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The study of total quality management core values and the influence of such values on employee behaviour and commitment in Allied-Signal Aerospace Singapore

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The Study of Total Quality Management Core Values and the Influence of such values on employee behaviour and commitment in Allied-Signal Aerospace Singapore.

MASTERS OF SCIENCE IN TOTAL QUALITY MANAGEMENT (HONS)

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by

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This paper is written with the supervision of Professor Michael Hough who has given me invaluable advice and assistance. I thank him for his patience in seeing me through this project..

I wish to express my sincere thanks to Angela Tan for providing me with pertinent information, without her co-operation and willingness to spend time with me, this report would not have been possible.

This paper is dedicated to my family and friends, especially Eric Lum for his encouragement, support, understanding and time throughout the duration of the Master of Science in Total Quality Management Course.

PREFACE

Total Quality Management has been a subject of growing interests in both industrialised and newly industrialising countries. However it is only in recent years that researchers have reported on the subject of quality management from an organizational theory perspective.

This study examines the degree of establishment of Total Quality Management core values and the influence of such values on employee behaviour and commitment. The sample of the study are employees of Allied-Signal Aerospace Singapore.

The results indicated that Allied-Signal's Total Quality Management effort has had positive influence on employees' attribute towards Employee Involvement and Company commitment. However, the program had no apparent influence on perceived management commitment to quality and continuous improvement. The study also revealed that the degree of establishment in belief and practice of Total Quality Control were different among its 3 employees segments.

This study is than undertaken to investigate the degree of belief in the core values of Total Quality Management of Allied-Signal employees. This exercise

also seeks to determine the influence of such values on the employee behaviour, and commitment and make recommendations for better Total Quality Management establishment. Specifically, this paper attempts to examine the following:

(a) To evaluate qualitatively Allied-Signal's Total Quality Management practices with respect to recommended approaches from a "content" perspective and review the merits and demerits in effecting the transmission of Total Quality Management core values;

(b) To evaluate qualitatively the extent of change in employee behaviour, values and commitment through trend analysis of Allied-Signal's annual attitude survey results in the period of 3 years after Total Quality Management initiation; and

(c) To evaluate quantitatively the results of Allied-Signal's first Total Quality Control Survey, examining the relations of Total Quality Management values comprehension, employee behaviour and perceived management behaviour with respect to employee status and tenure.

This report is organised into 5 chapters. Chapter 1 introduces the subject of Total Quality Management and presents the purposes behind the study and its

plausible contributions. It also presents the case details, covering the Allied-Signal's Total Quality Management practices, implementation status, survey results. Chapter 2 attempts to summarise the recent literature on Total Quality Management and establishes its relationships to corporate culture change and influence on employee behaviour and commitment.

Chapter 3 describes the methodology for the case study, including the description of the Attitude and Total Quality Control survey instruments used by Allied-Signal, and also the treatment of the data.

Chapter 4 presents the analysis of the company's Total Quality Management practice, findings from the trend analysis of the attitude surveys and the implications from the statistical analysis of the Total Quality Control survey instruments. Chapter 5 provides recommendations for Allied-Signal to overcome its problem and to achieve its goals. The basis for the recommendations will be cited. This report concludes with a review of the limitation of this case study and suggestions for future research.

This report serves as a useful self-analysis for Allied-Signal on its Total Quality Management effort by examining the key problems and derive some possible

solutions that will enable the company to further consolidate its effort toward establishing a Total Quality Control culture.

To other practitioners or would-be practitioners of Total Quality Management, it is hoped that this study would provide an insight into the implementation difficulties of Total Quality Management within the local manufacturing context.

Finally, to all others interested in the subject, it is hoped that the literature review and findings from the case analysis would stimulate further examination of topics pertaining to Total Quality Management.

CHAPTER 1. INTRODUCTION

1.1. TOTAL QUALITY MANAGEMENT

1.1.1. What is Total Quality Management?

Total Quality Management, according to Japanese industrial standards, is "a system of methods for the cost-effective provision of goods and services whose quality is fit for the purchasers' requirements" (Ishikawa 1985). According to Ishikawa, quality control 'consists of developing, designing, producing, marketing, and servicing products and services with optimum cost-effectiveness and usefulness, which customers will purchase with satisfaction."

The word "Total" as used on Total Quality Management emphasises total participation at all levels of employees and total company or company-wide practice. Quality here includes both quality of products and services. Indeed, Total Quality Management is a structural system for creating an organization-wide participation in planning and implementing a continuous improvement process that exceeds the expectations of the customer. It is developed from the foundation of treating your next process as your customer and is built on the assumption that 90 percent of our problems are process problems and not employee problems.

"Total Quality Management consists of continuous improvement activities involving everyone in the organization-managers and workers-in a totally integrated effort toward improving performance at every level. This improved performance is directed toward satisfying such cross-functional goals as quality, cost, schedule, mission need, and suitability. Total Quality Management integrates fundamental management techniques, existing improvement efforts, and technical tools under disciplined approach focused on continued process improvement. The activities are ultimately focused on increased customers (internal and external) satisfaction." (Air Force Development Test Centre, Eglin Air Force Base, Total Quality Management training package, 1991, Pg. 13)

Total Quality Management can be said to be a set of management philosophies and methods in which the focus is on satisfying stakeholders (especially customers) and optimizing the organization's efforts towards customer needs. Such a focus is related to the way Kotler and Armstrong (1987) defined the organization, with the customer at the centre and marketing as the integrative function. A difference may be that it is not clear that a Total Quality Management view would have marketing as the integrative function. Integration may come through the quality system itself.

As Total Quality Management emerges as the strategy for running a business or company and the paradigm shifts become the "new reality," a new set of employee behaviours is essential for the process to succeed. This derives from the fact that employee involvement, participation and empowerment form a cornerstone of Total Quality Management. A fundamental means of establishing desired behaviour and reinforcing that behaviour is through reward and recognition. Reward and Recognition will ensure employees are encouraged and motivated to practise the set of desired behaviours. In addition, proper training programmes will provide the working knowledge of the tools and techniques for quality improvements. However, Total Quality Management is not a magic pill for a company's success, we also need a sound business acumen and good decisions with seasoned executive leadership.

1.1.2 Interests in Total Quality Management

Interests in Total Quality Management has been growing since the early 1980's and has continued today in both industrialised and newly industrialising countries. Loss of competitiveness in market share and profits by many American and European firms to their Japanese competitors has fueled the surge in interest in Japanese quality management. Business consultants and management often prescribe Total Quality Management to be the panacea for the dilemma many Western industries are in, drawing from the successful

adoption of Total Quality Management by the Japanese firms in the past thirty years.

National institutions in many countries are promoting this interest following the Japanese lead. The Union of Japanese Scientists and Engineers (JUSE) conferred the first Deming Prize, Japan's most coveted prize for quality excellence in industry way back in 1951. The National Institute of Standards Technology (NIST) in America established the American equivalent, the Malcolm Baldrige Award (MBA) in 1988 for the American industry. In Europe and UK, accreditation schemes such as the International Standards Organisation 9000 (1981) and British Standards 5750 quality systems became the hallmark for quality standard for European and UK based industries. In Singapore, the Singapore Productivity and Standards Board (PSB) is active in conferring award and certification to local companies in areas of QCC promotion and quality systems establishment in line with international standards. The award programme in Singapore is to provide a self-appraisal of an organization's system by profiling both its strengths and areas for improvement in internal processes and systems.

In the context of Singapore, the Singapore Productivity Standard Board (PSB) has embarked on finding a suitable system in the early eighties and by 1988, it

decided to adopt the ISO 9000 Standards for use in Singapore, specified as Singapore Standard (SS) 308 series of standards. Identical to ISO 9000, the SS308 series of standards comprise of guidelines and specifications developed to suit both purchasers and suppliers. They consist of standards of quality systems that should be established by manufacturers. A company achieves these standards by developing, documenting and implementing the quality systems. Singapore Productivity Standard Board (PSB), acting as a third party, conducts audits of the entire system to confirm whether or not the company satisfies the set standards. Such audits use as reference points the SS308 series of standards against the quality systems that have been developed and documented. Singapore Productivity Standard Board (PSB) is the main certifying body in Singapore, accounting for almost two-thirds of all ISO stamps here. As of October 1996, there are approximately 1500 companies with the ISO 9000 certification in Singapore.

1.1.3 Literature Proliferation

Literature abounds with prescription for effective quality management. Eminent academics and practitioners including Deming (1986), Juran (1986), Crosby (1979), Feigenbaum (1983), Ishikawa (1985), and others have described a variety of technical and organisational approaches to managing quality. Literature also contains many case studies of successful companies, notably

Deming Prize and MBA Winners such as Texas Instruments, Toyota, Nissan, Rank Xerox, Motorola and descriptions of their quality concepts and quality programs. However, it is only in recent years that researchers have reported on the subject of quality management from an organisational theory. Such works include 'Benson, Saraph & Schroeder's investigation of 'The Effects of Organisational Context on Quality Management' (1991), and Graham James' account of 'Quality of Working Life and Total Quality Management' (1992). Related works from a Singapore context include 'Building Organisational Commitment through QCC Participation 'by Foo (1989) and The Role and Impact of the Work Improvement Teams in the Singapore Public Sector (WITS) by Loh (1988).

A literature search however reveals little in the area of Total Quality Management establishment particularly in relation to changes in organisational values and the effects of such changes on employee behaviour and commitment. However, the work of Dunn et al (1991) on 'Corporate Values and their Influence on Employee Behaviour, Values and Commitment; An Empirical study within the Banking Industry' was found to be relevant. The conclusion from their research provided a relevant structure for this study and will be summarized in Section 5.1.

1.2. OBJECTIVES OF THE PRESENT STUDY

1.2.1 Total Quality Management Initiation

Allied-Signal Aerospace, one of the world's largest aerospace equipment companies, is a unit of Allied-Signal Inc., a Fortune 30 company with annual sales of S$12 billion. It supplies essential components for nearly every type of civil and military aircraft and spacecraft. The company builds aerospace components, ranging from intricate miniaturized and circuits to powerful aircraft engines, actuators and controls.

The 42,000 employees at Allied-Signal Aerospace, located in 16 countries around the world are dedicated to serving a dynamic world-wide aerospace industry that demands engineering sophistication, innovation and quality performance.

Allied-Signal Aerospace is a unit of Allied Signal Inc., a S$ 12 billion diversified manufacturer with core business competencies in aerospace, automation, chemicals, fibres, plastics and advanced materials. In everything they do they are committed to creating wealth, always with integrity, to reward the stakeholders in Allied-Signal-their shareholders, their employees, their customers and suppliers.

They believe in continuing developing a style and climate which liberates talents, enthusiasm and commitment of all their people. They can then respond positively to the increasing pace of change in a rapid and flexible way to achieve real competitive advantage. With their bold, innovative strategic agenda Allied-Signal will be the world's most successful aerospace company in the 1990s and beyond.

Their vision as dictated in Allied-Signal's publication, is to refine their processes to focus on completely meeting the requirements of both their internal and external customers. They intend to accomplish this through a cultural change to a new environment in which all employees become a part of the process. It will require every manager to provide the necessary leadership to ensure constancy of purpose in creating the new company culture that will fully meet the needs of the future.

The mission of the Allied-Signal is to satisfy their customer's expectations for quality. It is the policy of the Allied-Signal to provide quality services in support of our mission and to be responsive to the individual and collective needs of our clients. They pledge to monitor our performance as an on-going activity and to strive for continuous improvement.

Continuous Improvement involves all employees working together in teams to search out the causes of the problems. This should be done on a daily basis so that Continuous Improvement becomes an integral part of the way Allied-Signal employees do their work. "It begins with the active involvement of every Allied-Signal manager to encourage every employee, but the real ownership and creativity essential to make Continuous Improvement work must start at the grass roots level."

In 1991, Allied-Signal formally adopted the Total Quality Control as its business management philosophy. Employees world-wide are encouraged to apply Total Quality Control as part of their normal work in striving for error-free output to meet their internal and external customer requirements. That decision was taken largely due to its declining market share and loss of profitability. They were at risk of being squeezed out of the market share.

In a period of 5 years beginning in 1986, Allied-Signal's aerospace sales turnover has dropped from fourth to the sixth position. It suffered a reduction in world-wide market share from 10% to 7%. By 1991, major competitors such as General Electric occupied the top 3 positions in the world. The change in corporate culture emphasising the values of "customer satisfaction" and

Company as the key to turning around the company's performance and competitiveness.

