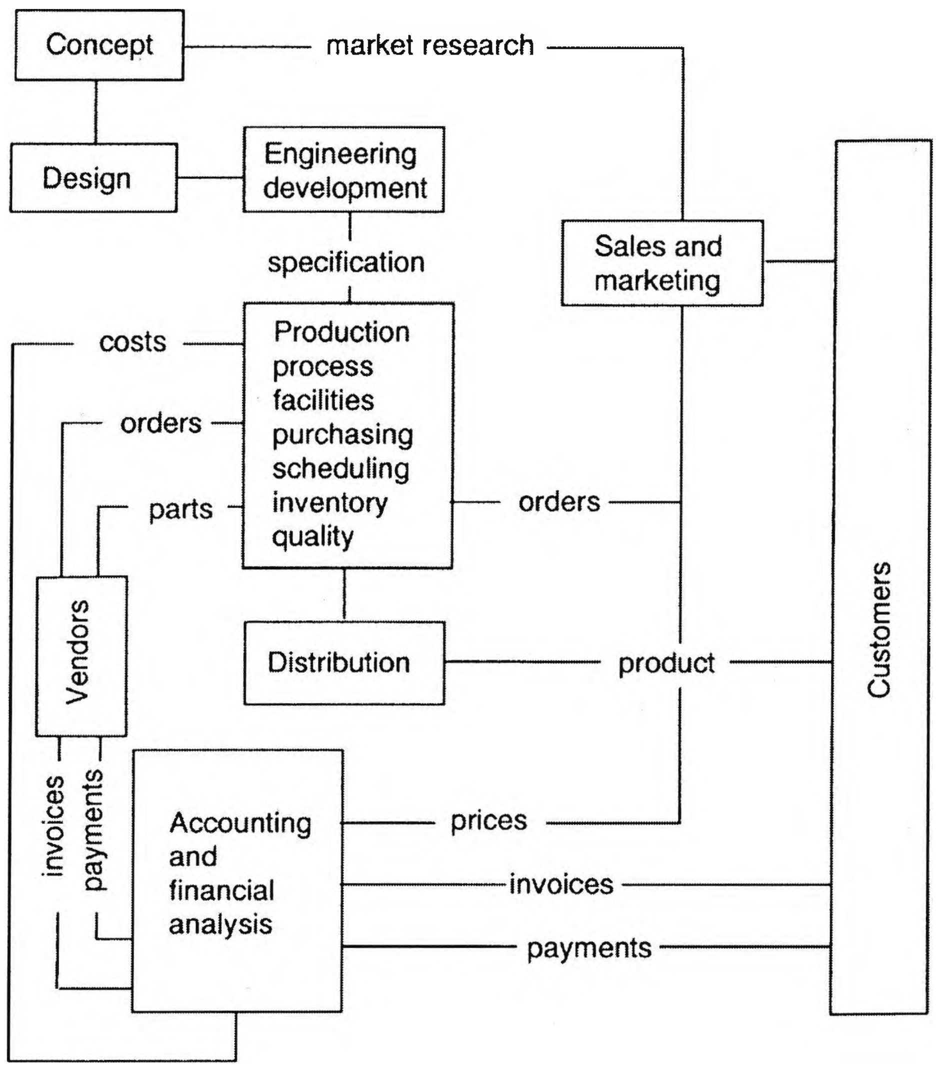

Figure 4-1: A Corporate System

Source: Chelsom, in *Management for Engineers* (Payne et al., 1996)

A review of management theory is provided illustrating the development of managerial techniques in response to the changing faces of competition. Further examination reveals that it can be argued that all theories were predicated on a systems approach in one form or another. More recent theories, commencing with Deming (1986), have expanded the components in the system and have demonstrated the special role quality plays within the system.

This has, in turn, led to a cumulative approach for the basis for competition and a Holistic Management theory developed by Chelsom (1998).

4.2.2 The Marketing Mix

Based on Figure 4-1, further examination of the individual elements of the marketing mix, comprised of the product, price, promotion and channel of distribution, as well as each one's impact on the system, is warranted.

4.2.2.1 Product

This element of the marketing mix involves the concept and design, the degree of research and development and level of innovation, engineering, the suppliers of raw materials, the efficiency of the production process and the facilities available. The quality of the preceding factors will determine the marketability of the final product and its ultimate success.

4.2.2.2 Price

In addition to basic economic principles such as supply and demand, price elasticity of demand and breakeven analysis, the price is determined by the use of various other financial and accounting tools. The ability to command a higher price is largely dependent upon possessing superior product and/or service quality,

4.2.2.3 Channels of Distribution

In order to create place and ownership utility, a method of ensuring that the product is accessible for purchase by the consumer is required. This can be achieved by the use of wholesalers, retailers, distributors, direct marketing or on-line services. Whatever the method, quality must be present at all stages in the channel if a purchase is to be facilitated and the customer is ultimately going to be satisfied with that purchase.

4.2.2.4 Promotion

Promoting the product through the use of advertising and/or public relations is largely, if not solely, dependent on the actual product. To maintain legal and ethical standards the product must be able to do what the promotion claims it can and, therefore, all the quality aspects enumerated in the product section above play an intrinsic role in how the product is promoted. More importantly, customer satisfaction, product loyalty and brand loyalty is created when the customer is exposed to advertising, makes a purchase and does not suffer any dissonance because the product meets the expectations created by the promotion. Meeting and/or exceeding customers' expectations was one the definitions of quality (Parasuraman et al., 1985) listed in Chapter Two.

4.2.2.5 Summary

It is apparent, even from the brief analysis above, that the four elements of the marketing mix are interdependent and form the basis for regarding the business as a system. It is also clear that quality plays a significant role in ensuring the cohesiveness and strategic success of those four components. It is therefore to be expected that current marketing literature places an emphasis on quality throughout the marketing process and even goes so far as to redefine marketing (Churchill and Peter, 1998) as "creating value for customers."

4.2.3 Management Theory

Management theory has evolved from Frank and Lillian Gilbreth (motion studies), to Frederick Taylor (scientific management), to Henri Fayol (classic managerial roles) to Henry Mintzberg (expanded managerial roles) and currently espouses a redefined conglomeration of the preceding positions. It can be argued that all these previous analyses seem to try to address the question of how to manage a system. Moreover, it has been argued, (Chelsom, 1998a) that many of the models developed to implement these theories are grossly deficient. By effectively dismantling the integrative component that a system provides and replacing it with a series of isolated and independent concepts, current models have belied the very theories they claim to apply.

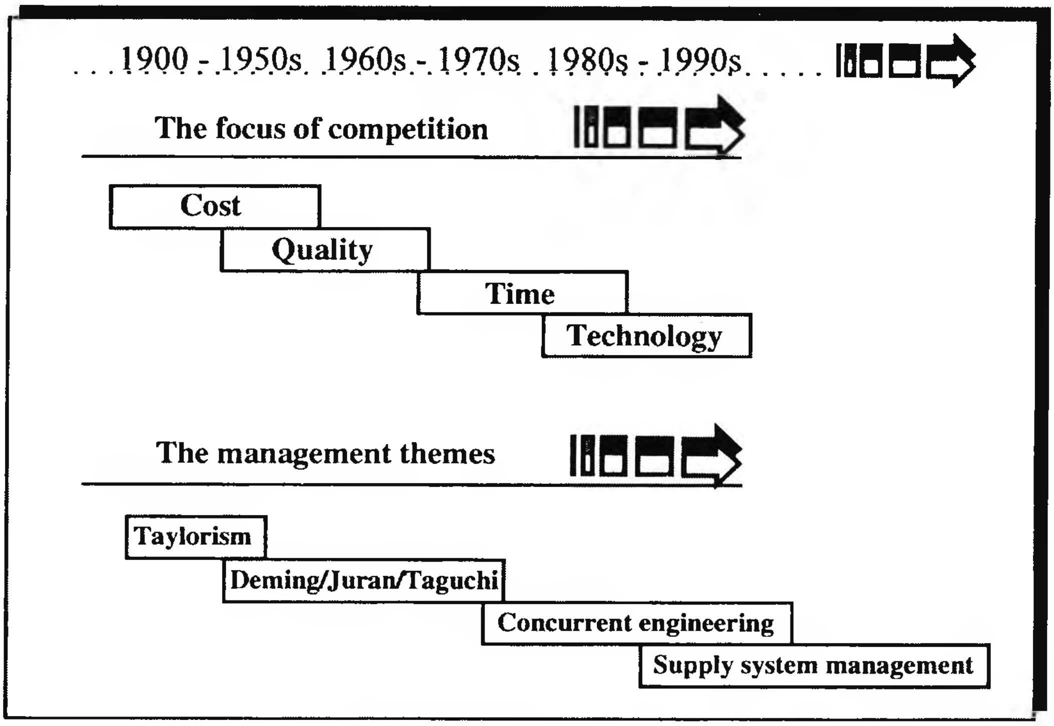

Figure 4-2: The Moving Edge of Competition
Source: Chelsom, in *Management for Engineers* Payne et al., 1996)

When the basis for competition changed, so did the managerial response, hence the development of the theories as illustrated above in Figure 4-2.

As the focus moved from cost to quality, Deming advanced his theories on quality control and statistical process control. Many firms studied and adopted his universal fourteen points but failed to understand his overall message, which was that the systems approach must be at the forefront of any quality initiative. Deming's view of production as a system, depicted below in Figure 4-3 was formally introduced in his book *Out of the Crisis*, (Deming, 1986) but was relatively ignored until reintroduced and publicised by Neave (1995).

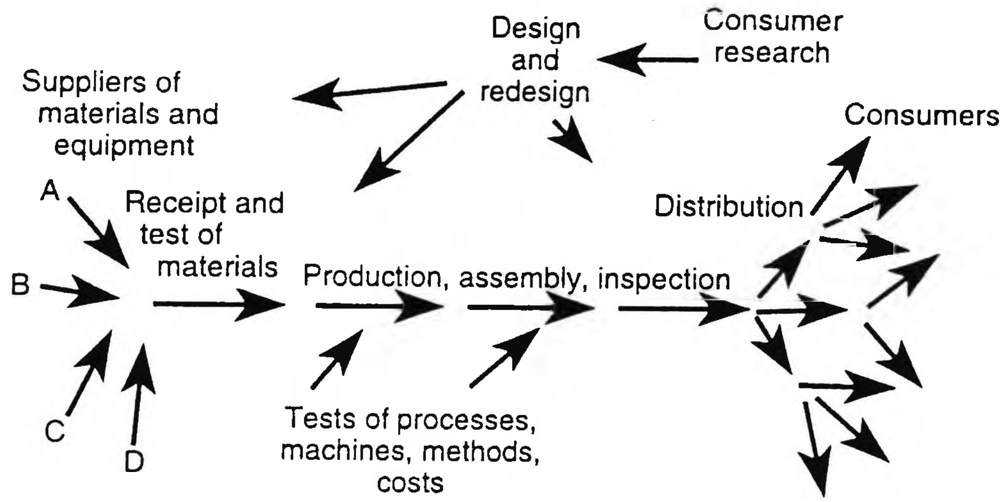

Figure 4-3: Production Viewed as a System
Source: (Neave, 1995)

With the introduction of the time factor into the competitive equation, management techniques shifted to theories that advocated simultaneous or concurrent engineering. Since bringing new products to market expeditiously represented the opportunity to gain a competitive advantage, it can be said that Taguchi's *loss avoidance* (Ross, 1989) was adapted into *change avoidance* (Payne et al., 1996) so that the time to fill an order can be minimised.

As technology began to change and develop more rapidly, it generated a more profound effect on the ability of a business to remain competitive and financially profitable. Hence, states Chelsom, (Payne et al., 1996) a different kind of time pressure – the time to implement new inputs and technologies into the production system – arose. It has been argued (Clewer, 1995) that the position of suppliers in Porter's (1985) value chain does not accurately reflect the requirements that manufacturers currently make on their suppliers. The response to this new challenge was the advent of SSM, supply systems management. SSM recognised that the role of suppliers cannot just be confined to providing raw materials but must be expanded to interactive participation and even innovation in the conceptual, design and development stages of the production process.

The concept of SSM and its total involvement in all stages of the production process from suppliers to customers is comprehensively covered in a model provided by Clewer (1995). It has since been presented by Chelsom, in *Management for Engineers* (Payne et al., 1996) and in the TQM Magazine, (Chelsom et al., 1998) and can be below in Figure 4-4. In a similar vein, the concept of an integrated supply programme (Axelson, 1997) has become a much discussed option within the distribution channel. As a basis for further research and as further evidence of the need for a systems approach, this thesis wishes to take note of and endorse the system attribute inherent in supply system management.

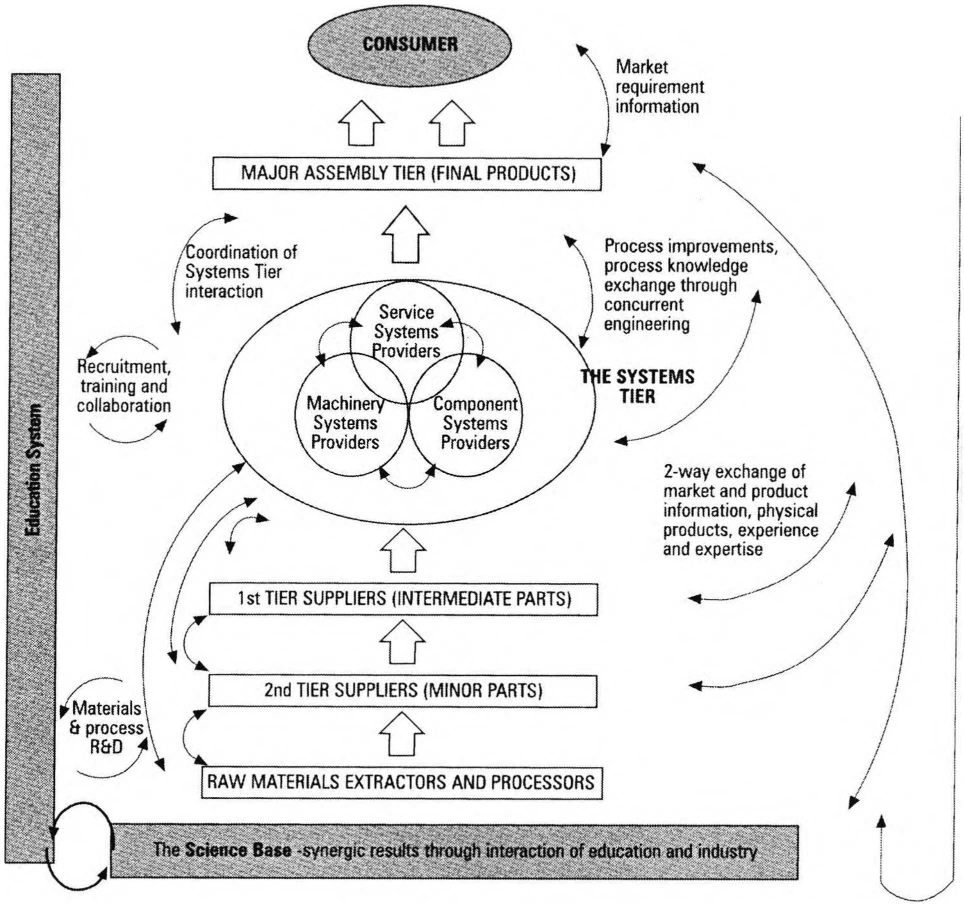

Figure 4-4: The "Total" Supply System

Source: (Chelsom, et al., 1998)
Adapted from: (Clewer, 1995)

4.3 Total Quality and the Systems Approach

4.3.1 Introduction

Chapter Two emphasised that total quality cannot be simply treated as a programme containing a methodology. It must be regarded as an organisational initiative which, elaborates Jocou (1996), needs to be adopted and practised, totally, by all constituents of the organisation. These include not only all the departments and employees but also external stakeholders that impact on the production and operations process. In other words, TQM is a total system of management.

In this section, total quality is considered as a system consisting of dynamic and responsive factors that are also non-static components of the overall organisation-wide system. A review of current critical thinking supports the position that the failure of total quality initiatives can be attributed to a narrow application of quality without regard for the system-wide ramifications. As it becomes more apparent that system components need to be sensitive to changes in the competitive, technological and end-user arenas, the eligibility criteria for inclusion in the system need to be made more expansive.

4.3.2 The Role of Quality in the System

It is clear that a major condition precedent for the success of any total quality initiative must be its enthusiastic acceptance by all constituents of the organisation. This will, of course, ensure that the quality concept penetrates all levels of the corporation. It is not sufficient to simply adopt and then apply a particular approach, be it Deming, Juran or Crosby, to the exclusion of the others (Roehm et al., 1995). Similarly, it is necessary that when any particular method or combination of methods is examined, implementation in a systems context is considered.

Earlier in this chapter, Deming's model of production viewed as a system (Deming, 1986; Neave, 1995) was introduced. Since Deming was indisputably a proponent of total quality, it can be concluded that he viewed Total Quality Management as a dynamic subsystem influencing the ebb and flow of the overall organisation's system. In fact, Neave (1996) has argued that Deming's earlier lectures were specifically directed toward the theory of a system and toward co-operation.

Figure 4-5 below presents an updated model of the "moving edge of competition" which appears in more recent literature (Chelsom 1998a; Chelsom et al., 1998). It is not surprising to learn that rather than isolating the basis for competition on one particular area the competitive focus manifests itself as a cumulative, integrative conglomeration of all the previous factors. It is to be expected that the most recent competitive developments are the ones which will call for immediate attention and adaptation since there can not be much of a learning curve or past experience in those areas.

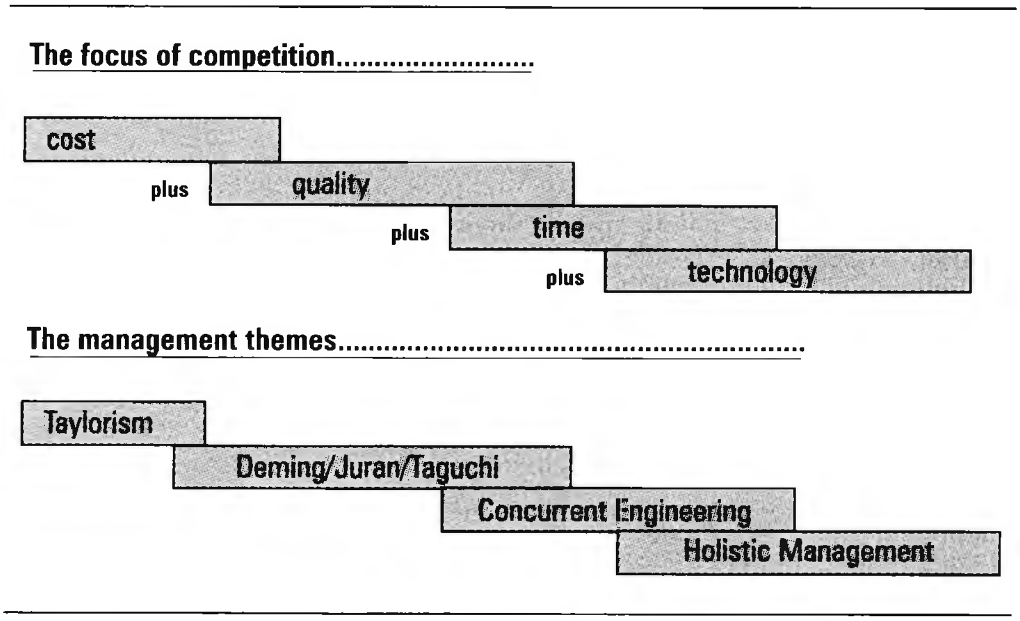

Figure 4-5: "The Moving Edge of Competition" Updated

Source: (Chelsom, et al., 1998)

Having established that total quality is all encompassing and infiltrates the entire system, it is appropriate that SSM be updated and included in the more encompassing term Holistic Management. This recognises the contribution quality makes to low-cost production (elimination of waste), expeditious delivery of product, and the incorporation of state-of-the-art technology. These tenets are currently providing the competitive edge (Chelsom et al., 1998) and "the key to a new concept of total quality."

The inclusion of the "plusses" in the model, indicating the cumulative link between the areas of competition, demonstrates the need to continually re-examine the way in which the management of quality is approached. The message is that quality operates as a continuum. Figure 4-6 on page 106 depicting Chelsom's update of

Deming's production model serves as a vital reminder that even Deming is not immune to change. It may even be argued that Deming himself would have expected nothing less from any true practitioner of total quality.

4.3.3 Discussion

In order for quality initiatives to succeed, it is vital to appreciate the value of co-ordination and integration. The decline of quality circles should not be attributed to an inherent flaw but rather, as previously stated, (Kano, 1993) to a failure of companies to integrate them as a dynamic in the system. This would perhaps explain why quality circles were simultaneously criticised for being too structured or too unstructured. The problem was, evidently, that they were not sufficiently integrated into the company in question. That flaw in implementation could give rise to two diametrically opposed criticisms.

This thesis, to date, has been less explicit as to what total quality is than as to what it is not. At this stage, however, it can be definitively argued that total quality is a system wide factor and that failure to infuse and integrate quality into all aspects of the system will cause a breakdown in the quality programme. This will assuredly lead to negative performance of the organisation-wide system, (i.e. the business).

The new concept of total quality requires that an organisation considers every factor in the internal and operating environments as system components that have to be injected with quality. Just as an intense effort has been made to include the customer in the production process, so too, must a concerted effort be made to involve the supplier. Input from suppliers at all key points in the system will enhance quality and improve efficiency. Making the suppliers a part of the team will make the organisation more competitive in addition to some obvious cost savings. This can best be illustrated by Chelsom's (1998a) updated model of Deming's "Production Viewed as a System," shown in Figure 4-6 on page 106. Chelsom elaborates that the inspection and testing of incoming materials can be eliminated when using total quality suppliers.

Furthermore, it is clearly not sufficient to install a director of quality or establish a quality programme because that places constraints on where quality can go. The fact is that quality must be allowed and, indeed, actively encouraged to go wherever it can.

4.4 Inventory Management and the Systems Approach

4.4.1 Introduction

Chapter Three explored the topic of inventory control, its development, and an examination of Just-In-Time method of inventory management. It was established that the success of JIT is contingent upon the presence of total quality. In the previous section, the concept that total quality is a system linked to the organisation-wide system was introduced and developed.

While it is quite apparent that total quality affects the entire business system, it is not so immediately obvious that inventory management generates a similar effect. Literature espousing the requirements for successful inventory management is reviewed from a systems perspective. It reveals that inventory does, indeed, have a profound influence on the system dynamic.

This section demonstrates that effective inventory management can and should equally be viewed as a system with its own particular links to the organisation-wide system. The ability to attain superior inventory performance necessitates an active systems approach integrated with the total quality system and related to the organisation-wide system.

4.4.2 The Role of Inventory in the System

As stated previously, there are three kinds of inventory held by a firm: raw materials, work-in-process and finished goods. Each has a significant effect on the ability of the business to satisfy its customers while maintaining profitability. Maintaining high levels of inventory in any of the three categories may ensure customer satisfaction but it will ultimately impair the company's ability to operate resulting in a severe decline in profitability. Conversely, maintaining extremely low levels of inventory can be beneficial to the organisation's business performance but if they are incorrectly managed the result will be customer rejection.

This thesis defines superior inventory management as the continuous drive towards reducing inventory and ultimately being able to operate on a JIT basis. If inventory is minimised or eliminated, then the ability to deliver satisfactory and timely outputs to the customer is dependent upon the quality, efficiency and timeliness of the production process and upon the quality, reliability and timeliness of the incoming materials.

This is conveyed in Figure 4-3 (Deming, 1986; Neave, 1995) on page 96. As a firm progresses towards leaner inventories, the need for integration and partnerships increases. It has been argued (Chelsom, 1998a; Chelsom et al., 1998) that truly efficient production requires superior inventory management (JIT), total quality and the extensive involvement and co-operation of suppliers. This is best illustrated by Chelsom's updated model, which appears below in Figure 4-6.

Chelsom (1998a) enumerates the key pointers to the systemic relationship between inventory, total quality and the entire system.

They include supplier involvement in consumer research, supplier initiation of design and technological advances, and supplier deliveries to the more advanced stages of the production process.

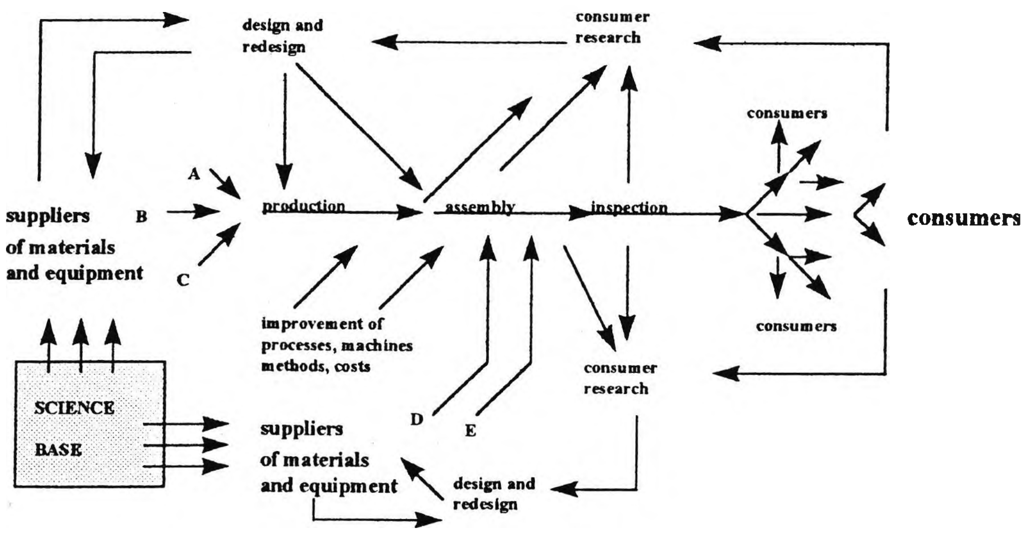

Figure 4-6: "Production Viewed as a System" Updated

Source: (Chelsom, 1998a)

If JIT is accepted as the paradigm of superior inventory management then the systems approach must hold true to an even greater extent for JIT. If maintaining inventory requires capital investment then JIT, which eliminates inventories, should be able contribute to a better bottom line on the financial statements. When the JIT decision is decomposed (see Figure 4-7 below), it reveals (Nyerges, 1996) that there are a number of components that are required for the system to operate and, if in place, they translate into savings and increased cash flows.

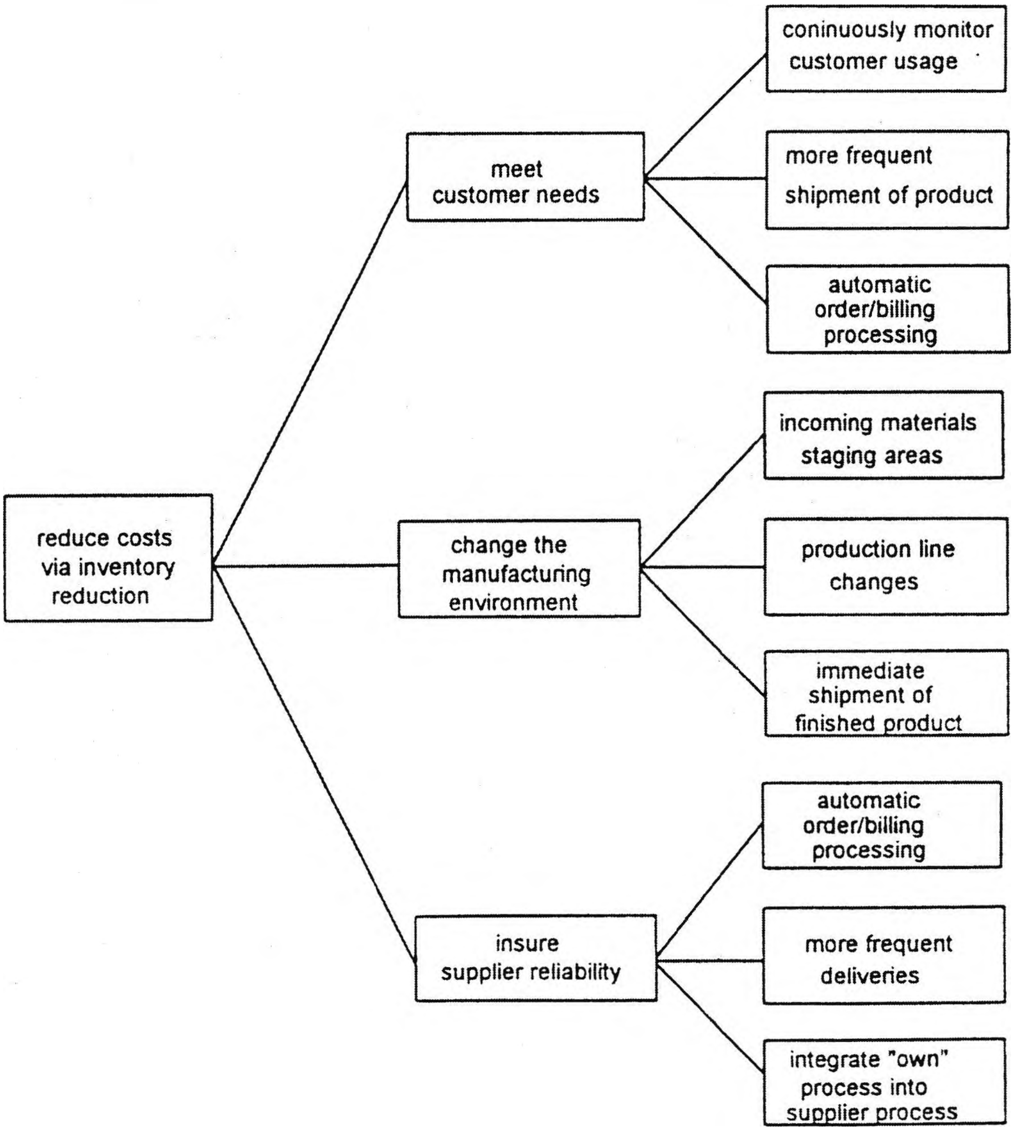

Figure 4-7: A Decomposition of the JIT Decision

Source: (Nyerges, 1996)

However, JIT is not only concerned with the strategic element of control, it also permeates the system operationally by requiring greater flexibility in manufacturing, more accuracy when forecasting and greater time and effort spent educating employees and suppliers.

Further evidence of the need to manage inventory as part of a system has been established earlier in this chapter using the concept of supply system management. Moreover, the adoption of an integrated supply program (Axelson, 1997) can reduce the number of suppliers and supplier-related transactions, optimise inventory and help TQM relationships flourish.

The fact is, that until recently, treatment of inventory management has been conducted along very narrow lines, failing in the process to recognise the contribution and influence that effective inventory management makes to the organisation. GM, which underwent a reorganisation of its inventory policies by establishing an efficient and effective JIT relationship with its suppliers (see section 3.2.4.1) has since revamped its contracts with the suppliers and disclosed sensitive information about them to competitors in an attempt to force prices lower. The additional imposition of a unilateral demand for a 20% price reduction has succeeded in generating fear and distrust of GM among its supplier base (Harari, 1997).

More recently, other arbitrary similar system-wide changes including an aggressive downsizing policy have provoked a labour strike at GM assembly plants which has cost the organisation more than $1.2 billion dollars to date. GM's strategic policy of using an increasing number of outside and/or foreign suppliers while eliminating jobs at its own factories is one of the major sources of the labour dispute. Other union demands include the resolution of some safety and health issues and the completion of an investment project at the Flint, Michigan factory.

The union strike is not about money but rather about loyalty to suppliers, to workers and to investment promises that upgrade factory efficiency. There cannot possibly be a realistic chance of success without the fundamental commitment to mutually beneficial supplier and employee relationships. The adoption of sound programmes, such as JIT and TQM, is not enough if the wisdom to recognise the requirements for implementation and continuity is simply not there.

True relationships emanating from the appreciation of a system have been developed on a basis of trust, honesty, mutual support and inclusion. Only in such a context can total quality flourish. In that spirit, companies such as Milliken, GTE and Ford have been willing to enter into long-term relationships with a select group of suppliers (Harari, 1997). By so doing they realised that the extra money spent on materials is more than offset by savings generated from co-operation on new ventures, joint efforts in problem-solving and mutual sharing of common resources such as central databases.

It is therefore suggested that the word "total" be appended to inventory management, as in TIM, so that an appreciation can be gained of the totality of inventory management and its comprehensive role in the system. The success of any attempt to improve inventory performance will depend on reaching the understanding that JIT and other inventory initiatives have system-wide ramifications.

4.4.3 Additional Influential System Factors

4.4.3.1 Introduction

The previous section recognised the pervasive nature of total quality and JIT as well as the importance of formulating and implementing programmes from a systems perspective. At this juncture it behoves any prospective analysis that other factors possibly having a significant system-wide effect be considered.

No programme can be defined as successful unless there is an improvement in the business and financial performance of the corporation. Total quality programmes are expensive to implement and incur ongoing costs as the journey toward zero defects continues. Changes in the way inventory control is managed are also costly, and limiting supplier relationships to a select group means that traditional cost-cutting tactics, such as comparison shopping, have to be abandoned. Furthermore, both kinds of programmes involve a change in philosophy, a redirection of resources, a redefinition of organisational culture and a proactive commitment from management. These initiatives cannot be considered worthwhile unless there is a demonstrable effect on the bottom line through increased profitability and/or improved cash flows.

While recent approaches such as JIT and TQM broaden the view of inventory analysis (Nyerges, 1996) they must display a commitment to integration with other system related decisions in order to maximise the organisation's value. Maintaining the interdependence between inventory, quality and finance is developed in an IFAM schematic (Nyerges, 1996) which appears below in Figure 4-8. This research would like to focus the reader's attention on the impact JIT and TQM have on the financial statements.

By reducing inventory, excess cash is made available, which in turn, can be used to generate additional revenues, assuming that everything else stays the same. The prior research, (Nyerges, 1996) which formed the basis for the illustration in Figure 4-7 on page 107 demonstrating the decomposition of the JIT decision, concluded that it is highly unlikely that everything else will remain equal. Given the involvement of many participants including customers, employees, suppliers, investors and anyone else in the operating environment, the JIT decision will be dependent on many variable factors.

Nyerges (1996) asserts that the decision-maker will always reduce the decision to the lowest level denoting a point of attack from which to commence strategic action. Consequently, the decomposition of the JIT decision commenced in Figure 4-7 will naturally continue backward through the impact on the financial statements as shown in Figure 4-8 below.

FORECASTED INCOME STATEMENT
SALES (customers)
COSTS (suppliers) (employees)
NET REVENUE (owners)

FORECASTED BALANCE SHEET	
ASSETS	LIABILITIES
inventory (suppliers)	**payables** (suppliers) employees)
receivables (customers)	EQUITY (owners)

Figure 4-8: Impact of JIT on Financial Statements
Source: (Nyerges, 1996)

As anticipated customer demand causes a change in inventory levels, many associated factors are affected. The balance sheet is directly influenced by the amount of inventory in stock and by accounts receivable, which are assets that are dependent on supplier and customer relationships. Similarly, total liabilities reflect changes in the accounts payable owed the suppliers and employees as a result of JIT decisions.

Minimal inventory levels of finished goods require expeditious production of items that meet consumer needs. By manufacturing goods that customers want, a company is able to increase its sales. Conversely, failing to have a short time-to-market will result in a decline in sales and an increase in inventories no matter how well the product might have met the customer's expectations. Strong partnerships and mutual co-operation with suppliers and employees will result in reduced costs.

A well-executed JIT decision can, therefore, result in increased sales and reduced costs thus generating higher profits. It will also be detectable over time in the balance sheet by improving cash flows. Poorly implemented JIT will actually result in an adverse financial performance, in both the income statement and balance sheet, no matter how well intentioned the inventory policy may have been.

Although financial measures tend to be judged over too short a period of time and initial financial reversals have led to criticism of TQM, such conclusions ignore the long-term strategic advantages that TQM stresses over short-term profits. There is no question that successful implementation of TQM should ultimately lead to financial success and, as such, traditional valuations of financial performance are appropriate. An in-depth study (Buzzell and Gale, 1987) conducted by the Strategic Planning Institute of Cambridge, Massachusetts and based on the performance data of 3,000 strategic business units definitively established the relationship between quality, profitability and market share. It concluded, "One factor above all others - quality - drives market share. And when superior quality and large market share are both present, profitability is virtually guaranteed." According to a 1992 Government Accounting Survey measuring TQM results (Bermar, 1993), 76% of companies adopting TQM reported a significant increase in profits. To that end this section will examine two other elements, which not only manifest themselves system-wide but they also have a quantifiable and measurable effect on financial performance.

4.4.3.2 R.O.C.E.

One of the more widely used financial evaluation tools and one which appears to be particularly appropriate in this situation is R.O.C.E., which is an acronym for return on capital employed. It is calculated by dividing profit before interest and taxes by capital employed. As with ROI (return on investment) R.O.C.E. is sensitive to the accumulation of non-productive assets therefore excess inventories will affect the firm's ability to generate a high return on capital. Moreover, it has been demonstrated by Chelsom, (Payne et al., 1996) that any R.O.C.E. ratio generated will be dependent on supply system management. Consequently, its usefulness in developing a measurement tool from a systems approach should prove to be most valuable.

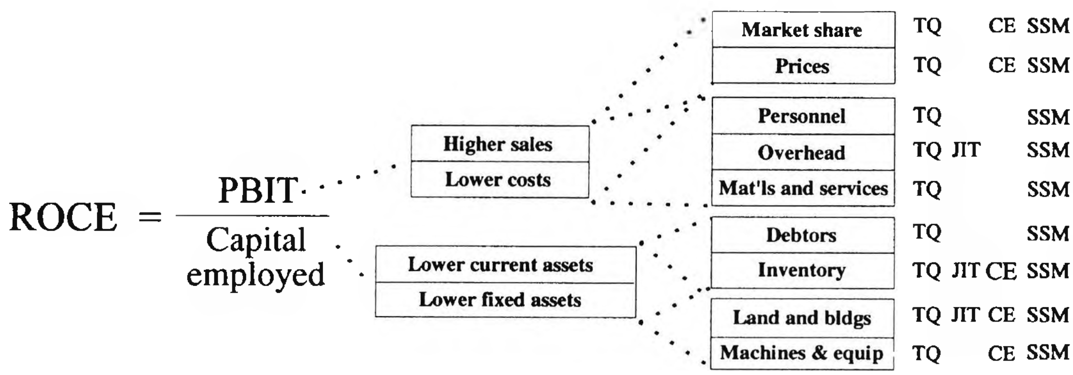

Figure 4-9: The Dependence of ROCE on SSM

Source: Chelsom, in *Management for Engineers* (Payne et al., 1996)

Low inventories require an acute awareness and anticipation of customer expectations. They also afford a company the opportunity to embody the market concept by providing exactly what the customer wants and needs. That can only be accomplished through total quality management. TQM ensures innovation and superior quality developed through the use of concurrent engineering. The effectiveness of concurrent engineering is dependent upon the adoption of SSM. Successful implementation of the above will result in greater market share and consequently higher sales. A determination to "get it right the first time" will make employees more productive and eliminate waste thereby lowering costs.

These same tools, TQ, JIT, CE and SSM can be effective in lowering inventories and ultimately, the costs of land, buildings and money required to maintain excess inventories. The result will be a lowering of both current and fixed assets. For even further details on this topic the reader is referred to Chelsom's discussion of R.O.C.E. and SSM in *Management for Engineers*, (Payne et al, 1996).

4.4.3.3 Employee Value

Both JIT and TQM are concerned with the elimination of waste. The importance of employees cannot be underestimated when undertaking such a task. In fact, TQM involves instilling a new corporate culture, which in addition to other factors emphasises (Anderson and Adams, 1997) valuing employees as the most important resource of the organisation.

One of IBM's initial goals in their effort to return to their status as a world-class company was to improve efficiency by cutting the work force and by increasing profit per employee. The Times (Thomson, 1997) reported that in the four years since this measure was introduced profit per employee had risen nearly 60%. Most industry analysts will agree that while IBM may not be back to its former self it is certainly well on the way.

TQM companies have been guilty of creating run-away bureaucracies with an abundant supply of directors, managers and employees supervising quality. A case in point is Florida Power and Light, which won the Baldrige award in 1989 but did so with a quality department of 85 full-time monitors of 1,900 quality teams. Needless to say, the financial gains were modest but so were the gains in quality. As with any resource, employees need to be used efficiently and productively.

Employees are a system-wide resource affecting all facets of the organisation and they are ultimately directly involved in improving the bottom line. It is, therefore, appropriate that their performance be measured.

4.4.3.4 Managerial Attitude and Commitment

Although not a readily quantifiable component, there is no question that the attitude of managers will directly impact on the success of any quality or inventory initiative. In general, American companies adopting TQM appear to have little understanding of what it is really all about. While they claim to have an unwavering commitment to TQM their mentality lags far behind, so reform was all right as long as it didn't change anything. In addition to still being encumbered by a management style that is shortsighted, they fail to imbue employees with the inner drive for quality that is so necessary for TQM to succeed.

Exploratory research was conducted which included the development and distribution, on a limited basis, of a questionnaire to gauge managerial attitude. The responses to the questionnaire found in Appendix II, were indicative of the attitudinal differences between American and Japanese transplants. As stated earlier, the executive in charge of revamping the Quality Assurance programme under TQM guidelines at Smith Barney, a giant American investment corporation, was asked whether there were any employee activities/characteristics that management would not tolerate and he answered, "sexual harassment." By contrast, Aurora International Computing, a Japanese business located in New York City asserted, "defective workmanship or inferior service." It is interesting to note that Mr. Hanabusa, the CEO of Aurora, claimed previously that his company did not practise Japanese management techniques.

Another ideological difference was revealed by the responses to Question 13 regarding the possibility of hiring a consultant to solve management problems. The executive at Smith Barney indicated that they would jump at the opportunity whereas Mr. Hanabusa disagreed with the use of consultants and added, " we know what's wrong better than outsiders, why not pay the costs of hiring a consultant to our employees!"

This is synonymous with the contentions of Joshua Hammond and Ernst & Young (Harari, 1997). Hammond felt that the proliferation of consultants exacerbates problems and the Ernst & Young study revealed that there was a glut of TQM techniques being peddled in the consulting market.

Despite the difficulty in identifying, reporting, quantifying and measuring managerial attitude, its importance as a system-wide factor must be recognised. Success of JIT or TQM programmes cannot be achieved without the total commitment of management and, indeed, all employees. Notwithstanding the measurement obstacle, many firms have still featured managerial attitude in their supplier appraisal systems. Ford, for example, (Chelsom, 1998b) assigned a weight of 20% to "Supplier Management Attitude and Commitment" in its world-wide Q1 rating system for internal and external suppliers.

4.4.3.5 Summary

In an effort to determine other factors which manifest themselves system-wide and also have a significant impact on the success of JIT and/or TQM programmes three distinct areas were identified. First, return on capital employed, which in addition to meeting the above criteria has a direct connection with the measurement of financial performance. Second, employee value, which has the dual advantage of being linked with financial success and organisational culture thus representing a bridge between the quantitative and qualitative areas of the business system. Third, managerial attitude, which is directly reflective of the commitment the firm has made to the JIT or TQM initiative upon which it has embarked.

4.5 Discussion and Basis for Research

It seems that a company's perceived level of TQM often exceeds the actual level determined by an evaluation of its performance and/or philosophy. This appears to be due in part to the failure in finding suitable performance categories that measure TQM levels accurately. Furthermore, it is quite possible that the measurements used may, in fact, produce adverse results by, for instance, stressing productivity as opposed to satisfaction or delivery time as opposed to higher quality. As one manager stated, (Harari 1997) "Before we invested in TQM, the rap on our company was that we churn out poorly made products that customers don't want. Now, after Total Quality Management, things have changed. We now churn out well made products that customers don't want."

It is also apparent that current theory and practice dictates that total quality must be viewed from a more expanded perspective, which substantially expands upon previous, somewhat limited parameters. Rather than examining a set of independent factors, it is now crucial to identify and analyse the complete system. This involves treating system components as interdependent factors while recognising that the system is constantly changing.

4.5.1 Links between TQM and JIT

Since total quality must be present in every component in the system for JIT to work, it would seem advisable to analyse other links between inventory performance and total quality. Pursuant to this, it is important to understand that total quality in a system is far more than just the narrow definition of product quality. It is, in fact, represented in all aspects of the system, including customer/supplier relationships, from both a physical and philosophical standpoint. Similarly, JIT is more than just the elimination of inventory. It is also represented in all aspects of the system, including customer/supplier requirements and expectations, from both a physical and philosophical standpoint.

Jocou (1996) asserts that total quality management is an entire system that includes a philosophy, principles, methods and tools. This involves the cost incurred in producing, selling, distributing and managing the product, the time it takes to bring it to market, the people and processes, and an understanding of customer values and expectations. This thesis argues that effective inventory management, which as it improves tends toward JIT, shares the same characteristics.

Table 4-1 below depicts the commonality between the requirements and concerns of both TQM and JIT versus traditional inventory control.

Table 4-1: TQM, Traditional Inventory Control and JIT

Main Requirements and/or Concerns	Total Quality Management	Traditional Inventory Control	The Inventory Management System (JIT)
Elimination of Waste	✓	✓	✓
Time to Market	✓		✓
Select Group of Quality Suppliers	✓		✓
Price Discount Suppliers		✓	
Product Quality	✓		✓
People and Processes are Part of the Strategic Plan	✓		✓
Lowering Overall Cost of Production	✓		✓
Lowering Total Cost of Ordering and Carrying Inventory		✓	
Inventory is Needed as a Protection Buffer		✓	
Encourage Rivalry with and among Suppliers		✓	
Mutual Co-operation and Joint-Growth with Suppliers	✓		✓
Meeting Customer Expectations	✓		✓
Customers and Suppliers are a Part of the System	✓		✓
Responsibility with One Department or Director/Manager		✓	
System-wide Responsibility at all Levels	✓		✓

As can be clearly seen from Table 4-1 above, JIT, which is the manifestation of an inventory management system, shares the same concerns and requirements as TQM, which represents the adoption of a total quality programme. For either initiative to be successful these concerns must be addressed and the requirements met. Advances and improvements in one area will, out of necessity, affect the other.

The unique affiliation with total quality which JIT enjoys is due to the fact that they both work hand in hand to generate a competitive advantage for the organisation. In order to satisfy customers it is crucial to meet their moment of value, which means delivering the right product at the right time and at the right place (Haag et al., 1998). Total quality control facilitates the manufacture of a high quality product, but that is not sufficient to totally satisfy customers. There must also be a management technique in place that ensures the timely delivery of a product that the customer really wants (meeting customer expectations). JIT is exactly such a technique in that low or zero finished goods inventories force manufacturers to design specifications based on the customers' requests. This is behind the concept of cell manufacturing at Compaq where production takes place in small cells or workstations as opposed to assembly lines. Compaq first receives an order from the customer and then it starts the production process (McGraw, 1998). Cell manufactured products are not manufactured on the "hope" that someone will buy them. The flexibility afforded by having no finished goods inventories allows Compaq to respond to a customer need the first moment it is identified, which subsequently ensures a timely start to (and hopefully, delivery of) the product. The end result, of course, is total customer satisfaction, which is synonymous with a philosophy of total quality.

Consistent with the systems orientation of this thesis, JIT can be viewed from an internal and/or external perspective. Internally, the task is to provide each department with what they need at the time it is required. As far as the customer is concerned, it means delivering the product when it is desired. Clearly, JIT cannot function without close co-operation between all participants in the process including customers, suppliers and internal divisions thus illustrating the need to view the entire process as an expanded system with many components. Earlier in this chapter it was demonstrated that the same holds true for total quality management. This solidifies the basis for the establishment of a close link between JIT and TQM.

The concept of JIT can be applied across the many industries able to adopt a total quality philosophy. While total quality management in health care is normally associated with patient satisfaction Baxter International of Deerfield, Illinois in the USA has employed a JIT delivery system called ValueLink to minimise inventories carried at hospitals (Conners, 1998). One of its main customers, Duke University Medical Centre experienced a real decrease in costs in an industry that has seen dramatic increases. Recognising the need to ensure system wide participation Baxter has entered into risk-sharing agreements with its partners. The end result has seen a 25% drop in the costs of an operation as opposed to a 31% increase in the three years prior to the agreement. Baxter has achieved reduced inventories, lower costs and the ultimate prize of a very high level of customer satisfaction, the cornerstone of total quality management.

Table 4-2 below denotes the applicability levels of competitive strategies in various industries. An **X** indicates some applicability whereas **XX** indicates a very high level of applicability. It is evident from the Haag et al., (1998) analysis that the JIT concept applies across the board and has very high applicability levels in two industries. No other strategy listed can make that claim, although "Learning Organisation" comes close. This underscores the contribution that JIT makes to the strategic success of the organisation and to its widespread applicability. The industries considered in the table below are Hospitality and Leisure, Financial Services, Health Care, Retail, Information Technology and Telecommunications, Food, Entertainment and Publishing, Manufacturing, and Transportation, respectively.

Table 4-2: Application of Organisational Strategies

Source: (Haag et al., 1998)

STRATEGIES	H&L	FS	HC	RETAIL	IT&T	FOOD	E&P	MANU	TRAN
Just-in-time	X	X	X	X	X	XX	X	XX	X
Teams	X		X		XX			X	
Information partnership			XX	X	X		X		X
Timeless and/or Locationless	X	X		XX			X		XX
Transnational firm		XX		X		X	X	X	X
Virtual organization		X	X	X	X		XX	X	
Learning organization	XX	X	X	X	X	X	X	X	X

JIT delivers a product when the customer wants it but perhaps more importantly, it prevents a product from being produced when there is no customer to want it. Excess production results in unsold inventories causing a delay in the introduction of new products that could potentially increase satisfaction among new and existing customers. Furthermore, quality is compromised since defects are not likely to be detected until the quality control process "catches up" with the inventory. If customer expectations are to be met and for TQM to be present the organisation needs to have superior inventory performance.

4.5.1.1 Elimination of Waste

JIT is concerned with the elimination of waste by disposing of excess inventories. Striving for zero defects, a fundamental principle of TQM, mitigates the need for rework and prevents the production of unusable items. Thus, TQM is also focused on the elimination of waste.

4.5.1.2 Time to Market

In order for JIT to function, the organisation has to continuously find better methods of bringing their product to market expeditiously. This coincides with a goal of TQM to meet and/or exceed customer expectations.

4.5.1.3 Satisfying Customer Needs

Similarly, the success of JIT depends on the company's ability to research and anticipate customer needs and values. It is vital that the company knows what the customers want. This is the first stage toward achieving customer satisfaction, which is a cornerstone of a total quality philosophy.

4.5.1.4 Lower Production Costs

TQM should be able to lower the overall production costs. Traditionally, firms were concerned with lowering costs in a very compartmentalised way. Each department - manager and subordinates individually and jointly - focused on lowering its bottom line. In purchasing, this meant buying cheaper materials or selecting suppliers on the basis of price discounts. Quality, however, does cost money and there is a significant capital investment required, to support an aggressive policy of continuous improvement. The extra costs should be more than offset by an improvement in employee efficiency, better technology, superior processes and less rework and waste. This is in contradistinction to traditional inventory control, which seeks to minimise the costs of holding and ordering inventory. Inventory turnover, a measure of inventory levels, uses cost of goods sold which reflects production cost.

4.5.1.5 Managerial Commitment

JIT requires a commitment from top management, outside suppliers and customer input into the system and these factors are all prerequisites for successful TQM as well.

4.5.1.6 Summary

This section clearly established interdependent links between TQM and JIT. It has always been understood that JIT needs to have total quality in place in order to be function, but further research has revealed that JIT and TQM operate as systems within the organisation-wide system. Furthermore, any progress in JIT and TQM are areas that complement each other and progress in one will benefit the other.

4.5.2 Scope of Research

Almost all prior methods of measuring quality have been predominantly subjective, involving the use of surveys, questionnaires or other opinion generating tools. This thesis utilises inventory performance, a strictly quantitative, objective method for measuring the level of quality in an organisation.

Exploratory research helped formulate the basis for the original hypothesis. Since JIT required total quality in order to be effective, a corollary was postulated: if it can be determined that a company is operating under JIT (or close to it), then total quality must be present. Thus, superior inventory management could be used as an indicator of total quality.

It has since been demonstrated that not only does JIT require total quality but that total quality and successful inventory management are the basis for an efficient and profitable business system. The hypothesis to be examined in the next chapter is that the more efficiently inventory is managed the greater the level of total quality. Since the system is used for managing customer value, people and processes (Jocou, 1996) it must be the system that is used to measure progress. Accordingly, a model was developed to test this hypothesis.

It is possible, that superior inventory management may not be sufficient on its own to indicate and/or predict levels of total quality Consequently other performance measures that are affected by the entire system, such as Employee Value and R.O.C.E. may need to be examined.

4.6 Discussion and Summary

This chapter examined and reviewed the current literature on systemic approaches in an attempt to establish a basis and a suitable guideline for further research.

It was initially established that the organisation operates as a dynamic system revolving about the elements of the marketing mix. Based on analysis and on the literature, it was further argued that

TQM and JIT operate as interdependent systems with many common goals. The both influence and are influenced by the organisation-wide system.

A review of management theory since the turn of the century developed as a response to the changing face of competition was provided. Previous work (Payne et al., 1996; Chelsom, 1998a; Deming, 1986; Neave, 1995) helped establish production as a system and developed the theories that inventory management and total quality management are systems.

It was further determined that total quality and/or inventory management must have financial benefits. In keeping with the systems approach developed, two system-wide measures were ascertained, R.O.C.E. and employee value. The completely qualitative yet important aspect of managerial attitude was also discussed.

It was hypothesised that inventory performance may be used to indicate the level of quality present in the organisation. Further research revealed that there were a significant number of system-wide factors that were common to and crucial for the success of TQM and the reduction and eventual elimination of inventories. A more detailed examination of these factors and their relevance to TQM and JIT was presented.

Jocou (1996) considered company changes to be like icebergs in that strategy, culture and technology represent the rather small visible part, whereas the values, perceptions and behaviours are the large hidden part. "The successes, failures, and transformations are directly linked to the progressive discovery of hidden elements (Jocou, 1996)."

This thesis maintains that inventory is also involved with a hidden part, one that is detrimental to the organisation's ability to operate profitably. Inventory, has often been regarded, (Chase and Aquilano, 1995; Heizer and Render, 1994; Payne et al., 1996) as a buffer concealing hidden problems much as a stream or a sea covers sharp rocks. The diminution of inventory (lowering the water level) exposes the problems (reveals the rocks). This thesis argues that for an effective inventory policy and a successful total quality programme, quality must be able to infiltrate the gaps and crevices between the rocks and proceed to erode them.

The next chapter discusses the research methodology and the collection of data for proving the hypothesis that superior inventory performance will indicate a higher level of total quality present in the organisation.

CHAPTER FIVE

5.0 RESEARCH DESIGN

5.1 Introduction

This chapter conducts a review of the procedures used for data collection as well as the methods used for research. These two areas, data collection and research methodology, are treated distinctly and the review enumerates respectively the successive stages that each area underwent.

A vast majority of previous data collection focused on service industries, which are essentially not relevant when examining inventory performance. The few studies conducted in manufacturing, despite exhaustive efforts made to obtain them, were not made available by the researchers involved.

Initial companies targeted provided mixed results in terms of obtaining data and the list was subsequently expanded. It was also decided to make more industries eligible for selection. Eventually, 48 companies were used in the model. Each one provided 4 years of data with the exception of one company that could only furnish 3 years' data since it only went public in 1995. This enabled the model to use 191 data points for analysis. 10 companies were used as the benchmark with the remainder participating in the testing of the model. The unavailability of data or the unwillingness of companies to provide information, complicated data collection. Accordingly, attention had to be turned to companies providing information as a matter of public record.

This greatly facilitated data collection since physical and electronic access could be gained to documents filed with the Securities Exchange Commission of the United States Government. However, in many cases, items such as the number of employees and a breakdown of inventories could only be obtained through protracted personal contact with the corporations involved. Similarly, foreign companies not requiring to file with the United States Government would, for the most part only make data available through personal communication.

Qualitative data was collected through the distribution of a survey designed to evaluate managerial attitudes and determine corporate philosophy with regard to quality. Most companies were highly secretive about their quality control specifics and were extremely reluctant to provide written information. After seeing that any data would not be valid for empirical analysis it was decided to collect data from Total Quality Management companies willing to supply the information. The data could then be used for an insightful but totally descriptive analysis of these human resource factors. The findings would either reinforce or mitigate the empirical results from the numerical data collected.

The research methodology employed remained consistent in its essence. A review of the literature indicated that there was a need for a more effective way of measuring the actual presence of total quality as opposed to relying on indicators that provided a perceived presence. Typical of the latter type of measures was winning awards, such as the Malcolm Baldrige Quality Award or the European Quality Award. Since previous research points to the inability to find suitable performance categories that measure Total Quality Management levels accurately, this particular methodology used seeks to isolate quantifiable factors which owe their success to the presence of an effective total quality programme. This will enable analysis to be conducted testing the validity of using these factors, either individually, or in combination as indicators and/or predictors of Total Quality Management. This chapter incorporates an examination of the stages involved in the development of the research methodology process.

5.2 Data Collection

This section details the approach used in obtaining primary and/or secondary data and the outlines the reasons for concentrating on particular companies. Previous attempts at data collection by other researchers were reviewed and difficulties encountered in the collection of the data for this current research are enumerated. The process, by which the companies were targeted, selected and for which data was collected, is depicted in Figure 5-1 below.

5.2.1 Target Industries

Much prior data collection and analysis in Total Quality Management was performed in the health care industry, a field to which inventory control procedures do not really apply. For similar reasons, other service-orientated industries must also be ruled out of this particular study. Furthermore, the pursuit of both Japanese as well as American companies necessitates the selection of industries including both kinds of companies. Industries targeted were automotive, technology, consumer durables, steel and aluminium manufacturers, electronics and personal effects.

U.S. "World Class Reputation" companies and Japanese transplants were targeted in order to establish relevant, measurable criteria which can be used as benchmarks for determining the level of TQM in an organisation. In accordance with the goals previously established, particular attention was given to inventory performance concentrating on such factors as inventory turns and inventory levels.

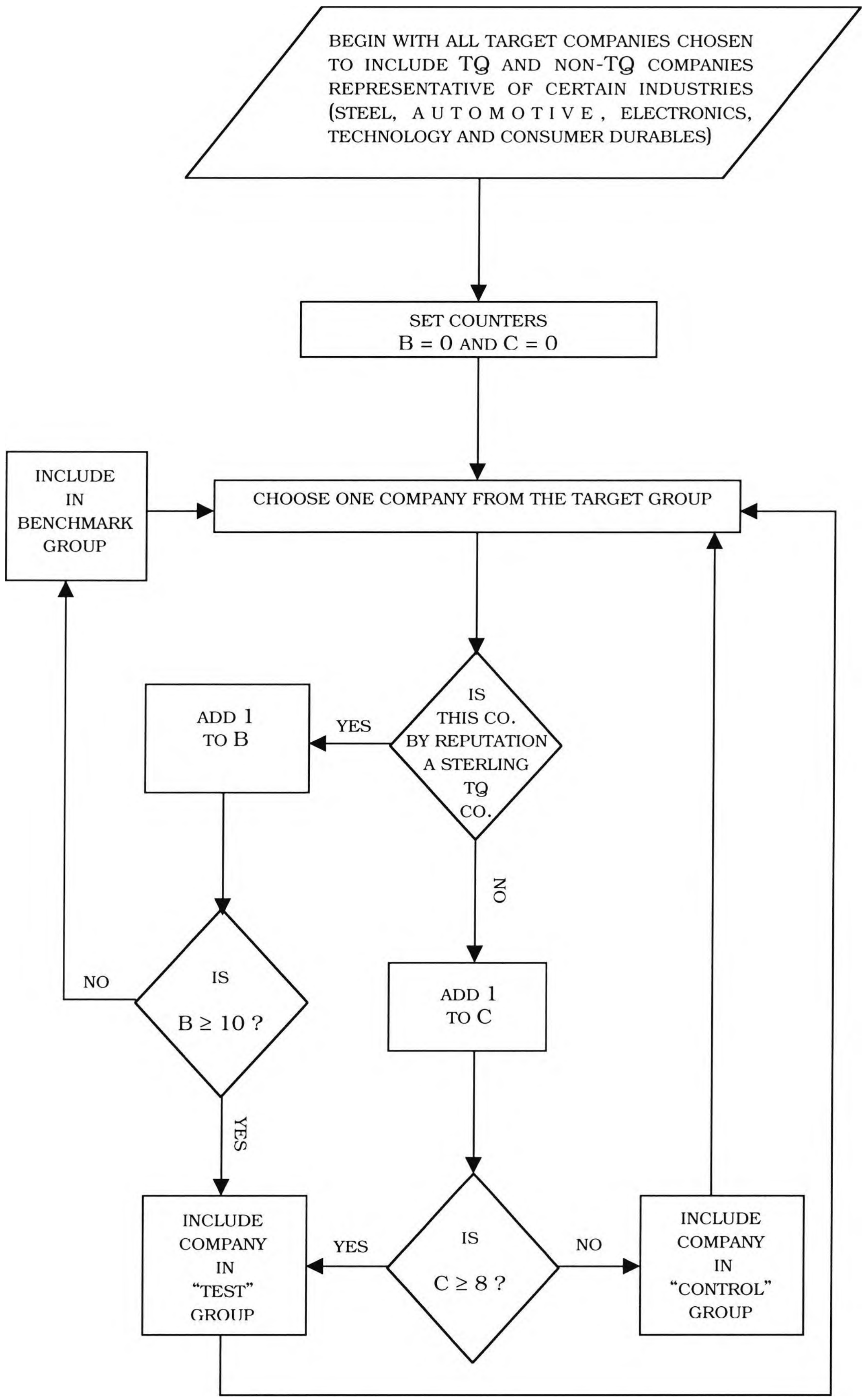

Figure 5-1: Data Collection Flow Chart

It is worthwhile to note that the Japanese culture and geographical limitations are particularly conducive to JIT and/or low inventory levels, so close examination of the approach of Japanese transplants in the USA to inventory control as a system was crucial to the study.

5.2.2 Target Companies

The companies participating in the study are divided into three groups, the benchmark group, the control group and the test group. The benchmark group companies were selected based on their universally acclaimed commitment to quality and represent a mixture of Japanese and U.S. World Class companies. The control group participants were selected primarily because of their low profile or non-existent reputation as far as quality was concerned. The participants in the test group were deliberately selected so as to include acclaimed total quality companies, companies that possessed no readily identifiable, especial commitment to total quality and predominantly miscellaneous companies for which no pre-test information was sought regarding their commitment to total quality.

Information on and profiles of the companies outlined below were taken from annual reports, media kits, personal communications and internet web pages. It is worthwhile to note, that companies which conveyed total quality through their literature content were much more helpful, timely and efficient in providing information.

5.2.2.1 The Benchmark Group

The following U.S. World Class and Japanese companies were targeted as participants in the initial evaluation stage in order to determine benchmarks for the model. Companies merited selection based on their acknowledged reputation as pioneers and subsequent leaders in the total quality field. The U.S. World Class companies, in addition to a solid reputation for quality, were Malcolm Baldrige or other Quality Award winners.

- <u>Milliken & Co.</u>

A leading international textile and chemical firm headquartered in Spartansburg, South Carolina that has displayed an unwavering commitment to quality and continuous improvement over the past seventeen years. Commencing with its pursuit of excellence (POE) campaign in 1981, an evolving process designed to ensure that the reality of customer satisfaction permeated throughout all levels of the company, to the more current Milliken Quality Process, Milliken has succeeded in reducing management positions, continuously increasing quality, enhancing customer satisfaction and responsiveness and improving business performance. Along the way, Milliken has won the Malcolm Baldrige National Quality Award, the European Quality Award, the British Quality Award, and the

Canadian Award for Business Excellence as well as accumulating an unprecedented five General Motors Mark of Excellence awards.

- Perdue Farms Inc.

Perdue Farms is the largest poultry producer in the Northeast and the fourth largest in the USA overall, catering to some 40% of the nation with 1993 sales in excess of $1.2 billion. In Chapter Two it was pointed out how Perdue Farms recognised that quality must be an integral part of everyday thinking and actions manifesting itself in all the functions of the company. Perdue's commitment to providing his customers with a quality product involved making significant capital investments, not to improve production efficiency or manufacturing capacity, but to improve the real and perceived quality of its products. The tradition of quality began with Perdue's father who founded the plant in 1920 and stressed an "all natural" product in order to meet and/or exceed customer expectations. This "all natural" product philosophy has continued unto the present day and Frank Perdue has made sure that the company is fully integrated with full control over breeding, hatching, raising, feeding, processing, packaging and shipping in order that the "all natural" and safety components are not compromised in any way. However, Frank Perdue was the one who made significant advances in the promotion and inculcation of the quality factor into the entire organisation. The extensive research and efforts undertaken to promote customer satisfaction resulted in Perdue becoming the first poultry producer to affix nutrition labels to its products. That was in 1983 well before government regulations mandated it. Other significant quality initiatives indicating a continuous quest to satisfy its customers and to make a superior product were undertaken. These included research into genetic and breeding techniques and the introduction of innovative services like pre-packaging at the plant, providing recipes in packages, offering a money-back guarantee of quality on all products, and the marketing of a fully cooked chicken. Perhaps the most important factor was the ability to turn the improvements in quality into a substantial financial and competitive advantage.

- Motorola Inc.

Motorola is one of the world's leading diversified electronics manufacturers. They provide cellular telephones, pagers, two-way radios as well as integrated circuits, computer chips, and microprocessor units. Recently they were the principal partners in the development of the Power PC chip.

Motorola competed successfully against elite Japanese companies and emerged as the world-wide leader in cellular phones, pagers and two-way radios. It alternates between the number one and number two positions in the telecommunications segment and is second only to Intel in the microprocessor industry.

Motorola's meteoric rise from a precarious business position can be attributed to its commitment to total quality. Adoption of TQM in 1979 culminated in its winning the Malcolm Baldrige Award in 1988 but the true devotion to total quality can be found in its mission statement. Motorola pledges to "provide [its] world-wide customers [with] what they want, when they want it, with Six-Sigma quality and best-in-class cycle time as [they] strive to achieve [their] fundamental corporate objective of total customer satisfaction." Six-Sigma quality involves 3.4 or less defects per million and requires a doubling of the amount of quality improvement every two years.

- <u>International Business Machines</u>

When the New York Stock Exchange crashed in October 1987 IBM was one of the big losers. It continued on a precipitous decline for the next few years sporadically making some adjustments but none of them were able to prevent IBM from establishing the then world record for a one year operating loss. Finally, on the brink of extinction, IBM realised it had to change its corporate and competitive philosophy. When Gerstner took over in 1993 he brought in new aggressive management which changed the focus of attention (Thomson, 1997). Customer satisfaction, a policy of inclusion for all its employees, employee productivity, cycle time and delivery time reduction, improving quality, and integrating suppliers became the new goals for IBM. The pursuit of these goals has enabled IBM to re-establish itself as a world-class company.

- Nucor

Nucor is one of the United States' largest steel producers and has been featured in the business media as a success story in an industry beset by many problems. It has a very distinct managerial philosophy, which has at its core employee relations and employee satisfaction. Its productivity-linked earnings scale has resulted in Nucor employees producing at the highest rates in the industry while earning wages as high as any comparable industrial business. Bonuses are paid to all employees, from the department manager to accountants, from engineers to receptionists and from secretaries to clerks based on the facility's return on assets.

Nucor maintains an unswerving commitment to uncompromising quality, responsive service and continuous innovation and insists on its equipment being maintained in top operating condition. Its commitment to technological leadership, not only for its products but also for the benefit and safety of its employees, plus its establishment of a teamwork philosophy, form the basis for Nucor being selected as a benchmark company representing the steel industry.

- Whirlpool

In 1995 Whirlpool was the world's leading producer and marketer of major home appliances. Whirlpool's management had concluded some years previously that in order to enter foreign markets and become a global competitor it would have to develop a strategy focused on customers combined with a best-cost, best-quality approach. Whirlpool has been particularly involved with quality circles, employee empowerment, customer satisfaction, the advancement of technology and the adoption of Japanese managerial techniques as detailed in Chapter Two.

- Toyota

Toyota is one of the world's leaders in automobile manufacturing. It has an impeccable reputation for quality and reliability and is able to capitalise on this by charging a higher price. Toyota products depreciate slower and command substantially better resale values than their competitors. This is true for all their market segments including the luxury division Lexus, which is perennially ranked number one in customer satisfaction surveys. Toyota was the inventor and developer of the JIT method of inventory management. Interestingly, Toyota literature does not single out quality goals, visions or initiatives.

- Honda Motor Co., Ltd.

Honda is one of the leading manufacturers of automobiles and the world's largest manufacturer of motorcycles. Honda specialises in expertise and research and development and is one of the few automobile makers to manufacture a unique engine specifically for each item in its product line. Its corporate policy emphasises originality, innovation and efficiency in product development, manufacturing and marketing in order to attain a goal of total customer satisfaction. Honda has striven to offer products of the highest quality at a reasonable price by following its fundamental belief of "bringing joy to people around the world." Honda products have traditionally been able to command higher retail prices because of their quality, reliability and superior resale value.

- Nissan Motor Co., Ltd.

In addition to being a world leader in automobile manufacturing, Nissan also is engaged in the production of aerospace, industrial and textile equipment. Nissan states that its first commitment is to customer satisfaction. Among its corporate principles Nissan lists the creation of attractive, innovative and technologically reliable products, sensitivity to customer needs, maximisation of customer satisfaction and the fulfilment of their requirements.

- Hitachi

Hitachi manufactures an expansive product line of over 25,000 items in Information Systems, Electronics, Power and Industrial Systems, Consumer Products, and Materials. Hitachi's vision is to continue the development and production of high quality, reliable products that please and satisfy their customers. The continuous pursuit of this vision and the resultant successes achieved by Hitachi makes it clearly recognisable as a total quality company.

- Compaq

Compaq designs, develops, manufactures and markets a range of computing products including desktops, portables and towers. It is an innovation-orientated company that established a quality hallmark for itself and sets customer satisfaction as its top priority. In addition to the exceptional warranty and industry-unique 365-day 24-hour hotline support Compaq provides, it continually seeks to introduce new ways of satisfying its customers. Most recently, Compaq implemented a new world-class strategy that entails providing global service and support through their newly formed world-wide alliances.

- Intel

Intel Corporation based out of Santa Clara, California designs, manufactures and markets microcomputer components and related products. It introduced the world's first microprocessor 25 years ago and remains on the cutting edge of computer technology. Intel supplies the computer industry with chips, boards, systems and software that are the components of computer architecture. Intel's mission to be the pre-eminent global building block supplier, its supplier and customer relationships, and its quest for continuous improvement warrants selection for the benchmark group.

- Chrysler Corporation

Chrysler is engaged in the research, design, manufacture, assembly and sale of cars, trucks and related parts and accessories. Principally based in the USA but with a substantial presence all over the world and especially in Europe, Chrysler has been outstandingly successful in the last five years. It recovered from the verge of bankruptcy to becoming the most profitable (measured by profit per vehicle) car company in the world in 1993. Its turnaround was achieved largely as a result of its commitment to teamwork and innovation, a revamping of its relationships with suppliers, adherence to the terms of that relationship through changing conditions and pressures, a reduction in order-to-delivery time and a philosophy of continuous improvement. A more detailed discussion by Chelsom, of Chrysler's remarkable re-engineering journey to a world-class company, can be found on pages 129-132 in the book *Management for Engineers*, (Payne et al., 1996).

5.2.2.2 The Control Group

The term Control Group is not being used in this thesis in its strict empirical sense. As described later on in this chapter in the section on research methodology, the terminology denotes a group of companies selected in response to the need to establish parameters for the rating system to be developed. Companies in the Control Group were selected from industries not particularly known for possessing a total quality philosophy and the targeted companies themselves had no identifiable reputation for a commitment to total quality. Representation of industries included in the benchmark group was also a factor.

Even if quality was mentioned in the literature, no real total quality can be determined to be present if the companies do not discuss specific strategies and initiatives that foster total quality. It was expected that the companies in the control group would score significantly lower than the benchmark group in the ratings. Of particular interest was the degree to which the scores differed.

- <u>Iomega Corporation</u>

Iomega designs, manufactures and markets data storage solutions that help computer users store and transport large numbers of files. Their entry into the market was initiated by the introduction of their line of Bernoulli drives and they have currently taken the market by storm with their Zip, Zip Plus and Jaz drives, and removable media. Iomega is currently the largest supplier of Ditto tape devices in Europe and the third largest supplier of such systems in the world.

The literature does not make any references to quality, and personal communications with Iomega customers (both retailers and end users) revealed negative experiences with the customer service department. A prima facie subjective assessment of this company would indicate that it was not a TQ entity.

- <u>Oregon Steel Mills Inc.</u>

Considered one of the USA's most diversified minimills, Oregon Steel produces a broad line of speciality and commodity steel products. Although the company has recently completed an extensive modernisation programme, no attention seems to have been given to improving quality, reducing time-to-market, or integrating suppliers and/or customers in its production improvements. Rather, the emphasis has been placed on Oregon's self-stated goal of low-cost.

- <u>Estee Lauder</u>

Estee Lauder is a well-known manufacturer and marketer of skin care, make-up and fragrances. Familiar brand names it uses are Clinique and Aramis. No indication of any commitment or consideration to quality or total quality was found in the literature or was brought up in personal communication.

Black and Decker

Black and Decker is based out of Towson, Maryland and manufactures, markets and services power tools and accessories, household appliances, and metal and plastic fasteners for commercial applications. Its products are marketed in more than 100 companies. No reference to quality can be found in the literature or was provided in personal communications.

- Texas Industries Inc.

TXI is one of the USA's leading producers of construction materials, structural products and cement. Its activities are concentrated in Texas, Louisiana and California and it is the largest cement producer in the state of Texas. TXI strives for growth in financial performance through market leadership, technological excellence, innovation and low-cost.

Further communication with the company revealed that TXI strives to maintain its position as the "highest quality, low-cost producer in the market place." Despite the reference to quality, TXI shows no real commitment to total quality initiatives or strategies. The aforementioned statement is vague and has no real meaning. Consequently, it was decided that inclusion in the Control Group is appropriate although it would be interesting to ascertain whether

TXI's stated commitment to high quality, innovation and low-cost is more than lip service.

- Bassett Furniture

Bassett is recognised as one of the largest and best-known furniture brands across the USA and throughout the world. While they profess a desire to provide superior quality, style and affordable prices, no indication is given of any total quality initiatives at the company. Bassett was particularly unhelpful and apathetic when it came to providing data.

- Cyprus Amax

Cyprus is one of the fastest-growing large U.S.-owned mining companies. It produces copper, coal and lithium and is headquartered in Virginia. No mention of quality or total quality is made in their literature and their stated mission is to make the company the most admired mining company in the world, hardly a specific formula for success. Contact with the representatives at Cyprus and obtaining data from them was an arduous and time-consuming task. Based on the information at hand Cyprus Amax cannot be considered a TQ company.

* <u>NEC</u>

NEC is engaged in the development, manufacture and sale of electronic products that comprise three product categories: communication systems and equipment, industrial electronic systems and electron devices. While the corporate philosophy describes a management commitment to customer satisfaction and "tapping the individual uniqueness of each employee," it is devoid of the kind of specific objectives inherent in the philosophies of the companies in the benchmark group. In addition to being a representative of an industry that needs to be covered, it was felt that NEC would be useful as perhaps a company on the cusp of total quality. Since it was hard to predict how NEC would score, its inclusion in the Control Group should prove useful from various analytical standpoints.

5.2.2.3 The Test Group

Companies participating in the test group were selected from various industries using search engines and databases as well as industry reputation or lack thereof. Target companies ultimately consisted of a group comprising total quality and non-total quality practitioners. On-line company information and corporate literature was able to provide a self-perception regarding total quality that could be compared and contrasted with the rating it received.

- Xerox

Referred to by its self-adopted appellation, The Document Company, Xerox is a global company offering an array of document-related business solutions, products and services. It boasts of its Customer First programme dedicated to putting the customer first and ensuring customer satisfaction. Xerox has won 25 quality awards in 20 different countries, including the Deming Prize, European Quality Award and the U.S. Malcolm Baldrige National Quality Award. In 1997 Xerox became a two-time winner of the Baldrige Award when its Business Services won the award. Xerox lists six guiding values as the reasons for its success, among them succeeding through satisfied customers, aspiring to deliver quality and excellence in all they do, and requiring a premium return on assets.