1.2.2 Issues on Total Quality Management Establishment

In 1994, Allied-Signal Singapore conducted its first Total Quality Control survey. The survey was part of the effort to determine the effectiveness of its Total Quality Control program after 3 years of Total Quality Management initiation. Total Quality Control was treated as a stepping stone to eventual full implementation of Total Quality Management. The complementary benefits of both of these ultimately will lead to improved productivity and reduced costs. In addition, it will improve financial performances, as well as more rewarding and secure jobs for employees.

In Allied-Signal, Total Quality Control aims at the reinforcement and maintenance of the management body to ensure a profitable business. It requires that company-wide activities should be continuously improved and revitalized. While Total Quality Management is being adopted throughout the Company as a fundamental philosophy, upon which strategies are being formulated to improve competitiveness of the Company in terms of our ability to better satisfy customer's needs and to significantly improve productivity. In

this way, the corporation is "glued together to the advantage of all of them and it really is possible to talk about "the way they do things around Allied-Signal."

With respect to their Total Quality Management effort, they believe that it will bring them back in a competitive position. After discussion with their people within corporation, the following problems were raised:

(a) The lack of an assessment of the relevance of the contents of its Total Quality Control program and for the presence of Critical Success Factors (CSFs);

(b) The lack of understanding of the influence Total Quality Management had on employee beliefs, behaviour and commitment; and

(c) The lack of understanding of the relative influence of value awareness and management behaviour on employee Total Quality Control behaviour.

The core of Total Quality Management the customer-supplier relationship, where the process must be managed. The 'soft' outcomes of Total Quality Management- the culture, communication and commitment provide the foundation for the Total Quality Management model. The process core is surrounded by the 'hard' management necessities of systems, tools and teams.

This model provides a framework against which an organization's progress towards Total Quality Management can be examined. The analysis of the Critical Success Factors (CSFs) can monitor and adjust the process alignment in response to difficulties in the change process. Answers to the above problems would help the company consolidate its effort towards establishing a Total Quality Control culture.

1.2.3 Research Objective

This study is undertaken to investigate the degree of belief in the core values of Total Quality Management of Allied-Signal employees. This exercise also seeks to determine the influence of such values on the employee behaviour, and commitment and make recommendations for better Total Quality Management establishment. Specifically, this paper attempts to examine the following:

(a) To evaluate qualitatively Allied-Signal's Total Quality Management practices with respect to recommended approaches from a "Content" perspective and review the merits and demerits in effecting the transmission of Total Quality Management core values;

(b) To evaluate qualitatively the extent of change in employee behaviour, values and commitment through trend analysis of

Allied-Signal's annual attitude survey results in the period of 3 years after Total Quality Management initiation; and

(c) To evaluate quantitatively the results of Allied-Signal's first Total Quality Control Survey, examining the relations of Total Quality Management values comprehension, employee behaviour and perceived management behaviour with respect to employee status and tenure.

1.3 SIGNFICANCE OF THE STUDY

This report serves as a useful self-analysis for Allied-Signal on its Total Quality Management effort by examining the key problems and to derive some possible solutions that will enable the company to further consolidate its effort toward establishing a Total Quality Control culture.

To other practitioners or would-be practitioners of Total Quality Management, it is hoped that this study would provide an insight into the implementation difficulties of Total Quality Management within the local manufacturing context.

Finally, to all others interested in the subject, it is hoped that the literature review and findings from the case analysis would stimulate further examination of topics pertaining to Total Quality Management.

1.4 ALLIED-SIGNAL SINGAPORE AEROSPACE BACKGROUND

Allied-Signal Aerospace Singapore, with headquarters in Arizona, Phoenix, builds aerospace components, ranging from intricate miniaturized and circuits to powerful aircraft engines, actuators and controls located in 16 countries. The total employee strength as of 31 December 1994 was 42,000 employees. Net revenues for year ended 31 December 1994 was US$6,784 million. The company suffered a loss from operations totalling US$249 million for the financial year 1994.

Allied-Signal was set-up in the early 1970s and was one of the earliest MNC subsidiaries to operate in Singapore. The company currently has 3 operating sites: Allied-Signal Avionics, the primary manufacturing site producing Turbine Engines at Joo Koon Circle; Allied-Signal Aerospace which in charge of the overhaul and after sales service of the aerospace components; and Allied-Signal Marketing in charge of the sales and business development in the Asia Pacific

Region. Each site has its own managing director who has independent responsibilities over his respective business operations but has administrative accountability to the local country manager who also holds appointment as the managing director of the overhaul and after sales service of the aerospace components.

The case analysis is based on the 3 sites in Singapore. Employee population as of 31 December 1994 was 1665. Employee mix consists of 69.9% production operators, 16.8% technicians and clerical staff and 13.3% supervisory and professional personnel.

1.5. ALLIED-SIGNAL'S TOTAL QUALITY MANAGEMENT PRACTICES

1.5.1. Corporate Directions

Allied-Signal Corporate supported programs for quality improvement is traceable to the early 1980s. Juran Quality Improvement (JQI), Statistical Quality Control (SQC), Quality Improvement Team (QIT), and Effectiveness Teams (ET), Allied-Signal's equivalent of QCC's, were established as programs in Allied-Signal by 1986.

Until 1987, the quality improvement effort in Allied-Signal was on a piecemeal basis with emphasis on skills and knowledge enhancement. Team approach to problem solving was also initiated. However, there was no formal communication or effort to create cultural or value change pertaining to quality.

In a period of 5 years beginning from 1986, Allied-Signal's aerospace components sales turnover has dropped from the fourth position (which it held since 1980) to the sixth position, and suffered a reduction in world-wide market share from 10% to 7%. By 1991, one of the competitors, General Electric occupied the top 3 positions in the world wide.

In 1991, Allied-Signal's president formally announced the adoption of Total Quality Control as the group's management philosophy. A change in corporate culture emphasising the values of customer satisfaction, continuous quality improvement and people involvement was stated as the key to turning around the company's performance and competitiveness.

The corporate new vision, goals, and quality policy were formalised and communicated to its subsidiaries.

1.5.2 Other Significant Events

Allied-Signal saw declining profits from 1991 through 1994 which turned into losses in 1993, and even larger losses in 1994 as depicted in ***Table 1.1.***

Components Millions of Dollars (US)

	1994	1993	1992	1991
Revenue	3421	3103	3211	3190
Profit / (loss)	(188)	(76)	276	424

Table 1.1 Industry Segment Profit (loss) - Allied-Signal

Allied-Signal Singapore was directed to exercise count reduction beginning in 1993. Rules on reducing travel expenses, office supplies, overtime, external training and education were enforced. Employees were advised on the need to keep costs down until the business situation recovered. This situation continued into 1994, culminating in the voluntary retrenchment of employees (with golden handshake) in the United States as well as in Singapore. Singapore operations' loss of slightly over a hundred workers, the majority of which were contract workers, was relatively small scale. The emphasis on cost reduction, revenue maximisation and capital expenditure curtailment continued into 1995.

1.5.3. Allied-Signal's Total Quality Control Concepts

1.5.3.1. Allied-Signal's Total Quality Control Definition

Allied-Signal's Total Quality Control definition reads: Total Quality Control is a commitment by all employees at all levels to achieve **CUSTOMER SATISFACTION** through continuous improvement in the quality of all products and services.

The definition succinctly captures the corporate's stated emphasis on the values of "customer satisfaction", "continuous quality improvement," and "total people involvement".

1.5.3.2. The Total Quality Control Campaign Logo

Total Quality Control in Allied-Signal put the customer in the central role of directing the company's efforts towards meeting the customer's needs. In ***Figure 1.1***, it shows the Allied-Signal's Total Quality Control logo.

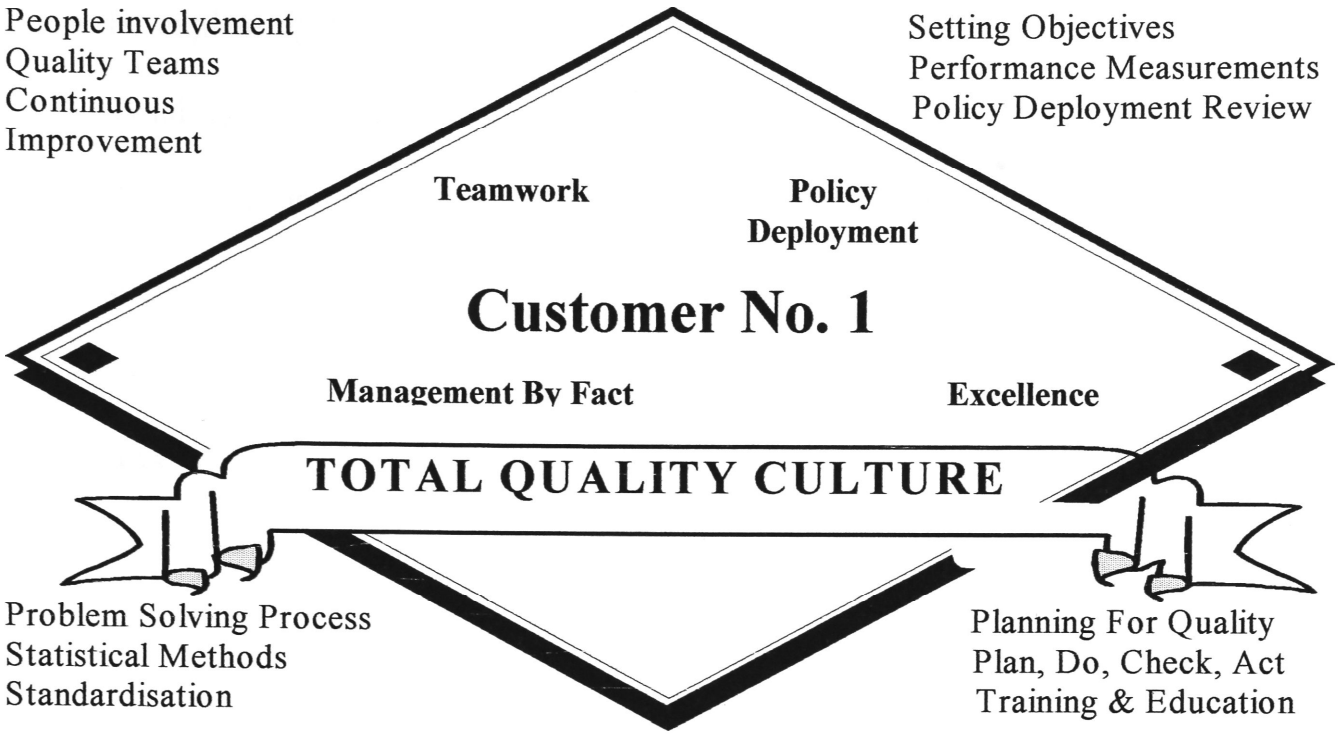

Figure1.1 Allied-Signal's Total Quality Control logo.

Supporting this central focus in a pyramid structure are 4 cornerstones stated as:

(a) Policy Deployment;

(b) Operational Excellence;

(c) Management by Fact; and

(d) Teamwork.

In explaining the Total Quality Control concepts, the introduction of Total Quality Control was first seen as an extension of the Allied-Signal's 2 long standing operating philosophies of recognising the need to satisfy customers and of nurturing participative employees. Secondly, Total Quality Control serves to bind the company's quality thrust that was initiated since the early 1980s.

In effect, Allied-Signal was stating that the values of "customer satisfaction", "employee involvement", and "quality improvement" were not new values but were existing values that require greater emphasis and attention.

1.5.3.3. "Customer No.1"

Allied-Signal defines the "customer", explains why customer focus is central and relates the "quality" theme to the "customer", and outlines expectant management and employee behaviours to instil "Customer #1" attitudes.

Allied-Signal's Total Quality Control definition of customer encompasses the following points:

(a) there are internal as well as external customers;

(b) the "next process" of a workflow procedure is your customer; and

(c) the person that receives your work is your customer.

Stated rationale for having a central focus on customers includes:

(a) satisfying customer is the only reason we are in business;

(b) meeting customer expectations is the way to guarantee Allied-Signal will continue to win in the market place;

(c) organisations focused on satisfying customers are likely to have the best chance for long term success; and

(d) in a competitive market place, the customers' choice determines which products/companies are winners.