- Solectron Corporation

Based out of Milpitas, California, Solectron is a world-wide provider of electronics design, manufacturing and support services to leading OEM (original equipment manufacturers). It boasts a deepening and broadening commitment to quality and performance excellence and seeks to provide its customers with a competitive advantage. Solectron tries to achieve this by giving its customers access to advanced manufacturing technologies, by shortening the time-to-market and by making more effective use of its assets. It monitors customer satisfaction very closely, seeks to create value through supply chain management and encourages employee efficiency and satisfaction. Solectron won its second Baldrige Award in 1997.

- Raytheon Systems Company

Raytheon is a leader in the development of defence technologies and then converting those technologies for use in commercial markets. It is perhaps best known for its adaptation of World War II radar technology to invent microwave ovens and the development of laser technology. It is one of the largest industrial corporations in the United States and has three main core businesses: defence and commercial electronics, engineering and construction, and business aviation.

Raytheon prides itself on innovation and quality and will only consider a corporation for strategic acquisition or merger if it has a distinguished record of innovation and superior quality. This is evidenced by its recent purchase of the assets of Texas Instruments Inc.'s Defence Systems and Electronics Group (TI-DSEG). TI-DSEG was a 1992 Baldrige Award winner and has achieved six-sigma quality, a significant progressive reduction in product development time each year and has succeeded in establishing integrated relationships with key suppliers. Its management team views TQM as the best approach to solving any problem in the business whether it is employee health care or market share.

- American Standard

American Standard manufactures bathroom and kitchen fixtures and fittings and central air-conditioning systems. It is a global and diversified manufacturer with a high reputation for quality. It is a world-wide leader in Demand Flow Technology (DFT) which is a process designed to enhance customer service by reducing manufacturing cycle time, increasing flexibility and improving product quality. DFT also improves productivity by increasing inventory turnover, reducing the requirements for working capital and reducing non-value-added work.

- Mazda Motor Corporation

Mazda manufactures a diverse line of passenger cars and commercial vehicles. Mazda carries the unique distinction as one of the only automakers featuring three types of engines: conventional gasoline-piston, diesel and rotary.

According to Mazda, wherever their products are sold, the same guiding principle prevails: "the customer always comes first," and all dealers must strive to maintain their high standards for customer service. Mazda claims that it remains committed to R&D efforts to develop vehicles that satisfy the diverse needs of customers world-wide. To pursue this, they created a global R&D network with operations in Japan, the United States and Germany.

In December 1996, Mazda launched Mazda Digital Innovation (MDI). MDI shortens overall development time in manufacturing, achieves cost efficiency, improves product quality, and provides the flexibility to cope with rapid market and consumer demand changes.

- Sony

Renowned for its commitment to research and development and the introduction of innovative products, Sony is one of the world's foremost companies in the consumer and industrial electronics, and entertainment business areas. Its reputation for quality, reliability and technological superiority would seem to indicate that Sony is a TQ company.

- Ameristeel

Formerly known as Florida Steel Corporation, Ameristeel is based in Tampa, Florida and operates electric steel minimills in Florida and Tennessee. It is involved in the fabricating and steel reinforcing business. Very little is mentioned regarding quality or customer initiatives and there is nothing to indicate that Ameristeel is a TQ company.

- Kaiser Aluminum Corporation

Kaiser is one of the world's leading producers and marketers of aluminium and operates in all principal aspects of the business. It mines bauxite, refines it, produces primary aluminium and fabricates aluminium products. It claims to have a commitment to technology, innovation, and supplier relationships.

- Premark International

As the parent company of leading global brands, Premark, which stands for premium trademarks, selects financially strong companies which also have a reputation for superior customer service. No specific total quality initiatives are to be found in this company's literature.

- Birmingham Steel Corporation

Birmingham Steel operates minimills that produce steel and steel products on a low-cost basis. It is based in the USA with operations in Alabama, Illinois, Washington and Ohio. Birmingham Steel claims that its steel bar and rod production facility in Cleveland, Ohio is recognised as one of the highest quality steel bar and rod producers in North America. Although it professes to be on the leading edge of quality products and superior services, no other indications of total quality specifics and objectives could be found.

- <u>National Steel</u>

Based in Mishawaka, Indiana National Steel's main product lines are hot and cold rolled steel, galvanised and other coated steel and tin mill products. It serves the automotive, metal buildings container and pipe industries. With the exception of a reference to restructuring the organisation by consolidating two operating units so that quality could be improved, no reference to quality could be found.

- <u>Weirton Steel Corporation</u>

Weirton steel considers itself a "world-class steel manufacturer" and, as the eighth largest integrated steel producer in the United States, it is "world leader" in the steel industry. It was a division of National Steel until 1982 when the employees purchased the company to become, at that time, the USA's largest wholly employee-owned company.

Weirton's corporate philosophy focuses on working toward producing a quality product and treating customers as well as possible by supplying services requested. It strives to develop new products and markets but not at the expense of quality and service. With a 97% satisfaction rating, Weirton was ranked number one by four percentage points over its closest competitor in the Steel Customer

Satisfaction Report published in a recent survey. Many indications of a total quality programme seem to be present in this company.

- <u>Fedders Corporation</u>

Originally founded as a metal products fabricator, Fedders has concentrated its capabilities on the advancement of heat transfer technology. It has introduced many innovations in air conditioning technology ranging from energy conservation units to units that are smaller and make less noise.

Fedders maintains that the reason for its success lies with its dedication to the highest standards of quality. It established the industry benchmark programme by which suppliers are evaluated for their adherence to company quality standards. Those that fail are dropped and those that excel are honoured. Fedders itself has received ISO-9001 certification.

Other total quality initiatives include their "Accurate-Response" programme, which was designed to meet the just-in-time needs of retailers. It also co-ordinates many facets of its operations using supply chain management.

- <u>The Boeing Company</u>

Located in Washington State, USA, Boeing became the world's largest aerospace company after its merger with McDonnell Douglas in 1997. It develops and produces jet transports, military aircraft, and space and missile systems. From a total quality standpoint Boeing has had a turbulent history. Although it has always been technologically advanced and innovative it has failed to realise that supplier relationships are crucial to the success of any total quality initiative. Section 3.5 outlined in greater detail the problems that beset Boeing with their suppliers. Boeing has recently embarked upon a quality initiative called Vision 2016 indicating the year by which they hope to have all factors of the programme operating. Vision 2016 concentrates on anticipating and responding to customer needs, advancing technological excellence, continuously improving quality, reducing time-to-market, efficient use of assets and keeping employees satisfied. Given its mixed past Boeing's ranking on the total quality scale is unpredictable.

- <u>Nokia</u>

Nokia is the world's second largest mobile phone manufacturer and a leading supplier of digital mobile and fixed networks. It offers advanced solutions and products while striving for continued industry leadership through speed in anticipating and fulfilling customer needs and providing quality in products and processes.

- General Electric

GE is an $80 billion company consisting of fourteen divisions including aircraft engines, plastics, lighting and consumer appliances. Several years ago it initiated a massive programme involving employee empowerment called Work-Out. It was designed to change the corporate culture so as to accommodate the implementation of total quality initiatives. Having done that, it set out to improve quality through the introduction of the Six Sigma methodology for improvement in quality and reduction in defects. GE corporate culture embraces a passion for excellence, a commitment to empowerment and an exhortation to "live quality." However, the perceived and actual quality of GE's consumer products seems to be very poor. A consumer action group (Keehn, 1997) strongly advocates that purchasers avoid GE products. Furthermore, the customer service department has one of the worst reputations in the United States when it comes to helping its clients.

- Ford Motor Company

Having just earned $6.9 billion, the most any automotive company has earned in a year, Ford is a powerhouse in the automotive industry. Several years ago it embarked on a series of total quality initiatives revolving around customer service and the slogan, "Quality is Job One." A statement on its web site, which is dedicated to its customers, demonstrates its commitment to customer satisfaction. "Customer service is not just an art. It's also a science. The art of learning and understanding your expectations as a customer. And the science of exceeding them." Ford has made the biggest improvement in initial quality of any manufacturer and its Atlanta Plant was ranked by J.D. Power and Associates as the factory with the highest initial quality in the world.

Ford has committed itself to delivering value, reducing the proportion of capital spending as it relates to revenue and has publicly announced financial goals and targets. Other total quality initiatives include global integration, technology advances, innovation, the unification of employees, suppliers and dealers into one team and increased speed in delivering products to market.

- <u>Reebok</u>

Reebok is a global sports and fitness company and is a leader in the design and development of authentic athletic products and services. Its philosophy advocates a strong customer relationship by committing to their success. This is accomplished by staying focused on customer expectations and placing a high value on people, their "greatest asset." Reebok professes a commitment to excellence and innovation in everything they do and is a firm believer in employee empowerment.

- <u>Nike, Inc.</u>

Nike designs, develops and markets sports footwear, apparel, equipment and accessory products. It maintains a commitment to high quality and meeting customer requirements, but total quality policies or initiatives are not immediately obvious when perusing the literature. There is an overall sense, however, that quality, customer responsiveness and employee productivity are important to the corporate culture.

- <u>Inland Steel Industries</u>

Inland Steel produces and sells a wide range of steels, including carbon and high-strength, low-alloy grades for the automotive industry and the consumer appliance industry. Inland Steel boasts that it is a premier supplier to some of the most demanding, quality-orientated customers in the world, such as Ford and Maytag. It states that its primary focus is on consistently meeting and exceeding customers' expectations while providing profitable solutions and that it has been successful in so doing. Inland Steel has a corporate mission that is guided by the concept of value creation, customer-orientated engineering, logistics and cost-reduction services.

- International Paper

International Paper manufactures, develops distributes and sells printing papers, packaging, specialty products and forest products. It maintains a close working relationship with its customers in order to create value-added solutions to a variety of paper needs. Its focus is on providing customers with quality products while accepting environmental responsibility.

- Hewlett-Packard

HP designs, manufactures and services electronic products and systems for measurement, computing and communication used by people in industry, business, engineering, science, medicine and education. Its basic business is to accelerate the advancement of knowledge and improve the effectiveness of people and organisations.

HP's two primary corporate objectives are listed, in order, as profit and customers. The profit objective is to finance company growth so as to provide the resources needed to achieve the other corporate objectives. The customer objective is to provide products and services of the highest quality and the greatest possible value to its customers.

HP seeks to attain its customer objective by establishing customer relationships based on its belief that HP exists for the express purpose of satisfying customer needs. This, in turn, can only be accomplished by the active participation and dedication of everyone in the company and through a commitment to quality that extends into every phase of their operations. HP pays particular attention to the use of high-quality materials, innovation and the establishment of rigorous criteria when selecting supplier and production partners.

- Armstrong World Industries

The Building Products Operations of Armstrong is based in Lancaster, Pennsylvania and is the world's largest manufacturer of acoustical ceilings. Additionally, it makes and markets hundreds of products for both home and commercial interiors.

The strategic management process centres on translating customer-focused goals into anticipated impacts on market and financial performance. All quality initiatives are expected to enhance customer value. The company has succeeded in substantially increasing manufacturing output per employee and has been able to quantify the returns on its investments in quality. Most notably, the costs of non-conformance have dropped by 37% since 1991, and in 1994 it was able to reduce operating costs by $40 million while maintaining or increasing its share in each of its markets. Armstrong BPO was a Baldrige Quality Award winner in 1995.

- Eastman Chemical Company

Eastman is a $4 billion company that manufactures and markets chemicals, fibres and plastics that go into such diverse products as beverage bottles, chewing gum, computer diskettes and coatings for floor materials. It is the 10th largest chemical company in the United States.

After losing market share in the 1970's, the company embarked upon a customer-orientated strategy using Baldrige Award criteria for self-assessment. Eastman's primary focus became meeting customer needs by providing high-quality products and services. Currently, it states that total quality management principles and techniques are interwoven throughout all its operations and that it has established key supplier relationships as well as key internal management-employee relationships in order to continuously improve quality. Eastman remains committed to innovation and employee empowerment. It won the Baldrige Quality Award in 1993.

- LTV Steel

LTV claims that it is the leading supplier of high-quality tin mill and tubular steel products and the third largest fully integrated steel manufacturer in the United States. LTV maintains that it makes extensive efforts to continuously improve its products and processes.

In addition to being ISO-9002 certified, LTV offers a 100% guarantee which enables customers to have any purchase of prime flat rolled products from LTV Steel replaced free of charge within one year of the shipment date. Although LTV claims to be geared toward customer satisfaction, many of the strategic initiatives in place seemed to be focused on corrective controls rather than a policy of proactive improvement.

- Maytag Corporation

Maytag is a leading appliance enterprise headquartered in Newton, Iowa. Its principal markets are the five areas of home management: laundry, cooking, dishwashing, refrigeration and floor care. It has always had a reputation for superior quality and particularly reliable products. It maintains and emphasises a strong customer focus and continuously strives for operating excellence. The customer focus revolves around anticipating and meeting the changing needs of its customers and the quest for operating excellence involves, according to Maytag, the effective management of inventories, cost control and asset utilisation.

- Salomon

Salomon is a fast-growing company headquartered in Annecy, France with a strong North American presence. It is the world-wide leader in winter sports equipment sales and has a reputation for innovation and for the introduction of cutting-edge technology. Salomon stresses product quality and a "friendly partnership" with its customers. No other information could be gleaned as to the presence of total quality initiatives.

- General Motors

As a major entity in the automotive industry, GM has rebounded from financial losses, negative cash flows, declining market share and a tarnished image. It has done so through the introduction of many total quality techniques, just-in-time inventory management and a focus on customer satisfaction. Its Cadillac Division won the Baldrige Award and its Saturn Division has earned a reputation as being a "total" company. While many have been critical of GM's approaches as being short-sighted and mercenary, its recent business and financial performance has been outstanding, recovering from a very precarious position in the early part of the decade. Currently, GM has been experiencing some problems, as described earlier in Section 4.4.2, which certainly reflect some of the criticisms levelled at them but any adverse results would not be reflected yet in the data used in the analysis. Upon review, the initiatives and programmes upon which GM has embarked in the last five years have been representative of a TQ company.

- <u>Toshiba</u>

Toshiba is a diverse corporation involved in the development, manufacture and sale of electronic devices, heavy electrical apparatus, consumer appliances and information/communication systems. Its penchant for innovation and cutting edge technology led to the introduction of the world's first laptop PC in Europe in 1985. Ever since, Toshiba has remained the leader in the portable PC market. The corporate philosophy places an emphasis on globalisation, anticipation of changing customer needs, and on an increased ability to bring products to market expeditiously.

- <u>ADAC Labs</u>

ADAC Laboratories is headquartered in Milpitas, California and is a maker of high-technology healthcare products. It initiated a management system based on quality management principles as a way to change the culture of the company after successfully coming out of a turnaround in the mid-1980s. Although it has adopted a number of programmes to focus the employees on customer satisfaction and there is a raised level of consciousness about employee empowerment and productivity, other total quality initiatives such as supplier and customer integration are not present. ADAC won the Baldrige Award in 1996.

- <u>Other Companies</u>

A number of other companies were considered but had to be rejected as a result of their unwillingness to provide information because they were privately held or because there was no breakdown of inventories. Similarly, some companies were rejected because of insufficiency of data. The companies in question were all perceived total quality organisations, a number of which had won Baldrige Awards. They are listed below:

<u>Reynolds Metals</u> – providers of aluminium products to the packaging, construction, distribution, consumer and automotive markets.

<u>Ames Rubber Corporation</u> – a small company based in Hamburg, New Jersey that happens to be the largest manufacturer in the world of rubber rollers for mid to large-sized copiers. It also produces highly specialised parts to protect the transaxle of front-wheel drive vehicles. It has a fierce commitment to customers and makes changes in its total quality techniques in sync with its customers.

<u>Globe Metallurgical Inc</u>. – an Ohio based company producing ferroalloys, it has a reputation for innovation and exceptional total quality initiatives.

<u>Trident Manufacturing Inc.</u> – involved in the manufacture of precision sheet metal components, it continuously strives to improve

quality by encouraging its customers to be more demanding. Trident's core values are customer satisfaction, employee satisfaction, supplier partnerships and operational performance.

Marlow Industries Inc. – is a Dallas, Texas based company manufacturing and selling customised thermoelectric coolers. It embarked upon a programme of continuous improvement using total quality management and set ambitious targets for innovation. Its total quality initiatives have resulted in a substantial increase in employee productivity, a significant reduction in cycle time and a 50% decrease in the costs of non-conformance. Business performance has also soared.

Zytec Corporation – makes power supplies for original equipment manufacturers, as well as electronic office, medical and testing equipment. It has built a total quality commitment programme based on Deming's fourteen points and has succeeding in integrating all aspects of the system to its strategic process.

5.2.3 Data Required

Initial data obtained from the companies was net sales, cost of sales, operating income, earnings before taxes, net earnings, inventories, total assets and the number of employees. A set of data for each company was collected for as many years as was readily available with a minimum requirement being at least three years.

It was decided that a more effective analysis of inventory performance could be achieved if a breakdown of inventories into raw materials, work-in-process and finished goods could be retrieved. In a number of instances the company in question was not willing or able to provide a breakdown whereas in other situations the company simply did not make those classifications. Since extended, summarised financial data does not include inventory classifications, data had to be collected through personal communication, or through obtaining archived annual reports or documents filed with the Securities Exchange Commission.

It was then decided that a trend analysis of some companies may ultimately be appropriate and therefore four years data may be more suitable. The collection of data was expanded to include a fourth year, which necessitated obtaining further archived financial reports or if available the most current report.

Ascertaining the correct number of employees for each given year proved equally difficult in that some companies did not keep track of such data. In some cases data could be obtained from the financial departments whereas in others it was necessary to pursue contact with the human resources department. A number of companies were extremely reluctant to release employee figures and did so only after extensive persuasion, and yet other companies had employee data prominently displayed in their literature or financial reports and even featured several calculations.

In general, it was considerably easier and faster to obtain information from companies considered total quality companies than from those that were not perceived as total quality companies. Furthermore, the total quality companies were far more accessible and provided swift responses by telephone, fax or email.

Another problem encountered in data collection was currency conversion. Many of the Japanese companies could only provide the most recent data in dollars and all prior data was in Yen. Since the analysis covered a time period in which there was a substantial fluctuation in the exchange rate of the dollar versus the yen a more extensive investigation had to be conducted into reconstructing an accurate exchange rate. This particular point is discussed in greater detail in the next chapter.

During the process of data collection it was discovered that the basis for calculating net earnings and/or operating income differed greatly from company to company and as such those two items could be used in any further calculation without jeopardising the integrity of the analysis. Accordingly, those two sets of figures were removed from consideration and discarded.

5.2.4 Survey Distribution

In order to determine managerial attitudes and the level of understanding and commitment to total quality management, a questionnaire was compiled and given to two companies located in New York City, New York. One was Aurora Computing, a Japanese owned computer solutions company, and the second was Smith Barney a huge investment corporation seeking to launch a new total quality programme. The answers supplied, which appear in Appendix II, and the subsequent personal communication revealed that the adoption of slogans and/or buzzwords is simply inadequate. In fact, it may be argued that true practitioners of total quality do not talk about total quality management or just-in-time inventory management, they rather pursue initiatives that by default engender those results.

Distribution of the questionnaire proved difficult in as much that the target companies changed depending on what data they were willing to make available. Furthermore, given the resistance to providing the number of employees and the breakdown of inventories it was decided that a different use of the survey must be entertained. Since the questionnaire did not possess the same construct and content validity as the rest of the analysis, it was decided that the results would be used as an informal gauge of managerial attitudes and levels of commitment present in total quality companies. Accordingly, the questionnaire was distributed to ten TQM companies in the New York metropolitan area. Its distribution was preceded by personal and/or phone contact and, if clarification, was necessary a follow-up was conducted. In a number of cases the companies were extremely reluctant to provide answers. The surveys and the relevant answers appear in Appendix II.

5.2.5 Summary

Companies were targeted for participation in the Benchmark Group, Control Group and the Test Group. Much of the information for the individual companies was obtained from literature, corporate web sites and/or home pages on the world-wide-web and corporate profiles residing in on-line databases and search engines. From this data it could be determined how the company perceives itself and how others perceive the company in terms of its quality perspective and mission. This was extremely valuable for determining the eligibility of companies as participants in the Benchmark group, Control Group and Test Group respectively. For selection into the Benchmark Group this information served to confirm expert opinions and publicly held beliefs about the unimpeachable qualifications of the Target Company as a TQ organisation. Selection into the Control Group and Test Group required that some overall assessment could be made as to how the company perceived itself regarding its quality philosophy. Company-generated literature and home web pages were invaluable in this regard. On-line databases providing corporate information were highly useful in determining how identifiable the company's commitment to total quality was to the industry and/or public at large.

The refusal of private companies to provide financial and other proprietary data necessitated their elimination from participation. This, particularly, had an impact on the development of the Benchmark Group and the Control Group. Most noticeable was the loss of Milliken & Co. and Perdue Farms both of which, as exemplary total quality organisations, could have helped solidify the benchmark ratings.

Difficulty in convincing privately held firms to part with the data required shifted the focus of data collection solely to public companies, which were required, by law, to file documents on the public record. These documents, in a number of cases were used to support verbal communication of data from company executives, and in many others. were supplied by the companies in hard copy or electronic format. In many instances, it was necessary to pursue contact with personnel in operations in order to obtain a breakdown of inventory figures into raw materials, work-in-process and finished goods. Some companies refused to provide this information, either because they did not keep track of it or because they claimed it was too sensitive to release. Notwithstanding the excuse given for not supplying the data, it became apparent that one could not always determine the true reason.

Unfortunately, this caused valuable companies such as Motorola and Reynolds Aluminium to be dropped from the Benchmark Group. Reynolds was the only company to provide a plausible reason for not dividing their inventory into raw materials, work-in-process and finished goods. Reynolds states that since they sell aluminium at all stages of the production process all their inventories are treated as finished goods.

Some potentially interesting companies had to be dropped due to insufficiency of data. It was decided that four years data would be used in order to obtain a balanced assessment over a time period. Some companies could not access needed information (such as inventory breakdown or number of employees for fiscal 1994 or fiscal 1993) and were not yet able to provide the most recent information for fiscal 1997 or fiscal 1998 as was needed. Other companies were sold or taken-over or only went public very recently and data consolidation would have either been inappropriate or impossible. Companies lost at this stage included Westinghouse Electric, Zytec Corporation and Ames Rubber Corporation, all of whom were recent Baldrige Award winners.

Other difficulties included changes in the way items were reported and possible differences between companies. Japanese companies provided only the most current data in dollars whereas all prior years were invariably reported in yen. Given the substantial fluctuation in the exchange rates over the time period in question, it became necessary to ascertain exactly when the reporting was done and what the exchange rate was at that point in time.

5.3 Research Methodology

5.3.1 Introduction

This section explores and outlines the basis for the methodology employed in the research. A summary of some prior techniques is included showing their relevance to the establishment of the direction for the research and the methodology to be used in this study. The requirements for developing an appropriate, effective and valid rating system are discussed and the methods used for completing the assessment of companies' total quality level are presented.

5.3.2 Prior Methods

A review of the literature revealed that there were conflicting opinions as to the sagacity of making changes in quality following the guidelines set forth in the Baldrige Award criteria (N.I.S.T., 1992, 1995) or the European Quality Award assessment model (E.F.Q.M., 1995). Supporters of the Baldrige Award can cite studies by the

United States General Accounting Office (1991) and by Wisner and Eakins (1994) which link improved performance with quality and imply that the presence of total quality programmes results in superior financial performance.

A study seeking to render the Baldrige Award and other self-assessment networks empirically valid, (Black and Porter, 1996) champions the use of the Baldrige Award criteria in adopting total quality initiatives. In its identification of the critical factors of Total Quality Management, however, no mention is made of Inventory Performance.

Finally, a study concluding that the implementation of an effective TQM programme improves operating performance, (Hendricks and Singhal, 1997) equates the winning of awards with the successful adoption of a total quality programme. Moreover, the study suggests that financial and operating performance need not necessarily suffer during the implementation period. Nonetheless, it remains to be seen whether the pursuit and/or winning of awards is a clear enough indicator of the presence of effective Total Quality Management even if business performance improved subsequent to winning the prize.

Contrary points of view are equally abundant and even go so far as to state that the pursuit, and even winning, of awards is actually counterproductive to developing a successful and financially rewarding total quality programme. The range of studies extends from those that analyse the failures and near bankruptcies of Baldrige Award winners to those asserting that the Baldrige Award reinforces a preoccupation with internal processes as opposed to a focus on external outcomes (Harari, 1996). This results, says the author, in a firm becoming more "efficient" but less responsive, flexible and interesting, hence less "effective."

5.3.3 Methods Used for Analysis

This section outlines the systemic factors used in conducting an analysis of the data collected. They include managerial attitude, employee value and productivity, financial performance and inventory management.

5.3.3.1 Inventory Management

The primary focus of this thesis is the link between inventory management as it approaches a just-in-time basis and the presence of total quality. It was decided that a more extensive investigation than just inventory turns using total inventory would be appropriate. Accordingly, ratings were developed using raw materials, work-in-process and finished goods as separate factors. Since raw materials and work-in-process were very often combined in company inventory breakdowns they were treated as one entity. Therefore, the data for companies itemising them separately was combined. Finished goods were treated as an individual category and the next chapter discusses the basis for attaching equal or greater importance to them.

5.3.3.2 Financial Performance

As was demonstrated in the previous chapter, return on capital employed (R.O.C.E.) is a systemic factor, which should be directly affected by the presence of total quality. Any form of total quality management that does not generate financial rewards cannot be "total" since it has been proven that excellence in quality yields to excellence in business performance.

5.3.3.3 Employee Value

As a result of the response from Aurora International wherein Mr. Hanabusa preferred to pay his own employees a "consultancy bonus" rather than hire an outside consultant, it became clear that greater attention needs to be paid to the contribution employees make to the efficiency and profitability of the company. Subscribing to a total quality philosophy, be it TQM, CQI, BPR or any other popular programme will not, of itself, provide immediate relief from all the organisation's problems. Ultimate success will depend upon the cultivation of a new corporate culture, which values employees (Anderson and Adams, 1997) as the most important resource of the organisation. Accordingly, it was decided to investigate "profit and/or sales per employee" as a performance measure that quantifiably reflects the contribution employees make to the level of quality and business success in the organisation.

Although no prior attempts have been found in the literature to involve sales and/or profit per employee in the assessment of total quality management, a study (Hendricks and Singhal, 1997) that attempts to link effective quality programmes with operating performance, which includes employee productivity, has just been published. This thesis seeks to include employee value as one of the measures used in evaluating the level of total quality present in the organisation.

5.3.3.4 Managerial Attitude

A lack of management commitment has been cited (Tatikonda and Tatikonda, 1996b) as one of the ten reasons that Total Quality Management has not improved business performance. Accordingly, the contributions of human resource factors such as managerial attitude and commitment, philosophy and team management were explored through a two-stage distribution of the questionnaire shown in Appendix II. This survey was discussed earlier in greater detail in Section 4.4.3.4 and the ramifications of the responses are analysed in the following chapter.

5.3.4 The Research Process

On the assumption that the relationship between inventory performance and quality holds true, a model was developed for assessing the actual level of total quality a firm operates at based on the success of its inventory control. Once the parameters linking inventory performance with quality have been determined all that would be required would be to input an objective evaluation of a firm's inventory situation. The model would then generate the extent to which a total quality control philosophy is demonstrably present. Figure 5-2 appearing below outlines the procedure that was followed for gathering the data and developing a rating system so that final analysis could be performed.

A rating system was developed using inventory data for raw materials, work-in-process and finished goods. At this point it became necessary to eliminate several companies because or their unwillingness or inability to provide inventory data. The companies in question were Milliken & Co., Perdue Farms and Motorola all selections for the benchmark group.

Eventually, forty data points were used from the benchmark group and three rating systems were calculated using different bases of evaluation depending on the weight attached to finished goods inventories. Upon further examination a final rating system was selected.

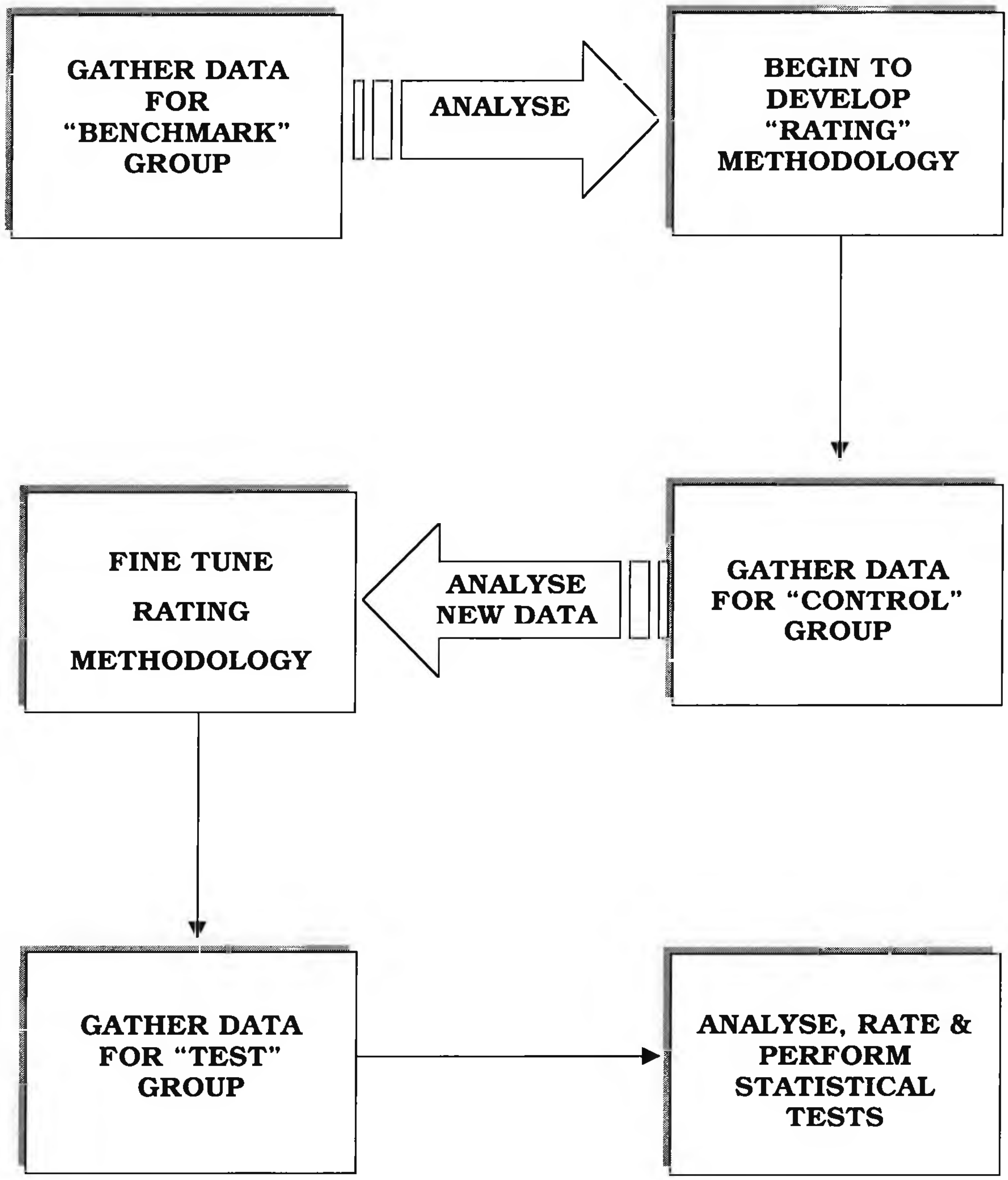

Figure 5-2: The Research Methodology Process

In order to establish some parameters and to better appreciate the significance of the results, further inventory data from the control group was examined and the ratings were compared to those of the benchmark group. The rating system was then "fine tuned" and data was collected for the test group. Calculations were performed for the entire sample population and ratings were assigned to each company. Similar methods were used for the development of rating systems based on R.O.C.E. and employee value. Analysis of the ratings is discussed in the next chapter.

5.3.5 Normalisation of Data

Another important part of the research methodology was the normalisation of data. The dollar levels of inventory would differ from company to company depending on the product. If company A manufactured paper clips and company B produced integrated circuit boards the raw dollar data would reflect that company B had a significantly higher dollar value of inventories. However, in reality company B may have negligible inventories whereas company A could have inventories that were huge. Additionally, the measurement scale used could seriously affect the impact each factor would have in a combination situation.

To remedy these potential problems a process of normalisation was embarked upon. Two different approaches were considered and it was decided to incorporate "cost of goods sold" which, in addition to placing dollar levels of inventory in context to their cost, would also render the final numbers "unitless." Furthermore, "cost of goods sold" was also a factor used when calculating "inventory turns."

Another problem to address was the fluctuation in the conversion rate between the yen and dollar and the fact that some data was only made available in one currency. Investigation of prevailing exchange rates for the time period in question enabled conversion of everything into dollars. The final normalisation process utilised ensured that consistency was maintained between the years. Further details are supplied in the following chapter.

5.3.6 Combining Factors

When it became necessary to combine raw materials, work-in-process and finished goods two different approaches to combining factors were considered each consisting of a weighted and non-weighted scoring method. Similarly, when Inventory, R.O.C.E. and Employee Value were combined a choice had to be made concerning the method to be used. Of the methods available for resolving this problem when combining factors, two principal ones, Arithmetic Weighted Average of Attributes (additive) and Dimensionless Analysis (multiplicative) were examined. It is particularly important to select an appropriate method when different weights are to be assigned so as to prioritise sets of data correctly and to resolve the problem of comparing "oranges and apples." The analytical process for evaluation of these methods and the final method selected are discussed in Section 6.2.2 in the next chapter.

5.3.7 Survey Distribution

As mentioned earlier in the chapter, the role of the questionnaire was limited to an exploratory, informative one which could facilitate the identification of key managerial attitudes and policies necessary for committing to a successful total quality management programme. Accordingly, the survey was distributed to companies which professed to operate under total quality management guidelines. Since personal interviews were necessary to ensure responses, distribution was limited to companies located in the New York area with the exception of Boeing. Completed questionnaires were obtained from the following 10 companies in addition to the initial two companies researched and outlined earlier in this and the previous chapters: Boeing Corporation, Esselte Corporation, Cendant Corporation, New York Public Library, ILC Data Device Corporation, Telephonics Corporation, The Horizon Group, Citibank, MetTel, and Symbol Technologies.

Many of the answers reinforced the theories heretofore enumerated in this thesis. They pointed to shorter times to market, employee satisfaction and productivity and responsiveness to customers' changing needs as being the key philosophies and commitments that drive total quality. This served to confirm the need to look at systemic factors such as inventory management, return on capital employed and employee value as being indicators of the presence of an effective total quality programme. As previously mentioned, responses to the questionnaires and comments thereon can be found in Appendix II.

5.3.8 Summary

This section discussed the research methodology used for developing a model that was able to assess the presence of total quality. Prior methodologies were reviewed and analysed and a description of the methods of evaluation to be used in this project was provided.

An overview of the research process was presented along with a diagram outlining the main stages directing the methodology used in the research. A discussion of the development of a rating system for the various factors culminated in the basis for the use of a benchmark group and a control group.

The requirements for normalisation of data as well as the potential problems inherent in combining factors emanating from different measurement scales were addressed. An overview of possible solutions was submitted.

5.4 Summary and Conclusion

This chapter presented the elements and requirements of the research design and a flow chart for conducting the process of data collection was presented. Industries were targeted and 58 companies were identified for data collection. Three years worth of data was sought initially but in anticipation of a more comprehensive evaluation incorporating some trend analysis this was increased to four years. Eventually some of the companies had to be dropped from consideration because of insufficiency of or incomplete data.

Private companies were unwilling to provide any or all of the data requested and this resulted in the loss of Marlow Industries, Ames Rubber, Globe Metallurgical, Perdue Farms, Milliken & Co., Westinghouse Electric, Trident Manufacturing and Zytac (which went public only in 1996).

Motorola and Reynolds were also dropped because they did not classify their inventories into raw materials, work-in-process and finished goods, which was necessary for participation in the rating system.

A description of the three groups, benchmark, control and test, into which the selected companies were placed was presented and a corporate profile and background was provided for each of the companies in its respective group. Particular attention was paid to the companies' total quality initiatives, specific strategic processes for quality and their self-perception regarding quality. Where possible the public perception or objective evaluation instruments were included in the assessment of the company. This was crucial for comparing how the rating based on the model developed in this thesis compares with the self and/or objective perception of the presence of total quality.

A discussion of the benefits and difficulties of a self-developed survey was presented and it was decided to use the survey as an informal guide to assessing managerial attitudes present in total quality management firms. It was found that crucial factors to look for and examine more closely in a quantitative fashion could be indicated by the survey but use of the questionnaire as an empirically valid document for inclusion into a multifactor model would be inappropriate.

The second part of the chapter dealt with the research methodology used and a diagram of the research process was presented. An explanation of the various rating methods to be employed and the process by which a rating system was developed was discussed. The main problems in dealing with different types of data (apples and oranges) possessing different measurement scales were presented and additional potential problems that could arise from combining data were examined. General solutions such as normalisation, arithmetic weighted-averages and dimensionless analysis were entertained but the final approach was left to be determined in the following chapter which details the analysis performed.

CHAPTER SIX

6.0 DATA ANALYSIS AND TESTING

6.1 Introduction

This chapter deals with the analysis and testing of the data collected. Initially, the inventory performance of the benchmark companies was examined using a variety of rating methods. Ultimately, one rating method was selected and the individual years' results were consolidated into one overall inventory rating for each company.

The importance of normalising data is discussed and the problems inherent in combining various different criteria are addressed. Some solutions to these problems are presented and the final methodology to be used is decided upon. After inventory ratings have been completed for the benchmark group, consisting of known TQ companies, they are applied to the control group, which consists of companies with no discernible total quality philosophy or programme in place.

Although, as expected, the benchmark companies scored much better than the control group there still were areas of overlap. Other system-wide factors such as R.O.C.E. and Employee Value are introduced and combined with inventory to form a multifactor rating which should help clarify some of the uncertainty.

The full range of data collected as well as some of the unremarkable or even unuseful results of analysis can be found in Appendix I. Selected results are presented here when required for illustration and to inform the reader. All data is in billions of dollars. In anticipation of consolidation of data and the eventual need to combine numbers into a multifactor model, it is appropriate to discuss the methods available early in this chapter.

6.2 Multifactor Analysis

Often, when there are multiple objectives to be satisfied the difficulty in finding a solution increases with the number of objectives. Each potential solution will have a set of outcome measures associated with it rather than a single outcome. Additionally, when there are multiple attributes they may not all lend themselves to quantitative measurement since they may have different measurement scales and their order of magnitude may not fall in the same frame of reference.

6.2.1 Alternatives for Data Normalisation

As previously discussed, whenever the possibility of combining different factors is contemplated a potential need for data normalisation arises. This is largely true because a change in the scale of measurement for the data will result in a completely different outcome simply because of the change in the magnitude of the numbers involved. In a situation where the factors are measured in different units the need for normalisation is even greater.

This can best be illustrated by the following simple example in which an individual would like to evaluate possible job opportunities based on two factors, the amount of salary and the amount of vacation time. The salary would most likely be expressed in terms of thousands of dollars and the vacation time in terms of days, ergo one is a very large number and the other quite small. Should this individual wish to combine the factors into an overall "job rating" the magnitude of the salary scale would overwhelm the vacation time score. If the factors were to be weighted then assigning even a significantly higher weight for the vacation time score would still not compensate for the discrepancy in the magnitude of the numbers. Alternatively, assigning a higher weight for the salary factor would effectively remove any input the vacation time score would have into the final job rating score.

Simply changing the scale of measurement could further compound this problem. If vacation time were to be measured in weeks then its impact would be non-existent and if it were to be measured in seconds then it would render the salary score insignificant. Similarly, the salary could be measured weekly or hourly rather than annually and in each case the final job-ranking evaluation would change, not because the data or the weights changed but simply because the scale of measurement changed.

In anticipation of the types of data analysis to be performed it was necessary to develop a method for normalising the data. Two methods were considered and they are elaborated upon in the sections that follow.

6.2.1.1 Normalisation Using the Maximum Score

This method involves using the maximum score to normalise the data. Each data point generated is divided by the maximum value in the set. The mathematical result is that the highest score will have a value of 1.0 and every other data point will have a value of less than 1.0 with the lowest scores having values that approach zero. However, this will not be true if there are negative values in the data set and consequently this method should not be used in such a case. However, since by definition all inventories are positive this was not a problem in this particular situation. Use of this method ensures that all the scores are between 1.0 and 0.0 and therefore, the measurement scale for every set of data is the same, regardless of the scale used in the original evaluation. Accordingly, when different sets of data are to be combined there will be no distortion of the impact the data might have on the overall score simply as a result of the measurement scale used.

6.2.1.2 Normalisation Using Cost of Goods Sold

An alternative method to be considered is dividing the inventory levels for each data point by the corresponding "cost of goods sold" for that data point. In addition to normalising the data, this method would provide a potential solution to problems that might arise when performing more advanced analysis.

6.2.1.3 Selection of Normalisation Method

One problem that needed to be addressed immediately was possible discrepancies in the dollar value of inventory that were due simply to the value of the items produced. Therefore, a company manufacturing paper clips would have a much lower dollar value of inventory than a company manufacturing silicon chips even though the paper clip company may actually have significantly higher levels of physical inventory. Dividing by the cost of goods sold would eliminate this discrepancy since each inventory rating would become a function of the inventory value relative to the value of the cost of the item manufactured. As such, the resultant number would become "unitless" since the dollars (value) would appear in both the numerator and denominator of the equation.

Another concern was the fluctuation in exchange rates from year to year, which would affect the dollar value of inventory. This was especially important when converting Japanese Yen, which had significant changes from year to year. In 1995 the Yen was very strong at 89 Yen to the dollar as opposed to 1994, 1996 and 1997 when they the exchange rates were 102, 106 and 124 Yen to the dollar respectively. Dividing by the cost of goods sold removed any problems with currency conversion since, as mentioned previously, the resultant number would be unitless. Therefore, even if the raw data were in Yen, Francs or Sterling the inventory ratings generated from all data points would fall in the same measurement scale.

In anticipation of possibly having to combine various factors at a later stage in the analysis, a potential obstacle was identified with using the "dividing by the maximum score" method. It was expected that Dimensionless Analysis, which involves multiplying factor scores as discussed later in this chapter in Section 6.2.2.2, would be used as a means of combining factors. Accordingly, a measurement scale that, by definition, must contain a score of 1.0 would be inappropriate since multiplying anything by 1.0 has no effect.
It was therefore decided that the preferred method would be to divide each inventory data point by the corresponding costs of goods sold.

6.2.2 Alternatives for Combining Multiple Factors

For many decision problems the list of objectives can be rather extensive. If one were in the market for a house purchase there would be many different criteria to evaluate, such as cost, proximity to transportation, proximity to work or schools, amount of space, and the quality of the neighbourhood. As the number and diversity of the factors to be evaluated increases so does the complexity of the problem. This, in turn, impacts adversely on the ability to find the "right" solution. The goal, therefore, is to be able to combine several factors into one overall ranking that accurately reflects the relative importance of the various criteria evaluated. In Section 5.3.6 two different methods for solving multiple objective problems were introduced and they are presented in greater detail in this section.

6.2.2.1 Arithmetic Weighted-Average of Attributes

A commonly used approach is to assign a weight to each of the attributes in direct proportion to their relative importance, and to add up the weighted scores for each attribute thus providing a weighted-average score. The alternative with the best weighted-average score would be selected.

One of the problems, however, in dealing with a weighted-average score is that it does not readily lend itself to meaningful interpretation. When combining different attributes in an additive manner the resulting average is, in essence, a meaningless number similar to the result of adding oranges and apples. A second problem is that, as with the Maximum Score Method of Normalisation discussed in Section 6.2.1.1, a change in the scale of measurement will result in a change in the relative ranking of the alternatives.

6.2.2.2 Dimensionless Analysis

Dimensionless Analysis (Bridgman, 1922) is a method of combining factors in a way that is free from the influence of the units in a measurement scale and also from the problems inherent in meaningful interpretation of an overall rating score that includes different criteria.

In Dimensionless Analysis, factors are combined multiplicatively. Each alternative is evaluated by multiplying sets of ratios and weights are assigned, if so desired, by raising each ratio to a power equivalent to its relative weight. Since whatever unit of measure appearing in the numerator will also appear in the denominator, the units will cancel out rendering the final number dimensionless. Therefore, the final ranking will always remain consistent irrespective of either the unit of measure or the measurement scale used.

Another advantage of using dimensionless analysis is the effect of the weights on the ratios. The higher the weight the more exaggerated the difference will be whether it is a movement in a "good" direction or a "bad" direction. In all cases the proportionate ranking between the alternatives is preserved. This is important because conclusions can be drawn and preferences established based on the actual score each alternative receives relative to the other alternatives in the problem.

Due to the weights being assigned as exponents, caution must be exercised in establishing the magnitude of the relative weights assigned to each of the criteria in the problem. It is possible that even a "small" change in weights could lead to significantly different results. Further elaboration and an example of dimensionless analysis can be found in *Management Science,* (Dannenbring and Starr, 1981) pp. 112–119.

It was decided that the choice of whether to use the arithmetic weighted-average method or the dimensionless analysis would be made dependent on the kind of analysis to be performed. Each stage in the subsequent analysis will indicate the method selected.

6.2.3 Summary

Since this thesis deals with three different ways of combining inventory in order to establish a rating of a company's inventory management effectiveness, it was necessary to examine alternative methods for combining different factors. Furthermore, as it became evident that other criteria such as R.O.C.E. and Employee Value were going to be introduced, additional methods appropriate for conducting an analysis of problems with multiple objectives had to be explored. Any method selected would have to be equipped to reconcile the problem of different units of measure and different measurement scales.

It was decided that the inventory data would be normalised through dividing the inventory dollar amounts by "cost of goods sold." This removed the unit of measure from the equation. It also simultaneously eliminated any potential problems from simply examining the dollar value of the inventories held by firms. Not taking into account the inherent value of the goods produced could give the erroneous impression that high dollar values of inventory are necessarily indicative of high physical inventory levels.

An examination of different methods for combining multiple factors revealed that there could be potential problems with using just an arithmetic weighted-average method. The concept of using an alternative method, dimensionless analysis, was introduced. The decision as to which method was used was made on a case by case basis and is indicated at each appropriate stage in the subsequent analysis.

6.3 Inventory Analysis of Benchmark Companies

As detailed in Section 5.2.2.1, ten companies were selected for inclusion into the benchmark group. Each had a reputation for total quality and additionally, the introduction of total quality initiatives at some point could readily be identified. After selection a check was run to see if the data for raw materials, work-in-process and finished goods had been itemised. In some instances companies did not delineate work-in-process and, upon further investigation, it was discovered that in such cases the raw materials inventory included work-in-process items. Since there was no apparent reason to assign a higher weight to either raw materials or work-in-process it was decided that they could, and indeed should, be combined. The inventory breakdown, in billions of dollars, for the benchmark companies is presented in

Table 6-1 below. It contains each data point for all ten companies over all the years covered.

6.3.1 Inventory Rating Methods

Three rating methods were developed based on whether finished goods inventories should be prioritised and if so to what extent. As mentioned in the previous section, initial consideration was given to dividing each data point by the highest value in the population in order to normalise the data. However, it was ultimately decided that each data point, expressed in dollars, should be divided by the corresponding cost of goods sold.

Table 6-1: Inventory Breakdowns by Year for Benchmark Group

COMPANY	YEAR	RAW MATERIALS	WORK IN PROCESS	FINISHED GOODS
Chrysler	1997	1.4400		1.8800
Chrysler	1996	1.5400		1.5700
Chrysler	1995	1.4600		1.2300
Chrysler	1994	1.2200		1.1500
Compaq	1997	0.7700		0.8000
Compaq	1996	0.6300		0.6300
Compaq	1995	0.7700	0.2700	1.1100
Compaq	1994	1.0130	0.2660	0.7260
Hitachi	1997	1.3150	8.4720	2.9290
Hitachi	1996	1.5963	10.4236	4.0853
Hitachi	1995	1.5700	12.1120	3.9440
Hitachi	1994	1.2900	10.0300	3.4700
Honda	1997	1.1500	0.1400	3.1400
Honda	1996	1.0500	0.1600	3.3900
Honda	1995	1.0430	0.1480	3.8070
Honda	1994	1.0430	0.1480	3.8070
IBM	1997	0.0200	4.0300	1.0900
IBM	1996	0.0800	4.3800	1.4100
IBM	1995	0.0920	4.9900	1.2400
IBM	1994	0.2560	4.6400	1.4400
Intel	1997	0.2600	0.9300	0.5100
Intel	1996	0.2800	0.6700	0.3400
Intel	1995	0.6700	0.7100	0.6200
Intel	1994	0.3450	0.5280	0.2960
Nissan	1997	1.2903		4.3145
Nissan	1996	1.4689		5.2825
Nissan	1995	1.8090		5.9551
Nissan	1994	1.5707		5.1707
Nucor	1997	0.2380		0.1588
Nucor	1996	0.2320		0.1544
Nucor	1995	0.1688		0.1381
Nucor	1994	0.1337		0.1093
Toyota	1997	0.5700	0.7600	3.0100
Toyota	1996	0.6500	0.7000	3.4300
Toyota	1995	0.7010	0.6960	3.6970
Toyota	1994	0.4400	0.5280	2.9200
Whirlpool	1997	0.3040	0.0690	1.0200
Whirlpool	1996	0.2100	0.0590	0.9900
Whirlpool	1995	0.1900	0.0840	0.9800
Whirlpool	1994	0.1600	0.0660	0.8300

Expressing each firm's value of inventory in terms of the cost of the items it manufactures ensures that every company's inventory levels are accurately portrayed. The equation is also representative of the formula for calculating inventory turns with the difference being that it was decided in this case to take the reciprocal so that low numbers reflected superior inventory management whereas, normally, high inventory turns indicate better inventory management.

For all three rating methods, if raw materials and work-in process, were not itemised separately, it was assumed, based on company information, that the raw materials level included work-in-process items. If raw materials and work-in-process were itemised as two separate categories, then they were added together into one lump sum which will be referred to as non-finished goods inventories. In either situation the final number obtained for the non-finished goods inventories was then combined with finished goods subject to the parameters of the rating method. In the formulae below, Raw Materials, Work-in-Process Finished Goods and Cost of Goods Sold have been abbreviated as RM, WIP FG and COGS respectively.

6.3.1.1 Rating Method 1

The premise upon which Rating Method 1 is based is that all inventories should be treated equally. Consequently, no differentiation should be made between non-finished goods inventories and finished goods inventories when assessing the effectiveness of a company's inventory policy. The formula for calculating Rating Method 1 is:

$$\frac{(RM+WIP+FG)}{COGS}$$

Each category was divided by cost of goods sold as previously explained. Since there was no prioritisation of types of inventory and the measurement scales were the same, an arithmetic weighted-average was used and equal weights were assigned to each category. The results are shown in Table 6-2 below.

6.3.1.2 Prioritising Finished Goods Inventory

Rating Methods 2 and 3 involve assigning a higher weight to the level of finished goods inventory. Such an action implies that low levels of finished goods inventory are likely to be more indicative of total quality than are low levels of other types of inventory. This section explains the basis for that rationale.

If we accept the premise that a staple ingredient of a total quality company is meeting and/or exceeding customer requirements, then the manufacturing process must be flexible enough to accommodate changing customer needs. High levels of finished goods inventories certainly will reduce the amount of time it takes to deliver the product to the consumer but will it be the product that the consumer wants? In other words, will it simultaneously increase customer satisfaction? The answer would have to be that it is unlikely.

Table 6-2: Inventory Rating Method 1

COMPANY	YEAR	RATING 1	COMPANY	YEAR	RATING 1
Chrysler	1997	0.0707	Intel	1997	0.1709
Chrysler	1996	0.0678	Intel	1996	0.1408
Chrysler	1995	0.0651	Intel	1995	0.2561
Chrysler	1994	0.0623	Intel	1994	0.2096
Compaq	1997	0.0881	Nissan	1997	0.1389
Compaq	1996	0.0848	Nissan	1996	0.1517
Compaq	1995	0.1749	Nissan	1995	0.1475
Compaq	1994	0.2463	Nissan	1994	0.1456
Hitachi	1997	0.2522	Nucor	1997	0.1108
Hitachi	1996	0.2929	Nucor	1996	0.1231
Hitachi	1995	0.2908	Nucor	1995	0.1058
Hitachi	1994	0.2868	Nucor	1994	0.0975
Honda	1997	0.1487	Toyota	1997	0.0542
Honda	1996	0.1581	Toyota	1996	0.0562
Honda	1995	0.1541	Toyota	1995	0.0659
Honda	1994	0.1816	Toyota	1994	0.0489
IBM	1997	0.1881	Whirlpool	1997	0.2109
IBM	1996	0.2169	Whirlpool	1996	0.1902
IBM	1995	0.2405	Whirlpool	1995	0.2006
IBM	1994	0.2439	Whirlpool	1994	0.1775

In fact, high inventory levels of finished goods would actually be counter-productive to meeting customers' needs. Efforts would be directed to sell what they have rather than what the customer wants in an attempt to use up inventory. This is another example of how inventory can hide the problems lying beneath the surface. Conversely, if a company has low finished goods inventories then it must be manufacturing "to specification" that is, meeting customer requirements. The low finished goods inventories not only affords the company greater flexibility to produce that which the customer wants but it actually <u>requires</u> the company to produce that which the customer wants as opposed to trying to unload something from inventory.

When total quality companies endeavour to shorten their time-to-market none advocate doing so at the expense of the customer or by maintaining high levels of finished goods inventory. Chrysler President, Thomas Stallkamp, stated in a very recent interview, (Fuller, 1998) that Chrysler had managed to decrease the time (and the costs) to make a car. Now they were looking at reducing the distribution time for delivery while still <u>increasing customer satisfaction</u>. It is not surprising, therefore, that he does not suggest increasing the levels of finished goods inventories to shorten the distribution time.

Raw materials, and to a slightly lesser extent work-in-process, have the advantage that they possess greater flexibility in what they will eventually turn out to be. In any given company there is, as described by Chelsom (1998b) a trombone effect in which all end products start out from the same raw materials. The raw materials can actually become any one of a number of final products and they remain in this generic limbo through most of the work-in-process stage. It is only at the very end of the production process that they "fan out" and take on the degree of specialisation and uniqueness that go into each item in the product line. It can therefore be deduced from this principle that high levels of raw materials inventories are not an obstacle to flexibility in the manufacturing process and thus not an impediment to meeting customers' needs.

There can be no question that low raw materials inventories combined with a high utilisation rate within the production process demonstrates the presence of high quality incoming raw materials coupled with good supplier performance. They do not, however, necessarily indicate that there is a high level of customer satisfaction. Essentially, carrying low levels of raw materials and work-in-process inventory relates more to the existence of producer satisfaction than customer satisfaction. It is for these reasons that finished goods inventories deserve more weight when evaluating inventory performance as an indicator of the presence of total quality.

6.3.1.3 Inventory Rating Method 2

By giving finished goods a weight twice that of the non-finished goods, Rating Method 2 reflects the greater significance attached to finished goods inventory levels. The inventory performance scores using this method are shown in Table 6-3 below.

Table 6-3: Inventory Rating Method 2

COMPANY	YEAR	RATING 2	COMPANY	YEAR	RATING 2
Chrysler	1997	0.0492	Intel	1997	0.3142
Chrysler	1996	0.0394	Intel	1996	0.1429
Chrysler	1995	0.0314	Intel	1995	1.1135
Chrysler	1994	0.0293	Intel	1994	0.4412
Compaq	1997	0.0869	Nissan	1997	0.3655
Compaq	1996	0.0762	Nissan	1996	0.4648
Compaq	1995	0.6903	Nissan	1995	0.4398
Compaq	1994	1.2499	Nissan	1994	0.4228
Hitachi	1997	0.6554	Nucor	1997	0.1308
Hitachi	1996	1.2065	Nucor	1996	0.1786
Hitachi	1995	0.9560	Nucor	1995	0.1320
Hitachi	1994	0.9938	Nucor	1994	0.1032
Honda	1997	0.4806	Toyota	1997	0.0235
Honda	1996	0.5643	Toyota	1996	0.0258
Honda	1995	0.5062	Toyota	1995	0.0414
Honda	1994	0.8285	Toyota	1994	0.0164
IBM	1997	0.2360	Whirlpool	1997	1.3474
IBM	1996	0.4475	Whirlpool	1996	0.9088
IBM	1995	0.4300	Whirlpool	1995	1.0779
IBM	1994	0.5790	Whirlpool	1994	0.7391

It was decided that Dimensionless Analysis was more appropriate when assigning weights so in keeping with the rules for assigning weights in multiplicative combinations the finished goods category was squared. The formula for calculating Rating Method 2 is:

$$\left[\frac{RM+WIP}{COGS}\right] \times \left[\frac{FG}{COGS}\right]^2$$

6.3.1.4 Inventory Rating Method 3

Given the reasons enumerated in the Section 6.3.1.2 for attaching greater significance to inventory levels of finished goods when evaluating inventory performance, it was decided to conduct a rating with an even higher weight assigned to the finished goods category. Once again, for the same reasons as outlined in the previous section, Dimensionless Analysis was used and in this rating method the inventory levels for finished goods were cubed.

The formula for calculating Rating Method 3 is:

$$\left[\frac{RM+WIP}{COGS}\right] \times \left[\frac{FG}{COGS}\right]^3$$

The inventory performance results generated using Rating Method 3 are presented in Table 6-4 below.

Table 6-4: Inventory Rating Method 3

COMPANY	YEAR	RATING 3	COMPANY	YEAR	RATING 3
Chrysler	1997	0.0197	Intel	1997	0.1611
Chrysler	1996	0.0135	Intel	1996	0.0530
Chrysler	1995	0.0093	Intel	1995	0.8840
Chrysler	1994	0.0089	Intel	1994	0.2342
Compaq	1997	0.0390	Nissan	1997	0.3908
Compaq	1996	0.0323	Nissan	1996	0.5517
Compaq	1995	0.6234	Nissan	1995	0.4975
Compaq	1994	1.1148	Nissan	1994	0.4720
Hitachi	1997	0.3808	Nucor	1997	0.0580
Hitachi	1996	0.8963	Nucor	1996	0.0878
Hitachi	1995	0.6221	Nucor	1995	0.0629
Hitachi	1994	0.6687	Nucor	1994	0.0453
Honda	1997	0.5064	Toyota	1997	0.0088
Honda	1996	0.6574	Toyota	1996	0.0104
Honda	1995	0.5943	Toyota	1995	0.0198
Honda	1994	1.1463	Toyota	1994	0.0060
IBM	1997	0.0941	Whirlpool	1997	2.0810
IBM	1996	0.2332	Whirlpool	1996	1.3590
IBM	1995	0.2028	Whirlpool	1995	1.6901
IBM	1994	0.3209	Whirlpool	1994	1.0310

6.3.2 Discussion and Summary of Rating Methods

Having completed the inventory ratings of the benchmark companies using the three different methods, the results were tabulated in rank order in order to effect a comparison between the different methods. The rankings are presented in Table 6-5 on the next page.

It became evident, even from a simple visual analysis of the data, that a meaningful interpretation of the data in its present form would be impossible. For this, as well as other reasons outlined in Section 6.3.3 the yearly data was aggregated for each company and consolidated rating was obtained for each organisation.

6.3.2.1 Other Inventory Rating Methods

Other methods utilised only the companies that provided a breakdown of inventories into each of the three categories of raw materials, work-in-process, and finished goods. Each category was then weighted separately. However, since there were no significant findings to report they have not been included here. The results appear in Appendix I.

Table 6-5: Rankings Using All 3 Rating Methods

COMPANY	YEAR	RATING 1	COMPANY	YEAR	RATING 2	COMPANY	YEAR	RATING 3
Toyota	1994	0.0489	Toyota	1994	0.0164	Toyota	1994	0.0060
Toyota	1997	0.0542	Toyota	1997	0.0235	Toyota	1997	0.0088
Toyota	1996	0.0562	Toyota	1996	0.0258	Chrysler	1994	0.0089
Chrysler	1994	0.0623	Chrysler	1994	0.0293	Chrysler	1995	0.0093
Chrysler	1995	0.0651	Chrysler	1995	0.0314	Toyota	1996	0.0104
Toyota	1995	0.0659	Chrysler	1996	0.0394	Chrysler	1996	0.0135
Chrysler	1996	0.0678	Toyota	1995	0.0414	Chrysler	1997	0.0197
Chrysler	1997	0.0707	Chrysler	1997	0.0492	Toyota	1995	0.0198
Compaq	1996	0.0848	Compaq	1996	0.0762	Compaq	1996	0.0323
Compaq	1997	0.0881	Compaq	1997	0.0869	Compaq	1997	0.0390
Nucor	1994	0.0975	Nucor	1994	0.1032	Nucor	1994	0.0453
Nucor	1995	0.1058	Nucor	1997	0.1308	Intel	1996	0.0530
Nucor	1997	0.1108	Nucor	1995	0.1320	Nucor	1997	0.0580
Nucor	1996	0.1231	Intel	1996	0.1429	Nucor	1995	0.0629
Nissan	1997	0.1389	Nucor	1996	0.1786	Nucor	1996	0.0878
Intel	1996	0.1408	IBM	1997	0.2360	IBM	1997	0.0941
Nissan	1994	0.1456	Intel	1997	0.3142	Intel	1997	0.1611
Nissan	1995	0.1475	Nissan	1997	0.3655	IBM	1995	0.2028
Honda	1997	0.1487	Nissan	1994	0.4228	IBM	1996	0.2332
Nissan	1996	0.1517	IBM	1995	0.4300	Intel	1994	0.2342
Honda	1995	0.1541	Nissan	1995	0.4398	IBM	1994	0.3209
Honda	1996	0.1581	Intel	1994	0.4412	Hitachi	1997	0.3808
Intel	1997	0.1709	IBM	1996	0.4475	Nissan	1997	0.3908
Compaq	1995	0.1749	Nissan	1996	0.4648	Nissan	1994	0.4720
Whirlpool	1994	0.1775	Honda	1997	0.4806	Nissan	1995	0.4975
Honda	1994	0.1816	Honda	1995	0.5062	Honda	1997	0.5064
IBM	1997	0.1881	Honda	1996	0.5643	Nissan	1996	0.5517
Whirlpool	1996	0.1902	IBM	1994	0.5790	Honda	1995	0.5943
Whirlpool	1995	0.2006	Hitachi	1997	0.6554	Hitachi	1995	0.6221
Intel	1994	0.2096	Compaq	1995	0.6903	Compaq	1995	0.6234
Whirlpool	1997	0.2109	Whirlpool	1994	0.7391	Honda	1996	0.6574
IBM	1996	0.2169	Honda	1994	0.8285	Hitachi	1994	0.6687
IBM	1995	0.2405	Whirlpool	1996	0.9088	Intel	1995	0.8840
IBM	1994	0.2439	Hitachi	1995	0.9560	Hitachi	1996	0.8963
Compaq	1994	0.2463	Hitachi	1994	0.9938	Whirlpool	1994	1.0310
Hitachi	1997	0.2522	Whirlpool	1995	1.0779	Compaq	1994	1.1148
Intel	1995	0.2561	Intel	1995	1.1135	Honda	1994	1.1463
Hitachi	1994	0.2868	Hitachi	1996	1.2065	Whirlpool	1996	1.3590
Hitachi	1995	0.2908	Compaq	1994	1.2499	Whirlpool	1995	1.6901
Hitachi	1996	0.2929	Whirlpool	1997	1.3474	Whirlpool	1997	2.0810

6.3.2.2 Final Selection of Rating Method

Although there appeared to be no significant difference between the results of the respective rating methods, such a result is not entirely unexpected among benchmark total quality companies that have succeeded in minimising their finished goods inventories. Inventory management policy among sterling total quality companies might be so finely tuned that there would be little difference between any of the rating methods used. However, since the model's intended use is for evaluation of all kinds of companies including TQ and non-TQ organisations then it is appropriate to incorporate an emphasis on the role finished goods inventories play. Furthermore, as companies strive to improve customer satisfaction, which will be reflected in the declining inventory levels of finished goods, then it becomes incumbent to have an evaluation model in place that will be sensitive to these changes.

Having developed and analysed three different inventory rating methods it was decided to use Rating Method 2 for the rest of the analysis. Rating Method 2 was selected because the argument for attaching a higher weight to finished goods inventory levels presented in Section 6.3.1.2 reinforces the underlying premise of the hypothesis of this thesis, that inventory performance is an indicator of the extent to which total quality is present. Customer satisfaction is undeniably an integral part of any total quality initiative and therefore, any evaluation of inventory performance must accurately reflect the weighted-impact any inventory factors have on total quality factors.

Although Rating Method 3 places an even greater weight on finished goods inventory levels, there are some caveats to be aware of when assigning such high weights using dimensionless analysis. Since all the numbers are less than one, when multiplied to a power they get smaller very rapidly. The benchmark group scores did not reveal any significant differences between Rating Method 1 and Rating Method 2. It was therefore decided that any potential future gain in accuracy obtained through using Rating Method 3 would be more than offset by possible errors that could result from an overly aggressive weight.

Given the combination of factors outlined above and the arguments presented in Section 6.3.2.2 it was decided to use Rating Method 2 which reflects an increased emphasis on finished good inventories without being too aggressive with the assignment of the weight.

6.3.3 Consolidation of Inventory Ratings

A fundamental objective of this thesis is the development of a model for evaluating the presence of total quality in an organisation. Having formulated rating methods for individual years it was decided to consolidate the separate data points for each company into one overall rating. Since it was determined that more recent data about inventory performance should be prioritised, the consolidation was effected on a weighted basis. The four years of data for each individual company were consolidated into one rating using weights of 0.4, 0.3, 0.2, and 0.1 with the most recent data point receiving a weight of 0.4, which would serve to exaggerate the trend. The company rankings for the four-year consolidated inventory ratings are represented in Table 6-6 below:

Table 6-6: Benchmark Group: Consolidated Inventory Ratings

Toyota	0.0271
Chrysler	0.0407
Nucor	0.1426
Compaq	0.3207
IBM	0.3725
Nissan	0.4159
Intel	0.4354
Honda	0.5456
Hitachi	0.9147
Whirlpool	1.1011

6.4 Inventory Analysis of Non-TQ Companies

As discussed in Section 5.2.2.2 eight companies were selected for inclusion in the so-called "control" group. These companies had no reputation for being TQ companies and the corporate literature and profiles did not indicate any total quality initiatives or strategies that could be readily identified.

No organisation ever claims to be anti-quality but the topic of quality is often noticeably absent from corporate literature and/or from conversations with company representatives. Even companies that do refer to the need for quality very often portray quality in very general, idealistic terms with plenty of hyperbole while offering very few specifics or concrete initiatives.

Perhaps most telling was the ability to obtain information, whether verbal or written, from any given company. The level of customer service, the speed with which any request was fulfilled, and the genuineness or even existence of an offer to assist in the future was consistently much higher with the benchmark selections. It was thus concluded that the control group contained companies that were either completely not total quality orientated or, at best, operated at discernibly lower levels of total quality than did the benchmark companies.

In accordance with the decision arrived at in Section 6.3.2.2, an inventory analysis on the control group was performed using only Rating Method 2. The individual years' ratings for each company were then consolidated utilising the same weighted-average combination used for the benchmark group and the results can be found in Table 6-7 below.

Table 6-7: Control Group: Consolidated Inventory Ratings

Oregon Steel	0.2972
Iomega Corp.	0.6120
Cyprus	0.9287
TXI	1.0089
Bassett	1.2791
NEC	2.4928
Black & Decker	2.5724
Estee Lauder	12.2931

6.5 Comparison of Benchmark and Control Groups

In order to evaluate the inventory performance of the companies from each of the groups relative to one another, the consolidated inventory ratings for all of the companies from both the benchmark and control groups were tabulated and presented in rank order. This information can be found in Table 6-8 on the following page.

6.5.1 Discussion

It has been previously demonstrated that an effective total quality programme implies the presence of superior inventory performance. The analysis to date has been conducted in order to ascertain what exactly constitutes good inventory performance. A rating method was developed whereby each company's inventory performance could be evaluated.

Table 6-8: Comparative Inventory Performance Ranking

B = Benchmark, C = Control Group

Toyota	B	0.0271
Chrysler	B	0.0407
Nucor	B	0.1426
Compaq	B	0.3207
Oregon Steel	C	0.3702
IBM	B	0.3725
Nissan	B	0.4159
Intel	B	0.4354
Honda	B	0.5456
Iomega Corp.	C	0.6120
Hitachi	B	0.9147
Cyprus	C	0.9287
TXI	C	1.0089
Whirlpool	B	1.1011
Bassett	C	1.2791
NEC	C	2.4928
Black & Decker	C	2.5724
Estee Lauder	C	12.2931

On the assumption that the benchmark companies are indeed total quality organisations, their consolidated inventory ratings should be indicative of the kind of numbers that superior inventory performance can be expected to achieve. Moreover, since the control group companies were assumed not to be TQ organisations, it is to be expected that their inventory ratings would be clearly inferior.

A more extensive discussion of the implications of the results of the comparative inventory rating results listed in Table 6-8 can be found in the next chapter. However, for the purposes of continuing the analysis it can be argued, at this juncture, that while there are clearly areas of demarcation indicating superior and inferior performance there is also an indeterminate area in which both benchmark and control group companies were mixed.

In an attempt to clarify this ambiguity, it was decided that it would be appropriate to introduce other performance measures that should be superior among companies that have an effective total quality programme. These measures, R.O.C.E. and Employee Value, were discussed in Sections 4.4.3.2 and 4.4.3.3 respectively and, as system-wide factors, are by-products of effective total quality management.

While it is not suggested here that either R.O.C.E. or Employee Value is a stand-alone indicator of total quality, nonetheless, companies scoring well in a combination of all three categories, namely inventory performance, R.O.C.E and Employee Value, must surely be total quality organisations. The next section examines multifactor performance measures using return on capital employed and employee value in conjunction with inventory performance.

6.6 Multifactor Performance Analysis

6.6.1 Introduction

The company rankings in Table 6-8 on page 219 obtained as a result of rating inventory performance, contained some aberrations. It is therefore possible that some companies in the benchmark group are not as committed to total quality as was believed, or it is also possible that some companies in the control group may indeed be practising effective total quality management. Additionally, while total quality companies are believed to have superior inventory performance the reverse may not necessarily be true. By including other factors in addition to inventory when evaluating these companies it was hoped that the aforementioned ambiguities would be clarified.

6.6.2 Return on Capital Employed

As discussed in Section 4.4.3.2, R.O.C.E. is calculated by dividing the earnings before taxes by total assets. By avoiding the accumulation of unnecessary assets and through more efficient use of existing assets, i.e. elimination of waste, the return on employed capital is increased. While it is possible to achieve a good R.O.C.E. score without total quality, the principles of eliminating waste and minimising the accumulation of assets (of which inventory is one) are fundamentals of total quality management.

6.6.2.1 The Use of R.O.C.E. in Multifactor Analysis

The introduction of R.O.C.E. into a multifactor analysis requires that three potential problems areas be addressed before any analysis can be commenced.

6.6.2.1.1 Data Normalisation

As discussed previously, in order to avoid problems with different measurement scales or with extreme variations between companies, the data needs to be normalised. In the case of R.O.C.E. however, no normalisation is required since the R.O.C.E. value is obtained through a ratio, which will be the same no matter what measurement scale is used. Furthermore, since there are dollars in both the numerator and denominator the R.O.C.E. score is actually unitless.

6.6.2.1.2 Combining Multiple Factors

Since R.O.C.E. will be combined with other factors for the final multifactor rating, it is necessary to ensure that even though it is unitless it does not carry a disproportionate weight in any final combination. The use of the dimensionless analysis method for combining factors eliminates any potential problems in this area. Please refer to Section 5.3.6 for a more detailed discussion of this topic.

6.6.2.1.3 Negative Values

Unlike inventory ratings it is possible to have a negative value when using R.O.C.E. for evaluating financial performance. If the company makes a loss before income taxes, then the R.O.C.E. calculation will result in a negative number since the numerator is less than zero. This, by far, presented the greatest difficulty.

The first solution contemplated adding a constant to each R.O.C.E. score ensuring that all results were positive. The problem with this method is threefold. Firstly, the number used for adjustment is, by definition, arbitrary and therefore the adjusted R.O.C.E. scores may not correctly reflect the raw data. Secondly, if the evaluation is to be valid for testing on any company then the adjustment number would have to be large enough to ensure that any potential negative R.O.C.E. for every company likely to be evaluated would become positive, which is impossible to do. Thirdly, if any adjusted score would be zero then its inclusion in a multiplicative combination would be pointless.

Mathematically, adding a constant would also fail to preserve the proportion between the scores. This would prevent any meaningful interpretation of the relative scores between companies since only an ordinal scale would be generated.

The second possible solution entertained was to assign an evaluation score based on a company's R.O.C.E. ratio. A scale would be developed incorporating a range of R.O.C.E. values and then an individual company's evaluation score could be generated depending on how its R.O.C.E. ratio compared to the scale. This was rejected because the evaluation score would be a "meaningless" number in terms of interpretation and furthermore, by arbitrarily casting various R.O.C.E. values together into one category, discrepancies between company R.O.C.E. scores end up being ignored. It did not seem prudent to discard the subtleties of a genuine calculation such as R.O.C.E.

The third possible solution was to convert the R.O.C.E. raw data using an exponential distribution. This method remedied all of the aforementioned problems. Using an exponential R.O.C.E. all negative numbers would be eliminated and the integrity and relative order of the values would still be preserved thus ensuring that they can be interpreted meaningfully.

6.6.2.2 Method for Computation of R.O.C.E. Ratings

First the R.O.C.E. was calculated for each year of the benchmark and control group companies. Then a simple average of all years was calculated to obtain an average R.O.C.E. for each company. It was decided that, unlike inventory, recent performance does not merit a higher weight. An investment in assets may take time to generate a return or conversely a failure to reinvest may not have adverse results till later. Also, given the possibility of any company having a one-year financial aberration, it was decided that generating a composite without weighting any of the data would present a more accurate evaluation of a company's long-term financial performance.

"Exponential R.O.C.E." was calculated by applying the R.O.C.E score as an exponent to "e" - the base of the natural logarithm. Since higher R.O.C.E. values reflect better performance it was necessary to take the reciprocal of e^x in order to keep the results compatible with the inventory rating method which reflected better performance with lower scores. This was accomplished mathematically by using a negative exponent, which is equivalent to taking the reciprocal. The formula used for calculating exponential R.O.C.E. was $EXP^{(-ROCE)}$ and the raw data for each company's exponential R.O.C.E. ratio is presented in Appendix I. The exponential R.O.C.E. scores for the companies in the benchmark and control groups appear in Table 6-9 below.

Table 6-9: Exponential R.O.C.E. Ratings

COMPANY	EXPONENTIAL R.O.C.E.
Bassett	0.9700
Black & Decker	0.9575
Chrysler	0.9126
Compaq	0.8338
Cyprus	0.9807
Estee Lauder	0.8459
Hitachi	0.9709
Honda	0.9576
IBM	0.9099
Intel	0.7251
Iomega Corp.	0.9117
NEC	0.9789
Nissan	1.0142
Nucor	0.8461
Oregon Steel	0.9775
Toyota	0.9647
TXI	0.8878
Whirlpool	0.9827

6.6.3 Employee Value

A review of the literature revealed that an increasing number of total quality companies are focusing not only on employee satisfaction but also on the contribution the employee makes to bettering the performance of the organisation. If one of the ingredients of a successful total quality programme is the empowerment of employees then surely there should be extra responsibilities and requirements that go along with the benefit of having more autonomy. Additionally, a satisfied employee should be able and willing to be more productive and if total quality is generated by "getting it right the first time" then employee efficiency is an appropriate measuring stick.

Corporate data in many total quality companies included a category such as sales per employee, profit per employee or some other measure of employee productivity. The effect that employees have system-wide and the increased employee efficiency that should emanate from effective total quality management make employee performance worthy of inclusion in this thesis as one of the factors in a multifactor rating. It was decided that sales per employee would be an appropriate measure to use for quantifying employee value.

6.6.3.1 Cautions for Using Sales Per Employee

While there are no problems with measurement scales since each company will be dividing its net sales by the number of employees in the organisation, there is a potential problem with the unit of measurement. Since there are dollars in the numerator but not in the denominator the result of the calculation will not be unitless. This could be problematic, as explained in Section 6.2.2, if employee value is to be included in a multifactor rating.