Allied-Signal's Total Quality Control integrates the quality concept to the customer concept by stating that:

(a) quality is defined by the customer;

(b) quality of a product/service is whatever the customer perceives it to be; and

(c) quality means customer satisfaction

Expectant management behaviours and expectant employee behaviours for instilling "Customer #1" attitudes were also outlined.

1.5.3.4. Policy Deployment

Policy deployment was defined as the process by which the Aerospace Component Group's goals and priorities are deployed across all functions and throughout all organisational levels. Key elements are: setting objectives; performance measurements; and policy deployment review.

An important characteristic of the setting objective process is the cycle of top-down communication of goals/objectives and bottom-up negotiation and alignment of those goals/objectives, that helps close the gap between plans and commitments. The cycle spans from the group level to the line supervisors' level.

Performance measurements are those critical results that must be achieved at each level in order to reach overall organisational goals. They are to be used as checkpoints to ensure that the process of quality

improvement is operating properly. Policy deployment review is the means to monitor progress of improvement plans, analyse deviations and encourage problem identification.

1.5.3.5. Operational Excellence

Operational excellence was stated as "the achievement of the highest level of customer satisfaction in the most economical manner possible".

The key tactics to achieve operational excellence include:

(a) Planning for quality

(b) Use of the PDCA (Plan, Do, Check, Act) Cycle in daily work; and

(c) Continuous training and education for employees

In "planning for quality", Allied-Signal advocates the use of Quality Function Deployment (QFD), Business Process Management (BPM), and adopting a Cycle Time reduction approach.

In employing Shewart's PDCA Cycle for daily work, equal attention to planning, execution, verification and feedback actions was emphasised. The value of continuous training and education for employees was recognised. A Training and Education Model (TEM) and a

corresponding Training and Education Plan (TEP) which mapped the mandatory, recommended and optional training for each job function was established.

1.5.3.6. Management By Fact

Management by Fact was explained as management which bases decisions and actions on verifiable data rather than on instinct or opinion. It requires managers to create an atmosphere of openness to encourage the raising of problems and to insist on obtaining and questioning data.

The key elements of Management by Fact were:

(a) Use of the 8-step Problem Solving Process such as

1) Identify the problem,
2) Select the problem
3) Analyse problem
4) Generate potential solutions
5) Select and plan solution: evaluate all options
6) Implement solution
7) Evaluate solution: measure results, identify problems arising

8) Recycle

(b) Use of statistical methods such as the seven QC Tools, Design of Experiment (DOE), and Taguchi Methods (TM); and

(c) Standardisation of the process for documenting operating procedures and preserving the knowledge gained when improvement was achieved.

1.5.3.7. Teamwork

Teamwork was defined as the "organised use of each individual's talent, expertise and creativity to accomplish a common objective". The key elements of teamwork in Allied-Signal's Total Quality Control context were:

(a) The value of people involvement;

(b) The structure of quality teams for problem solving; and

(c) The concept of continuous improvement.

Allied-Signal advocates a structure of teams covering all levels of employees without functional boundary limitations for involvement in quality improvement. These were the Quality Steering Team (QST), a management team that directs the Total Quality Control process, Quality

Improvement Team (QIT), a team assigned by the QST to make a specific quality improvement; Corrective Action Team (CAT), a team assigned by the Quality Steering Team (QST) to resolve an urgent problem; and Effectiveness Team (ET), a work group that forms voluntarily to improve quality of an item of their choice in their work area.

Allied-Signal's concept of continuous improvement was based on Juran's teaching that "quality improvement is made project by project..." and that the "decisive factor in the race for quality leadership is the rate of quality improvement".

1.6. TOTAL QUALITY CONTROL IMPLEMENTATION IN ALLIED-SIGNAL

Preparation for Total Quality Control implementation in Allied-Signal Singapore began in 1989 with the appointment of a top senior manager as Total Quality Control Manager, followed by a Total Quality Control study mission to Japan. Mission members, comprising the Allied-Signal Managing Director, the Total Quality Control Manager and the Training and Education (T&E) Manager, attended a week long training session conducted by JUSE

(Union of Japanese Scientists and Engineers) to learn about Total Quality Control fundamentals and application. Following that, communication was made to all managers of the company of the Total Quality Control implementation intent. The Total Quality Control Manager and the Training and Education Manager worked in co-ordination with corporate staff to formalise plans to officially launch Total Quality Control in the company.

1.6.1. Communicating the Cultural Change

Formal announcement that Allied-Signal will adopt Total Quality Control as its management and operating philosophy was made in early 1991 by the president of Allied-Signal Corporate. The primary communication media was a 20-minute video tape recording of the President's message on the competitive business environment, the rationale for adopting Total Quality Control and the corporate's values of customer satisfaction, continuous quality improvement and total employee involvement, business goals and priorities for the 1990s, as well as Allied-Signal corporate's new vision and quality policy.

Communication sessions for managers were led by the Managing Director. Senior managers then led communication sessions for their respective exempt and supervisory staff. Communication to the non-exempt operators, clerical

and technician population were conducted by the Managing Director in the quarterly site meetings that followed.

In the months following the official announcement, various artefacts extolling the Total Quality Control values and principals were put in the company premises. Posters containing the company's Total Quality Control logo, goals, vision statement, quality policy and performance standard (Right the First Time) were prominently displayed in meeting rooms and passage ways. Photographs of teams who had successfully completed improvement projects and of individual employees with outstanding performance, lined the hallways of the factory premises.

In 1992, a meeting room with quality finishing and decor was exclusively set aside for customer visits only. Customer awards and plagues adorned an entire wall of the room designated the "Customer No.1 Room". Three meeting rooms designated "Effectiveness Team Rooms" were constructed on the production floors that Effectiveness Teams have priority to make use of. Posters of the problem solving process and the statistical methods and tools were prominently displayed.

1.6.2. Total Quality Control Education and Training

Allied-Signal Corporate President in his communication message announced that every employee shall be trained in Total Quality Control concepts. Following that direction, the training department mapped out a mandatory training course in Total Quality Control for all Allied-Signal employees, based on materials provided by the corporate Total Quality Control organisation. Senior managers and supervisory staff attended an 8 hour Total Quality Control seminar over a 2 day period, while non-exempts and operators were given 4-hour training sessions. Cascaded training was employed with senior and experienced manger training the 'exempts' who in turn train their staff and operators.

By 1994, 99% of "directs", 97% of "non-exempts" and 88% of "exempts" had received Total Quality Control training. Allied-Signal also extended its Total Quality Control training to major suppliers through half-day Total Quality Control seminars and workshops led by the Total Quality Control Manager. In addition to the Total Quality Control concept training, the employees were given skills training pertaining to the problem solving process and statistical methods.

1.6.3. Organisational and Structural Changes

In 1991, Allied-Signal's Total Quality Control promotion centre was established. Its function included Total Quality Control policies administration, training and education and teams promotion. It was staffed by a Total Quality Control manager, a training manger, a Total Quality Control administration manager, 2 Effectiveness Team facilitators and 2 clerical staff. In 1993, the Total Quality Control Promotion Centre was integrated into the Human Resources Department with the Total Quality Control Manager reporting to the Human Resources Director of Allied-Signal.

Organisationally, Allied-Signal retained its functional structure with functional managers having operational and administrative responsibilities over their respective branches. However, from a team structure perspective, all Allied-Signal functional or branch managers were members of the company-wide Quality Steering Team led by the Managing Director. Similarly, departmental managers reporting to their branch managers became the branch level Quality Steering Team led by the branch manager. By this arrangement, branch level objectives were aligned to company-wide Quality Steering Team objectives, and departmental level objectives became aligned to branch level Quality Steering Team objectives.

Besides the 2 levels of Quality Steering Teams that had members from within functional boundaries, the company established several cross functional QSTs (ET QST, SPC QST, TPM QST) to direct critical plant-wide activities. Branch and departmental objectives are deployed through the Policy Deployment process to QITs which are primarily cross functional matrix teams. QIT leaders are appointed by QST level managers. They have responsibility for a specific quality improvement project but have no performance evaluation authority over team members.

The Policy Deployment process commenced in 1988. The communication and alignment of objective are typically completed within the first month of the calendar year and is documented in an annual Policy Book. QST hold weekly reviews of QITs progress on their specific improvement project. All major objectives are reviewed once every quarter.

The structure of teams (QSTs and QITs) in conjunction with the Policy Deployment process is the primary mechanism through which the vital quality improvement objectives of Allied-Signal are met, and involvement of the majority of the "exempt" population in improvement activities is effected. The status of QIT participation is shown in ***Figure 1.2.***

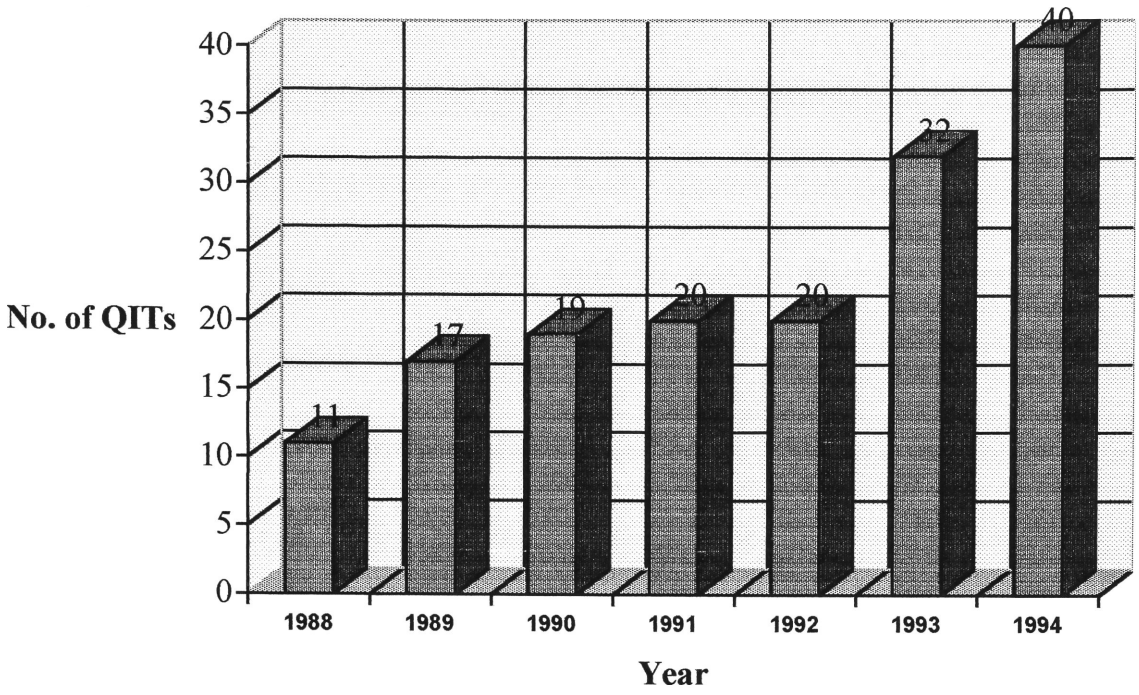

Figure 1.2 Growth of QIT

However, the involvement in quality improvement covered by Policy Deployment does not include the 'direct' and 'non-exempt' populations. The company relies on the system of the Effectiveness Team and Methods Improvement Recommendation (MIR) to promote employee involvement from these 2 populations.

ET promotion is effected through the ET Steering Committee, established since 1988. It is chaired by a senior operations manager and facilitated by the Total Quality Control promotion centre. Next to the company-wide QST, this committee has the largest number of senior management representation, an indication of Allied-Signal management support to voluntary team promotion.

Given the voluntary nature of the teams and their autonomy in selection of improvement projects, the ET program is viewed as an employee development effort. The program objectives are to build quality consciousness among its 'direct and non-exempt' employees, and to enable them to participate in continuous improvement, by addressing the many useful, though economically less significant, improvement projects. Allied-Signal currently has about 33% of 'direct' and 'non-exempt' employees participating in ET. ***Figure 1.3*** shows the Effectiveness Team participation trend.