6.6.3.2 Calculation of Employee Value

An employee value factor (EVF) was calculated by taking the reciprocal of net sales divided by the number of employees. Since simply ascertaining the net sales per employee generated a scale on which high numbers reflected superior performance, it was necessary to invert the calculation so that low EVF scores would reflect favourable employee values. This kept the ratings compatible with the direction of the inventory performance scale in which lower numbers were indicative of better inventory management. The EVF scores for each company in the benchmark and control group are presented in Table 6-10 below.

Table 6-10: EVF Ratings

COMPANY	EVF
Bassett	9.1646
Black Decker	1.6791
Chrysler	1.1424
Compaq	0.5489
Cyprus	0.9818
Estee Lauder	0.5908
Hitachi	1.6121
Honda	0.8243
IBM	1.1484
Intel	0.4470
Iomega Corp.	1.1649
NEC	1.2288
Nissan	1.1101
Nucor	1.1916
Oregon Steel	3.0231
Toyota	0.8936
TXI	1.7140
Whirlpool	2.6514

A simple average was calculated using all the individual years for each company so that an average EVF could be generated for every company in either the benchmark or control groups. It was decided that since the number of employees can sometimes be volatile subject to certain environmental factors, a weighted-average prioritising one particular year over another would not be advisable.

6.6.4 Multifactor Analysis Using R.O.C.E. and EVF

As mentioned previously, it was decided to conduct a multifactor analysis of the benchmark and control group companies. It was hoped that this would remove some of the ambiguity in the area of apparent overlap between the benchmark and control group companies in inventory performance. The additional factors introduced were R.O.C.E. and EVF. Inclusion of these factors along with Inventory Performance into a multifactor rating was conducted using the multiplicative method associated with dimensionless analysis. This enabled the direct use of EVF even though it was in specific units subject to a different measurement scale.

As discussed in Section 5.3.6, the use of dimensionless analysis when combining factors ensures that there is normalisation and it removes the unit of measure so that no distortions result from adding "apples and oranges." Accordingly, any concern in using EVF was allayed.

Table 6-11 below shows the results for the Multifactor Rating of the companies in the benchmark and control groups. They are ranked in order.

The formula for calculating the multifactor rating for each company is:

{Inventory Rating x Exponential R.O.C.E. x Employee Value}

Table 6-11: Multifactor Ratings

B = Benchmark, C = Control Group

Toyota	B	0.0233
Chrysler	B	0.0424
Intel	B	0.1411
Nucor	B	0.1438
Compaq	B	0.1468
IBM	B	0.3893
Honda	B	0.4307
Nissan	B	0.4682
Iomega Corp.	C	0.6500
Cyprus	C	0.8943
Oregon Steel	C	1.0846
Hitachi	B	1.4317
TXI	C	1.5352
Whirlpool	B	2.8687
NEC	C	2.9987
Black & Decker	C	4.1357
Estee Lauder	C	6.1438
Bassett	C	11.3708

6.7 Statistical Analysis

Statistical Analysis was performed in order to confirm visual assessments and descriptive evaluations of the data analysed in this chapter. Frequency histograms and bar charts for the benchmark group and control group separately, as well in combination, did not prove particularly helpful.

Other statistical analyses included testing for correlation between the inventory ratings and the multifactor ratings for the benchmark group, the control group, and the test group. An additional test was then performed for the entire population of 48 companies. An upper control limit was calculated for the benchmark group using a t- score assuming a one-tail test with an alpha of 0.05. Discussion of the statistical results and their implication can be found in the following chapter.

Table 6-12: Inventory Ratings for All Groups

Adac Labs	1.9057	Iomega Corp.	0.6120
American Std.	0.1206	Kaiser	0.4742
Ameristeel	1.6323	LTV	1.6624
Armstrong	0.4230	Maytag	0.3931
Bassett	1.2791	Mazda	0.0948
Birmingham	1.1897	National Steel	1.2252
Black & Decker	2.5724	NEC	2.4928
Boeing	19.9518	Nike	0.5998
Chrysler	0.0407	Nissan	0.4159
Compaq	0.3207	Nokia	2.3720
Cyprus	0.9287	Nucor	0.1426
Eastman	1.4432	Oregon Steel	0.3702
Estee Lauder	12.2931	Premark	1.8066
Fedders	1.1060	Raytheon	0.4330
Ford	0.0268	Reebok	0.8785
General Electric	1.2388	Salomon	6.0703
General Motors	0.1473	Solectron	0.2199
Hewlett Packard	4.0568	Sony	1.5023
Hitachi	0.9147	Toshiba	2.1943
Honda	0.5456	Toyota	0.0271
IBM	0.3725	TXI	1.0089
Inland Steel	1.6379	Weirton	0.7567
Internat'l Paper	0.6563	Whirlpool	1.1011
Intel	0.4354	Xerox	7.8431

6.8 Analysis of Test Group

Having established an inventory rating method and a multifactor rating method it was decided to apply those ratings to the test group as defined in Section 5.2.2.3. The ratings for all 48 companies were then tabulated. The results of the inventory ratings are illustrated in Table 6-12 above and the multifactor ratings for each company can be found in Table 6-13 below.

Table 6-13: Multifactor Ratings for All Groups

Adac Labs	1.8652	Iomega Corp.	0.6500
American Std.	0.3787	Kaiser	1.3626
Ameristeel	3.0213	LTV	4.2390
Armstrong	0.6055	Maytag	0.8494
Bassett	11.3708	Mazda	0.1321
Birmingham	2.2737	National Steel	2.7945
Black & Decker	4.1357	NEC	2.9987
Boeing	88.2141	Nike	0.3195
Chrysler	0.0424	Nissan	0.4682
Compaq	0.1468	Nokia	2.6993
Cyprus	0.8943	Nucor	0.1438
Eastman	1.8349	Oregon Steel	1.0846
Estee Lauder	6.1438	Premark	3.2191
Fedders	3.3925	Raytheon	1.2766
Ford	0.0866	Reebok	0.3625
General Electric	2.8773	Salomon	4.5212
General Motors	0.4191	Solectron	0.9452
Hewlett Packard	3.5940	Sony	2.0902
Hitachi	1.4317	Toshiba	2.9354
Honda	0.4307	Toyota	0.0233
IBM	0.3893	TXI	1.5352
Inland Steel	3.4370	Weirton	3.1349
Internat'l Paper	1.3272	Whirlpool	2.8687
Intel	0.1411	Xerox	15.8290

6.9 Discussion and Summary

Earlier in this thesis it was demonstrated that effective total quality management requires superior inventory performance. It was therefore expected that the benchmark companies would score markedly better than non-TQ companies when their inventory performance was evaluated. Initially, in order to identify and quantify inventory performance a number of different rating methods were developed. The final rating method selected incorporated a weight that gave twice as much importance to finished goods inventory levels as compared to non-finished goods inventory levels. Using dimensionless analysis, a rating was developed for each year of every company in the benchmark group.

A simple visual analysis of the data prompted the decision to consolidate the individual years' ratings into one overall company rating. Notwithstanding the fact that this thesis set out to develop a model that could facilitate the assessment of an organisation's total quality management policy as an entity, the comparison between different years for the same company does not lend itself to meaningful interpretation. When performing the consolidation it was decided to give a higher priority to more recent data. This was accomplished by assigning a weight of 0.4 to the most recent data point and 0.3, 0.2 and 0.1 respectively to each previous year.

The inventory performance rating method was then applied to companies from the control group and the individual years' ratings for each company were consolidated using the same method as the benchmark group. All the consolidated ratings from both the benchmark group and control group were tabulated and sorted in rank order.

A visual analysis revealed that there were some unclear results with an admixture of benchmark and control group companies, so it as decided to include R.O.C.E. and EVF along with inventory performance in a multifactor rating. R.O.C.E. and EVF each reflect system-wide components, and effective total quality management should positively influence their rating. Therefore, any organisation scoring well on the multifactor rating containing the three aforementioned factors, must quite irrefutably be a TQ company. Finally, in order to confirm some of the descriptive and visual analysis some statistical testing was conducted.

In the next chapter some of the analysis is examined in greater detail and the implications and ramifications of the results obtained from all the various analytical exercises outlined in this chapter are discussed.

CHAPTER SEVEN

7.0 OBSERVATIONS AND IMPLICATIONS

7.1 Introduction

In the previous chapter a review of the analytical techniques used in the research was presented. Where necessary a brief discussion took place in order to help the reader progress through the various stages of analysis. This chapter provides a more comprehensive examination and discussion of the findings of the research and analysis described in Chapters Five and Six. The implications and ramifications of those findings are submitted and then deliberated upon. In order to assist the reader, tables that have already been presented in previous chapters are reproduced where appropriate.

7.2 Benchmark and Control Group Observations

This section examines the findings and implications stemming from the analysis of the benchmark and control groups using inventory ratings alone and also in combination with R.O.C.E. and EVF as a multifactor rating.

7.2.1 Inventory Ratings

Table 6-8 showed that there were clear lines of demarcation between the groups. The top nine companies consisted of eight organisations from the benchmark group, and the bottom section consisted of five companies, all of which were from the control group. This is more clearly illustrated in Table 7-1 below in which the benchmark companies are in bold on a shaded background and the control group companies are in regular on a clear background. The lines of demarcation are also depicted.

Table 7-1: Delineation of Company Inventory Rankings

Toyota	**B**	**0.0271**
Chrysler	**B**	**0.0407**
Nucor	**B**	**0.1426**
Compaq	**B**	**0.3207**
Oregon Steel	C	0.3702
IBM	**B**	**0.3725**
Nissan	**B**	**0.4159**
Intel	**B**	**0.4354**
Honda	**B**	**0.5456**
Iomega Corp.	C	0.6120
Hitachi	**B**	**0.9147**
Cyprus	C	0.9287
TXI	C	1.0089
Whirlpool	**B**	**1.1011**
Bassett	C	1.2791
NEC	C	2.4928
Black & Decker	C	2.5724
Estee Lauder	C	12.2931

With a score of 0.55 representing the first cut-off point, the eight benchmark companies make up a statistically very significant 80% of the total benchmark population examined. For scores higher than 1.11 there are four control group companies, which make up a significant 50% of the entire control group population. The area requiring clarification is the range of scores between 0.55 and 1.11. The five companies scoring in that range represent a balance of two benchmark and three control group companies. Figure 7-1 below shows the clear distinction between the inventory ratings of the benchmark and control group companies and the magnitude of their representation in the respective categories.

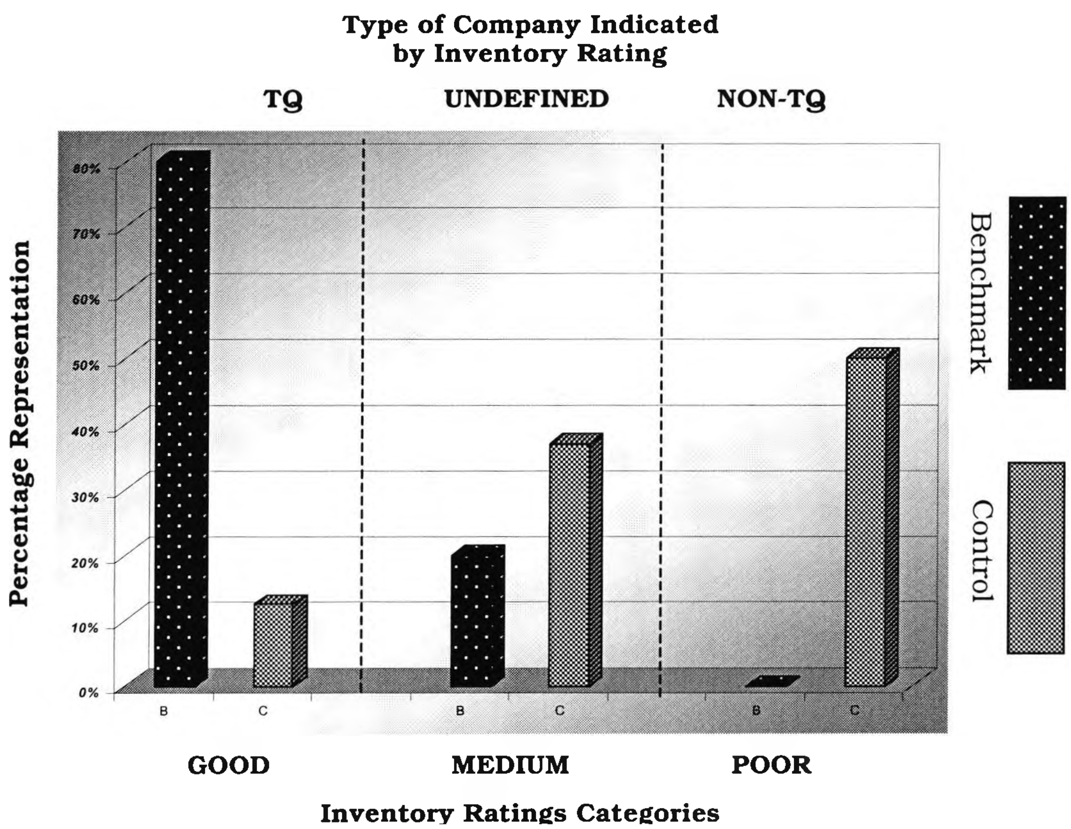

Figure 7-1: Inventory Ratings Categories and Total Quality

From this data it can be determined that companies having an inventory rating lower than 0.55 should be TQ organisations and those having an inventory rating greater than 1.27 should be non-TQ companies. The status of companies scoring in the intermediate range is presently unclear.

As mentioned previously, for total quality management to be effective superior inventory performance is required. Thus, TQ companies should have excellent inventory ratings, which as per the data analysed, they do. The question that this thesis has repeatedly posed is whether good inventory performance indicates the presence of total quality. While the ratings scored by the companies in the benchmark and control groups appear to confirm this assertion, there are still some areas of doubt.

Since at this stage it could be argued that Iomega, Hitachi, Cyprus, TXI and Whirlpool are, in fact, all TQ companies or it could equally be argued that one or all of them are non-TQ companies, it was determined that further analysis was appropriate. Such analysis should help confirm whether companies having a good inventory rating are indeed total quality organisations. If that can be demonstrated, then in addition to being able to better classify companies falling in the middle range, it will have been shown that superior inventory performance is, indeed, a valid indicator of a total quality organisation.

7.2.2 Multifactor Ratings

As reported in the previous chapter, a multifactor rating was developed using the inventory rating, R.O.C.E. and EVF. Since each of those three areas are by-products of effective total quality management, it was felt that any company scoring well in all three of those categories combined – the multifactor rating – must be a TQ organisation. The results of the multifactor ratings for the benchmark and control group companies were originally presented in the previous chapter but are reproduced in Table 7-2 with the ranges and cut-off points more clearly illustrated. The benchmark companies are in bold on a shaded background and the control group companies are in regular typeface on a clear background.

Closer examination of the table shows an even more distinct picture. The top eight companies are all total quality organisations and they represent 80% of the entire benchmark group. The bottom four companies are all non-TQ organisations and they represent 50% of the control group. This demarcation into readily identifiable categories is illustrated in Figure 7-2.

This clear delineation between benchmark and control group companies, plus the statistically significant percentage representations, enabled the analysis to conclude that a multifactor rating less than 0.47 indicates a TQ organisation and a rating greater than 2.99 reflects a company that does not practise TQ.

Table 7-2: Delineation of Company Multifactor Ratings

Toyota	**B**	**0.0233**
Chrysler	**B**	**0.0424**
Intel	**B**	**0.1411**
Nucor	**B**	**0.1438**
Compaq	**B**	**0.1468**
IBM	**B**	**0.3893**
Honda	**B**	**0.4307**
Nissan	**B**	**0.4682**
Iomega Corp.	C	0.6500
Cyprus	C	0.8943
Oregon Steel	C	1.0846
Hitachi	**B**	**1.4317**
TXI	C	1.5352
Whirlpool	**B**	**2.8687**
NEC	C	2.9987
Black & Decker	C	4.1357
Estee Lauder	C	6.1438
Bassett	C	11.3708

Although a question still remains concerning the status of the six companies scoring in the intermediate range, there was definitely some movement in the ranking of those companies when compared to the inventory rating.

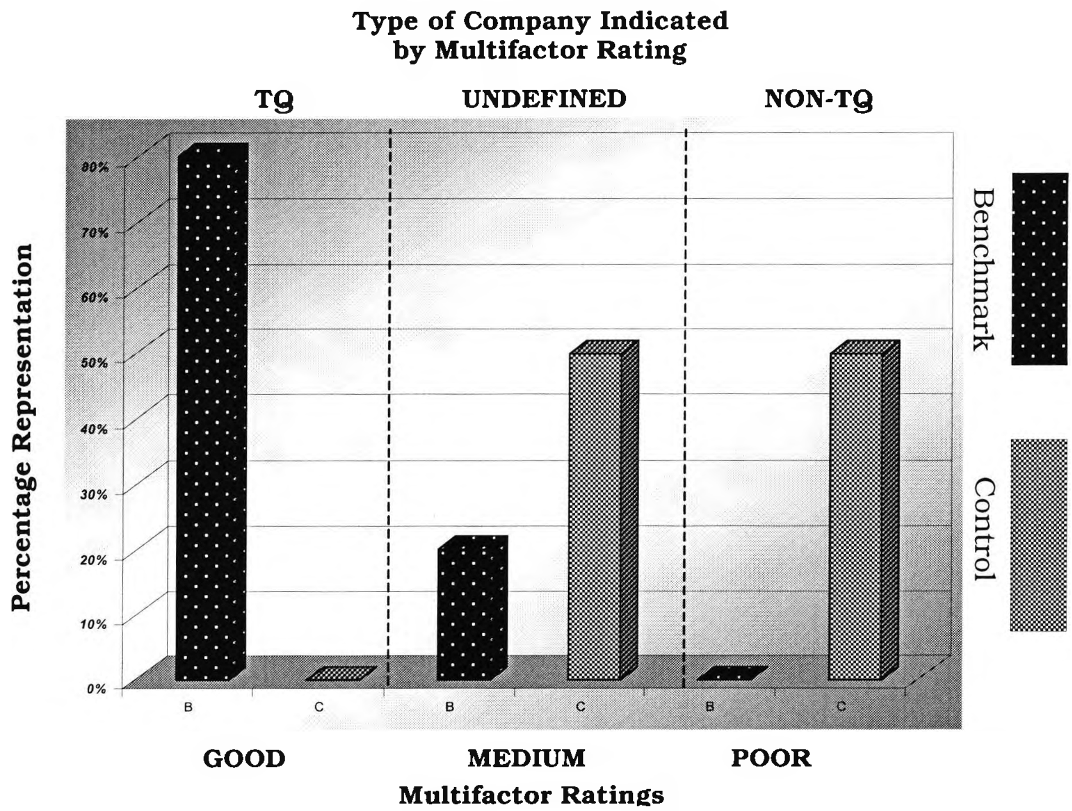

Figure 7-2: Multifactor Ratings Ranges and Total Quality

Since this thesis hypothesised that inventory performance is an indicator of the presence of total quality, it was decided to analyse whether there were any significant changes between the rankings using inventory ratings and the rankings using multifactor ratings.

A comparison between the two methods, inventory and multifactor, is presented in the rankings depicted in Table 7-3 below.

Table 7-3: Comparison of Inventory and Multifactor Ratings

Inventory Ratings

Toyota	**B**	**0.0271**
Chrysler	**B**	**0.0407**
Nucor	**B**	**0.1426**
Compaq	**B**	**0.3207**
Oregon Steel	C	0.3702
IBM	**B**	**0.3725**
Nissan	**B**	**0.4159**
Intel	**B**	**0.4354**
Honda	**B**	**0.5456**
Iomega Corp.	C	0.6120
Hitachi	**B**	**0.9147**
Cyprus	C	0.9287
TXI	C	1.0089
Whirlpool	**B**	**1.1011**
Bassett	C	1.2791
NEC	C	2.4928
Black & Decker	C	2.5724
Estee Lauder	C	12.2931

Multifactor Ratings

Toyota	**B**	**0.0233**
Chrysler	**B**	**0.0424**
Intel	**B**	**0.1411**
Nucor	**B**	**0.1438**
Compaq	**B**	**0.1468**
IBM	**B**	**0.3893**
Honda	**B**	**0.4307**
Nissan	**B**	**0.4682**
Iomega Corp.	C	0.6500
Cyprus	C	0.8943
Oregon Steel	C	1.0846
Hitachi	**B**	**1.4317**
TXI	C	1.5352
Whirlpool	**B**	**2.8687**
NEC	C	2.9987
Black & Decker	C	4.1357
Estee Lauder	C	6.1438
Bassett	C	11.3708

7.2.3 Discussion

When the rankings of the companies' inventory ratings are compared to the rankings of the companies' multifactor ratings there appears to be some minor movement within the ranges but there is little change between the ranges with only Oregon Steel dropping from the TQ category to the undetermined one.

While the multifactor rating may offer a more comprehensive analysis it does not seem as if any significant errors would be made had only the inventory rating been relied upon. Since there appeared to be a strong connection between the two rating methods a test for correlation was conducted. This test revealed that the benchmark group had a correlation coefficient of $r = 0.90$. The control group was tested for correlation without the extreme score of Bassett and it had a correlation coefficient of $r = 0.89$. The combined benchmark and control group minus Basset had a coefficient of correlation of $r = 0.86$ indicating a strong relationship between the inventory ratings and the multifactor ratings. It was decided that, in order to confirm the presence of correlation between the inventory ratings and the multifactor ratings, a test for correlation should be conducted on the entire set of 48 companies. The test resulted in a correlation coefficient of $r = 0.85$ confirming the postulation that inventory ratings and multifactor ratings are indeed strongly linked.

Based on the insignificant change in the rankings between inventory ratings and multifactor ratings and the strength of the correlation coefficient between the two ratings, it was concluded that an inventory rating alone for each of the companies would be sufficient to confirm whether an organisation was practising effective total quality or not.

7.3 Testing of the Model

Having established that the inventory rating should be a good indicator of TQ organisations it was decided to conduct statistical analysis to determine an upper confidence limit as a cut-off point for TQ companies. This was preferred to the visual cut-off score described earlier and was considered to be more scientifically objective.

Given that the benchmark group was ten companies, a t-distribution was assumed. Using 9 degrees of freedom and a one-tail test with an alpha of 0.05, a t-score of 1.833 was determined. The benchmark group had a mean of 0.43 and a standard deviation of 0.35, which resulted in an upper limit of 1.0755 for the inventory rating distribution. Accordingly, there is 95% confidence that an inventory rating of 1.0755 or less will reflect a TQ company.

Based on the visual information ascertained from the benchmark group it was determined that companies scoring higher than 1.27 were not TQ organisations. Companies scoring between 1.08 and 1.27 would be regarded as undefined. It was felt that further analysis would be required in order to determine the level of total quality present in those companies. Table 7-4 below illustrates the rank order of companies and the TQ categories into which they fall.

Table 7-4: Inventory Performance Rankings for 48 Companies

TQ COMPANIES

Ford	0.0268
Toyota	0.0271
Chrysler	0.0407
Mazda	0.0948
American Std.	0.1206
Nucor	0.1426
General Motors	0.1473
Solectron	0.2199
Compaq	0.3207
Oregon Steel	0.3702
IBM	0.3725
Maytag	0.3931
Nissan	0.4159
Armstrong	0.4230
Raytheon	0.4330
Intel	0.4354
Kaiser	0.4742
Honda	0.5456
Nike	0.5998
Iomega Corp.	0.6120
Internat'l Paper	0.6563
Weirton	0.7567
Reebok	0.8785
Hitachi	0.9147
Cyprus	0.9287
TXI	1.0089

UNDEFINED COMPANIES

Whirlpool	1.1011
Fedders	1.1060
Birmingham	1.1897
National Steel	1.2252
General Electric	1.2388

NON-TQ COMPANIES

Bassett	1.2791
Eastman	1.4432
Sony	1.5023
Ameristeel	1.6323
Inland Steel	1.6379
LTV	1.6624
Premark	1.8066
Adac Labs	1.9057
Toshiba	2.1943
Nokia	2.3720
NEC	2.4928
Black & Decker	2.5724
Hewlett Packard	4.0568
Salomon	6.0703
Xerox	7.8431
Estee Lauder	12.2931
Boeing	19.9518

7.3.1 Discussion of Companies

Given the corporate profiles set forth in Section 5.2.2, most of the companies fell into the appropriate TQ or non-TQ range as expected, and the reader is encouraged to review any given company profile in the context of the inventory rating it has now received. However, there were a few companies that merited extra discussion and they are included in this section.

7.3.1.1 "TQ" Range

The first two companies listed below did not possess total quality programmes or initiatives that were immediately recognisable. Nonetheless, their inventory performance rating suggest that they are, indeed, total quality organisations.

7.3.1.1.1 Oregon Steel

Oregon does not profess to have any specific quality initiatives in place. Its inventory rating, however, clearly indicates that it is solidly in the range for TQ organisations. Its focus on "flexible manufacturing facilities which are sensitive to changes in market conditions" does seem to indicate a desire to meet customer needs. This focus has led to superior inventory management.

7.3.1.1.2 Cyprus Amax

No indication of total quality management can be found in corporate literature from Cyprus. Other than a commitment to leading edge technology and a high quality of life for employees none of the ingredients of a total quality programme are evident. Nonetheless, the inventory rating indicates that Cyprus has been "discovered" to be a total quality organisation.

7.3.1.1.3 TXI

It was determined in Section 5.2.2.2 that Texas Industries was very forthcoming in its general commitment to total quality but that the specifics were not listed. It appears from its inventory rating that TXI could be a total quality organisation.

7.3.1.1.4 IBM

IBM is included here simply as tribute to its ability to rebound from near extinction. After having abandoned its pursuit of total quality management and suffering nearly irreversible losses, IBM embarked upon a new and aggressive total quality initiative as detailed in Section 5.2.2.1. While a recent article (Thomson, 1997) debated whether IBM had returned, the inventory rating it received seems to confirm that IBM is, once again, a total quality organisation.

7.3.1.2 "Undefined" Range

This range covers companies that missed the confidence limit cut-off for inclusion with the TQ companies, but were above the second cut-off indicating the range of companies with poor on non-existent total quality programmes. Two companies that surprisingly fell in this range are discussed in this section.

7.3.1.2.1 Whirlpool Corporation

As one of the benchmark companies and a frontrunner in various total quality management techniques in the early part of the decade Whirlpool is at best in a state of flux. Recent expansion programmes including mergers and acquisitions in Europe, South America and Asia have proved very demanding on company resources and they may well have distracted the company from its focus on adopting and implementing total quality initiatives.

7.3.1.2.2 Fedders Corporation

Fedders' corporate literature is replete with commitments to total quality and describes many programmes that purport to enhance total quality. Its position as an "undefined" organisation requires further investigation.

7.3.1.3 "Non-TQ" Range

The following companies were either not expected to fall in this range or certainly not so far down in the ratings. A detailed analysis of these companies needs to be performed in order to understand why their rating is much lower than anticipated.

7.3.1.3.1 Hewlett Packard

Widely thought of as a front-running TQ organisation, this was the most surprising result of all the companies. Its inventory rating is very poor both comparatively and absolutely. It would appear that Hewlett Packard's focus on customer satisfaction and other quality initiatives has not translated into actual operations. Given the strength of the relationship between total quality management and inventory management it does not seem possible that any organisation could have an effective total quality programme in place with such a poor inventory performance. A full understanding of Hewlett Packard can only be gained through an intense examination of all facets of the company.

7.3.1.3.2 Xerox

Since winning its first Baldrige Award, Xerox abandoned the tenets of total quality management and the company fell on hard times and almost ceased to exist. Its recent return to the total quality track culminated in winning another Baldrige Award. It seems evident from its inventory rating that the company has quite a way to go till it returns to its former status as a TQ organisation.

7.3.1.3.3 Boeing

Boeing is another case of a company that was committed to total quality but managed to depart from the underlying principles governing the maintenance and improvement of total quality management. Since recently acquiring McDonnell-Douglas, Boeing has embarked on a long-term strategic programme, called Vision 2016, to restore total quality to the organisation. Its inventory rating indicates that Boeing has a long way to go before becoming a TQ company. For more information, the reader is directed to Appendix II, which contains a questionnaire filled out by a representative of Boeing.

7.3.1.4 Discussion and Summary

The cut-off points for the ranges determining which companies are TQ, non-TQ, or undefined were established by the calculation of a confidence limit using a t-score. Most of the companies fell in the range that might have been expected judging by the corporate literature and profiles summarised in Section 5.2.2. There were, however, some anomalies and these were discussed. It is worthwhile to note that some of the lower-end companies in the TQ range actually fell outside the cut-off point established by the eight benchmark companies. More importantly, a visual examination of the rankings reveals some break points that could be quite revealing. For these reasons, companies scoring higher than a 0.65 should be considered borderline TQ organisations. These companies listed in Table 7-5 below should be subjected to further analysis before making a final determination.

Table 7-5: Borderline TQ Companies

Weirton	0.7567
Reebok	0.8785
Hitachi	0.9147
Cyprus	0.9287
TXI	1.0089

A premise of this thesis was that when it comes to total quality management there is often a difference between the way a company is perceived, by either itself or others, and what actually is occurring. Many of the ratings confirmed that this is true. Often, companies made flowery statements portraying a commitment to quality. Upon examination, however, they fared worse than those that did not talk about quality but had specific programmes in place that engendered TQ.

7.3.2 Multifactor Ratings

Although it had been clearly established that there was a correlation between inventory ratings and multifactor ratings, it was decided that an investigation into any discrepancies between the inventory performance determinations and the multifactor evaluations might prove to be beneficial. Table 7-6 lists the rankings for all 48 companies using the multifactor rating.

Since an analysis of the data revealed that there was a clear breakpoint between 1.53 and 1.83 an extra category was added. Although numbers less than 2.25 fell in the TQ range calculated through statistical analysis it was clear that some sub-group should be made within the range commencing at that break point.

Table 7-6: Multifactor Rankings for 48 Companies

TQ COMPANIES		BORDERLINE TQ COMPANIES	
Toyota	0.0233	Eastman	1.8349
Chrysler	0.0424	Adac Labs	1.8652
Ford	0.0866	Sony	2.0902
Mazda	0.1321	**UNDEFINED COMPANIES**	
Intel	0.1411	Birmingham	2.2737
Nucor	0.1438	Nokia	2.6993
Compaq	0.1468	National Steel	2.7945
Nike	0.3195	Whirlpool	2.8687
Reebok	0.3625	General Electric	2.8773
American Std.	0.3787	**NON-TQ COMPANIES**	
IBM	0.3893	Toshiba	2.9354
General Motors	0.4191	NEC	2.9987
Honda	0.4307	Ameristeel	3.0213
Nissan	0.4682	Weirton	3.1349
Armstrong	0.6055	Premark	3.2191
Iomega Corp.	0.6500	Fedders	3.3925
Maytag	0.8494	Inland Steel	3.4370
Cyprus	0.8943	Hewlett Packard	3.5940
Solectron	0.9452	Black & Decker	4.1357
Oregon Steel	1.0846	LTV	4.2390
Raytheon	1.2766	Salomon	4.5212
Internat'l Paper	1.3272	Estee Lauder	6.1438
Kaiser	1.3626	Bassett	11.3708
Hitachi	1.4317	Xerox	15.8290
TXI	1.5352	Boeing	88.2141

The cut-off points derived from a visual analysis of Table 7-2 showed that a multifactor rating lower than 0.47 indicated companies practising total quality management and a rating higher than 2.99 reflected companies that could not be considered TQ organisations. The range of scores in between indicated companies that could not be accurately defined at present without further analysis.

Using statistical analysis, an upper confidence limit was calculated assuming a t-distribution with one tail, 9 degrees of freedom and an alpha of 0.05. The resulting t-score of 1.833 was used to establish a rejection region, with 95% confidence level, of 2.25. As previously mentioned, it was decided to combine both the visual and empirical observations to form four ranges for the companies as depicted in Table 7-6.

7.3.2.1 Discussion of Companies

As with the inventory ratings there were a number of companies that either scored differently from what was expected given the perception of the existence of total quality. Additionally, the multifactor ratings provided a TQ assessment for organisations for which no predetermination of TQ could be made. Since the companies in question scored very similarly in the inventory performance rating, the reader is referred to Section 7.3.1 which provides a discussion of their respective levels of total quality management.

Of interest at this juncture, are the discrepancies between the TQ rankings obtained through use of the inventory performance ratings and the rankings generated by the multifactor ratings. These are discussed in the next section.

7.3.2.2 Comparison of Multifactor and Inventory Ratings

While the vast majority of companies were placed in the same range whether the inventory performance rating was used or whether the multifactor rating was used there was some movement within the ranges. This can be attributed to the fact that the multifactor rating will exaggerate the inventory performance rating. The inclusion of R.O.C.E. and EVF, which are system-wide factors that are affected by the presence of total quality. serves to make the TQ organisations score even better and the non-TQ organisations even worse. The result is a much larger spread of scores between the companies. The highest inventory performance score was 19.9578 and the lowest 0.0268 whereas the highest multifactor rating was 88.2141 and the lowest 0.0233. The greater exaggeration represented in the multifactor ratings makes it easier to ascertain breakpoints in the distribution. In general, the multifactor rating, because of the inclusion of R.O.C.E. and EVF. will provide a more definitive evaluation of the level of total quality present in an organisation.

Of greater concern are the variances between the inventory performance and multifactor ratings that cause a company to be assessed differently because it appears in a different TQ category. These companies are listed in Table 7-7 below.

Table 7-7: Multifactor & Inventory Ratings Discrepancies

COMPANY	INVENTORY RATING	MULTIFACTOR RATING	INVENTORY CLASS	MULTIFACTOR CLASS
Weirton	0.7567	3.1349	**TQ**	**NTQ**
Fedders	1.1060	3.3925	**U**	**NTQ**
Eastman	1.4432	1.8349	**NTQ**	**BTQ**
Sony	1.5023	2.0902	**NTQ**	**BTQ**
Adac Labs	1.9057	1.8652	**NTQ**	**BTQ**
Nokia	2.3720	2.6993	**NTQ**	**U**

TQ = Total Quality NTQ = Non-TQ B = Borderline TQ U = Undefined

7.3.3 Discussion

Table 7-7 shows the six companies for which the inventory performance rating produced different classifications than the multifactor rating. Two companies presented only minor changes in classification and are therefore not of any substantial significance. In fact, it was expected that the multifactor rating would help clarify and/or reinforce the inventory rating. As such, it can be concluded that Fedders, which was classified as "undefined" by the inventory rating is, upon further analysis, a non-TQ organisation. Similarly, Nokia is definitely not a non-TQ company as suggested by its inventory rating, but may need further analysis to finalise an evaluation. There is also the question of the direction in which these companies are headed that could help determine their level of total quality. This could be ascertained by conducting a closer examination of the data for each year, which can be found in Appendix I to try and establish a trend.

Three of the remaining four companies were rated as non-TQ organisations using the inventory performance score, whereas the multifactor rating indicated that they were borderline TQ companies. Once again, given the extra factors, the multifactor rating is expected to refine the inventory performance rating. Eastman and Sony placed at the top of the non-TQ category on the cusp of the undefined category. The multifactor rating indicates that they may indeed be TQ organisations but at best they are borderline.

A year by year examination of Eastman reveals that each year's inventory ratings have been poorer than its 1994 ratings, which was the first evaluation year since it won the Baldrige Award. Its R.O.C.E. and EVF scores have been progressively getting worse each year since 1995. It appears that since winning the Baldrige, Eastman had one good year of inventory performance, which seemed to yield results in R.O.C.E. and EVF in the following year. However, in 1995 the inventory rating was considerably worse and since then all ratings have been declining. An initial analysis of the data reveals a company that seems to have compartmentalised its approach to total quality management. Since it has not managed to succeed in simultaneously improving the three key areas of total quality - R.O.C.E. , inventory, and EVF - it has not been able to break into the TQ range.

A look at the trend of the past three years seems to indicate that Eastman is moving in the wrong direction and that sub-TQ performance indicated by inventory levels has manifested itself in the other areas as well. It is therefore arguable that the inventory rating was the more accurate one since it defined Eastman as being non-TQ based on the deleterious effect that poor inventory management has on the other total quality aspects of the organisation. The multifactor rating still reflected a good average R.O.C.E. and a decent average EVF but those factors are far more indicative of the present than of the future. Since each rating suggested a more detailed look at the organisation, there would be no material difference between whichever method was used.

The yearly breakdown for Eastman shown below in Figure 7-3 tabulates the inventory rating, R.O.C.E. and EVF data for each year. In all cases, low numbers reflect superior results. A value of greater than 1.0 for R.O.C.E. indicates a negative return on capital employed as a result of pre-tax losses.

Figure 7-3: Yearly Performance Data for Eastman

Year	Inventory Rating	EVF	Exponential R.O.C.E.
1997	1.4518	1.5215	0.9257
1996	1.3463	1.4847	0.8911
1995	1.5670	1.1775	0.8315
1994	1.2878	1.6458	0.8824

Adac Labs won a Baldrige award in 1996. Its inventory performance has been steadily improving in each of the last three years and in 1997 it was approximately 4 times better than it was in 1995. The EVF and R.O.C.E. scores for Adac have also been progressively getting better every year. Since 1994 was a good year and 1995 the worst, it is possible that efforts spent on winning the Baldrige came at the expense of actual company performance. It is also true, however, that the company has improved in each of the three factors every year since 1995. Further research would be warranted to see whether these improvements came because of or in spite of the pursuit of a Baldrige Award. Once again, whichever rating was used, multifactor or inventory performance, these companies' scores suggested further analysis. Accordingly, neither rating method would result in a substantial error being made.

Figure 7-4 below depicts the inventory rating, R.O.C.E. and EVF data for each year. In all cases, low numbers reflect superior results. A value of greater than 1.0 for R.O.C.E. indicates a negative return on capital employed as a result of pre-tax losses.

Figure 7-4: Yearly Performance Data for Adac Labs

Year	Inventory Rating	EVF	Exponential R.O.C.E.
1997	0.9362	0.9778	0.8651
1996	2.0171	1.0286	0.8702
1995	3.9855	1.5314	0.8980
1994	1.2896	0.9807	0.9138

Weirton was classified as a definite non-TQ company by the multifactor rating but the inventory performance rating indicated it was a TQ organisation. This appears to be the most serious discrepancy given the magnitude and the direction of the difference.

Further segregation within the TQ group as discussed in Section 7.3.1.4 and illustrated in Table 7-5 on page 122 revealed that the inventory rating may only consider Weirton to be a borderline TQ company. If that were to be the case then Weirton, as with any borderline or undefined organisation, would be subjected to further analysis.