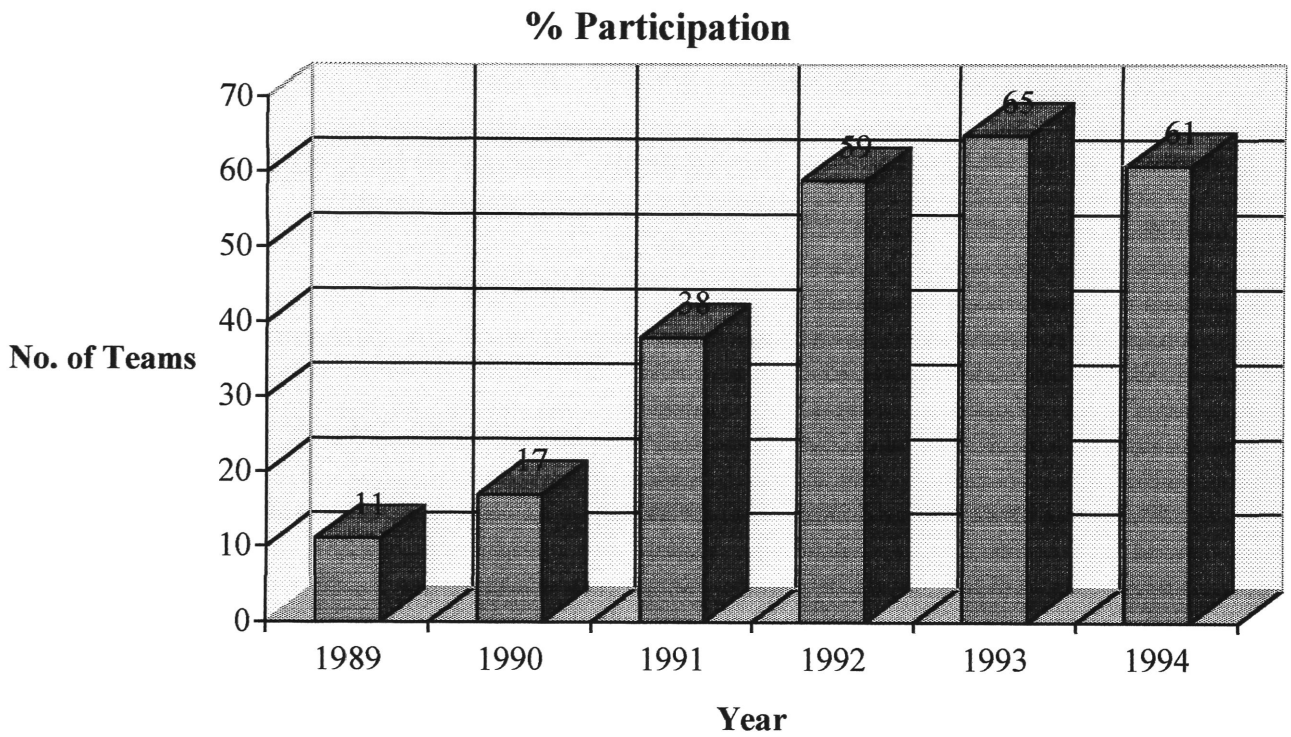

Figure 1.3 Effectiveness Team Participation Trend

1.6.4. Promotion of Employee Involvement

Promotion of 'exempt' employee involvement is primarily structural in nature, arising from the QSTs and QITs team structure, and the policy deployment process. Policy deployment provided an avenue for 'exempt' employees to be involved in setting objectives.

Customer satisfaction indices such as "on-time-delivery" and "quality rate" are priority objectives in annual policies that focus 'exempt' employees' attention on customer needs. Teamwork is developed through their appointment into QITs or CATs. The MIR system (which encourages suggestions for improvement) is also opened to 'exempt' employees.

However, there is currently no formal system to award or recognise specific QIT performances or the individual's role as an effective QIT member. Furthermore, QIT leaders, though by appointment have accountability over project objectives, have no evaluative authority over team members' performances, nor visible recognition for their appointed roles.

Although teamwork had always been a performance review factor in Allied-Signal, the performance review system had had no major change to give additional recognition for effective team participation.

Promotion of 'non-exempts' and directs' involvement in quality improvement is more extrinsic in nature, given that company's ET program is based on voluntary membership as opposed to membership by appointment for the 'exempts'.

The ET program has high visible management support and recognition. Formal team inauguration sessions with badge presentations and photograph taking sessions are attended by ET steering committee managers. ETs are trained in the problem solving process by full-time ET facilitators. Team members are given time-off to attend ET meetings. Upon completion of projects, they participate in departmental presentations in which they are awarded with certificates, plagues and a celebration lunch with managers.

The top 10 teams will proceed on to plant-level presentations competing for the Plant Manager's Trophy and the Plant Manager's New-Comer Trophy in a highly-publicized ET Convention. Finalists are given S$50 gift vouchers per member and the opportunity to participate in the National QCC held by the Singapore Productivity and Standards Board (PSB). The winners of plant trophies are further rewarded by overseas trips to visit other Allied-Signal's factory in the region and make presentations of their successful projects. ET membership is also highlighted in the employee's annual job performance

review record in recognition for their involvement in quality improvement projects.

1.6.5. Total Quality Control Supporting Systems and Programs

In addition to the formal Total Quality Control training and structures as described, Allied-Signal had over the year developed other quality systems and programs that are supportive of the Total Quality Control effort.

Supporting systems include a strong emphasis on in-house training administered by the T&E department, which offers a variety of statistical, trade, quality and management training for all segments of its employee population. Awards for its outstanding in-house training effort were conferred by both the Singapore Productivity and Standards Board (PSB) and Institute of Technical Education (ITE).

Allied-Signal has since the early 1980s established an autonomous Quality Assurance (QA) Department that reports directly to the corporate headquarters. The role of the QA department included administration of the quality systems governing all aspects of process and material control, product quality and reliability assurance as well as quality records documentation. By

1992, the role was extended to cover that of customer engineering for the Asia Pacific market, with functions of resolving customer complaint, facilitating customer audits and visits.

In 1988, Allied-Signal initiated its Supplier Award Program giving formal recognition to suppliers for outstanding performance in quality, delivery and pricing of their products and services. Major suppliers are gathered annually to be updated on Allied-Signal quality and purchasing policies and winners are presented Best Supplier awards. In 1994, Allied-Signal established its Supplier Total Quality Control Workshop, an event to educate major suppliers on Allied-Signal Total Quality Control philosophy and align Allied-Signal expectations to suppliers' deliverables. Over the years, the system of recognising the best supplier has given increasing weightage to the factor of quality.

Total Productive Maintenance (TPM) was introduced into the operations in 1994, a system that focuses quality improvement through correct equipment operation, preventive maintenance and effective new equipment. Employees are organised into small mixed teams of operators, technicians and engineers to work on equipment improvement while facilitated by intensive equipment operations and maintenance training.

The emphasis for built-in quality were initiated as early as 1990 by the formalisation of Design in Reliability (DIR) rules for the new products and the establishment of lessons learnt information database to support DIR application. Engineers were subsequently introduced and trained on the use of quality planning tools such Quality Function Deployment (QFD) and Failure Mode Effect Analysis (FMEA) methodologies in 1992 and 1993 respectively.

CHAPTER 2. LITERATURE REVIEW

This chapter reviews the literature pertaining to Total Quality Management, Corporate Culture, and Employee Behaviour and Attitudes.

2.1 Total Quality Management

2.1.1 Definition of TQM

In spite of the plethora of conference papers and reports on the subject, the definition of Total Quality Management remains shrouded in vagueness. Various authors have noted this situation as exemplified by James Graham's (1992, p.41-58) statement there is growing weight of evidence that Total Quality Management means all things to all people An insight into the definition of Total Quality Management is best approached by reflecting on the definitions of quality.

Joji Arai (1991) in his article Quality: A World-wide Perspective' stated the following: Quality can be defined in many ways. Juran (1986) defined it as 'fitness for use.' Ishikawa (1976) as 'customer satisfaction, Deming (1986) as 'the most useful products demanded by customers', Feigerbaum (1983) as 'the best products made to customers satisfaction', Crosby (1979) as 'conformance to requirements', the Oxford Dictionary as 'the degree of excellence', and

Motorola Company which received the Malcolm Baldridge Award as 'a product almost completely bereft of defects.' Given the variety of perspectives on quality by many eminent quality management experts, it follows that the meaning of Total Quality Management is not likely to be definitive. Total Quality Management definitions from the literature review could however be classified into 2 categories, content based definitions and process based definitions.

2.1.2 Content -Based Definitions

A Total Quality Management content definition focuses on what the author regards as the key element of total quality management. It is based on this definition that the core values of Total Quality Management emerges. Saraph, Benson & Schroeder's (1989) empirical research on "An Instrument for measuring the Critical Factors of Quality management" identified a survey instrument that was verified to be both reliable and valid (alphas ranged from 0.71 to 0.94, multiple correlation coefficient of 0.8) to measure the 8 critical factors. The factors include top management leadership for quality, autonomous role of the Quality Department, training for all employees, built-in quality products/service design, supplier management emphasising quality, process management based statistical control, fool-proofing and prevention of

errors, use of quality data and reporting, and the extent of employee involvement in making quality decisions.

Other content-based definitions include James (1992) 9 point Total Quality Management framework which emphasises a "management-led" approach, a "company-wide" scope, a "everyone is responsible for quality" scale, a "prevention of errors" philosophy, a "right the first time" standard, a "continuous improvement" theme, a "delight the customer goal", a "process" focus, and finally, a "scientific and statistical " methodology.

Similarly, Dale and plunkett (1990) advocated 6 principle points of the Total Quality Management process that included continuous improvement, suppliers and customers involvement, total operations/functions involvement, performance measurements, teamwork, and employee involvement.

2.1.3. Process- Based Definitions

A Process-based definition describes the system of quality management and/or the implementation strategy. Pzydek (1991) describes Total Quality System as a process that assures continuous improvement while implementing the policy established by top management.

The process starts with top management establishing the company's quality policy which then is translated into quality standards for its processes, products, services and its suppliers. A measurement system is set up to monitor the conformance of its processes, products and vendors to those standards. This is followed by the conduct of audits by top management and consultants for effective conformance. Feedback of quality information is administered through a Quality Information System that encompasses quality data collection, analysis, dissemination as well as informal feedback from employees, customers and suppliers. This quality information then forms the basis for company-wide continuous quality improvement, executed through employee training, product redesign and process optimisation. The loop closes by considering the effects of continuous improvement for future quality policy establishment .

A Process-based definition was also detailed by Harvey (1989) in his paper "The Strategic implementation of Total Quality Management" and in Porter & Hird's (1989) conference proceedings of "Total Quality Management Implementation Strategy - TIOXIDE UK Ltd".

2.1.4. Content of Total Quality Control Systems and Programs

The assessment of Allied-Signal Total Quality Control supporting systems and programs for critical success factors was based on Saraph et al's (1989) established matrix of critical factors of quality management (***See Appendix A***). Saraph et al's (1989) identified 8 Critical Success Factors (CSFs) for Total Quality Management that includes top management leadership for quality, role of quality department, training, product/service design, supplier quality management, quality data and reporting, and employee relations. Further detailed examination of Total Quality Critical Success Factors is made in Section 4.1.2.

Systems and programs that conformed to the description of factors were listed. The lack of critical success factors was indicated by the absence of related programs and systems. It is to be noted that the evaluation was not based on an item by item review of Saraph et al's (1989) original 78 items construct, and no attempt was made in scoring for the degree of practice for each of the factors. This limited the analysis to that of indicating the number and type of critical success factors that were lacking. This analysis did not provide a quantifiable measure of adequacy of critical success factors that were present.

There is no right or wrong model to choose from to adopt Total Quality Management in Allied-Signal. The most appropriate model (or models) will depend on the situation of the Company and the timing of the planned Total Quality Management introduction.

2.1.5. Core Values of Total Quality Management

Four core values emerges from definitions of Total Quality Management. These are customer satisfaction, quality commitment, continuous improvement and employee involvement.

2.1.5.1 Customer Satisfaction

That Total Quality Management is a customer-centred program is widely recognised and is deemed the most important value of Total Quality Management. The customer concept encompasses the traditional "external" customer (the person/organisation that purchases a product/service) as well as the "internal" customer (the person/group within your organisation that receives your work for further processing). This concept is also termed as "the next process is your customer". Satisfaction is seen as meeting the customer's requirements, beyond that of conforming to product/service specifications, but also in meeting or

even surpassing the customer quality perceptions with the intent of "delighting the customer". Associated with this value are themes of "right the first time" and "right all the time". That customer satisfaction is the central value also simply stems from the rational notion that the customer is the reason for the company's existence.