Nonetheless, it is appropriate to conduct a further examination as to why this discrepancy exists. One possibility is that Weirton has made significant advances in its inventory management over the last two years. This may have come at the expense of short-term profits, which resulted in a negative return on capital employed in those same two years. Additionally, Weirton's employee value factor has been volatile, vacillating between poor and very poor. It remains to be seen whether the benefits of Weirton's inventory management efforts and TQ initiatives will be reflected in future year's R.O.C.E. scores and whether it can simultaneously improve employee productivity. Figure 7-5 below shows Weirton's inventory rating, R.O.C.E. and EVF data for each year. In all cases, low numbers reflect superior results. A value of greater than 1.0 for R.O.C.E. indicates a negative return.

Figure 7-5: Yearly Performance Data for Weirton

Year	Inventory Rating	EVF	Exponential R.O.C.E.
1997	0.7377	3.4807	1.0249
1996	0.7058	5.3730	1.0505
1995	0.8266	3.3265	0.9534
1994	0.8457	4.5244	0.9943

7.4 Overall Findings and Summary

This section is divided into two parts. The first discusses the findings and implications of the research, analysis and testing of the data and the second presents a comprehensive summary of the chapter.

7.4.1 Company Findings

The presentation of the inventory performance rankings and the multifactor rankings in Table 7-3 on page 242 revealed that a strong relationship between inventory performance and multifactor ratings was very probable. This was confirmed by tests for correlation performed on the benchmark group, control group and on all 48 companies. Based on this relationship, inventory performance alone can be used as a reliable indicator of the presence of total quality management.

Nonetheless, there were some discrepancies between the multifactor ratings and the inventory performance determinations. Two of the discrepancies were minor and did not present a significant problem. Of the remaining four, possible explanations were suggested. The likelihood exists, however, that in one case specifically, and maybe in two others, the inventory performance assessment was incorrect. If that were true, it would represent an error rate of approximately 2% - 6%, which is within acceptable statistical levels of confidence.

It is also important to examine other statistical factors as being possible explanations for any variations between the different measures. Since the multifactor rating exaggerates the range of values, a company such as Whirlpool, which scored poorly for a benchmark company, will affect the confidence limit calculated through use of the mean and standard deviation. Therefore, the multifactor rating had a significantly larger range warranting inclusion as a TQ company compared to the range established by the visual break points. This was pointed out in Section 7.3.1.4. It is also possible to adjust the alpha so that the rejection region can be set more or less stringently depending on whether one is more concerned with an alpha error or a beta error.

7.4.2 General Findings

The use of inventory performance, as calculated in this thesis, is sufficient on its own to assess whether an organisation practises total quality management or not. This work has demonstrated that in a worst case scenario it will prove accurate 94% of the time. In reality, however, it is strongly recommended that inventory performance be used for general identification and a multifactor rating be used if one wishes to analyse a specific company. In general, the multifactor rating will provide a more comprehensive rating and will exaggerate the differences, good or bad, between TQ and non-TQ organisations. It is also strongly recommended that an analysis of several years' data be conducted when confronted with companies that fall near the cusp of any two categories or if they are in the "undefined" group. Such an examination will reveal any trends or any areas to be addressed in order to accurately classify the company.

In the course of the collection of data it was found that companies which engaged in the use of slogans or touted their commitment to quality without specifying any initiatives tended to be non-TQ companies. Many companies did describe strategic plans that included total quality activities as defined in this thesis. These included a move towards integration of suppliers and customers, a shortening of the time-to-market, an increased flexibility in production so as to meet customer expectations, and a commitment to technological superiority. It was interesting to note that the literature of the sterling TQ organisations hardly contained any reference to quality at all. Perhaps because quality was a given by-product of the strategies they pursued. Furthermore, achievement of the goal of a particular initiative may not of itself cause total quality but the pursuit of that goal may. Non-TQ companies were very focused on the concept of total quality rather than strategic initiatives that engender total quality.

Another theme that tended to be prevalent among TQ organisations was a strategic move toward globalisation, which by necessity must have as its offshoot greater manufacturing flexibility, more rapid time-to market, better anticipation of customers' needs and expectations, a quest for the latest technology and the development of supplier partnerships. These will all result in superior inventory performance.

7.4.3 Summary

This chapter presented an analysis and discussion of the research data and findings. Upon examination of the inventory ratings for the benchmark and control group companies it was found that there were clear lines of demarcation between the inventory performance of the benchmark companies and that of the control group companies.

A further analysis of the benchmark and control groups was performed using a multifactor rating, which included in addition to inventory performance, return on capital employed and a measure of employee value. Since the multifactor rating contained three system-wide factors that would be strongly linked to the presence of total quality initiatives, it was concluded that a good multifactor rating would definitely indicate that the organisation practises total quality management. The multifactor ratings did not differ significantly from the inventory performance ratings.

As a result, it was postulated that the relationship between inventory performance and multifactor ratings may be strong enough that inventory performance alone would be sufficient to indicate the presence of an effective total quality programme. A test for correlation was conducted between the inventory performance and multifactor ratings for the benchmark group and it returned a value of $r = 0.90$ indicating a very strong correlation between the two measures. Similar tests were performed for the control group (minus one skewed value) and the two groups combined and they returned values of $r = 0.89$ and $r = 0.86$ respectively. In order to confirm the relationship a test for correlation was performed on all 48 companies and it returned a value of $r = 0.85$ indicating that, indeed, there was a strong link between the two measures. Accordingly, it was decided to test the model using inventory performance alone as a measure of the presence of total quality.

Inventory performance ratings were, with the help of some statistically determined confidence limits, able to divide the companies into three categories: TQ organisations, non-TQ organisations and "undefined" organisations for which a definitive assessment of TQ could not be made. Upon further examination, the TQ category was later amended to include a sub-category of borderline TQ companies.

Companies that did not score as expected or for which there was no prior estimate of total quality were discussed. A multifactor rating was conducted for all 48 companies in order to try and elicit some more information and to attempt to clarify the TQ status of some of the borderline and/or "undefined" organisations.

The results of the multifactor rating did not differ significantly from the inventory performance rating. In total, only six companies were categorised differently and possible explanations were discussed. In all events any borderline or "undefined" companies warrant further analysis by first looking at a multifactor rating for the company and then examining the individual years' data for possible clarification and/or trends.

CHAPTER EIGHT

8.0 CONCLUSIONS

8.1 Goals and Objectives

As stated in the early chapters of this thesis, there has been a significant amount of research and analysis focusing on the success or failure of TQM. Its detractors have accused it and its progeny such as CQI, BPR etc., of being simply examples of sloganeering and "feel-good" morale-boosting buzzwords that have resulted in very little, if any, improvement in quality, operational or financial performance. The pursuit and winning of awards such as the Malcolm Baldrige Quality Award and the European Quality Award have not, state the critics of total quality management, resulted in any tangible benefits. Moreover, a number of companies have actually teetered on the brink of extinction after having won one of the numerous world-wide quality awards.

The protagonists of TQM, however, argue that there has been a raised consciousness about the importance of quality and customer satisfaction as a result of its introduction. They point to the successes of companies such as Chrysler and Ford in the United States or ABB in Europe as examples of how total quality can turn around a company on the verge of collapse or vastly improve the competitive position of a solid organisation. The defenders of TQM insist that the winning of awards, while not the ultimate goal, does help focus an organisation on increasing the input of quality.

Nobody argues that quality is a bad idea! The question has always been how to generate quality in a manner whereby the costs of quality are exceeded by the benefits. This thesis has argued that in order to evaluate the success or failure of total quality management one must first identify whether a legitimate TQ programme is in effect. This has proven difficult in the past since perceptions of the TQ level of a company have always been subjective. Furthermore, almost all of the evaluation methods have revolved around qualitative measurements such as customer satisfaction surveys.

This thesis set out to find a non-subjective quantitative method by which the presence of total quality can be detected. In so doing, the research identified three objectives:

- to determine whether inventory performance is a valid measurement tool for assessing TQ levels

- to determine whether other factors should be combined with inventory performance to form a multifactor measurement method

- to determine, through testing a model on a sampling of TQ and traditional companies, whether a multifactor rating system provides significantly better evaluations of total quality management than inventory performance alone.

In order to accomplish these objectives, a review of the literature was conducted with the express purpose of establishing whether there was a link between total quality and inventory performance.

The first stage in the review was to define quality and understand how it permeates throughout the entire organisation. This was achieved in Chapter Two. The second stage in the review process was to define inventory performance and specifically JIT, in order to understand how it manifests itself in the operational performance of the company. This was undertaken in Chapter Three in which the link between total quality and superior inventory performance was also established.

At that point it became evident that if total quality was present there had to be superior inventory management but the question remained as to whether the reverse was true. Chapter Four examined total quality and inventory management as systems and found them to be closely interwoven in a systemic platform. This finding meant that using inventory performance to assess the presence of total quality was a valid approach and thus the first objective was achieved.

Chapter Four established that return on capital employed and employee productivity are also system-wide factors that are directly affected by the level of total quality in the system. The findings suggested that serious consideration be given to including R.O.C.E. and employee value in combination with inventory performance to form a multifactor rating. This achieved the second objective.

In order to develop a model for testing, data for 48 companies was collected. Chapter Five described the method of data collection as well as a synopsis of the perceived level of total quality that the companies operate under. This was particularly important for assessing the actual level of total quality versus the perceived level.

The analysis of the data in Chapter Six and the discussion and subsequent implications of the findings in Chapter Seven established that inventory performance is strongly correlated with multifactor ratings. Since superior multifactor ratings reflect high levels of total quality it could now be concluded that inventory performance alone should be sufficient to assess the presence of total quality. This conclusion was tested on the 48 companies and re-checked using the multifactor rating. The results indicated that the findings were valid and consequently superior inventory performance is a good indicator of effective total quality management. This meant that the third objective was attained.

8.2 Hypothesis Testing

The null hypothesis outlined in Chapter One was that inventory performance is a reliable indicator of the presence of effective total quality.

It became clear as the research and subsequent analysis progressed that total quality organisations should have superior inventory performance. However, the question whether companies possessing superior inventory performance were by definition total quality companies still remained.

Testing of 48 companies was performed and evaluations indicating whether companies were TQ organisations or not were conducted.

R.O.C.E. and employee value was combined with inventory performance into a multifactor rating in order to compare the assessments derived from this "supermodel" against the determinations of the inventory performance model.

A test for correlation between multifactor ratings and inventory performance was performed for all 48 companies resulting in a value of $r = 0.85$ indicating a strong relationship. Visual assessment of the rankings using multifactor ratings versus inventory performance revealed very little difference. Accordingly, it must be concluded inventory performance is, indeed, a reliable and valid indicator of total quality management and therefore the null hypothesis should be accepted.

8.3 Contribution of Research to Knowledge

Prior assessments of total quality management have been conducted through subjective, non- or quasi-quantitative measures. This thesis has developed two quantitative methods for determining the presence of effective total quality programmes in an organisation. Firstly, an inventory rating method and secondly a multifactor rating method.

The use of inventory performance as an indicator of total quality is, of itself, a novel approach. The relationship between inventory management and total quality has been addressed before but only in terms of total quality needing other techniques such as JIT to be effective. The assertion that both JIT and total quality management are system-wide tools that are inextricably linked has been made only very recently.

This thesis concluded:

(a) that the presence of total quality means that a company should have good inventory performance

(b) that good inventory performance means a company practises total quality management.

In (a) the analysis confirmed the findings of previous research but (b) is a novel approach and conclusion that a review of the literature has not seen attempted.

The second concept of using a multifactor rating is also an innovative approach to detect total quality organisations. The fact that multifactor analysis makes the "good" companies better and the "bad" companies worse lends support and confirmation to recent research that asserts that quality, inventory, productivity and financial performance are all systemic factors.

Finally, this thesis asserts that inventory performance is a reliable identifier of TQ and non-TQ companies but that multifactor ratings should be used to evaluate an individual company more thoroughly. If one were selecting a squad of the "best" total quality organisations inventory performance will more than suffice, but if one needed to select the "first XI" then it would be more prudent to use the multifactor rating.

It is hoped that the inventory rating model and/or the multifactor rating model developed in this thesis will serve as the basis for a reliable comprehensive tool for assessing the presence of total quality in organisations.

8.4 Further Research

It is suggested that further research be directed in three areas. Firstly, expanding the company base to cover more industries. This would also involve the inclusion of privately held sterling TQ companies such as Milliken & Co. The selection of even one or two such firms could help immensely in increasing the confidence of establishing appropriate ranges and break points.

Secondly, expanded analysis of the current data. This would involve an examination of the statistical parameters for calculating the confidence limit. Close attention should be paid to the desired rejection criteria. Also, an evaluation of the trends and movement over the time period for each individual firm should be conducted. This is especially applicable to the companies on the cusp between categories because it would help determine whether the company is headed toward TQ or whether it was a total quality organisation and is now sliding away from it.

Thirdly, conducting a more comprehensive analysis of companies that have won quality awards such as Baldrige, E.F.Q.M., British Quality Award etc. to assess their quality standing using the inventory performance and multifactor measures outlined in this thesis. Of particular interest would be the differences in performance before, during the pursuit of, and after winning the award. It is possible that the quest for an award may have adversely affected the company in other areas. If certain factors were not a crucial part of the award evaluation criteria they may well have been neglected.

A further point to consider would be whether the company has "slacked-off" after having won an award. The reader's attention is drawn toward Eastman and Adac Labs discussed in Section 7.3.3. Both are past Baldrige Award winners but they each tell a different story. Adac has been consistently improving in all areas since winning the award whereas Eastman's performance has been declining. This would perhaps explain why there are such conflicting opinions as to the merits of pursuing and winning awards. If a company is striving to improve quality and in so doing it happens to win an award then it will continue to pursue higher levels of quality. However, if a company is striving to win an award and in so doing it happens to improve quality then any efforts will cease once the award has been won.

Finally, any future research must take into account that the concept of total quality is constantly changing. A review of the literature revealed that the definition of total quality could change from department to department and from company to company. It is equally true that since flexibility is an inherent component of TQM an organisation must constantly be changing and reassessing its total quality programme. Even Deming would neither want nor expect his prescription for total quality to go unchanged. This was a motivating force for the development of Figure 4-6: "Production Viewed as a System" Updated on page 106.

As the face of total quality changes so too must the criteria used to evaluate total quality. This may well result in factors being added or dropped from a multifactor model. In this regard, researchers and practitioners of TQM should treat a total quality programme, as they would have a TQ organisation treat its customers. This entails constantly trying to anticipate TQ requirements as well as maintaining the flexibility necessary to adapt to changes in the system. It is vital that TQM be analysed and evaluated using an approach that embodies the principles of total quality.

REFERENCES AND BIBLIOGRAPHY

Abbott, L. Quality and Competition, New York; Columbia University Press, 1955

Ahire, Sanjay L. "An Empirical Investigation of Quality Management in Small Firms," Production and Inventory Management Journal," 37(2), Second Quarter 1996b, pp.44-50

Ahire, Sanjay L. "TQM Age Versus Quality: An Empirical Investigation," Production and Inventory Management Journal," 37(1), First Quarter 1996a, pp.18-23

American Electronics Association 1992 Productivity Survey, Pittiglio, Rabin, Todd & McGrath and KPMG Marwick High Technology Practice, 1992a

American Electronics Association Productivity Survey Management Summary 1992, Pittiglio, Rabin, Todd & McGrath and KPMG Peat Marwick High Technology Practice, 1992b

Anderson, Elizabeth A. and Dennis A. Adams. "Evaluating the Success of TQM Implementation: Lesson from Employees," Production and Inventory Management Journal," 38(4), Fourth Quarter 1997, pp.1-6

Anon., "The Cracks in Quality," The Economist, 323(7755), April 18, 1992, pp.67-68

Anon., "Troubled Boeing Takes Further Charge Over 737s." The Times, London, April 10, 1998, Business News, p.28

Axelson, Barbara. "Plant Engineers Take On Integrated Supply," Industrial Distribution, 86(5) May 1997, pp.62-68

Baatz, Elizabeth B. "CEO's Talk a Good Quality Game, But....," Electronics Business, 19(10), October 19, 1993, pp.75-79

Ballantine, J. and S. Brignall. "A Taxonomy of Performance Measurement Frameworks," Warwick, England; Warwick Business School Research Papers (No.135), 1994

Barrier, Michael and Amy Zuckerman. "Quality Standards the World Agrees On," Nation's Business, 82(5), May 1994, pp. 71-73

Barrier, Michael, "Learning the Meaning of Measurement," Nation's Business, 82(6), pp. 72-74

Bermar, Amy, "TQM," Computer World, 27 (44), November 1, 1993, pp.97-100

Black, Simon A. and Leslie J. Porter. "Identification of the Critical Factors of TQM," Decision Sciences, 27(1), Winter 1996 pp.1-21

Boznak, R.G. "When Doing It Right The First Time Is Not Enough," Quality Progress, 27(7), July 1994, pp.74-78

Bridgman, P.W., Dimensionless Analysis, Yale University Press, 1922

Brignall, S. "Performance Measurement Systems as Change Agents: A Case for Further Research," Warwick, England: Warwick Business School Research Papers (No.72), 1992

Buzzell, Robert D. and Bradley T. Gale. The PIMS Principles: Linking Strategy to Performance, New York, The Free Press, 1987

Chelsom, J.V. "Getting Equipped for the 21st Century," Logistics Information Management, 11(2), 1998a

Chelsom, J.V., L.R.P. Reavill and J.T. Wilton. "Left Right, Left Right, Wrong!" The TQM Magazine, 10(2), 1998, pp.72-82

Chelsom, John V. Professor, City University Business School, City University, London, 1998b, Personal Communication

Churchill, Gilbert A. and J. Paul Peter. Marketing: Creating Value for Customers, 2nd ed., Boston, Massachusetts, Irwin/McGraw-Hill, 1998

Clauson, Jim. "List Relays Large Quantity of Quality Messages," Quality Progress, 29(1), January 1996, pp.107-111

Clewer, Graham R. "Understanding Supply-Chains and Forces or Feedback and Systems? Time for a Rethink," Proceedings of the European Management of Technology Conference. Aston University, Birmingham. 1995, pp.93-100

Conners, Mary. "Baxter's Big Makeover in Logistics," Fortune, July 8, 1996, pp. 106C-106N

Crosby, P.B. Quality is Free: The Art of Making Quality Certain. New American Library, 1979

Cupello, James M. "A New Paradigm for Measuring TQM Progress," Quality Progress, 27(5), May 1994

Daniel Shirley J. and Wolf D. Reitsperger. "Strategic Control Systems for Quality: An Empirical Comparison of the Japanese and U.S. Electronics Industry," Journal of International Business Studies, Second Quarter 1994: 275-294

Dannenbring, David G. and Martin K. Starr, Management Science, New York; McGraw-Hill, 1981

Dar-El, Ezey M. "What We Really Need is TPQM!" International Journal of Production Economics, 52(1,2), October 15, 1997, pp.5-13

Delaney, Patrick J. and Renee M. Gregoire, "Too Much Inventory? How Do You Know?" Hospital Materials Management Quarterly, 16(1), August 1994, pp. 1-3

Deming, W. Edwards "Improvement of Quality and Productivity Action Through Action by Management," National Productivity Review, 1(1), Winter 1981-1982, pp.12-22

Deming, W. Edwards "Transformation of Western Style of Management," Interfaces, 15(3), May/June 1985, pp.6-11

Deming, W. Edwards, Out of the Crisis, Cambridge; Massachusets Institute of Technology, Center for Advanced Engineering Study, 1986

Develin and Partners. The Effectiveness of Quality Improvement Programmes in British Business, London; Develin and Partners, 1989

E.F.Q.M. Self-assessment Guidelines. European Foundation for Quality Management, Brussels, 1995

Feigenbaum, A.V. Total Quality Control, 3rd ed., New York; McGraw-Hill, 1983

Feigenbaum, A.V. Total Quality Control, 4th ed., New York; McGraw-Hill, 1991

Feigenbaum, A.V. Quality Control: Principles, Practice and Administration, New York; McGraw-Hill, 1951

Feigenbaum, A.V. Total Quality Control: Engineering & Management, 2nd ed., New York; McGraw-Hill, 1961

Ford Sr., Henry and Samuel Crowther, My Life and Work, New York; Garden City Publishing, 1926. New York; Doubleday, 1982

Fruin W. Mark and Masao Nakamura. "Top-Down Production Management: A Recent Trend in the Japanese Productivity-Enhancement Movement," Managerial & Decision Economics, 18(2), March 1997, pp.131-139

Fuller, David W., "Chrysler and Daimler-Benz: Speeding Toward the Future," The Costco Connection, 13(8) August 1998, pp.18-20

G.A.O. Management Practices: U.S. Companies Improve Performance Through Quality Efforts. Washington, D.C.: General Accounting Office, GAO/NSIAD, 1991, pp.91-190

Gale, Bradley T., "How Quality Drives Market Share," The Quality Review, 18(2), Summer 1987, pp.18-23.

Garvin, David A., "Competing on the Eight Dimensions of Quality" IEEE Engineering Management Review, 24(1), Spring 1996, pp.15-24

Garvin, David A., "What Does Product Quality Really Mean?" Sloan Management Review, 26(1), Fall 1984, pp.25-43

Genasci, L. "The Downside of Downsizing," St. Louis Post-Dispatch, 36(192), July 1994, p.18

Ghoshal, S. and Bartlett, C.A. "Linking Organizational Context and Managerial Action: The Dimensions of Quality Management," Strategic Management Journal, 15(Special Issue), 1994, pp.91-112

Giauque, William C. and William J. Sawaya. "Strategies for Production Control." Production and Inventory Management Journal, 33(3), Third Quarter 1992

Gilmore, H.L. "Product Conformance Cost," Quality Progress, 7(5), May 1974, pp.16-19

Giunipero, Larry C. and Daniel J. Brewer, "Performance Based Evaluation Systems Under Total Quality Management," International Journal of Purchasing and Materials Management, 29(1), Winter 1993, pp. 35-41

Gradig, Rita M. and John K. Harris. "The Baldrige Award: A Quest for Excellence," Review of Business, 15(3), Spring 1994, pp.20-24

Grossman, S.R. "Why TQM Doesn't Work...And What You Can Do About It," Industry Week, 243(1), January 3, 1994, pp.57-62

Guillen, M.F. "The Age of Eclecticism: Current Organizational Trends and the Evolution of Managerial Models," Sloan Management Review, 36(1), Fall 1994, pp.75-86

Haag, Stephen, Maeve Cummings and James Dawkins. Management Information Systems for the Information Age, New York; Irwin/McGraw-Hill, 1998

Hakanson, William P. "Managing Manufacturing Operations In The 1990's," Industrial Engineering, 26(7), July 1994, pp.31-34

Halerow, Allan. "Managing Change: The Optimal Award Winner. At L.L. Bean, Quality Starts with People," Personnel Journal, 73(1), January, 1994, p. 60

Hampton, W.J., "Why Image Counts: A Tale of Two Industries," Business Week, Iss: 3002 June 8, 1987, pp.138-140.

Harari, Oren. "Ten Reasons TQM Doesn't Work," Management Review, 86(1), January 1997, pp.38-44

Hart, Christopher W.I. "What's Wrong - And Right – With The Baldrige Awards," Management, November/December 1993, pp. 36-47

Hart, Marilyn K. "Quality Control Training for Manufacturing," Production and Inventory Management Journal, 32(3), Third Quarter, 1991, pp. 35-40

Heldt, John J. "More Than Ever Quality Pays," Quality, (33)2, February 1994, pp. 31-33

Heller S. "Putting the Total into Total Quality," Management Today, August 1994, pp. 61-66.

Hendricks Kevin B. and Vinod R. Singhal. "Does Implementing an Effective TQM Program Actually Improve Operating Performance? Empirical Evidence from Firms That Have Won Quality Awards." Management Science, 43(9), September 1997, pp.1258-1274

Hermel, Phillipe. "The New Faces of Total Quality in Europe and the US," Total Quality Management, 8(4), August 1997, pp.131-143

Hernandez, A. Just-In-Time Manufacturing: A Practical Approach. Englewood Cliffs, New Jersey: Prentice-Hall, 1989

Jocou, Pierre. "TQM Beyond Buzzwords: At Mack Trucks," Chief Executive, 116, September 1996, pp.54-57

Juran, J.M. "Strategies for World Class Quality," Quality Progress, 24(3), March 1991a, pp.81-85

Juran, J.M. "The Quality Trilogy," Quality Progress, 19(8), August 1986, pp.19-24

Juran, J.M. "Universal Approach to Managing Quality," Executive Excellence, 6(5), May 1989, pp.15-17

Juran, J.M. Quality Control Handbook, New York; McGraw-Hill. 1951

Juran, J.M. and F.M. Gryna, Juran's Quality Control Handbook, New York; McGraw-Hill, 1988

Juran, J.M., "Made in USA--A Quality Resurgence," Journal for Quality and Participation, 14(2), March 1991b, pp.6-8;

Kano, Noriaki. "A Perspective on Quality Activities in American Firms," California Management Review, 35(3), Spring 1993, pp.12-31

Kaplan Robert S. and David P. Norton, "The Balanced Scorecard - Measures That Drive Performance," Harvard Business Review, January-February 1992, pp.71-79

Kaplan Robert S. and David P. Norton, "Putting the Balanced Scorecard to Work," Harvard Business Review, September-October 1993, pp.134-147

Kaplan Robert S. and David P. Norton, "Using the Balanced Scorecard as a Strategic Management System," Harvard Business Review, January-February 1996, pp.75-85

Kearney, A.T. in Association with The TQM Magazine, "Total Quality: Time To Take Off The Rose-Tinted Spectacles," Special Report, 1993

Kendrick, John, J., "Total Quality Management Ups Revenues, Productivity, Studies Show," Quality, 32(12), December 1993, pp.17

Krieter, Cindy. "Total Quality Management Versus Business Process Reengineering: Are Academicians Teaching What Businesses Are Practicing?" Production and Inventory Management Journal," 37(2), Second Quarter 1996, pp.71-75

Kulas, Paul A., "Controlling inventory performance in a just-in-time environment," Hospital Material Management Quarterly, 16(1), August 1994, pp.67-75.

Mack, Joseph A. and Henry H. Jordan. "How to reduce your inventory: A real world case study," Hospital Material Management Quarterly, 16(1), August 1994, pp.4-9

McGraw, Dan. "Staying Loose in a Tense Tech Market," U.S. News and World Report. July 8, 1996, p.46

Miller, Cyndee, "TQM Out; 'Continuous Improvement' In." Marketing News, 28(10), May 9, 1994, p.5

Miltenburg, John and David Sparling. "Managing and Reducing Cycle Time: Models and Analysis," International Journal of Production Economics, 46-47, December, 1996, pp.89-108

N.I.S.T. Malcolm Baldrige National Quality Award Criteria. U.S. Department of Commerce, National Institute of Standards and Technology, 1992

N.I.S.T. Malcolm Baldrige National Quality Award Criteria. U.S. Department of Commerce, National Institute of Standards and Technology, 1995

Naj, Amal Kumar, "Some Manufacturers Drop Efforts to Adopt Japanese Techniques," Wall Street Journal, May 7, 1993, p.A1

Nakamura, Masao, Sadao Sakabibara and Roger G, Schroeder, "Japanese Manufacturing Methods at U.S. Manufacturing Plants: Empirical Evidence," Canadian Journal of Economics, 29(Special Issue), April 1996, pp. 468-474

Naveh, Eitan, Miriam Erez and Avigdor Zonnenshain. "Developing a TQM Implementation Model," Quality Progress, 31(2), February 1998, pp.55-59

Neave, H.R., "I Shall Teach...the Theory of a System and Co-operation," Proceedings of the First International Conference on ISO 9000 & TQM, 1996, pp.109-118

Neave, H.R., "W. Edwards Deming (1900-1993): the man and his message." Total Quality Management, Proceedings of the First World Congress, ed Kanji, G.K., London; Chapman-Hall, 1995, pp.50-59

Neely, A., M. Gregory and K. Platts. "Performance Measurement System Design: A Literature Review and Research Agenda," International Journal of Operations and Production Management, 15(4), 1995, pp. 80-116

Neves, Joao S. and Benham Nakhal "The Evolution of the Baldrige Award," Quality Progress, 27(6), pp. 65-70

Nyerges, Richard T. "The New Management Paradigm: An Extension Through the IFAM Perspective," International Journal of Production Economics, 45(1-3), August 1, 1996, pp.203-214

Olsten Forum. 1994 "Quality Programs and Practices," Westbury, NY: Olsten Corporation

Owen, Dave, Bill Hubbard and Greg Blair. "IE Techniques Improve Productivity at Service Companies," Industrial Engineering, 25(12), December 1993, pp.27-30

Owen, Jean V. "Are Lasers Measuring Up?" Manufacturing Engineering, 104(1), January 1990, pp. 60-68

Parasumaran, A., V.A. Zeithaml and L.L. Berry, "A Conceptual Model of Service Quality and Its Implications for Future Research," Journal of Marketing, 49(4), Fall 1985, pp.41-50

Payne, Andrew C., John V. Chelsom and Lawrence R.P. Reavill, Management for Engineers, Chichester; J. Wiley, 1996

Perdue and Chicken, A Tradition in Quality, Perdue Farms Incorporated, 1994

Peters, Tom. Thriving on Chaos, Pan Books in association with McMillan, London, 1987

Peterson, Rick. Quality Implementation Manager, Smith Barney & Co. 1994, Personal Communication

Pike, John and Richard Barnes. TQM in Action: A Practical Approach to Continuous Performance Improvement, London; Chapman and Hall, 1994

Poe, Randall and Carol Lee Courter. "Fast Forward," Across the Board, 29(6), June 1992, p. 5

Port, Otis. "Dueling Pioneers," Business Week, Special Bonus Issue, "The Quality Imperative," October 25, 1991, pp.8-17

Porter, Anne Millen. "Was It All Just Talk?" Purchasing, 124(1), January 15, 1998, pp.51-59

Porter, Michael E. Competitive Advantage, New York; The Free Press, 1985

Powell, T.C. "Total Quality Management as Competitive Advantage: A Review and Empirical Study." Strategic Management Journal, 16(1), January 1995, pp.15-37

Raia, Ernest "JIT in Detroit," Purchasing, 105(3), September 15, 1988, pp.68-77

Random House Dictionary, New York; Random House, 1992

Roehm, H., D. Klein and J. Castellano. "Blending Quality Theories for Continuous Improvement," Management Accounting, 76(8), February 1995, pp.26-32

Romano, Catherine, "Report Card on Total Quality Management," Management Review, 83(1), January 1994, pp.22-25

Ross, P.J. Taguchi Techniques for Quality Engineering. New York, McGraw-Hill. 1989

Roth, Jill, "Productivity and Quality Improvement," American Printer, 212(2), November 1993, pp.41-46

Schmahl, Karen E., Yasser Dessouky and David Rucker. "Measuring the Cost of Quality: A Case Study," Production and Inventory Management Journal," 38(4), Fourth Quarter 1997, pp.58-64

Schniederjans, M.J. 1993, Topics in Just-In-Time Management. Boston, Massachusetts; Allyn and Bacon

Schroeder, R. G., S. Sakakibara, E. James Flynn and Barbara Flynn. "Japanese Plants in the U.S.: How Good Are They?" Business Horizons, 35(4), July-August 1992: pp.66-72

Schuler, Randall S. "Strategic Human Resources Management: Linking the People With the Strategic Needs of the Business," Organizational Dynamics, 21(1), Summer 1992, pp.18-32

Shepard, S., "Defining the Q-Word." Editor's Note, Business Week, Special Bonus Issue, "The Quality Imperative," October 25, 1991, p.4

Sissel, Dennis D. "Continuous Quality Improvement at Acme Printing," Management Accounting, 75(7), January 1994, pp. 53-55

Stevens, David P. "Avoiding Failure With Total Quality," Quality, 32(12), December 1993, pp.18-22

Stone, Claire L. "Facilitating the Use of 'Soft' Employee-Related Measures in the Analysis of Business Performance," Ph.D. thesis Anglia Polytechnic University, 1997

Stuart F. Ian and P. Mueller, Jr. "Total Quality Management and Supplier Partnerships: A Case Study," International Journal of Purchasing and Materials Management, 30(1), Winter 1994, pp. 14-20

Stuelpnagel, Thomas R., "Déjà Vu: TQM Returns to Detroit and Elsewhere," Quality Progress, 26(9), September 1993, pp.91-95

Sullivan, Jeremiah J., Invasion of the Salarymen: The Japanese Business Presence in America, Westport, Connecticut: Praeger Publishers. 1992

Tamimi, Nabil and Rose Sebastianelli. "How Firms Define and Measure Quality," Production and Inventory Management Journal, 37(3), Third Quarter 1996, pp.34-39

Tatikonda, Lakshmi U. and Rao J. Tatikonda. "Top Ten reasons Your TQM Effort is Failing to Improve Profit," Production and Inventory Management Journal," 37(3), Third Quarter 1996b, pp.5-9

Tatikonda, Lakshmi U. and Rao J. Tatikonda. "Measuring and Reporting the Cost of Quality," Production and Inventory Management Journal," 37(2), Second Quarter 1996a, pp.1-7

Thomas, Michael F. and James T. Mackey. "Activity-Based Variances For Just-In-Times," Management Accounting, (75)10, April 1994, pp.49-54

Thomson, Richard. "Big Blue Sea Change May Not Be Enough For Critics," The Times, London, May 19, 1997, Business News, p.46

Titone, Rick C. "Integrating MRP II and JIT to Achieve World-Class Status," Hospital Materials Management Quarterly, 15(4), May 1994, pp. 62-66

Trunick, Perry A. "JIT Brings Together Production and Logistics," Training & Development, 48(8), August 1994, p.56

Union of Japanese Scientists and Engineers, QC Circle Koryo (General Principles of the QC Circle), JUSE, Tokyo, 1980

Wigmore, Barry, "The Rise of the Wow Wow Girls," The Times, London, May 21, 1997, Features Section, p.23

Wilkinson, A., D. McCabe and D. Knights, "What is happening in 'Quality' in the Financial Services? The TQM Magazine, 7(4) 1995, pp.9-12

Wilkinson, A., D. McCabe and D. Knights, "Looking for Quality: a survey of quality initiatives in the financial services sector," Total Quality Management, 7(1), 1996, pp.67-78

Williams, Gordon and Leigh Reid. "Enhancing Customer-Supplier Relationships," Quality, 33(4), April 1994, pp.20-25

Wisner J.D. and S.G. Eakins. "A Performance Assessment of the U.S. Baldrige Quality Award Winners." International Journal of Quality and Reliability Management, 11(2), 1994, pp.8-25

Withers, Barbara E., Maling Ebrahimpour and Neset Hikmet. "An Exploration of the Impact of TQM and JIT on ISO 9000 Registered Companies," International Journal of Production Economics, 53(2), November 20, 1997, pp.209-216

Woodruff, Davis M. "Ten Essentials for being the Low-Cost, High-Quality Producer," Management Quarterly, 36(4), Winter 1995-1996, pp.2-7

Zangwill, Willard L. "Ten Mistakes CEOs Make About Quality," Quality Progress, 27(6), pp. 43-48

APPENDIX I

A1.0 MISCELLANEOUS DATA

A1.1 Introduction

This appendix includes various tables and/or figures containing the following information:

- Raw data collected (in billions of dollars)
- Individual year breakdown of Inventory Performance data for all 48 companies using rating method 1
- Inventory Results for companies providing a breakdown for raw materials, work-in-process, and finished goods
- Individual year breakdown of company exponential R.O.C.E. ratings
- Company average exponential R.O.C.E. rankings
- Individual year breakdown of company EVF ratings
- Company average EVF rankings

A1.2 Raw Data for All 48 Companies

Company	Year	Employees	Raw Materials	Work in Process	Finished Goods	Net Sales	EBIT	Cost of Sales	Assets
Adac Labs	1997	880	0.0140	0.0030	0.0100	0.2120	0.0300	0.1220	0.2070
Adac Labs	1996	720	0.0160	0.0050	0.0110	0.1780	0.0260	0.1080	0.1870
Adac Labs	1995	781	0.0140	0.0010	0.0130	0.1370	0.0170	0.0860	0.1580
Adac Labs	1994	559	0.0140	0.0030	0.0060	0.1350	0.0110	0.0780	0.1220
Am. Std.	1997	51,000	0.0890	0.0870	0.2600	6.0000	0.240	4.4800	3.550
Am. Std.	1996	44,000	0.0960	0.0780	0.2400	5.8000	0.058	4.3800	3.330
Am. Std.	1995	43,000	0.0870	0.0850	0.1900	5.2200	0.270	3.8900	3.330
Am. Std.	1994	38,000	0.0800	0.0820	0.1600	4.4570	(0.015)	3.3770	3.156
Ameristeel	1998	1,951	0.0332	0.0097	0.0875	0.6650	0.052	0.5400	0.562
Ameristeel	1997	1,966	0.0327	0.0142	0.0593	0.6170	0.016	0.5310	0.536
Ameristeel	1996	1,942	0.0233	0.0163	0.0732	0.6280	0.006	0.5340	0.555
Ameristeel	1995	1,956	0.0247	0.0216	0.0814	0.6400	0.020	0.5457	0.562
Armstrong	1997	10,643	0.0510	0.0200	0.1490	2.1990	0.296	1.4620	2.375
Armstrong	1996	10,572	0.0420	0.0200	0.1440	2.1560	0.240	1.4610	2.136
Armstrong	1995	11,365	0.0510	0.0240	0.1200	2.0860	0.008	1.4610	2.150
Armstrong	1994	11,612	0.0390	0.0230	0.1030	2.0060	0.266	1.3250	2.139
Bassett	1997	5,400	0.0280	0.0090	0.0290	0.4500	(0.042)	0.4000	0.320
Bassett	1996	6,300	0.0380	0.0140	0.0430	0.4500	0.022	0.3800	0.340
Bassett	1995	6,100	0.0450	0.0160	0.0470	0.4900	0.030	0.4100	0.350
Bassett	1994	5,700	0.0450	0.0160	0.0450	0.5110	0.035	0.4190	0.341
Birmingham	1997	1,789	0.0520	0.0720	0.0850	0.9800	0.025	0.8900	1.210
Birmingham	1996	1,604	0.0380	0.0950	0.0630	0.8300	(0.002)	0.7700	0.930
Birmingham	1995	1,665	0.0450	0.0520	0.0760	0.8900	0.086	0.7600	0.760
Birmingham	1994	1,517	0.0510	0.0370	0.0440	0.7020	0.036	0.5990	0.696
Black Decker	1997	29,300	0.1990		0.5990	4.9400	0.349	3.1690	5.360
Black Decker	1996	29,200	0.2100		0.5700	4.9100	0.200	3.1600	5.150
Black Decker	1995	29,300	0.2300		0.6700	4.7700	0.230	3.0170	5.550
Black Decker	1994	29,200	0.2000		0.5400	4.3700	0.150	2.7700	5.260
Boeing	1997	238,000	1.8700		26.5700	45.8000	(0.340)	40.6400	38.024
Boeing	1996	211,000	1.4800		23.2900	35.4500	2.480	29.3800	37.880
Boeing	1995	169,000	0.8900		13.1100	32.9600	(0.410)	27.3700	31.880
Boeing	1994	119,400	0.9170		10.3500	21.9240	1.143	20.7730	21.463
Chrysler	1997	121,000	1.4400		1.8800	56.9900	4.560	46.9400	60.420
Chrysler	1996	114,200	1.5400		1.5700	57.5900	6.090	45.8400	56.180
Chrysler	1995	112,500	1.4600		1.2300	49.6000	3.450	41.3000	53.760
Chrysler	1994	111,600	1.2200		1.1500	49.4000	5.830	38.0300	49.540
Compaq	1997	32,565	0.7700		0.8000	24.5800	2.760	17.8300	14.630
Compaq	1996	26,801	0.6300		0.6300	20.0000	1.880	14.8600	10.530
Compaq	1995	25,435	0.7700	0.2700	1.1100	16.6800	1.330	12.2900	7.820
Compaq	1994	22,838	1.0130	0.2660	0.7260	10.8700	1.172	8.1400	6.170
Cyprus	1997	8,674	0.1100	0.2300	0.1800	3.3500	0.040	2.2600	6.460
Cyprus	1996	9,285	0.0970	0.2400	0.1600	2.8400	0.077	2.0740	6.790
Cyprus	1995	9,057	0.0790	0.2100	0.1600	3.2100	0.120	2.1100	6.200
Cyprus	1994	9,532	0.0780	0.1930	0.1820	2.7880	0.221	2.0830	5.407
Eastman	1997	16,676	0.2110	0.1400	0.4360	4.6780	0.446	3.5820	5.778
Eastman	1996	17,505	0.2140	0.1330	0.4260	4.7820	0.607	3.6030	5.266
Eastman	1995	17,709	0.1990	0.1270	0.4610	5.0400	0.899	3.5360	4.872
Eastman	1994	17,495	0.1700	0.1090	0.4010	4.3290	0.550	3.2660	4.395