2.1.5.2 Management Commitment to Quality

James (1992) describes management commitment to quality as the change from the traditional short term result-oriented business view, to one of longer term quality improvement-oriented view. Joji Arai (1991) cites quality orientation in his Total Quality Management definition. Saraph et al (1989) 13 point summary on the role of top management to quality describes this as the visible leadership in improving quality, the establishing of clean quality policies, objectives, strategies and programs as well as evaluation of management's performance based on meeting quality objectives. This commitment to quality as demonstrated by "deeds" rather than "words", by the people that lead the company, constitutes the next core value of Total Quality Management.

2.1.5.3 Continuous Improvement

Continuous improvement emphasises the fact that quality improvement is a never-ending process. It also emphasises the need to constantly strive for the ideal of zero defects, and towards achieving "first time right" and "right all the time ideals". The Japanese calls this value **'KAIZEN'**, the continuous attainment of incremental 'small step' improvements expected from all employees. This is the employee's responsibility to work improvements, apart from innovations, that is not often recognised in traditional management approaches.

2.1.5.4 Employee Involvement

The fourth core value of Total Quality Management, employee involvement, is the concept of total participation of all employees in quality improvements. This arises from the need to change the traditional belief in 'management think workers do' to the belief that 'workers can and should contribute to quality improvement at all levels and in all functions.' James (1992) describes this as the 'company wide' scope and 'everyone is responsible for quality' scale in his Total Quality Management definition. The concept of teamwork, the breaking down of functional barriers, and that of employee empowerment in quality

decisions, of workers assuming responsibility to (error-free output) are in support of this other critical value of Total Quality Management. A common measure of the extent of this belief is the participation of employee in Quality Control Circle activities.

2.1.5.5 Content of Allied-Signal's Total Quality Control package

The content evaluation of Allied-Signal Total Quality Control training package consisted of the qualitative comparison of Allied-Signal's Total Quality Control concepts with respect to the 4 core Total Quality Management values inferred from the literature review. Key elements of similarities and differences were identified. Weaknesses in terms of coverage, clarity and specificity were highlighted.

2.2 Corporate Culture

2.2.1 Definition & Strategic Implications of corporate culture

Uttal (1983) describes corporate culture as the 'system of shared values (i.e. what is important) and beliefs (how things work) that interact with a company's

people, organisational structures, and control systems to produce behavioural norms'.

Other notable authors such as Schein (1984), Marguiles & Raia (1978) and Albrecht (1987) offered similar though not identical perspectives on corporate culture. This paper uses Schein's (1984) 3 element definition that includes the unconsciously held basic assumptions, the consciously held values and beliefs as well as the visible organisational artefacts.

Corporate Culture can be defined in Schein's words as:

> ***"A pattern of basic assumptions-invented, discovered, or developed by a given group as it learns to cope with its problems of external adaptation and internal integration-that has worked well enough to be considered valid and, therefore to be taught to new members as the correct way to perceive, think and feel in relation to those problems".***

Several authors have stated the importance of corporate culture to the successful implementation of the strategy of the company. Hickman (1984),

Goodstein et al (1985), Peters and Waterman (1982) have cited relations of corporate culture to vision, strategy and organisational performance.

Peters and Waterman provided a list of seven basic values that are found in the best American companies. These two management writers present corporate culture as a recipe for success in which quality is one of the seven essential beliefs. These basic values are defined as follows:

1) A belief in being the "best"

2) A belief in the importance of the details of execution, the nuts and bolts of doing the job well.

3) A belief in the importance of people as individuals.

4) A belief in superior quality and service.

5) A belief that most members of the organization should be innovators, and its corollary, the willingness to support failure.

6) A belief in the importance of informality to enhance communication.

7) Explicit belief in, and recognition of, the importance of economic growth and profits.

Peters and Waterman wrote In Search of Excellence while they were working as management consultants for McKinsey. It was there they learned the centrality of values in an organization which is graphically portrayed in ***Figure 2.1***, developed by Tom Peters, Robert Waterman, Richard Pascale and others. When quality becomes the central value as in a Total Quality Management programme, everything else flows from it-system, strategy, structure, style, skills and staff and shared values. It is clear from the established literature that the culture of an organisation can have a significant influence on both organisational and individual behaviour and is a major contributor to implementation success of its strategies. Organisations undergoing change should therefore be cognizant of, be interested in, and be facilitated by an appropriate corporate culture.

2.3 Leadership and Managing Change

The greatest challenge of instituting Total Quality Management is to get everyone moving in the same direction to achieve optimal performance. People's dogmatic and counterproductive attitudes are strong barriers to implementing a Total Quality Management effort. These features of organizational life are the toughest to change because they are deeply rooted. Changing the culture of an organization, therefore, is a huge and difficult task.

The key things that a leader of an organizational change effort must focus on and communicate so that the organization moves in the same direction are the organization's purpose, objectives, strategy, structures, and culture. This is not just a prescription for organizational change; it is a way of thinking that can leverage the organization's ability to manage change effectively and achieve greatness.

The leaders of Total Quality Management efforts must focus their attention on creating clarity and commitment to the organization's direction. A leader must create a vision of organizational greatness and then inspire the members to achieve it. That is not only the secret ingredient in leadership, it is the key to managing change.

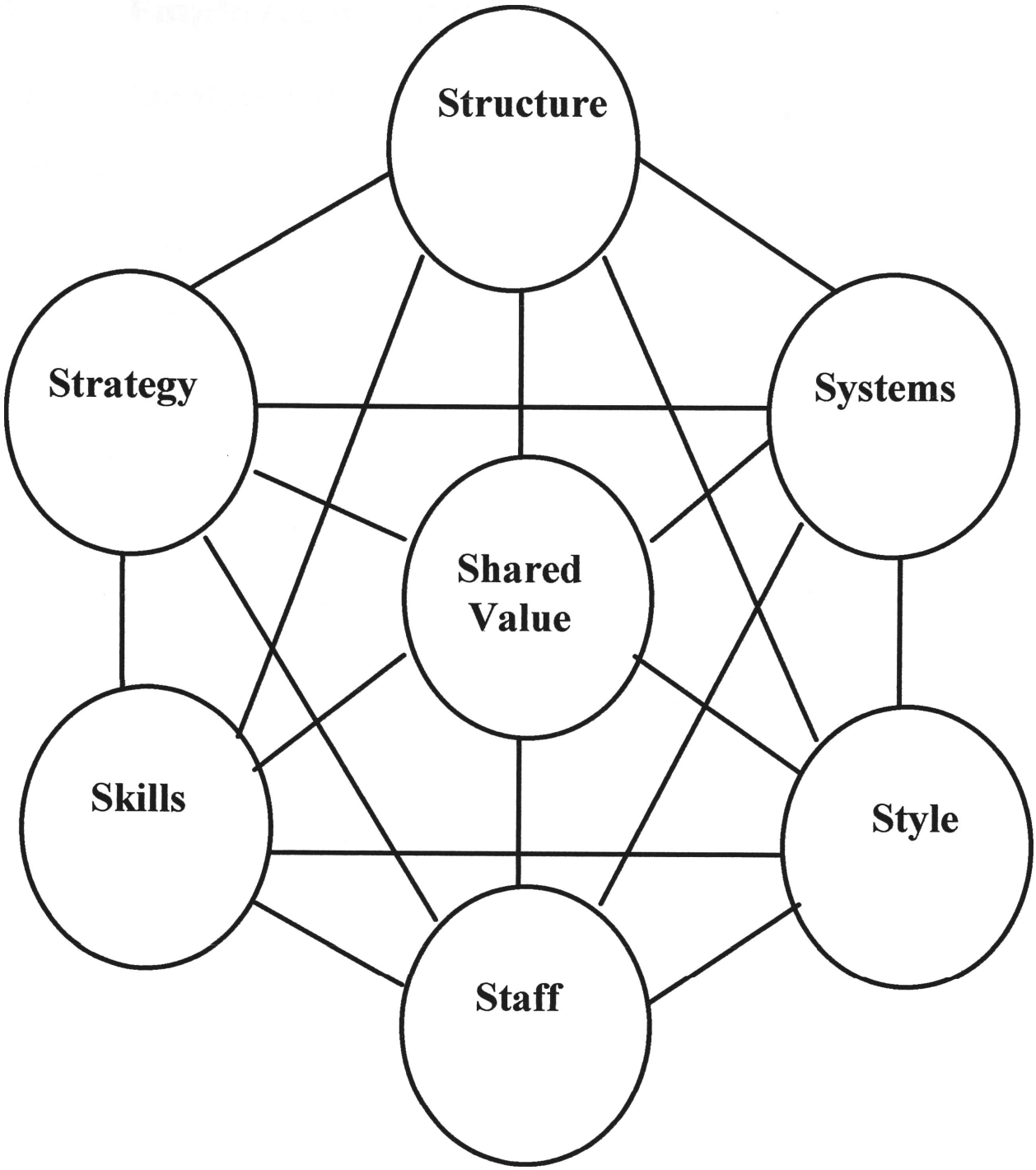

Figure 2.1 The McKinsey 7-S framework

2.4 Employee Behaviour and Attitudes

2.4.1 Employee Behaviour & Attitudes

Definitions of Employee Behaviour are well established. Authors such as Dubrin (1984), Ivancevich (1987) and Dunham (1984) have expressed various perspectives on Employee Behaviour. The focus of this study will be based on the accepted view of employee behaviour being what the work does (that set of tangible acts or decisions) within the organisation.

The influence of attitudes on behaviour are well established. Johns (1987) defines attitude to be 'a fairly emotional tendency to respond consistently to some object,..' and established that attitude is thus a function of beliefs (what we think or assume) and values (what we feel) about an object.

The relationship between attitudes and behaviour is described by Goldstein and Sorcher (1974) using their models on attitude change. They subsequently suggest that behaviour change (through modelling, role-playing and social reinforcement) leads to the desired attitude change.

The relationship of values and beliefs (the key dimensions of culture) to attitudes, and of attitudes to employee behaviour, as established through the

above definitions, form the basis of the analysis of the effectiveness of the company's attempt in establishing Total Quality Management values and its influence on employee attitudes and behaviours.

2.4.2 Corporate Culture and its Influence on Employee Behaviour, Values and Commitment.

Dunn, box, Odom and Johnson (1991) in their empirical study within the banking industry on the above topic, observed that employees from banks with an "excellence culture" showed good organisational value congruency, demonstrated behaviour consistent with organisational expectations and possessed higher company commitment. The results of the above study suggest that where there is identification with the organisation's value of excellence (such as superior quality, being the best etc.), there is better expectant behaviour and higher commitment to the organisation.

The analysis of the company's Total Quality Management value establishment effort will seek to examine to what extent is this evident among the company's employees.

It is important to note that strategic planning puts a balanced focus on 'means' and 'ends'. All too often strategic planning methodologies become an exercise

in exploring only outcome values required to bring about changes in behaviour, which is the essence of improved performance. In this regard, it is important to develop measurement criteria for critical success factors. The adoption of Total Quality Management in our Company will inevitably mean a much stronger focus on the process values of the people in the organization. In most cases, there is no understanding of these as they currently exist in the Company, so there is little understanding of the magnitude of the changes represented by Total Quality Management. This emerges, often with some trauma, only after the Company has made the commitment and commenced the journey.

CHAPTER 3.CASE ANALYSIS METHODOLOGY

This chapter describes the key variables and methodologies used to address the 3 issues on Total Quality Management establishment faced by Allied-Signal. Descriptions of the company's employee profile and the statistical methods used are also included.

3.1. CONTENT ANALYSIS OF ALLIED-SIGNAL'S TOTAL QUALITY MANAGEMENT PRACTICES

3.1.1. Problem Statement

Allied-Signal had been using the corporate published Total Quality Control Manual since 1991 for its training of employee on Total Quality Management concepts (Allied-Signal Continuous Improvement Resource Guide, April 1990). Although many publications had been made on Total Quality Management since 1991, no revisions had been done nor formal assessment made on the relevance of its program content. There was also no formal audit of the company's program for the presence of critical success factors for establishing Total Quality Management. The assessment of the above issues would determine the need for a revision of its current Total Quality Control package as well as its supporting Total Quality Control programs and systems.

3.1.2. Key Variables and Methodology

The key variables of this analysis were the content of Allied-Signal's Total Quality Control package and the content of Allied-Signal's Total Quality Control supporting systems and programs.

Data on Total Quality Management practices were drawn from Allied-Signal's Total Quality Control training manuals, Allied-Signal's internal quarterly publication (Allied-Signal Total Quality Control World), and documentation from the training centre covering the period 1991 though 1994.

3.2. INFLUENCE OF TOTAL QUALITY MANAGEMENT ON EMPLOYEE ATTITUDES

3.2.1. Problem Statement

Up till 1994, Allied-Signal had not measured the influence Total Quality Management had on employee beliefs, behaviour and commitment. This lack of understanding constitutes the second problem faced by the company in its effort to determine the effectiveness of its Total Quality Control program.

3.2.2. Key Variables

The key variable of this analysis were management commitment to quality, continuous improvement, employee involvement (3 of the 4 core values of Total Quality Management), and company commitment.

3.2.3. Methodology

Data on employees' attitude were taken from the results of Allied-Signal annual attitude survey. The sample population comprised all employees less those on probation. The population was divided into 2 groups according to our payroll classification: the 'exempt' population comprising engineers, supervisors, administrative officers and managers; and the 'direct & non-exempt' population comprising production operators, technicians and clerical staffs. Data used covered the period 1991 through 1994.

The attitude survey instrument had been in use since the early 1980s, many years before the official launching of the Total Quality Control effort in 1991. The survey is a construct of 66 questions out of 100 randomly mixed covering 11 categories of interest. These are company management, supervision, internal equity, work satisfaction, teamwork, workload, job understanding, career opportunity, benefits and quality. Personal data consists

of the employee's job status and department. Employees indicate either an agreeable or disagreeable response (2 levels) to each question pertaining to their belief or behaviour. Employees have choice to use either the English, Chinese, Malay or Indian version of the instrument. An extract of the English questionnaire is attached ***Appendix B.***

For this analysis, the 66 questions were individually vetted for relevance to the 4 core Total Quality Management values, customer satisfaction, management commitment to quality, continuous improvement and employee involvement and to the factor of company commitment.

The percentile of favourable responses for each of the 4 variables was computed by averaging the favourable responses percentile of the relevant questions in each category. This was repeated for each year of the 4 year period of interest, and for each of the 2 employee populations. These results were then trended. Qualitative comments were made pertaining to either favourable or unfavourable shifts in trend. Plausible reasons for these observations with respect to the Total Quality Control effort were offered. The Total Quality Control effort was deemed to have a positive influence on a variable if a favourable trend was observed.

The trend analysis of relevant historical data constituted only an initial assessment of the influence of Total Quality Management on employee attitudes over time. The use of the attitude survey data for this study arises from the limitation that it is the only measure for value changes within the company's data bank that spanned the period of interest. Future assessment should be conducted by using 'specifically designed survey instruments that served the purpose of longitudinal analysis.

3.3. EFFECT OF TOTAL QUALITY CONTROL VALUES AWARENESS AND MANAGEMENT BEHAVIOUR ON EMPLOYEE BEHAVIOUR

3.3.1. Problem Statement

The third problem to be addressed in consolidating Allied-Signal's Total Quality Management effort is the lack of understanding of the relative influence of value awareness and management behaviour on employee behaviour. The determination of the significant factor influencing employee behaviour will enable Allied-Signal to focus its attention on establishing a Total Quality Control culture more effectively.

3.3.2. Key Variables

The key variable of this analysis was Total Quality Control Values Awareness; Employee Behaviour; and Perceived Management Behaviour. In examining their relationships, Employee Behaviour was treated as the dependent variable, while Values Awareness and Perceived Management Behaviour were the independent variables.

3.3.3. Methodology

Data used for the analysis were taken from the results of Allied-Signal's first Total Quality Control survey conducted in 1994. The sample population comprised all employees less those on 3 months probation.

Employee profile information extracted from Allied-Signal Human Resources database is shown in ***Table 3.4.*** Significant differences among the 3 groups were educational level, a reflection of Allied-Signal entry requirement for each group; tenure distribution; and the ethnic composition between the 'direct' and 'indirect' employees.

The Total Quality Control survey instrument was developed in Allied-Signal headquarters in Arizona, USA, for the specific purpose of collecting employee

feedback on Total Quality Control. It also served to complement the feedback derived from the long established general attitude survey instrument. The survey was developed by a team drawn from different parts of the corporation. This was discussed with many people within the corporation and with expert management consultants. Then it was approved by the Board. The survey consists of 22 questions on personal data; 17 questions on Total Quality Control Values Awareness, Employee Behaviour and perceived Management Behaviour; 1 question on overall quality rating; and a final question on suggestions to improve customer satisfaction. Personal data comprise employee's job status, tenure and shift information.

For the 17 questions on Total Quality Control attitudes, employees were required to indicate their degree of agreement on a 5 level scale ranging from strongly agree (1) to strongly disagree (5). For quality rating assessment, respondents were required to indicate their rating on a 5 level scale ranging from very good (1) to very poor (5).

Employees have a choice to use either the English, Chinese, Malay or Indian version of the instrument. ***Appendix C*** shows the English version of the instrument.

The Total Quality Control survey data was processed using Microsoft Excel. Invalid responses arising from incorrect or partial entries were removed from original 1316 responses, resulting in a net response base of 1180. The 17 questions on Total Quality Control attitudes were classified into 3 categories; 5 questions on Total Quality Control Values Awareness; 6 questions on Employee Behaviour; and 6 questions on Perceived Management Behaviour related to Total Quality Control. These questions are listed in ***Appendix D***.

Survey responses of each category were further classified by job status, into the 3 employee populations: the 'exempt' or supervisory population; the 'non exempt' population comprising technicians and clerical staff; and the 'direct' population comprising production operators.

The first part of the analysis examined the degree of Total Quality Control Values Awareness, Expectant Employee Behaviour across the 3 employee groups. The statistical mean score and standard deviation for the 3 variables were computed for the 3 classifications of respondents following the established statistical definitions (Newbold, 1988, p.38). One Way Analysis of Variance (Newbold, 1988, p.610-612) at 1% significance level was employed to examine differences in mean scores among the 3 employee populations.

The next part of the analysis examines the effect of tenure on employee attitudes on Total Quality Control. Survey responses within each employee group were further classified into 4 tenure groups: less that 1 year; between 1 and 5 year; between 5 and 10 years; and greater than 10 years service. The mean score and standard deviation for each tenure group within each employee population were computed. This was done for all 3 key variables. One Way Analysis of Variance at 1% significance level was also used to examine differences in mean scores among the 4 tenure classifications for each of the 3 employee groups.

The final part of the Total Quality Control survey quantitative analysis was to determine the correlation between Values Awareness and Employee Behaviour, and between Perceived Management Behaviour and Employee Behaviour. Composite scores of Values Awareness and Perceived Management Behaviour for each respondent were correlated to composite score of Employee Behaviour. Multiple regression based on Least Squares Estimation (Newbold, 1988, p.497-499) was performed. Expectant employee behaviour was the dependent variable (Y), while Values Awareness (X_1) and Perceived Management Behaviour (X_2) were the independent variables. Correlation coefficients and partial regression coefficients for each employee group were

computed. The degree of influence Values Awareness and Perceived Management Behaviour had on Employee Behaviour was indicated by the correlation coefficient. The significant factor influencing Employee Behaviour was determined from the magnitudes of partial regression coefficients.

3.4. LIMITATIONS OF THE METHODOLOGIES

The primary limitation of the methodologies used is in the use of Allied-Signal's existing attitude survey and Total Quality Control survey instrument which had not been tested for reliability and validity. In addition, the attitude survey construct was not designed primarily for Total Quality Control factor analysis. Questions selected from the construct permit only a partial analysis of Total Quality Management core characteristics. For both survey instruments, possible errors arising from the translation of the questionnaires from English to other languages were also not determined.

Another limitation of this study is that it is only a single company case situation. For the Total Quality Control survey, it is only a single point in time survey which has limitations in predicting whether the relationship is an enduring one or one that varies over time. Longitudinal studies over several

survey cycles would be required to determine the causal relationship more exactly.

CHAPTER 4. THE CASE ANALYSIS

4.1. CONTENT ANALYSIS OF ALLIED-SIGNAL'S TOTAL QUALITY MANAGEMENT PRACTICES

The analysis is a qualitative assessment of the relevance of Allied-Signal's Total Quality Control concept in relation to core values established in the Total Quality Management literature, and the presence of critical success factors.

4.1.1. Total Quality Management Core Values

Allied-Signal's Total Quality Control concepts of Customer Satisfaction as central value, supported by Policy Deployment, Operational Excellence, Management By Fact and Teamwork, contained many points of similarities to the core value of Total Quality Management of Customer Satisfaction, Management Commitment to Quality, Continuous Improvement and Employee Involvement.

The common values are Customer Satisfaction and Employee Involvement through teamwork. For Customer Satisfaction, the notion of internal and external customers, and the prioritising of activities to satisfy customer needs are consistent with literature findings.

The 2 key elements of people involvement and problem solving through quality teams contained in Allied-Signal's concept of Teamwork are consistent with the value of Employee Involvement. However, a significant difference of Allied-Signal's concept of Teamwork from Employee Involvement is the inclusion of Continuous Improvement as a supporting element. Total Quality Management literature, on the other hand, distinguishes Continuous Improvement and Employee Involvement as 2 separate core values. Furthermore, the element of empowerment is not defined in Allied-Signal's Teamwork concept.

Allied-Signal's concept of Operational Excellence is aligned with the value of Continuous Improvement. The emphasis on planning for quality which supports the 'do it right the first time' ideal and the use of the PDCA (Plan, Do, Check, Act) Cycle for problem solving, are consistent with the description of Continuous Improvement. Although the value of Continuous Improvement was explicitly cited in Allied-Signal's Total Quality Control definition, it is perhaps not effectively communicated by being termed as Operational Excellence. This problem is further compounded by the treatment of Continuous Improvement merely as an element of Teamwork.

The fourth Total Quality Management core value of Management Commitment to Quality is not explicitly stated in Allied-Signal's Total Quality Control campaign logo. The commitment to quality (quality is associated to customer satisfaction) is expected of all employees as encompassed in Allied-Signal's Total Quality Control definition. However, Allied-Signal's Total Quality Control concept in not specific in emphasising Management commitment to Quality. The commitment to quality by the people who lead the company is clearly distinguished from the element of employee quality orientation in the Total Quality Management literature. The expectant roles of managers in promoting Total Quality Control and in achieving customer satisfaction, though stated, were treated as supporting elements of the value of Customer Satisfaction and were not clearly expounded as a core value.

Allied-Signal's Total Quality Control concepts of Policy Deployment and Management by Fact do not relate to Total Quality Control values but are rather mechanistic structural elements for the execution of Total Quality Control. Policy Deployment facilitates the process of communication and evaluation of objectives while Management by Fact defines a set of 'quality tools' to process information.

Overall, Allied-Signal's Total Quality Control principles establishes adequately 3 of the 4 commonly expressed values of Total Quality Management viz. Customer Satisfaction, Employee Involvement, and Continuous Improvement. However, it lacks specificity in the value of management Commitment to Quality.

4.1.2. Total Quality Management Critical Success Factors

Sareph et al (1989) identified 8 critical success factors for Total Quality Management that includes top management leadership for quality, role of quality department, training, product/service design, supplier quality management, quality data and reporting, and employee relations (***Reference Appendix A).***

In ***Table 4.1*** lists Allied-Signal's Total Quality Control supporting systems and programs against the 8 critical success factors. Allied-Signal's Total Quality Control and its supporting quality systems and programs provide evidence of the presence of all 8 factors in varying degrees. Top management leadership for quality is evident from the establishment of Total Quality Control as the management philosophy. The autonomous role of the QA department was

long established in the company. Effective company training of employees was recognised by the Singapore Productivity and Standards Board (PSB) and the Institute of Education (ITE). Product/Service design emphasising built-in quality is facilitated by the company's design in reliability system, lessons learnt databases and promotion of use of Failure Mode and Effect Analysis (FMEA) tools for its engineering community.

	Critical Success Factors	**Allied-Signal Total Quality Control Supporting Systems and Programs**
1	Top Management Leadership For Quality	Total Quality Control management philosophy
2	Role of the Quality Department	Autonomous QA Department
3	Training	Training & Education/ Department (PSB & ITE Company Training Awards)
4	Product / Service design	DIR System; and FMEA Tools
5	Supplier Quality Management	Supplier Excellence Award Program: and Supplier Total Quality Control Workshop
6	Process Management	SPC; and TPM
7	Quality Data & Reporting	Management by Fact; and Policy Deployment
8	Employee Relations	ET; QIT; and MIR System

Table 4.1 Total Quality Management Critical Success Factors

Supplier quality management is evident from the company's supplier award program and supplier Total Quality Control workshop. Process management is evident from the principle of Management By Fact, advocating statistical methods and statistical process control and the introduction of Total Productive Maintenance emphasising preventive maintenance.