Company	Year	Employees	Raw Materials	Work in Process	Finished Goods	Net Sales	EBIT	Cost of Sales	Assets
Estee Lauder	1997	14,700	0.1200	0.0240	0.1900	3.3800	0.360	0.7700	1.870
Estee Lauder	1996	14,616	0.1100	0.0300	0.2000	3.1900	0.310	0.7300	1.780
Estee Lauder	1995	14,601	0.1100	0.0240	0.1600	2.9000	0.230	0.6700	1.700
Fedders	1997	2,700	0.0240	0.0063	0.0322	0.3141	0.029	0.2440	0.329
Fedders	1996	2,600	0.0251	0.0065	0.0217	0.3718	0.050	0.2887	0.290
Fedders	1995	2,543	0.0119	0.0025	0.0146	0.3165	0.036	0.2494	0.137
Fedders	1994	2,150	0.0072	0.0012	0.0096	0.2320	0.020	0.1823	0.101
Ford	1997	363,892	2.8800		2.5900	122.9400	3.860	108.9100	279.097
Ford	1996	371,702	3.3700		3.2800	118.0230	4.220	108.8800	262.867
Ford	1995	346,989	3.7170		3.4450	110.5000	6.705	101.1710	243.283
Ford	1994	337,778	3.1920		3.2950	107.1370	8.789	96.1800	219.354
GE	1997	276,000	3.0700		2.8950	36.0590	10.013	26.7500	67.430
GE	1996	239,000	3.0300		2.4000	34.1960	9.575	24.5940	59.930
GE	1995	222,000	3.2100		2.2800	33.1770	8.632	24.3080	55.716
GE	1994	221,000	2.9300		2.1700	30.7670	7.797	22.7750	50.813
GM	1997	608,000	7.0200		7.3500	153.6800	7.714	130.0300	228.890
GM	1996	647,000	7.6860		6.5600	145.3400	6.670	123.9200	222.140
GM	1995	745,000	6.5700		4.9600	143.6700	8.350	121.3000	217.120
GM	1994	728,000	5.4800		4.6500	134.7600	7.100	113.5900	198.600
Hewlett P	1997	121,900	2.6300		4.1400	36.6700	4.450	24.2200	31.750
Hewlett P	1996	112,000	2.4400		3.9600	33.1100	3.690	22.0130	27.700
Hewlett P	1995	102,300	2.6500		3.3700	27.1300	3.630	17.0690	24.430
Hewlett P	1994	98,400	1.8100		2.4700	21.3800	2.420	13.0120	19.570
Hitachi	1997	330,152	1.3150	8.4720	2.9290	68.7347	2.124	50.4104	80.361
Hitachi	1996	331,852	1.5963	10.4236	4.0853	76.6400	3.289	54.9890	92.485
Hitachi	1995	331,673	1.5700	12.1120	3.9440	85.3030	3.146	60.6070	102.697
Hitachi	1994	330,637	1.2900	10.0300	3.4700	71.8500	2.220	51.5700	87.132
Honda	1997	101,100	1.1500	0.1400	3.1400	42.6500	3.150	29.8000	33.770
Honda	1996	96,800	1.0500	0.1600	3.3900	39.9800	1.080	29.1000	33.108
Honda	1995	92,800	1.0430	0.1480	3.8070	44.5640	1.059	32.4280	33.870
Honda	1994	91,300	1.0430	0.1480	3.8070	37.6850	0.457	27.5163	28.498
IBM	1997	269,465	0.0200	4.0300	1.0900	49.0700	9.027	27.3200	81.500
IBM	1996	240,615	0.0800	4.3800	1.4100	49.3700	8.590	27.0600	81.130
IBM	1995	225,347	0.0920	4.9900	1.2400	48.2600	7.810	26.2900	80.290
IBM	1994	219,839	0.2560	4.6400	1.4400	43.6900	5.160	25.9800	81.091
Inland Steel	1997	14,318	0.6240		0.5440	5.0470	0.208	4.3160	3.646
Inland Steel	1996	14,695	0.4950		0.4180	4.5840	0.116	3.9790	3.542
Inland Steel	1995	15,410	0.4610		0.3860	4.7810	0.237	4.0430	3.558
Inland Steel	1994	15,479	0.4290		0.3640	4.4970	(0.074)	3.8530	3.353
Int'l Paper	1997	82,000	0.4800		2.6300	20.1000	0.016	14.9700	26.750
Int'l Paper	1996	87,000	0.5500		1.6200	20.1400	0.802	14.9000	28.250
Int'l Paper	1995	81,500	0.5900		1.5600	19.8000	2.030	13.9000	23.980
Int'l Paper	1994	70,000	0.3650		1.2960	14.9700	0.664	13.9500	17.840
Intel	1997	63,700	0.2600	0.9300	0.5100	25.0700	10.660	9.9500	28.880
Intel	1996	48,500	0.2800	0.6700	0.3400	20.8500	7.930	9.1600	23.740
Intel	1995	41,600	0.6700	0.7100	0.6200	16.2000	5.640	7.8100	17.500
Intel	1994	32,600	0.3450	0.5280	0.2960	11.5210	3.600	5.5760	13.820
Iomega Corp.	1997	4,816	0.1300	0.0187	0.0976	1.7400	0.177	1.1920	0.962
Iomega Corp.	1996	2,926	0.0887	0.0140	0.0692	1.2130	0.094	0.8800	0.687
Iomega Corp.	1995	1,667	0.0890	0.0057	0.0040	0.3260	0.012	0.2360	0.266
Iomega Corp.	1994	886	0.0075	0.0048	0.0049	0.1414	0.000	0.0920	0.076

Company	Year	Employees	Raw Materials	Work in Process	Finished Goods	Net Sales	EBIT	Cost of Sales	Assets
Kaiser	1997	9,553	0.1080	0.2300	0.1040	2.3700	0.060	1.9600	3.017
Kaiser	1996	9,567	0.1100	0.2000	0.1100	2.1900	0.002	1.8700	2.940
Kaiser	1995	9,546	0.1200	0.2000	0.0910	2.2400	0.103	1.8000	2.810
Kaiser	1994	9,468	0.1020	0.2030	0.0490	1.7800	(0.152)	1.6250	2.690
LTV	1997	15,500	0.2500		0.6600	4.4500	0.069	3.8000	5.550
LTV	1996	14,000	0.2300		0.5700	4.1400	0.170	3.6000	5.410
LTV	1995	14,400	0.2300		0.5100	4.2800	0.310	3.6200	5.380
LTV	1994	15,300	0.2470		0.5730	4.2330	0.199	3.9080	5.589
Maytag	1997	22,433	0.0610	0.0531	0.2290	3.4070	0.300	2.4700	2.514
Maytag	1996	20,464	0.0530	0.0450	0.2200	3.0000	0.230	2.1800	2.330
Maytag	1995	16,595	0.1000		0.1600	3.0400	0.060	2.2500	2.130
Maytag	1994	19,772	0.1300		0.2500	3.3700	0.240	2.5000	2.500
Mazda	1997	24,891	0.0430	0.1760	1.2210	15.2800	0.014	13.4000	10.150
Mazda	1996	26,072	0.0560	0.2130	0.9390	17.3850	(0.038)	15.4300	12.910
Mazda	1995	35,361	0.0800	0.2900	1.4200	24.7700	(0.420)	22.2900	12.230
Mazda	1994	33,118	0.0720	0.2730	1.2600	21.3480	(0.462)	19.2170	14.827
Natl Steel	1997	9,417	0.1500		0.3600	3.1400	0.240	2.6700	2.450
Natl Steel	1996	9,579	0.1800		0.3900	2.9500	0.032	2.6200	2.550
Natl Steel	1995	9,474	0.1800		0.3700	2.9500	0.090	2.5300	2.670
Natl Steel	1994	9,711	0.1060		0.2610	2.7000	0.152	2.3500	2.499
NEC	1997	151,966	1.4940	3.9170	2.4260	39.9070	0.978	28.4540	38.703
NEC	1996	152,719	2.0260	4.7250	3.2860	41.0950	1.414	27.8570	43.767
NEC	1995	151,069	1.7220	5.1520	3.4390	43.3250	0.859	29.3970	40.241
NEC	1994	147,910	1.3400	4.2700	2.6900	35.1000	0.250	24.1500	39.610
Nike	1997	21,800	0.0400	0.0502	1.2480	9.1860	1.295	5.5030	5.361
Nike	1996	17,200	0.0275	0.0289	0.8750	6.4700	0.899	3.9070	3.952
Nike	1995	14,240	0.0022	0.0091	0.6185	4.7610	0.650	2.8650	3.143
Nike	1994	11,293	0.0020	0.0029	0.4651	3.7900	0.491	2.3010	2.374
Nissan	1997	135,331	1.2903		4.3145	53.7016	0.815	40.3548	60.274
Nissan	1996	139,856	1.4689		5.2825	56.8644	(0.763)	44.5104	66.780
Nissan	1995	145,582	1.8090		5.9551	65.5506	(2.539)	52.6404	80.820
Nissan	1994	143,310	1.5707		5.1707	56.5951	(1.932)	46.3122	71.493
Nokia	1997	35,490	0.4695	0.4742	0.4190	9.8022	1.560	6.3344	7.709
Nokia	1996	31,766	0.4896	0.1718	0.5353	7.3260	0.726	5.2221	6.200
Nokia	1995	31,948	0.7695	0.1992	0.8628	6.8581	0.919	4.7543	6.104
Nokia	1994	28,043	0.5282	0.1831	0.5506	5.6223	0.746	3.8768	5.189
Nucor	1997	6,900	0.2380		0.1588	4.1800	0.460	3.5800	2.980
Nucor	1996	6,600	0.2320		0.1544	3.6500	0.390	3.1400	2.620
Nucor	1995	6,200	0.1688		0.1381	3.4600	0.430	2.9000	2.300
Nucor	1994	5,900	0.1337		0.1093	2.9760	0.357	2.4920	2.000
Oregon Steel	1997	2,380	0.0519	0.0655	0.0311	0.7685	0.019	0.6791	0.990
Oregon Steel	1996	2,730	0.0498	0.0460	0.0250	0.7728	0.035	0.6708	0.910
Oregon Steel	1995	2,640	0.0514	0.0520	0.0381	0.7100	0.016	0.6384	0.810
Oregon Steel	1994	3,019	0.0377	0.0500	0.0503	0.8383	0.009	0.7613	0.666
Premark	1997	17,200	0.2100	0.0150	0.1700	2.4100	0.170	1.5300	1.770
Premark	1996	16,300	0.1400	0.0260	0.1600	2.2700	0.110	1.4400	1.660
Premark	1995	17,400	0.1400	0.0380	0.1700	2.2100	0.120	1.4200	1.550
Premark	1994	23,900	0.1930	0.0620	0.2570	3.4510	0.311	1.7890	2.358

Company	Year	Employees	Raw Materials	Work in Process	Finished Goods	Net Sales	EBIT	Cost of Sales	Assets
Raytheon	1997	119,200	0.5090	1.3400	0.3140	13.6700	0.790	10.5800	28.600
Raytheon	1996	75,300	0.4800	0.7000	0.6200	12.3300	1.080	9.7500	11.130
Raytheon	1995	73,200	0.4600	0.7300	0.6000	11.8000	1.190	9.1600	9.840
Raytheon	1994	60,200	0.3800	0.8130	0.6670	10.1000	0.900	7.7700	7.400
Reebok	1997	7,000	0.0282		0.5360	3.6440	0.158	2.2940	1.756
Reebok	1996	6,300	0.0272		0.5170	3.4790	0.238	2.1440	1.786
Reebok	1995	6,100	0.0317		0.6030	3.4810	0.276	2.1140	1.656
Reebok	1994	6,000	0.0312		0.5937	3.2800	0.408	1.9660	1.649
Salomon	1997	2,820	0.0412	0.0042	0.1183	0.8095	0.066	0.4496	0.727
Salomon	1996	2,712	0.0368	0.0048	0.0907	0.7337	0.100	0.4042	0.645
Salomon	1995	2,606	0.0322	0.0037	0.0970	0.6980	0.054	0.4026	0.591
Salomon	1994	2,322	0.0377	0.0075	0.0943	0.6599	0.033	0.3890	0.571
Solectron	1997	18,215	0.3656		0.1290	3.694	0.238	3.2661	1.852
Solectron	1996	12,999	0.2536		0.1152	2.817	0.173	2.5348	1.452
Solectron	1995	11,049	0.2062		0.0926	2.066	0.120	1.8637	0.941
Solectron	1994	9,872	0.1648		0.0676	1.4568	0.084	1.3104	0.766
Sony	1997	163,000	0.5900	0.9600	4.2500	43.4200	2.520	31.6900	47.600
Sony	1996	151,000	1.2800	1.1400	4.9200	40.9400	1.300	30.3500	47.512
Sony	1995	138,000	1.2610	1.2320	5.0740	42.9970	(2.483)	32.7690	47.460
Sony	1994	130,000	0.9640	0.9670	3.9760	35.2200	1.000	26.8900	41.657
Toshiba	1997	186,000	0.9839	5.4032	3.0323	43.9758	1.008	31.4516	46.855
Toshiba	1996	186,000	0.9134	5.4802	3.7194	48.2109	1.667	34.0113	52.354
Toshiba	1995	190,000	0.8539	7.7079	4.1011	53.8315	1.360	38.1573	61.348
Toshiba	1994	175,000	0.6732	6.6732	3.4146	45.1805	0.878	32.6341	52.293
Toyota	1997	150,736	0.5700	0.7600	3.0100	98.7400	5.710	80.0500	102.460
Toyota	1996	146,855	0.6500	0.7000	3.4300	101.1200	3.970	85.0500	107.000
Toyota	1995	142,068	0.7010	0.6960	3.6970	91.2470	3.088	77.2670	116.807
Toyota	1994	110,534	0.4400	0.5280	2.9200	91.3400	2.310	79.5300	94.221
TXI	1997	3,400	0.0630	0.0270	0.0770	0.9740	0.123	0.7670	0.848
TXI	1996	3,000	0.0628	0.0233	0.0640	0.9670	0.135	0.7570	0.801
TXI	1995	2,800	0.0504	0.0191	0.0558	0.8300	0.078	0.6820	0.753
TXI	1994	2,700	0.0416	0.0218	0.0726	0.7070	0.044	0.5990	0.750
Weirton	1997	4,873	0.0980	0.0690	0.0940	1.4000	(0.031)	1.2600	1.260
Weirton	1996	5,373	0.0880	0.0760	0.0950	1.3800	(0.063)	1.2800	1.280
Weirton	1995	5,655	0.0780	0.0860	0.0910	1.3500	0.062	1.1800	1.300
Weirton	1994	5,565	0.1000	0.0890	0.0811	1.2600	0.007	1.1370	1.226
Whirlpool	1997	61,370	0.3040	0.0690	1.0200	8.6170	(0.170)	6.6040	8.270
Whirlpool	1996	48,163	0.2100	0.0590	0.9900	8.5200	0.130	6.6200	8.012
Whirlpool	1995	45,453	0.1900	0.0840	0.9800	8.1600	0.240	6.2500	7.800
Whirlpool	1994	39,106	0.1600	0.0660	0.8300	7.9500	0.290	5.9500	6.660
Xerox	1997	91,400	0.4060	0.0970	1.5500	9.8810	2.141	5.3300	27.732
Xerox	1996	86,700	0.3200	0.0800	1.5700	9.2900	1.940	5.1300	26.820
Xerox	1995	85,900	0.3000	0.0880	1.6500	8.7500	1.850	4.9800	26.010
Xerox	1994	87,600	0.2700	0.0880	1.4600	7.8200	1.510	4.6700	27.280

A1.3 Inventory Rating Method 2 for all 48 Companies

Company	Year	Rating 2
Adac Labs	1997	0.9362
Adac Labs	1996	2.0171
Adac Labs	1995	3.9855
Adac Labs	1994	1.2896
Am. Std.	1997	0.1323
Am. Std.	1996	0.1193
Am. Std.	1995	0.1055
Am. Std.	1994	0.1077
Ameristeel	1998	2.0859
Ameristeel	1997	1.1015
Ameristeel	1996	1.3935
Ameristeel	1995	1.8879
Armstrong	1997	0.5044
Armstrong	1996	0.4123
Armstrong	1995	0.3463
Armstrong	1994	0.2828
Bassett	1997	0.4862
Bassett	1996	1.7522
Bassett	1995	1.9551
Bassett	1994	1.6792
Birmingham	1997	1.2708
Birmingham	1996	1.1563
Birmingham	1995	1.2763
Birmingham	1994	0.7927
Black Decker	1997	2.2436
Black Decker	1996	2.1623
Black Decker	1995	3.7597
Black Decker	1994	2.7440
Boeing	1997	19.6682
Boeing	1996	31.6552
Boeing	1995	7.4606
Boeing	1994	10.9585
Chrysler	1997	0.0492
Chrysler	1996	0.0394
Chrysler	1995	0.0314
Chrysler	1994	0.0293
Compaq	1997	0.0869
Compaq	1996	0.0762
Compaq	1995	0.6903
Compaq	1994	1.2499
Cyprus	1997	0.9543
Cyprus	1996	0.9670
Cyprus	1995	0.7876
Cyprus	1994	0.9932
Eastman	1997	1.4518
Eastman	1996	1.3463
Eastman	1995	1.5670
Eastman	1994	1.2878
Estee Lauder	1997	11.3867
Estee Lauder	1996	14.3953
Estee Lauder	1995	11.4057

Company	Year	Rating 2
Fedders	1997	2.1694
Fedders	1996	0.6191
Fedders	1995	0.1980
Fedders	1994	0.1285
Ford	1997	0.0150
Ford	1996	0.0281
Ford	1995	0.0426
Ford	1994	0.0390
GE	1997	1.3442
GE	1996	1.1732
GE	1995	1.1618
GE	1994	1.1679
GM	1997	0.1725
GM	1996	0.1738
GM	1995	0.0906
GM	1994	0.0808
Hewlett P	1997	3.1727
Hewlett P	1996	3.5871
Hewlett P	1995	6.0518
Hewlett P	1994	5.0123
Hitachi	1997	0.6554
Hitachi	1996	1.2065
Hitachi	1995	0.9560
Hitachi	1994	0.9938
Honda	1997	0.4806
Honda	1996	0.5643
Honda	1995	0.5062
Honda	1994	0.8285
IBM	1997	0.2360
IBM	1996	0.4475
IBM	1995	0.4300
IBM	1994	0.5790
Inland Steel	1997	2.2969
Inland Steel	1996	1.3729
Inland Steel	1995	1.0394
Inland Steel	1994	0.9937
Int'l Paper	1997	0.9897
Int'l Paper	1996	0.4363
Int'l Paper	1995	0.5346
Int'l Paper	1994	0.2258
Intel	1997	0.3142
Intel	1996	0.1429
Intel	1995	1.1135
Intel	1994	0.4412
Iomega Corp.	1997	0.8363
Iomega Corp.	1996	0.7217
Iomega Corp.	1995	0.1153
Iomega Corp.	1994	0.3793
Kaiser	1997	0.4855
Kaiser	1996	0.5736
Kaiser	1995	0.4544
Kaiser	1994	0.1707

Company	Year	Rating 2
LTV	1997	1.9846
LTV	1996	1.6017
LTV	1995	1.2611
LTV	1994	1.3588
Maytag	1997	0.3971
Maytag	1996	0.4578
Maytag	1995	0.2247
Maytag	1994	0.5200
Mazda	1997	0.1357
Mazda	1996	0.0646
Mazda	1995	0.0674
Mazda	1994	0.0772
Natl Steel	1997	1.0213
Natl Steel	1996	1.5223
Natl Steel	1995	1.5216
Natl Steel	1994	0.5564
NEC	1997	1.3824
NEC	1996	3.3721
NEC	1995	3.2001
NEC	1994	2.8821
Nike	1997	0.8429
Nike	1996	0.7240
Nike	1995	0.1838
Nike	1994	0.0870
Nissan	1997	0.3655
Nissan	1996	0.4648
Nissan	1995	0.4398
Nissan	1994	0.4228
Nokia	1997	0.6519
Nokia	1996	1.3307
Nokia	1995	6.7101
Nokia	1994	3.7005
Nucor	1997	0.1308
Nucor	1996	0.1786
Nucor	1995	0.1320
Nucor	1994	0.1032
Oregon Steel	1997	0.3626
Oregon Steel	1996	0.1984
Oregon Steel	1995	0.5769
Oregon Steel	1994	0.5029
Premark	1997	1.8155
Premark	1996	1.4232
Premark	1995	1.7966
Premark	1994	2.9415
Raytheon	1997	0.1539
Raytheon	1996	0.4894
Raytheon	1995	0.5574
Raytheon	1994	1.1314
Reebok	1997	0.6711
Reebok	1996	0.7377
Reebok	1995	1.2201
Reebok	1994	1.4472
Salomon	1997	6.9946
Salomon	1996	5.1740
Salomon	1995	5.1828
Salomon	1994	6.8367

Company	Year	Rating 2
Solectron	1997	0.1746
Solectron	1996	0.2066
Solectron	1995	0.2731
Solectron	1994	0.3347
Sony	1997	0.8797
Sony	1996	2.0954
Sony	1995	1.8240
Sony	1994	1.5700
Toshiba	1997	1.8876
Toshiba	1996	2.2481
Toshiba	1995	2.5920
Toshiba	1994	2.4646
Toyota	1997	0.0235
Toyota	1996	0.0258
Toyota	1995	0.0414
Toyota	1994	0.0164
TXI	1997	1.1826
TXI	1996	0.8130
TXI	1995	0.6822
TXI	1994	1.5548
Weirton	1997	0.7377
Weirton	1996	0.7058
Weirton	1995	0.8266
Weirton	1994	0.8457
Whirlpool	1997	1.3474
Whirlpool	1996	0.9088
Whirlpool	1995	1.0779
Whirlpool	1994	0.7391
Xerox	1997	7.9809
Xerox	1996	7.3031
Xerox	1995	8.5529
Xerox	1994	7.4927

A1.4 Three-Category Inventory Rating Method

An inventory rating was calculated using those companies from the benchmark and control groups that furnished a breakdown of inventories in to three categories: raw materials, work-in-process and finished goods. A single weight was given to raw materials, double to work-in-process and triple to finished goods. The multiplicative formula used was:

$$\left[\frac{RM}{COGS}\right] \times \left[\frac{WIP}{COGS}\right]^2 \times \left[\frac{FG}{COGS}\right]^3$$

The inventory performance rankings generated by the use of the above formula can be found in Figure A1-1 below. The lines of demarcation are once again clearly indicated with the top five companies and six out of the top seven coming from the benchmark group. Moreover, there is a distinct visual break-point between the last benchmark company and the rest of the constituents which are all control group members.

Figure A1-1: Three-Category Rating Method

Toyota	**B1**	**0.0000**
Honda	**B1**	**0.0001**
IBM	**B1**	**0.0063**
Whirlpool	**B1**	**0.0154**
Hitachi	**B1**	**0.0205**
NEC	C1	0.2192
Intel	**B1**	**0.3482**
Cyprus	C1	8.4247
TXI	C1	15.5728
Oregon Steel	C1	54.9946
Bassett	C1	70.7104
Estee Lauder	C1	86.8706
Iomega Corp.	C1	154.4261

A1.5 Exponential R.O.C.E. for all 48 Companies

Company	Year	EXP R.O.C.E.
Adac Labs	1997	0.8651
Adac Labs	1996	0.8702
Adac Labs	1995	0.8980
Adac Labs	1994	0.9138
Am. Std.	1997	0.9346
Am. Std.	1996	0.9827
Am. Std.	1995	0.9221
Am. Std.	1994	1.0048
Ameristeel	1998	0.9111
Ameristeel	1997	0.9710
Ameristeel	1996	0.9891
Ameristeel	1995	0.9654
Armstrong	1997	0.8828
Armstrong	1996	0.8937
Armstrong	1995	0.9963
Armstrong	1994	0.8831
Bassett	1997	1.1403
Bassett	1996	0.9373
Bassett	1995	0.9179
Bassett	1994	0.9025
Birmingham	1997	0.9796
Birmingham	1996	1.0026
Birmingham	1995	0.8930
Birmingham	1994	0.9496
Black Decker	1997	0.9370
Black Decker	1996	0.9619
Black Decker	1995	0.9594
Black Decker	1994	0.9719
Boeing	1997	1.0090
Boeing	1996	0.9366
Boeing	1995	1.0129
Boeing	1994	0.9481
Chrysler	1997	0.9273
Chrysler	1996	0.8973
Chrysler	1995	0.9378
Chrysler	1994	0.8890
Compaq	1997	0.8281
Compaq	1996	0.8365
Compaq	1995	0.8436
Compaq	1994	0.8270
Cyprus	1997	0.9938
Cyprus	1996	0.9887
Cyprus	1995	0.9808
Cyprus	1994	0.9600
Eastman	1997	0.9257
Eastman	1996	0.8911
Eastman	1995	0.8315
Eastman	1994	0.8824
Estee Lauder	1997	0.8249
Estee Lauder	1996	0.8402
Estee Lauder	1995	0.8735

Company	Year	EXP R.O.C.E.
Fedders	1997	0.9159
Fedders	1996	0.8408
Fedders	1995	0.7712
Fedders	1994	0.8220
Ford	1997	0.9863
Ford	1996	0.9841
Ford	1995	0.9728
Ford	1994	0.9607
GE	1997	0.8620
GE	1996	0.8523
GE	1995	0.8565
GE	1994	0.8577
GM	1997	0.9669
GM	1996	0.9704
GM	1995	0.9623
GM	1994	0.9649
Hewlett P	1997	0.8692
Hewlett P	1996	0.8753
Hewlett P	1995	0.8619
Hewlett P	1994	0.8837
Hitachi	1997	0.9739
Hitachi	1996	0.9651
Hitachi	1995	0.9698
Hitachi	1994	0.9748
Honda	1997	0.9109
Honda	1996	0.9679
Honda	1995	0.9692
Honda	1994	0.9841
IBM	1997	0.8952
IBM	1996	0.8995
IBM	1995	0.9073
IBM	1994	0.9384
Inland Steel	1997	0.9445
Inland Steel	1996	0.9678
Inland Steel	1995	0.9356
Inland Steel	1994	1.0223
Int'l Paper	1997	0.9994
Int'l Paper	1996	0.9720
Int'l Paper	1995	0.9188
Int'l Paper	1994	0.9635
Intel	1997	0.6913
Intel	1996	0.7160
Intel	1995	0.7245
Intel	1994	0.7707
Iomega Corp.	1997	0.8319
Iomega Corp.	1996	0.8721
Iomega Corp.	1995	0.9559
Iomega Corp.	1994	0.9961
Kaiser	1997	0.9803
Kaiser	1996	0.9994
Kaiser	1995	0.9640
Kaiser	1994	1.0581

Company	Year	EXP R.O.C.E.
LTV	1997	0.9876
LTV	1996	0.9691
LTV	1995	0.9440
LTV	1994	0.9650
Maytag	1997	0.8875
Maytag	1996	0.9060
Maytag	1995	0.9722
Maytag	1994	0.9085
Mazda	1997	0.9986
Mazda	1996	1.0029
Mazda	1995	1.0349
Mazda	1994	1.0316
Natl Steel	1997	0.9067
Natl Steel	1996	0.9875
Natl Steel	1995	0.9669
Natl Steel	1994	0.9410
NEC	1997	0.9750
NEC	1996	0.9682
NEC	1995	0.9789
NEC	1994	0.9937
Nike	1997	0.7854
Nike	1996	0.7965
Nike	1995	0.8132
Nike	1994	0.8133
Nissan	1997	0.9866
Nissan	1996	1.0115
Nissan	1995	1.0319
Nissan	1994	1.0274
Nokia	1997	0.8168
Nokia	1996	0.8895
Nokia	1995	0.8602
Nokia	1994	0.8661
Nucor	1997	0.8570
Nucor	1996	0.8617
Nucor	1995	0.8295
Nucor	1994	0.8365
Oregon Steel	1997	0.9810
Oregon Steel	1996	0.9623
Oregon Steel	1995	0.9804
Oregon Steel	1994	0.9864
Premark	1997	0.9084
Premark	1996	0.9359
Premark	1995	0.9255
Premark	1994	0.8764
Raytheon	1997	0.9728
Raytheon	1996	0.9075
Raytheon	1995	0.8861
Raytheon	1994	0.8855
Reebok	1997	0.9140
Reebok	1996	0.8752
Reebok	1995	0.8465
Reebok	1994	0.7808
Salomon	1997	0.9129
Salomon	1996	0.8561
Salomon	1995	0.9120
Salomon	1994	0.9433

Company	Year	EXP R.O.C.E.
Solectron	1997	0.8794
Solectron	1996	0.8877
Solectron	1995	0.8803
Solectron	1994	0.8961
Sony	1997	0.9484
Sony	1996	0.9730
Sony	1995	1.0537
Sony	1994	0.9763
Toshiba	1997	0.9787
Toshiba	1996	0.9687
Toshiba	1995	0.9781
Toshiba	1994	0.9833
Toyota	1997	0.9458
Toyota	1996	0.9636
Toyota	1995	0.9739
Toyota	1994	0.9758
TXI	1997	0.8650
TXI	1996	0.8449
TXI	1995	0.9016
TXI	1994	0.9430
Weirton	1997	1.0249
Weirton	1996	1.0505
Weirton	1995	0.9534
Weirton	1994	0.9943
Whirlpool	1997	1.0208
Whirlpool	1996	0.9839
Whirlpool	1995	0.9697
Whirlpool	1994	0.9574
Xerox	1997	0.9257
Xerox	1996	0.9302
Xerox	1995	0.9313
Xerox	1994	0.9462

A1.6 Company Average Exponential R.O.C.E. Rankings

Company	Avge Exp. R.O.C.E.	Company	Avge Exp. R.O.C.E.
Intel	0.7251	Birmingham	0.9553
Nike	0.8020	Black Decker	0.9575
Compaq	0.8338	Honda	0.9576
Fedders	0.8359	Ameristeel	0.9587
Estee Lauder	0.8459	Am. Std.	0.9605
Nucor	0.8461	Int'l Paper	0.9630
Reebok	0.8527	Toyota	0.9647
GE	0.8571	GM	0.9661
Nokia	0.8578	LTV	0.9663
Hewlett P	0.8725	Inland Steel	0.9670
Eastman	0.8819	Bassett	0.9700
Solectron	0.8858	Hitachi	0.9709
Adac Labs	0.8865	Ford	0.9759
TXI	0.8878	Boeing	0.9761
Salomon	0.9055	Toshiba	0.9772
IBM	0.9099	Oregon Steel	0.9775
Premark	0.9113	NEC	0.9789
Iomega Corp.	0.9117	Cyprus	0.9807
Raytheon	0.9123	Whirlpool	0.9827
Chrysler	0.9126	Sony	0.9871
Armstrong	0.9128	Kaiser	0.9998
Maytag	0.9180	Weirton	1.0051
Xerox	0.9333	Nissan	1.0142
Natl Steel	0.9500	Mazda	1.0169

Note: An Exponential R.O.C.E. score greater than 1.0 indicates a negative return on capital employed.

A1.7 EVF Ratings for all 48 Companies

Company	Year	EVF
Adac Labs	1997	0.9778
Adac Labs	1996	1.0286
Adac Labs	1995	1.5314
Adac Labs	1994	0.9807
Am. Std.	1997	3.3553
Am. Std.	1996	3.0986
Am. Std.	1995	3.2331
Am. Std.	1994	3.5185
Ameristeel	1998	1.5608
Ameristeel	1997	2.2860
Ameristeel	1996	2.0660
Ameristeel	1995	2.0742
Armstrong	1997	1.4441
Armstrong	1996	1.5212
Armstrong	1995	1.8184
Armstrong	1994	1.7051
Bassett	1997	10.8000
Bassett	1996	9.0000
Bassett	1995	7.6250
Bassett	1994	6.1957
Birmingham	1997	1.9878
Birmingham	1996	2.6733
Birmingham	1995	1.2808
Birmingham	1994	1.4728
Black Decker	1997	1.6544
Black Decker	1996	1.6686
Black Decker	1995	1.6714
Black Decker	1994	1.8250
Boeing	1997	4.6124
Boeing	1996	3.4761
Boeing	1995	3.0233
Boeing	1994	10.3736
Chrysler	1997	1.2040
Chrysler	1996	0.9719
Chrysler	1995	1.3554
Chrysler	1994	0.9815
Compaq	1997	0.4824
Compaq	1996	0.5214
Compaq	1995	0.5794
Compaq	1994	0.8366
Cyprus	1997	0.7958
Cyprus	1996	1.2121
Cyprus	1995	0.8234
Cyprus	1994	1.3521
Eastman	1997	1.5215
Eastman	1996	1.4847
Eastman	1995	1.1775
Eastman	1994	1.6458
Estee Lauder	1997	0.5632
Estee Lauder	1996	0.5941
Estee Lauder	1995	0.6548

Company	Year	EVF
Fedders	1997	3.8516
Fedders	1996	3.1288
Fedders	1995	3.7899
Fedders	1994	4.3260
Ford	1997	2.5937
Ford	1996	4.0654
Ford	1995	3.7195
Ford	1994	3.0828
GE	1997	2.9649
GE	1996	2.4891
GE	1995	2.5031
GE	1994	2.7653
GM	1997	2.5708
GM	1996	3.0205
GM	1995	3.3304
GM	1994	3.4388
Hewlett P	1997	0.9791
Hewlett P	1996	1.0093
Hewlett P	1995	1.0168
Hewlett P	1994	1.1759
Hitachi	1996	1.8017
Hitachi	1995	1.5327
Hitachi	1994	1.3430
Hitachi	1993	1.6304
Honda	1997	0.7868
Honda	1996	0.8897
Honda	1995	0.7647
Honda	1994	0.8979
IBM	1997	1.2389
IBM	1996	1.0785
IBM	1995	1.0257
IBM	1994	1.2413
Inland Steel	1997	1.9587
Inland Steel	1996	2.4289
Inland Steel	1995	2.0881
Inland Steel	1994	2.4036
Int'l Paper	1997	1.5984
Int'l Paper	1996	1.6603
Int'l Paper	1995	1.3814
Int'l Paper	1994	6.8627
Intel	1997	0.4213
Intel	1996	0.4149
Intel	1995	0.4958
Intel	1994	0.5484
Iomega Corp.	1997	0.8788
Iomega Corp.	1996	0.8787
Iomega Corp.	1995	1.8522
Iomega Corp.	1994	1.7935
Kaiser	1997	2.3300
Kaiser	1996	2.9897
Kaiser	1995	2.1695
Kaiser	1994	6.1084

Company	Year	EVF
LTV	1997	2.3846
LTV	1996	2.5926
LTV	1995	2.1818
LTV	1994	4.7077
Maytag	1997	2.3941
Maytag	1996	2.4956
Maytag	1995	2.1006
Maytag	1994	2.2726
Mazda	1997	1.3240
Mazda	1996	1.3336
Mazda	1995	1.4258
Mazda	1994	1.5541
Natl Steel	1997	2.0036
Natl Steel	1996	2.9027
Natl Steel	1995	2.2557
Natl Steel	1994	2.7746
NEC	1997	1.3269
NEC	1996	1.1536
NEC	1995	1.0846
NEC	1994	1.3508
Nike	1997	0.5919
Nike	1996	0.6711
Nike	1995	0.7511
Nike	1994	0.7584
Nissan	1997	1.0140
Nissan	1996	1.1321
Nissan	1995	1.1277
Nissan	1994	1.3937
Nokia	1997	1.0234
Nokia	1996	1.5099
Nokia	1995	1.5186
Nokia	1994	1.6065
Nucor	1997	1.1500
Nucor	1996	1.2941
Nucor	1995	1.1071
Nucor	1994	1.2190
Oregon Steel	1997	2.6622
Oregon Steel	1996	2.6765
Oregon Steel	1995	3.6872
Oregon Steel	1994	3.9208
Premark	1997	1.9545
Premark	1996	1.9639
Premark	1995	2.2025
Premark	1994	1.4380

Company	Year	EVF
Raytheon	1997	3.8576
Raytheon	1996	2.9186
Raytheon	1995	2.7727
Raytheon	1994	2.5837
Reebok	1997	0.5185
Reebok	1996	0.4719
Reebok	1995	0.4462
Reebok	1994	0.4566
Salomon	1997	0.7836
Salomon	1996	0.8231
Salomon	1995	0.8821
Salomon	1994	0.8572
Solectron	1997	0.4854
Solectron	1996	0.6922
Solectron	1995	0.8164
Solectron	1994	1.0087
Sony	1997	1.3896
Sony	1996	1.4259
Sony	1995	1.3492
Sony	1994	1.5606
Toshiba	1997	1.4851
Toshiba	1996	1.3099
Toshiba	1995	1.2122
Toshiba	1994	1.3948
Toyota	1997	0.8065
Toyota	1996	0.9138
Toyota	1995	1.0162
Toyota	1994	0.9359
TXI	1997	1.6425
TXI	1996	1.4286
TXI	1995	1.8919
TXI	1994	2.5000
Weirton	1997	3.4807
Weirton	1996	5.3730
Weirton	1995	3.3265
Weirton	1994	4.5244
Whirlpool	1997	3.0487
Whirlpool	1996	2.5349
Whirlpool	1995	2.3797
Whirlpool	1994	1.9553
Xerox	1997	2.0083
Xerox	1996	2.0841
Xerox	1995	2.2785
Xerox	1994	2.7810

A1.8 Company Average EVF Rankings

Company	Average EVF	Company	Average EVF
Intel	0.4470	Black Decker	1.6791
Reebok	0.4839	TXI	1.7140
Compaq	0.5489	Ameristeel	1.9307
Estee Lauder	0.5908	Premark	1.9553
Nike	0.6641	Birmingham	2.0005
Salomon	0.8225	Int'l Paper	2.1000
Honda	0.8243	Xerox	2.1624
Toyota	0.8936	Inland Steel	2.1701
Cyprus	0.9818	Maytag	2.3537
Hewlett P	1.0154	Natl Steel	2.4009
Adac Labs	1.1040	LTV	2.6388
Nissan	1.1101	Whirlpool	2.6514
Chrysler	1.1424	GE	2.7098
IBM	1.1484	Kaiser	2.8737
Iomega Corp.	1.1649	GM	2.9444
Nucor	1.1916	Oregon Steel	3.0231
NEC	1.2288	Raytheon	3.2315
Nokia	1.3267	Am. Std.	3.2702
Toshiba	1.3689	Ford	3.3093
Mazda	1.3703	Fedders	3.6699
Sony	1.4095	Weirton	4.1219
Eastman	1.4417	Boeing	4.5298
Armstrong	1.5682	Solectron	4.8513
Hitachi	1.6121	Bassett	9.1646

APPENDIX II

A2.0 QUESTIONNAIRE AND RESPONSES

A2.1 Introduction

As mentioned in the thesis, surveys were distributed in order to gauge managerial attitude. Because of the difficulty in obtaining empirically valid data it was decided to use the surveys on an informal basis. The surveys were useful in observing how companies perceive themselves and whether the corporate strategies were consistent with the stated goal of total quality.