The concepts of Management by Fact and the system of Policy Deployment offers evidence for the presence of the factor of quality data and reporting. However, the use of Cost of Quality (COQ) data is not emphasised in Allied-Signal's Total Quality Control concept. This differs from the recommendations made by Saraph et al (1989), Atkinson (1990) and Ernst & Young (1990). It is noted that Allied-Signal had prior to formal Total Quality Control implementation used COQ data for management review of performances but this was not sustained.

Allied-Signal's Total Quality Control and supporting systems and programs provided coverage of all 8 critical success factors for Total Quality Management as established by Saraph et al (1989), p810-829. While presence of all factors could be substantiated by evidences of activities, the adequacy of each factor is not quantifiable.

The content evaluation of Allied-Signal's Total Quality Control concept for both core values and critical success factors revealed strong content coverage by way of similarities to the literature findings. A Limitation identified was the lack of specificity on the value of Management Commitment to Quality. In addition, adequacy of each critical success factor could not be established.

4.2. INFLUENCE OF TOTAL QUALITY MANAGEMENT ON EMPLOYEES' ATTITUDE

The qualitative analysis of the company's attitude survey is based on a trend analysis of favourable responses to selected questions pertaining to the values of quality commitment, continuous improvement, employee involvement and company commitment. The results are trended over the period of 1991 through 1994, and implications of the results in relation to the Total Quality Management effort determined.

4.2.1. Attitude Survey (1991-1994)

Table 4.2 shows the percent favourable response to the 16 questions pertaining to quality commitment, continuous improvement, employee involvement and company commitment for the years 1991 to 1994 for the

combined 'direct and non-exempt' population. The questions were extracted from the Company's attitude survey instrument comprising 66 questions, of which 16 were found relevant for Total Quality Management evaluation and are listed in ***Appendix E***. The ***Table 4.3*** shows the corresponding information for the 'exempt' population.

Questions on management quality commitment pertain to provision of adequate materials for quality work, supervisor's emphasis on quality and management's concern on quality improvement. The 2 questions related to continuous improvement pertain to the adequacy and availability of training to enhance job performance. The 9 questions related to employee involvement consists of 5 questions pertaining to open communication between employee and supervisor, and 4 questions pertaining to evidence of good teamwork. The 2 questions of company commitment seeks response on whether the company is a good place to work for and a poll on whether employees have sought job opportunities outside Allied-Signal.

Percent Favourable				
Survey Question	1991	1992	1993	1994
Management Quality Commitment				
Question -23	92.0	90.3	90.0	87.8
Question - 27	81.4	83.1	83.3	78.7
Question - 49	72.9	74.1	71.3	69.2
Average	82.0	82.5	81.5	78.6
Continuous Improvement				
Question - 24	67.7	67.9	63.5	65.9
Question - 44	76.6	72.3	74.0	73.6
Average	72.2	70.1	68.8	69.8
Employee Involvement				
Question - 5	67.0	66.5	68.6	61.8
Question - 13	74.4	71.2	80.1	70.6
Question - 14	69.5	69.8	83.0	66.4
Question - 25	68.8	66.1	79.0	62.2
Question - 26	65.1	63.7	78.5	59.8
Question - 34	72.7	73.4	69.5	67.5
Question - 35	62.7	61.8	60.5	58.7
Question - 37	76.9	79.9	77.1	67.3
Question - 54	64.7	65.7	65.6	62.1
Average	69.1	68.7	73.5	64.0
Company Commitment				
Question - 17	79.2	80.2	84.7	81.0
Question - 21	91.8	91.7	90.0	85.4
Average	85.5	86.0	87.4	83.2

(Source: Allied-Signal Human Resources Department, 1994.)

Table 4.2 Total Quality Management Values & Commitment - Directs & Non - Exempts Employees

Percent Favourable				
Survey Question	1991	1992	1993	1994
Management Quality Commitment:				
Question-23	92.3	90.1	90.9	90.1
Question-27	91.4	87.8	82.7	83.1
Question-49	70.2	63.9	68.0	64.0
Average	84.6	80.6	80.5	79.1
Continuous Improvement				
Question-24	70.2	64.0	58.9	58.1
Question-44	79.9	76.8	67.1	66.9
Average	74.6	70.4	63.0	62.5
Employee Involvement				
Question-5	75.0	74.9	86.8	82.0
Question-13	76.9	79.1	69.5	68.6
Question-14	76.0	80.0	81.7	73.8
Question-25	74.0	81.0	79.5	82.0
Question-26	77.9	82.5	81.7	78.5
Question-34	92.3	92.2	91.8	90.1
Question-35	81.7	78.5	84.9	76.7
Question-37	71.2	71.1	65.3	53.5
Question-54	76.0	78.7	88.6	84.3
Average	77.9	79.8	81.1	76.6
Company Commitment				
Question- 17	62.5	73.8	73.5	68.0
Question-21	90.4	91.1	84.9	79.7
Average	76.5	82.5	79.2	73.9

(Source: Allied-Signal Human Resources Department, 1994.)

Table 4.3 Total Quality Management Values & Commitment - Exempts Employees

4.2.2. Trend Analysis of Management Commitment to Quality

(Reference: Appendix E and Tables 4.2 and 4.3)

Figure 4.1 shows the trend of percent favourable responses for the value of Management Commitment to Quality, for the 'direct' and 'non-exempt' employees as well as for the 'exempt' employees.

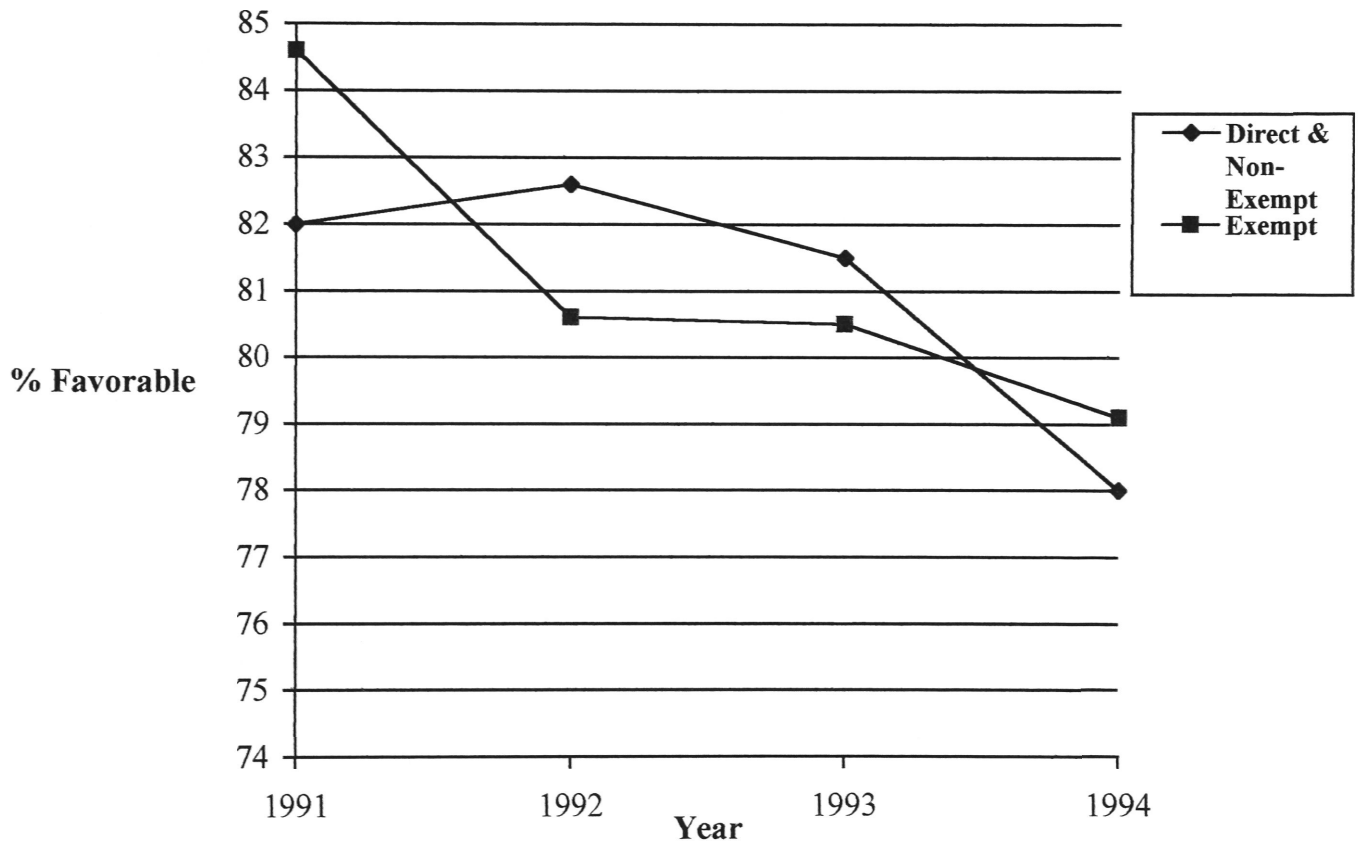

Figure 4.1 Management Commitment to Quality

Both graphs show negative trend on the value of management Commitment to Quality as measured by the dimensions of adequacy of materials to produce quality work, the emphasis on quality by supervisors, and the concern by management in improving quality. The results suggest the lack of influence of Allied-Signal Total Quality Management effort in altering employees' perception of Management Commitment to Quality for the dimensions surveyed. This could be in part explained by the lack of specificity of Management Commitment to Quality as a core value as described in **Section 4.1.1**. In addition, erosion of favourable responses was likely to be brought about by the emphasis on cost reduction, revenue maximisation, and investment curtailment since 1993. The retrenchment of workers (the majority of which were direct employees) in 1994 might account for the significant drop in favourable responses for the 'direct and 'non-exempt' population for that year.

4.2.3. Trend Analysis of Continuous Improvement

Figure 4.2 shows the trend of percent favourable responses for the value of Continuous Improvement as measured by the dimensions of adequacy and availability of relevant training.

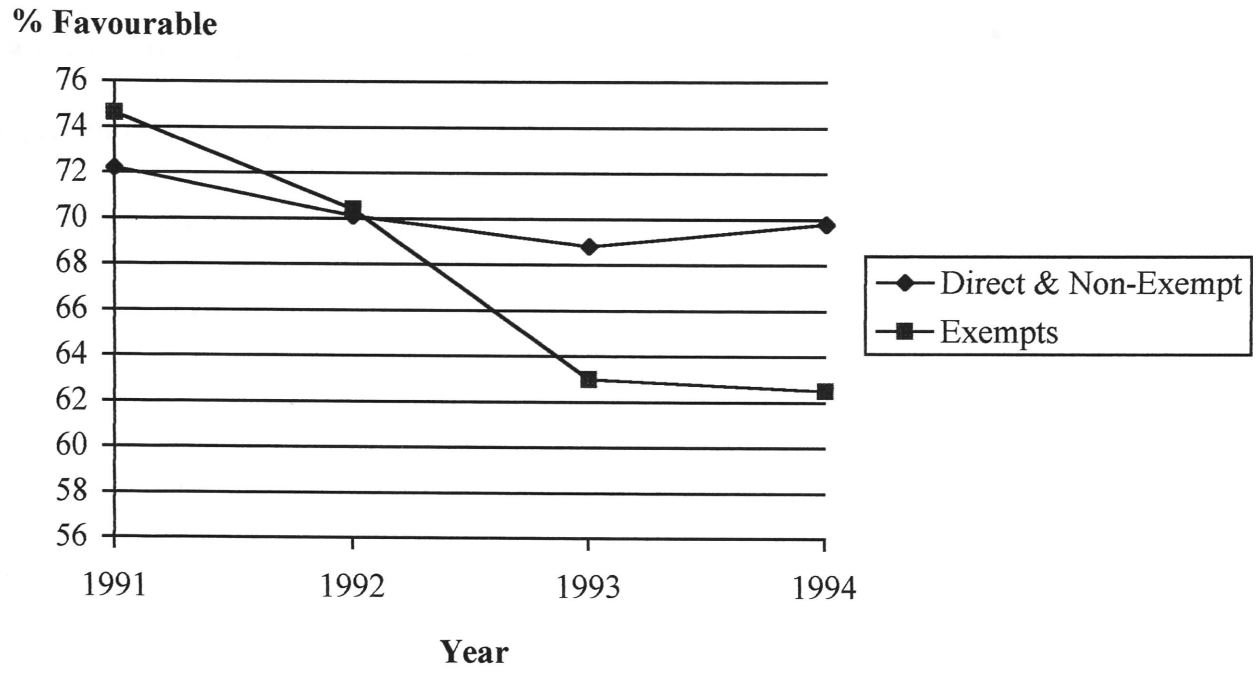

Figure 4.2 ***The Trend of percent favourable response of Continuous Improvement.***

For the 'direct and non-exempt', the graph only indicates marginal degradation in favourable responses over the 4 year period. Given that Allied-Signal had training awards in 1991 and1994 respectively, and that the training program for operators, clerical staffs and technicians had had no significant change over the period, the marginally degraded result is inexplicable from the case evidence. That there had been no improvement since 1991 could perhaps be due to rising expectations for more employee training, while the training program had largely remained at status quo.