All the companies in question considered themselves to be practitioners of total quality management with the exception of Aurora International, which was a Japanese firm doing business in New York City. It was interesting to note that sexual harassment was a key issue, which served as a response to Question 16 on several occasions. The responses to Question 13 regarding a management consultant were also enlightening.

In some cases a number of answers belied their purported commitment to total quality management. It appears that while there is a far greater knowledge of total quality initiatives, nonetheless, the motive behind their implementation is less clear.

In order to have success with a total quality programme it is not sufficient to know the strategic tool. All of the company personnel must be thoroughly familiar with the underlying theme that must be brought to fruition.

This can, perhaps, best be illustrated by using an analogy. A truly accomplished chess player must not only know the various openings used in a game but he/she must also understand the design, strategy and goals behind the openings. All too often, as with TQ, the amateur memorises the many variations of standard opening moves and then resorts to a completely contradictory series of moves once the game is well under way.

The attitude towards customers and towards employees from the companies surveyed revealed some of the current approaches to total quality management that companies in the New York City metropolitan area today. Hopefully, the responses can serve as a basis for more research into managerial attitude as a factor in evaluating total quality programmes.

The answers are included exactly as provided by the respondents. No correction of grammatical or spelling errors was made. In order to help the reader, a blank questionnaire has been included before the completed questionnaires.

A2.2 QUESTIONNAIRE TO ASSESS MANAGERIAL ATTITUDE

Company: ______________________

1. How long has your company been in existence?

2. List and explain any Japanese Management concepts (JIT, TQM) that are in effect at your company.

3. Does your company practice TQM? If yes, for how long?

4. What is your definition of quality?

5. What is your company's mission statement or philosophy?

6. Does your current organizational culture reflect the company's mission statement?

7. What are the challenges or conflicts currently facing the organization?

8. What are the greatest strengths of the organization?

9. If you could improve one process/policy in your company today, what would it be?

10. What are the organization's greatest weaknesses?

11. What are some suggestions you might have to improve the quality and efficiency of your organization?

12. Is the organization systematically analyzing the environment to identify new threats and opportunities?

13. Would you seek a Management Consultant for unsolved management problems? Please explain.

14. Is the dominant managerial philosophy authoritarian, stressing accountability and closed control, or more democratic, encouraging initiative and teamwork throughout the organization?

15. Is there sufficient communication and feedback among staff members? How could it be improved?

16. Are there any employee activities/characteristics that management will not tolerate?

17. How do you reward your employees?

18. In general how do you believe your employees view the workplace?

A2.3 Aurora International Computing

1. How long has your company been in existence?

10 years

2. List and explain any Japanese Management concepts (JIT, TQM) that are in effect at your company.

No

3. Does your company practice TQM? If yes, for how long?

No

4. What is your definition of quality?

<u>Production</u>

1. To meet customer's needs

2. Continuous upgrade of current system -Portability -Multi-task processing in window environment -Powerful search capability -User friendly menu driven system - Speedness to operate system Flexibility to customize to meet the needs of the customer

<u>System Support</u>

1. Follow the system support operational check lists
2. Customer support by modem phase

<u>Timeliness</u>

1.Deliver and install system on time.

<u>Organizational Aspects</u>

1.Total participation and teamwork emphasized.

Understanding the short-term goals of the organization and the long run basis.

a) current year: production of international window version.

b) long run: developing international market, in the Far East and Australia.

5. What is your company's mission statement or philosophy?

1. Financial Stability

2. Positive approach toward developing current market.

3. Updating current system to meet the customer's needs.

4. Strong emphasis on working atmosphere called "WA": "let's be a family, let's work together."

6. Does your current organizational culture reflect the company's mission statement?

See above

7. What are the challenges or conflicts currently facing the organization?

Challenges:

1. Multi-language oriented version using window technology
2. Multi-vendor control
   -PC-LAN, Unix, VAX/UMS, AS/400
   -client / server control system
3. Financial simulation program
4. Making contracts with Japanese trading company to cultivate international market.

8. What are the greatest strengths of the organization?

Great teamwork and familiarity with all phases of accounting process and system.

9. If you could improve one process/policy in your company today, what would it be?

Establishing well organized network system on multi-vendor contract system.

10. What are the organization's greatest weaknesses?

Shortage of programming technical staff; currently one employee. Target by end of year: four employees.

11. What are some suggestions you might have to improve the quality and efficiency of your organization?

To increase number of technical employees.

12. Is the organization systematically analyzing the environment to identify new threats and opportunities?

Yes, we review the organization's strengths and weaknesses on a weekly basis. But not the threats. As for opportunities, timing is best now for gaining market share in Japan.

13. Would you seek a Management Consultant for unsolved management problems? Please explain.

Not necessary. We know what's wrong better than outsiders, why not pay the costs of hiring a consultant to our employees.

14. Is the dominant managerial philosophy authoritarian, stressing accountability and closed control, or more democratic, encouraging initiative and teamwork throughout the organization?

Depending on phase of management cycle

1. Setting up of company's goals and policy - Management side: "Top Down approach".

2. Daily operational work: "Bottom up a??roach" (teamwork orientation throughout organization.

15. Is there sufficient communication and feedback among staff members? How could it be improved?

Yes, we have daily and sufficient communication.

16. Are there any employee activities/characteristics that management will not tolerate?

No response to customer request. - lack of concern for due date for completing orders. - detail: trifle issues in the office will not be tolerated. My only concern is a quick respond to client request/needs.

17. How do you reward your employees?

Rewards are based on the contribution toward the organization. Foll,owing are examples: - periodical appreciation business dinner education and increasing level of staff's technical expertise, mainly programming techniques. periodical salary increases.

18. In general how do you believe your employees view the workplace?

They basically feel comfortable and show pride in their work.

A2.4 Smith Barney

1. How long has your company been in existence?

No answer

2. List and explain any Japanese Management concepts (JIT, TQM) that are in effect at your company.

None

3. Does your company practice TQM? If yes, for how long?

No. There is a commitment within operations to introduce process management tools.

4. What is your definition of quality?

Deliver what the customer needs efficiently and quickly

5. What is your company's mission statement or philosophy?

To be the best financial service company in the U.S.

6. Does your current organizational culture reflect the company's mission statement?

Not yet.

7. What are the challenges or conflicts currently facing the organization?

Aligning services provided by process instead of function or region.

8. What are the greatest strengths of the organization?

The retail distribution network.

9. If you could improve one process/policy in your company today, what would it be?

The inquiry/response process request

10. What are the organization's greatest weaknesses?
Short terms management style of life managers

11. What are some suggestions you might have to improve the quality and efficiency of your organization?

Training, align support functions with the products they support use activity base costing for financial accounts.

12. Is the organization systematically analyzing the environment to identify new threats and opportunities?

Don't know.

13. Would you seek a Management Consultant for unsolved management problems? Please explain.

If I had the authority, yes.

14. Is the dominant managerial philosophy authoritarian, stressing accountability and closed control, or more democratic, encouraging initiative and teamwork throughout the organization?

It is beginning to change from the former to the latter.

15. Is there sufficient communication and feedback among staff members? How could it be improved?

No, I have begun team-building exercises within my group.

16. Are there any employee activities/characteristics that management will not tolerate?

Sexual harassment, unethical behavior.

17. How do you reward your employees?

Salary and bonus.

18. In general how do you believe your employees view the workplace?

All the organization seems disorganized as a result of various mergers and organizational changes.

A2.5 Cendant Corporation

1. How long has your company been in existence?

Our corporation was formerly named Hospitality Franchise Services (HFS). We have currently merged with Cendant Corporation

2. List and explain any Japanese Management concepts (JIT, TQM) that are in effect at your company.

3. Does your company practice TQM? If yes, for how long?

(Question 2 & 3 answered here)

Speaking as manager for the Cendant Helpdesk, management incorporates the total quality management philosophy. Due to the volatility of the technical environment, management has put great emphasis on continual improvement in our Information Technology department. Budgets require for upper management to incorporate business practices that promote a higher quality of service while minimizing costs. Though I cannot vouch that we are practising Totel Quality Management, I have taken management courses in college, and I feel we institute many of its concepts. It is interesting that you mention Japanese Management concepts. The Japanese has a term known as Kaizen. Kaizen has a commitment focusing on individual and groups taking on responsibility for problems. Our Helpdesk department fully promotes self-empowerment. Self-empowerment is crucial in our department. Prior management instilled an Orwellian, "Big Brother" paranoia in the past, which only proved to create high turnover rates and inefficiencies.

4. What is your definition of quality?

Quality is defined by teamwork. There should be no timidity in our work environment. For instance, a newly hired IT Consultant should have no fear of making suggestions to my superiors or myself. Quality in any company should also promote a vigorous program in education and re-training.

5. What is your company's mission statement or philosophy?

The following is the Cendant Helpdesk's mission statement "creating and providing ever more innovative ways of delivering value to our customers. Like our name, which is rooted in "ascendant," we strive to rise to the challenge of determining what you want, when you want it, with optimal convenience and value and delivering!"

6. Does your current organizational culture reflect the company's mission statement?

Yes

7. What are the challenges or conflicts currently facing the organization?

The organization is undergoing major changes due to the recent merger with Cendant. We are currently in the process of creating a new infrastructure for our Helpdesk to incorporate Cendant into our HelpDesk. This entails creating a new problem management system, hiring high quality ernployees, and reinventing obsolete ways of doing business.

8. What are the greatest strengths of the organization?

I feel the greatest strengths in the organization are the emphasis upon teamwork. Also upper management has taken on a policy of self-empowerment to our employees. We also have an open door policy with our employees.

9. If you could improve one process/policy in your company today, what would it be?

Eliminate Consultants. Hire employees' full time. Consultants do not promote teamwork.

10. What are the organization's greatest weaknesses?

I choose to not answer this question.

11. What are some suggestions you might have to improve the quality and efficiency of your organization?

Adopt and institute leadership. Break down barriers between staff members. Promote extensive self-improvement for employees,

12. Is the organization systematically analyzing the environment to identify new threats and opportunities?

Yes

13. Would you seek a Management Consultant for unsolved management problems? Please explain.

The organization is undergoing major changes due to the recent merger with Cendant. We are currently in the process of creating a new infrastructure for our Helpdesk to incorporate Cendant into our Help Desk. This entails creating a new problem management system, hiring high quality employees, and reinventing obsolete ways of doing business.

14. Is the dominant managerial philosophy authoritarian, stressing accountability and closed control, or more democratic, encouraging initiative and teamwork throughout the organization?

The latter

15. Is there sufficient communication and feedback among staff members? How could it be improved?

I believe there is. Every week, all employees are required to participate in a team-oriented meeting to discuss past, current and future business issues.

16. Are there any employee activities/characteristics that management will not tolerate?

Dress codes, drugs, sexual harassment, etc.

17. How do you reward your employees?

We have group meetings every week to ensure the workers that we appreciate the job that they are doing in the company. We give evaluations and raises upon completing a good evaluation.

18. In general how do you believe your employees view the workplace?

I feel that we are a family. I think everyone feels that they are able to come to the management when they are having problem. I ensure that in every weekly meeting.

A2.6 Esselte Corporation

1. How long has your company been in existence?

50 years

2. List and explain any Japanese Management concepts (JIT, TQM) that are in effect at your company.

Currently, we have TQM meetings to explain what it is and how we as a company would like to follow this type of rnanagement.

3. Does your company practice TQM? If yes, for how long?

Yes, 3 years

4. What is your definition of quality?

Committed to excellence through the establishment of a continuous improvement process in our company. To provide service and leadership that will bridge all areas of our organization

5. What is your company's mission statement or philosophy?

To be the world-wide leader in supplying consumer needs for increased efficiency and organization to the office.

6. Does your current organizational culture reflect the company's mission statement?

All organisations try to mirror their mission statement. In some areas we are very successful in others we need some improvement.

7. What are the challenges or conflicts currently facing the organization?

The industry as a whole is getting smaller. It is becoming increasingly more difficult to compete with other office supply manufacturers.

8. What are the greatest strengths of the organization?

Constantly re-evaluating job performance, company responsibility and staying in tune with the technological changes.

9. If you could improve one process/policy in your company today, what would it be?

I feel that we should try to improve the vacation schedule'

10. What are the organization's greatest weaknesses?

Currently I think employee morale, and that in some areas we are short staffed.

11. What are some suggestions you might have to improve the quality and efficiency of your organization?

First, it would be to start communicating better. It is important that all levels communicate needs, desires and wants within an organization.

12. Is the organization systematically analyzing the environment to identify new threats and opportunities?

Yes, We are always concerned with what everyone else in the consumer product industry is doing. It is important that we remain competitive.

13. Would you seek a Management Consultant for unsolved management problems? Please explain.

No, currently we only use internal team building seminars to keep our organization strong.

14. Is the dominant managerial philosophy authoritarian, stressing accountability and closed control, or more democratic, encouraging initiative and teamwork throughout the organization?

All organizations would like to believe that they encourage creativity and teamwork, but it is sometimes difficult when certain jobs have to get done and you cannot take the time to be creative.

15. Is there sufficient communication and feedback among staff members? How could it be improved?

It needs improvements like more meetings and seminars that encourage employee feedback. Employee relations also need some help.

16. Are there any employee activities/characteristics that management will not tolerate?

Nothing out of the ordinary. Drinking on the job, drugs, sexual harassment and discrimination etc.

17. How do you reward your employees?

The company has service awards (length of time with company) parties, picnics, departmental lunches and raises.

18. In general how do you believe your employees view the workplace?

It depends on who you talk to, what department, and who their supervisor or manager is. Management people view the workplace differently.

A2.7 Telephonics

1) How long has your company been in existence?

60 years

2) List and explain any Japanese Management concepts (JIT, TQM) that are in effect at your company.

Ishikawa, a cause-effect analysis method is a Japanese management concept that is in effect at Telephonics.

3) Does your company practice TQM? If yes, for how long?

Yes, for the past 9 years

4) What is your definition of quality?

Finished products free of defects and minimizing any defects within hardware and software processes.

5) What is your company's mission statement or philosophy?

Telephonics' mission statement is:

"In the pursuit of total customer satisfaction, Telephonics Corporation shall provide high value electronic products and systems that meet or exceed their performance and quality requirements, on time, and at the lowest possible price, to all of our end users.

6) Does your current organizational culture reflect the company's mission statement?

Yes, our current organizational culture does reflect the company's mission statement to strive for continuous improvement. Telephonics has metrics to measure on-time performance, reduce cycle time, improve test yields, and reduce defects.

7) What are the challenges or conflicts currently facing the organization?

Some challenges and conflicts that the organization currently faces are: the rapid growth of the company and the challenges to instill and extend the TQM culture to new employees and train them in our procedures challenge to maintain TQM culture with some employees who don't understand

8) What are the greatest strengths of the organization?

The greatest strengths of this organization are: openness of management ability to communicate horizontally and vertically multiple lines of communication to inform all employees (e-mail, newsletters, etc.)

9) If you could improve one process/policy in your company today, what would it be?

The attitude of searching for blame is one process that I would improve. When identifying problems, there is a difference for blaming people than improving process. (e.g. Some people at fault deny having problems to prevent being blamed, even though blame is not the point of concern but rather improvement and acknowledging of faults)

10) What are the organization's greatest weaknesses?

One of the organization's weaknesses which is a temporary condition is being under-manned and unable to meet growing business needs quick enough. Telephonics is in the process of recruiting more employees to resolve this problem.

11) What are some suggestions you might have, to improve the quality and efficiency of your organization?

In addition to question #9, step-up, achieving uniform state-of-art computer and software support.

12) Is the organization systematically analyzing the environment to identify new threats and opportunities?

Yes, the organization is systematically analyzing the environment to identify new threats and opportunities.

13) Would you seek a Management Consultant for unsolved management problems?

Telephonics already seeks a Management Consultant for unsolved management problems.

14) Is the dominant managerial philosophy authoritarian, stressing accountability and closed control, or more democratic, encouraging initiative and teamwork throughout the organization?

(Did not want to answer this question)

15) Is there aufficient communication and feedback among staff members? How could it improve?

Yes, there is aufficient communication and feedback amongst staff members.

16) Are there any employee activities/characteristics that management will not tolerate?

Laziness and horseplay

17) How do you reward employees?

Telephonics rewards employees through recognition (plaques and awards) and monetary promotions (bonuses for special jobs, well done)

18) In general, how do you believe your employees view the workplace?

In general I think that the employees view Telephonics favorably, in view of increased participation in employee suggestions to improve employee well being (health and safety). There is good feedback. Telephonics tries hard to accommodate needs/suggestions to make a satisfying work environment.

A2.8 Boeing

1. How long has your company been in existence?

75 years

2. List and explain any Japanese Management concepts (JIT, TQM) that are in effect at your company.

TQMS was used, now High Performance Teams are the concept that is being used.

3. Does your company practice TQM? If yes, for how long?

Four years.

4. What is your definition of quality?

Getting the product completed as required in the least amount of time.

5. What is your company's mission statement or philosophy?

Vision 2016

6. Does your current organizational culture reflect the company's mission statement?

Not yet.

7. What are the challenges or conflicts currently facing the organization?

Integrating the large number of supplier products into a single product.

8. What are the greatest strengths of the organization?

Technical skill.

9. If you could improve one process/policy in your company today, what would it be?

Pay for performance

10. What are the organization's greatest weaknesses?

Too many meetings that do not add value.

11. What are some suggestions you might have to improve the quality and efficiency of your organization?

Greater team work.

12. Is the organization systematically analyzing the environment to identify new threats and opportunities?

Yes, it is necessary.

13. Would you seek a Management Consultant for unsolved management problems? Please explain.

No, consultants just create more problems that you need to hire them to solve. Their business is finding problems not fixing them

14. Is the dominant managerial philosophy authoritarian, stressing accountability and closed control, or more democratic, encouraging initiative and teamwork throughout the organization?

Teamwork through High Performance Teams is being stressed.

15. Is there sufficient communication and feedback among staff members? How could it be improved?

We use email, meetings and telecons to communicate.

16. Are there any employee activities/characteristics that management will not tolerate?

Not unless they are illegal or disruptive

17. How do you reward your employees?

Awards and pay raises

18. In general how do you believe your employees view the workplace

When the economy is in good shape? The employees are happy.

A2.9 Citibank

- How long has your company been in existence?

Unknown

2. List and explain any Japanese Management concepts (JIT, TQM) that are in effect at your company.

We currently utilize a concept similar to TQM in which it holds all employees accountable to an ideal called a "Vision" which emphasizes the concepts of leadership, quality, teamwork and initiative. In my division, it is also seeking to empower all levels of employees so that they can handle customer needs. It also strives to become "Employer of Choice" and offers many programs related to employee satisfaction, i.e., flextime.

3. Does your company practice TQM? If yes, for how long?

My company believes that if employees are empowered, they will strive to work harder and smarter.

4. What is your definition of quality?

Quality is defined at my organization as doing things right the first time.

5. What is your company's mission statement or philosophy?

The mission statement is to become the complete financial resource for all of our customers needs.

6. Does your current organizational culture reflect the company's mission statement?

Although empowerment is a key to the company's mission statement; the immenseness of the organization makes it difficult to place the theory into practice.

7. What are the challenges or conflicts currently facing the organization?

The immenseness of the organizational structure and of the organization itself, make it difficult to achieve. Most recently they have created a "business effectiveness" group charged with identifying duplicative work and streamlining processes along all divisions to allow for greater speed and quality of service to the customer.

8. What are the greatest strengths of the organization?

The greatest strength of the organization is its size and name, which gives it tremendous bargaining power in the marketplace when choosing vendors, etc.

9. If you could improve one process/policy in your company today, what would it be?

I would hope that the company would provide the employees with more voice in the organizational procedures.

10. What are the organization's greatest weaknesses?

The greatest weakness is immensity, which as a result has caused duplicative effort, lack of empowerment and unclear lines of responsibility and accountability. To this end, they have created an "effectiveness" group to overcome these obstacles to obtaining their vision.

11. What are some suggestions you might have to improve the quality and efficiency of your organization?

The quality and efficiency of the organization could be improved by streamlining the management structure, i.e., removing excess management layers and by re-organizing structure in some of the divisions so that there would be clearer accountability.

12. Is the organization systematically analyzing the environment to identify new threats and opportunities?

The organization is always systematically analyzing its venue and seeks to exploit all possible areas of opportunity while minimizing consequences, including adverse financial consequences.

13. Would you seek a Management Consultant for unsolved management problems? Please explain.

In the past, there has been a tendency to rely on consultant groups for certain initiatives. With the establishment of the business effectiveness group, there is currently a moratorium on the retaining of consultants.

14. Is the dominant managerial philosophy authoritarian, stressing accountability and closed control, or more democratic, encouraging initiative and teamwork throughout the organization?

Although the "vision" of the corporation espouses an environment, which encourages initiative and teamwork, due to the size of the corporation, at the higher management levels, there is a more "authoritarian" approach

15. Is there sufficient communication and feedback among staff members? How could it be improved?

At the lower management and clerical level, there appears to be sufficient communication and teamwork. However, the upper management does not communicate to the lower levels as often as needed. The building of better communication vehicles between upper and lower management is currently being focused on.

16. Are there any employee activities/characteristics that management will not tolerate?

The corporation has most recently launched a "diversity" initiative, which all staff members will be required to attend. The purpose of this initiative is to increase awareness and understanding of the various different cultures, class and background of our fellow employees. Management will not tolerate discrimination of any kind or in any manner.

17. How do you reward your employees?

Depending on the employee level, staff may be rewarded for their efforts by anything from receiving promotional items, i.e. mugs, shirts to bonuses.

18. In general how do you believe your employees view the workplace?

Employees tend to view the workplace as a fast-paced stressful environment. However, they also believe that there is a level of fairness and equal opportunity for anyone who shows he is capable.

A2.10 Symbol Corporation

1. How long has your company been in existence?

Over 20 years

2. List and explain any Japanese Management concepts (JIT, TQM) that are in effect at your company.

ComprehensiveTQM, Poka-Yoke
*Definition of Poka-Yoke
Poka: Inadvertant Errors
Yokeru: Avoid
Poka-Yoke: Avoid Inadvertant errors: Mistake proof
Poka-Yoke is a Japanese Management concept with a goal to stop errors at their source before they become defects. Human being will make errors, but this process should correct the problems.
*The 3 types of Poka-Yoke used by symbol:
Type 1:Eliminates the error at the source before it can occur
Type 2: Detects an error in the process of it occuring, before it can result as a defect
Type 3: Detects a defect after it has been made, but before it reaches the next operation

3. Does your company practice TQM? If yes, for how long?

Comprehensive TQM - 7 years

4. What is your definition of quality?

"Symbol will provide defect-free products and services to its customers and Associates on time every time. We commit to continuous improvement by understanding customer requirements, measuring our performance, and mistake proofing our operations to prevent defects before they occur"

5. What is your company's mission statement or philosophy?

"Exceed customer expectations worldwide by providing innovative and high quality bar code scanning, hand held computing and wireless communications systems and be the company of choice for our associates and investors."

6. Does your current organizational culture reflect the company's mission statement?

Yes

7. What are the challenges or conflicts currently facing the organization?

No answer

8. What are the greatest strengths of the organization?

Innovation, creativity

9. If you could improve one process/policy in your company today, what would it be?

No answer

10. What are the organization's greatest weaknesses?

No answer

11. What are some suggestions you might have to improve the quality and efficiency of your organization?

No answer

12. Is the organization systematically analyzing the environment to identify new threats and opportunities?

Always

13. Would you seek a Management Consultant for unsolved management problems? Please explain.

If necessary. We have used them in the past

14. Is the dominant managerial philosophy authoritarian, stressing accountability and closed control, or more democratic, encouraging initiative and teamwork throughout the organization?

Our management philosophy is Democratic stressing initiative and teamwork with requisite accountability

15. Is there sufficient communication and feedback among staff members? How could it be improved?

Communication is a challenge at any big company
Symbol uses the following techniques to improve Leadership Communication:
-Mission and quality policy displayed throughout the business
-All hands communications meetings by CEO and COO
-Division communication meetings
-Corporate quality review and Division quality review
-Cafeteria monitors
-Newsletters
-Intranet

16. Are there any employee activities/characteristics that management will not tolerate?

No answer

17. How do you reward your employees?

Bonus, Spot Awards, Celebrations

18. In general how do you believe your employees view the workplace?

Positively, high energy, fast paced

A2.11 The Horizon Group

1. How long has your company been in existence?

The Horizon Group has been in existence for 8 years

2. List and explain any Japanese Management concepts (JIT, TQM) that are in effect at your company.

The Horizon Group practices Total Quality Management

3. Does your company practice TQM? If yes, for how long?

The Horizon Group has practiced TQM for about 5 years

4. What is your definition of quality?

My definition of quality is a standard by which no reasonable person would find fault

5. What is your company's mission statement or philosophy?

The Horizon Group's mission statement : Provide the highest level of search service at the same time as maintaining the highest level of business ethics

6. Does your current organizational culture reflect the company's mission statement?

Yes, our current organizational culture does reflect the mission statement

7. What are the challenges or conflicts currently facing the organization?

- the changes in technologies
- system integration and information processing
- to instill the TQM culture onto new employees

8. What are the greatest strengths of the organization?

- ability to communicate with management
- openness of management
- Company strength : niche market focus

9. If you could improve one process/policy in your company today, what would it be?

10. What are the organization's greatest weaknesses?

One of the organization's greatest weaknesses is the training in new software and equipment as well as the terminology of new technologies

11. What are some suggestions you might have to improve the quality and efficiency of your organization?

Obtaining new software and hardware for office processing

12. Is the organization systematically analyzing the environment to identify new threats and opportunities?

No, not systematically, but does analyze to identify new threats and opportunities

13. Would you seek a Management Consultant for unsolved management problems? Please explain.

Yes, at times we hire consultants to keep us abreast at trends and how we should address them

14. Is the dominant managerial philosophy authoritarian, stressing accountability and closed control, or more democratic, encouraging initiative and teamwork throughout the organization?

It is a mix, depending on the manager

15. Is there sufficient communication and feedback among staff members? How could it be improved?

Yes, there is a sufficient feedback among staff members

16. Are there any employee activities/characteristics that management will not tolerate?

Laziness will not be tolerated

17. How do you reward your employees?

The Horizon Group rewards employees with plaques, awards and outings as well as commission and yearly salary increases.

18. In general how do you believe your employees view the workplace?

I think that the employees view the workplaces favorably. The management is willing to hear all suggestions and try to accommodate those suggestions

A2.12 H.C. Data Device Corporation

1. How long has your company been in existence?

My company was established in 1964

2. List and explain any Japanese Management concepts (JIT, TQM) that are in effect at your company.

We have only been used Total Quality Management (TQM) concept. This method of management process helps our company in many ways. For example, for us the employees are communicating better with our boss. And for the side of customers, we understand what are their needs and how to satisfying them

3. Does your company practice TQM? If yes, for how long?

Our company have been practice Total Quality Management for more than 7 years

4. What is your definition of quality?

My definition of quality is the resultant product that satisfies the customers need to the highest extent

5. What is your company's mission statement or philosophy?

Our company mission statement is to be: The number one supplier of Electronic products in the markets we serve

6. Does your current organizational culture reflect the company's mission statement?

Yes. We are the number one supplier for both military and private companies.

7. What are the challenges or conflicts currently facing the organization?

Our company has many old staff, and they have to take training programs or go back to school to learn new technology

8. What are the greatest strengths of the organization?

The greatest strengths of my companyis the organization and communication. Our ability to accomplish every task in an orderly fashion produces ver yhigh results. Another strength of my company is team work, everyone are share same responsibility

9. If you could improve one process/policy in your company today, what would it be?

This I would say we should hire some new blood and more new machines

10. What are the organization's greatest weaknesses?

My company weakness is our Old Thinking. Many employees are over 40 years old and have limited ability to learn new ideas and concepts

11. What are some suggestions you might have to improve the quality and efficiency of your organization?

I would have to say to have more new people working in the company. This way we can mix the new thinking and old thinking together

12. Is the organization systematically analyzing the environment to identify new threats and opportunities?

Yes, However we are always ready challenges the threats and opportunities. Doing data conversion for the military is one of the greatest challenges for our company

13. Would you seek a Management Consultant for unsolved management problems? Please explain.

We have a management consultant on hand for unsolved management problems. He is on staff for all the employees and managers.

14. Is the dominant managerial philosophy authoritarian, stressing accountability and closed control, or more democratic, encouraging initiative and teamwork throughout the organization?

I would say its more democratic. Theoretically, no one has more power than everybody else. Everyone is working towards the same goal, which is success of the company

15. Is there sufficient communication and feedback among staff members? How could it be improved?

Our company has great benefits, includes madical, dental. Our education assistance program offers 100% coverage. We also have great vacation time, year-end holiday shutdowm. And many other benefits for our employees

16. Are there any employee activities/characteristics that management will not tolerate?

The company has many rules.Some are small, but some very important for safety of all employees. If these rules are broken, it will not tolerated

17. How do you reward your employees?

We have year-end bonuses, flexible hours and other ways to reward our employees

18. In general how do you believe your employees view the workplace?

Everyone are equal, they all share same amount of responsibility. We are happy with our working environment

A2.13 New York Public Library

1. How long has your company been in existence?

Unknown

2. List and explain any Japanese Management concepts (JIT, TQM) that are in effect at your company.

We currently utilize a concept similar to TQM in which it holds all employees accountable to an ideal called a "Vision" which emphasizes the concepts of leadership, quality, teamwork and initiative. In my division, it is also seeking to empower all levels of employees so that they can handle customer needs. It also strives to become "Employer of Choice" and offers many programs related to employee satisfaction, i.e., flextime.

3. Does your company practice TQM? If yes, for how long?

My company believes that if employees are empowered, they will strive to work harder and smarter.

4. What is your definition of quality?

Quality is defined at my organization as doing things right the first time.

5. What is your company's mission statement or philosophy?

The mission statement is to become the complete financial resource for all of our customers needs.

6. Does your current organizational culture reflect the company's mission statement?

Although empowerment is a key to the company's mission statement; the immenseness of the organization makes it difficult to place the theory into practice.

7. What are the challenges or conflicts currently facing the organization?

The immenseness of the organizational structure and of the organization itself, make it difficult to achieve. Most recently they have created a "business effectiveness" group charged with identifying duplicative work and streamlining processes along all divisions to allow for greater speed and quality of service to the customer.

8. What are the greatest strengths of the organization?

The greatest strength of the organization is its size and name, which gives it tremendous bargaining power in the marketplace when choosing vendors, etc.

9. If you could improve one process/policy in your company today, what would it be?

I would hope that the company would provide the employees with more voice in the organizational procedures.

10. What are the organization's greatest weaknesses?

The greatest weakness is immensity, which as a result has caused duplicative effort, lack of empowerment and unclear lines of responsibility and accountability. To this end, they have created an "effectiveness" group to overcome these obstacles to obtaining their vision.

11. What are some suggestions you might have to improve the quality and efficiency of your organization?

The quality and efficiency of the organization could be improved by streamlining the management structure, i.e., removing excess management layers and by re-organizing structure in some of the divisions so that there would be clearer accountability.

12. Is the organization systematically analyzing the environment to identify new threats and opportunities?

The organization is always systematically analyzing its venue and seeks to exploit all possible areas of opportunity while minimizing consequences, including adverse financial consequences.

13. Would you seek a Management Consultant for unsolved management problems? Please explain.

In the past, there has been a tendency to rely on consultant groups for certain initiatives. With the establishment of the business effectiveness group, there is currently a moratorium on the retaining of consultants.

14. Is the dominant managerial philosophy authoritarian, stressing accountability and closed control, or more democratic, encouraging initiative and teamwork throughout the organization?

Although the "vision" of the corporation espouses an environment, which encourages initiative and teamwork, due to the size of the corporation, at the higher management levels, there is a more "authoritarian" approach

15. Is there sufficient communication and feedback among staff members? How could it be improved?

At the lower management and clerical level, there appears to be sufficient communication and teamwork. However, the upper management does not communicate to the lower levels as often as needed. The building of better communication vehicles between upper and lower management is currently being focused on.

16. Are there any employee activities/characteristics that management will not tolerate?

The corporation has most recently launched a "diversity" initiative, which all staff members will be required to attend. The purpose of this initiative is to increase awareness and understanding of the various different cultures, class and background of our fellow employees. Management will not tolerate discrimination of any kind or in any manner.

17. How do you reward your employees?

Depending on the employee level, staff may be rewarded for their efforts by anything from receiving promotional items, i.e. mugs, shirts to bonuses.

18. In general how do you believe your employees view the workplace?

Employees tend to view the workplace as a fast-paced stressful environment. However, they also believe that there is a level of fairness and equal opportunity for anyone who shows he is capable.

A2.14 MetTel

1) How long has your company been in existence?

MetTel has been in existence for three years but has been providing service for about 1 year.

2) List and explain any Japanese Management concepts (JIT, TQM) that are in effect at your company.

We do not practice JIT but we do practice some sort of TQM. In the operations division, we have several shifts that check each other to make sure quality is not compromised. The morning shift checks the previous days' orders. These orders are then relayed to the sales division to follow up on these orders.

The afternoon shift checks the current days orders so orders are double checked. Then they have separate people check the database and respond to any customer problems.

3) Does your company practice TQM? If yes, for how long?

These practices have been in effect since December 1996.

4) What is your definition of quality?

The ability to provide a product or service that is superior to the competitors yet still affordable to the customers.

5) What is your company's mission statement or philosophy?

As of now we don't have one.

6) Does your current organizational culture reflect the company's mission statement?

Does not apply.

7) What are the challenges or conflicts currently facing the organization?

The greatest challenge facing our company today is the constant uncooperative tactics put fourth by Bell Atlantic. Laws prohibit utility companies from being monopolies so they encourage competition. The established company is required to loan their equipment and services to the new company. Not only does Bell Atlantic not loan their equipment but they constantly use tactics to avoid helping us out so we are always in court.

8) What are the greatest strengths of the organization?

Open channels of communications are our greatest strengths. We are able to communicate with each other.

9) If you could improve one process/policy in your company today, that would it be?

I would like to hire more industry trained people. Employees that have some experience in the field.

10) What are the organization's greatest weaknesses?

Since we have a relatively young company, our inexperience in the field would be the greatest weakness.

11) What are some suggestions you might have to improve the quality and efficiency of your organization?

The need for experienced employees cannot be stressed enough. With the hiring of experienced employees quality and efficiency will improve.

12) Is the organization systematically analyzing the environment to identify new threats and opportunities?

Yes, there is one department that is composed of former Bell Atlantic employees that constantly monitor Bell Atlantic's tactics to make sure they are not threatening to MetTel.

13) Would you seek a Management Consultant for unsolved management problems? Please explain.

Yes, anybody that has experience in the field and could help in improving efficiency is always welcomed.

14) Is the dominant managerial philosophy authoritarian, stressing accountability and closed control, or more democratic, encouraging initiative and teamwork throughout the organization?

He is a little of both. If he has an idea, his idea will be implemented. If he doesn't then he welcomes suggestions.

15) Is there sufficient communication and feedback among staff members? How could it be improved?

There is not sufficient communication among staff members. We hold monthly staff meetings instead of weekly ones.

16) Are there any employees' activities/characteristics that management will not tolerate?

We do not tolerate carelessness, lateness, unprofessional behavior or any illegal activities in general.

17) How do you reward your employees?

With bonuses.

18) In general how do you believe your employees view workplace?

I think we provide a relaxed and friendly environment, which makes it enjoyable for our employees to come to work.