Unlike the responses from the 'direct and non-exempt' employees, the value of Continuous Improvement for 'exempts' showed a significant drop in favourable responses over the 4 year period. The "non-exempt" employee training was only in-house-based, whereas 'exempt' employee had a combination of in-house training and external training and education funded by the company. While expectations for more training was raised by the Total Quality Control promotion package, the availability of external training and education was in fact reduced by the cost reduction regulation imposed of 1993. The tremendous decrease in favourable responses for the 'exempt' population is likely to be due to the curtailment of external training opportunities.

Allied-Signal Total Quality Control effort does not show any positive influence over employees' attitudes towards Continuous Improvement. The most likely reason for the above appears to be the discrepancy between what was emphasised as important (more training and education) and what was actually practised (status quo or curtailed training opportunities) .

4.2.4. Trend Analysis of Employee Involvement

Figure 4.3 shows the trend of percent favourable for the value of Employee Involvement based on the 9 questions addressing employee teamwork and communication with supervisors.

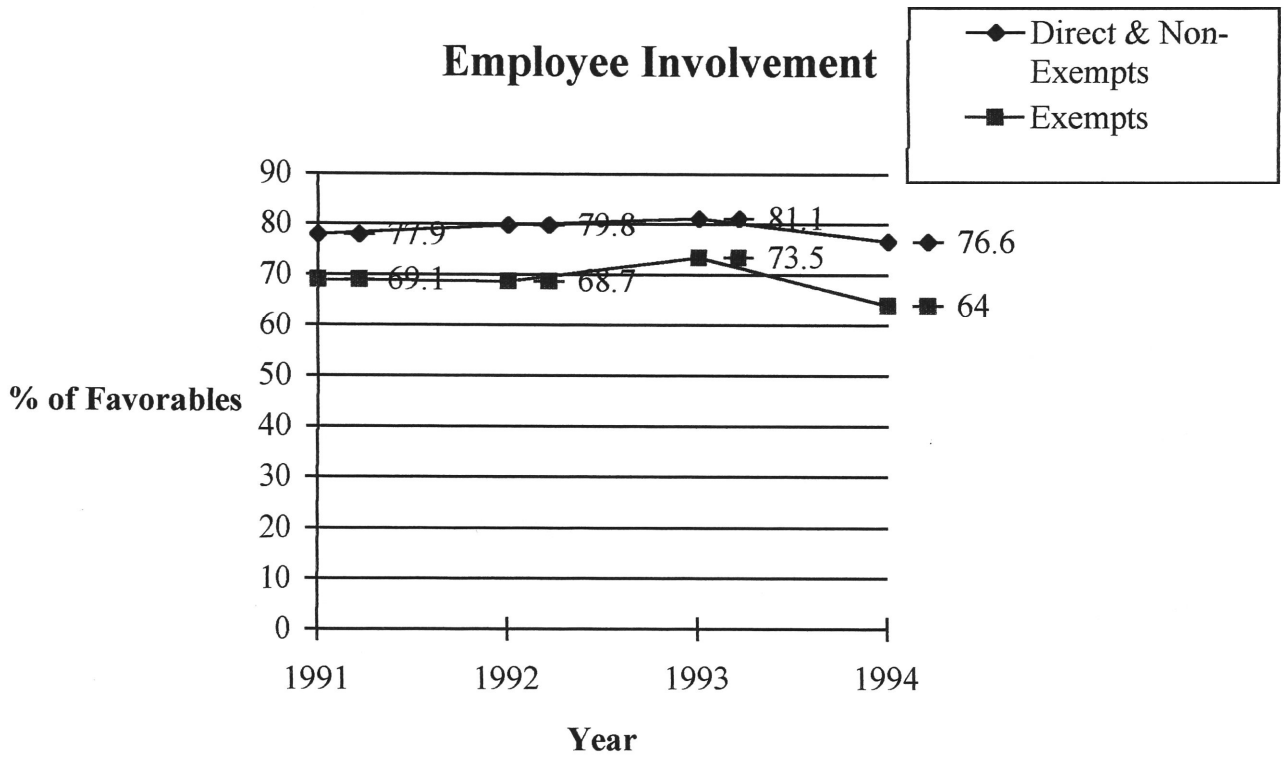

Figure 4.3 Employee Involvement

Both graphs show a positive trend up to 1993, but a significant decline in favourable responses in 1994. The results up to 1993 appear to be correlated with the growth of Quality Improvement Team and Effectiveness Team

participation in that period (**Reference Figures 1.2 and 1.3**). However, the drastic drop in favourable response in 1994 could not be accounted for on a team participation rate basis as memberships in both Effectiveness Teams and Quality Improvement Teams continued to increase in 1994. Furthermore, 1994 was also the year of voluntary retrenchment of workers. It is inferred that the inconsistency of management's words to deeds, extolling the value of recognition of employee participation on one hand, while reducing workforce on the other, could be the reason for the adverse trend for 1994.

The 'exempt' population consistently showed a higher level of favourable responses that the 'direct and non-exempt' employees. The average score for the questions related to teamwork (**Questions 5, 25, 34 and 54 of Tables 4.1 and 4.2**) was 15% higher for the 'exempts' over the 4 year period. Participation rate in Quality Improvement Teams for the 'exempts' was above 90% while participation rate in Allied-Signal for the 'direct and non-exempts' was about 33%. This evidence suggests that participation in teams may be a significant determinant of the levels of favourable responses of attitudes on teamwork. But the effect of the nature of the teams (nominated as opposed to voluntary) and the effect of the type of rewards (intrinsic as opposed to extrinsic) could not be ascertained in the analysis.

The observations suggest that Allied-Signal Total Quality Control effort had a positive influence on employees' attitudes towards Employee Involvement. However, attitudes on this core Total Quality Management value were also critically influenced by other significant events such as cost reduction and retrenchment.

4.2.5. Trend Analysis of Company Commitment

Figure 4.4 shows the trend of percent favourable responses for Company Commitment as measured by the assessment of Allied-Signal being a good company to work for, and intention of employees to remain with the company.

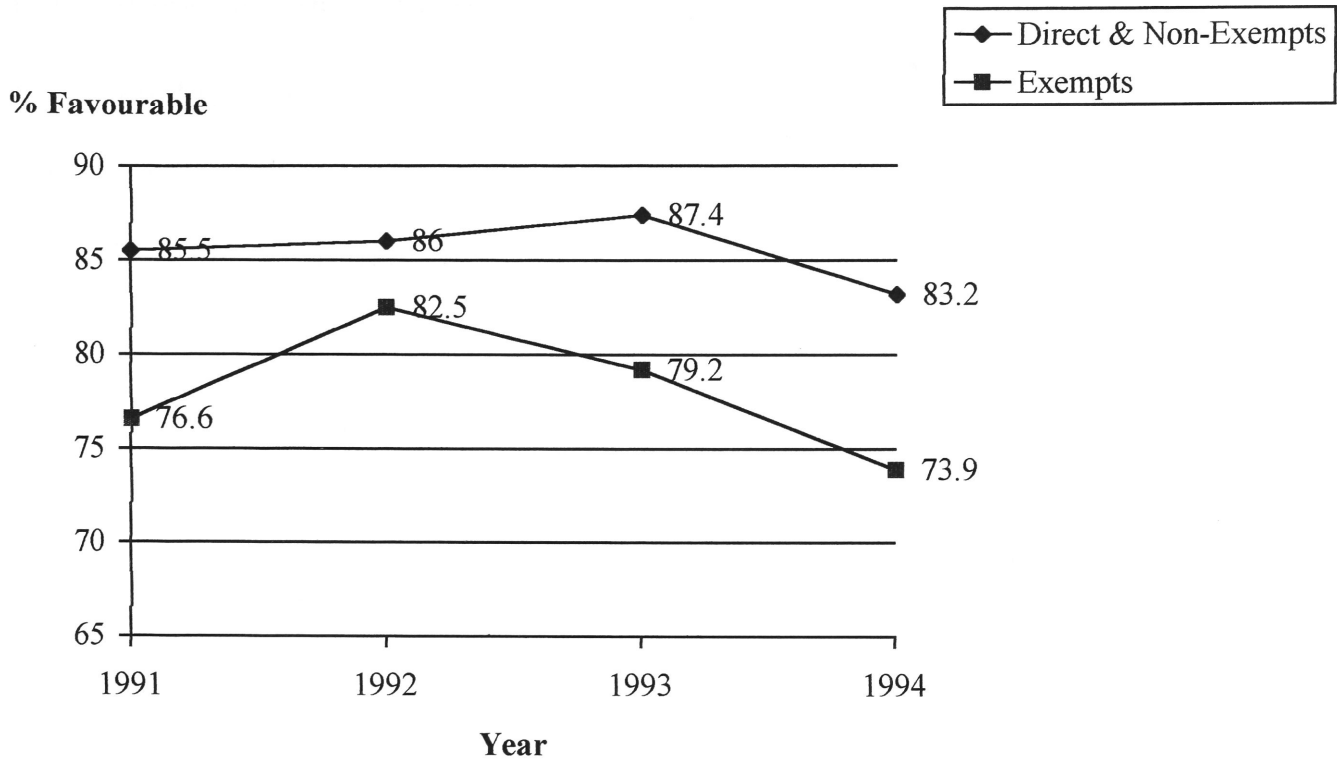

Figure 4.4 Allied-Signal's Commitment

The Company Commitment score showed a positive trend up 1993, and like the other variables, registered a drop in 1994, predictably for the same reasons, i.e. in 1994 was the year of voluntary retrenchment of workers. This observation suggests that Allied-Signal Total Quality Control effort in 1991 also had positive influence on employee attitudes towards Company Commitment, but was not the only significant determinant.

Unlike Employee Involvement, the Company Commitment score was consistently lower for the 'exempt' population than for the 'direct and non-exempt' employees. This trend is consistent with most research findings that observed positive correlation between tenure and commitment, and negative correlation between education level and commitment, an observation supported by Becker's (1990) side-bet theory. The significantly shorter tenure and higher educational level of the 'exempt' population explains the significantly lower score for the 'exempts' in their intention to remain with the company.

4.3. EFFECT OF TOTAL QUALITY COTROL VALUE AWARENESS AND MANAGEMENT BEHAVIOUR ON EMPLOYEE BEHAVIOUR.

The quantitative analysis consists of 3 parts. In Part 1, it examines the degree of Total Quality Control Value Awareness, Expectant Employee behaviour, and Perceived Management Behaviour across the 3 employee profile for 1994 is as depicted in ***Table 4.4.***

As for Part 2, it examines the effect of tenure on employee attitudes on the 3 Total Quality Control variables. The final part of the analysis measures the correlation between Value Awareness and Employee Behaviour and Employee Behaviour.

4.3.1. Total Quality Control Survey (1994)

The 17 questions in the survey were categorised into 5 questions on Total Quality Control Value Awareness, 6 questions on Employee Behaviour, and 6 questions on Perceived Management Behaviour related to Total Quality Control. The Value Awareness, Employee Behaviour and Perceived Management Behaviour are denoted as 'Values', 'Employee Behaviour' and 'Management Behaviour' in subsequent tables and charts.

The 5 questions on Values Awareness cover employees' understanding of the Total Quality Control concepts of Customer Satisfaction, Policy Deployment, application of Total Quality Control principles as well as congruency to management's commitment to total quality and customer satisfaction. The 6 questions on employee behaviour seek evidence of employee actions to achieve customer satisfaction, to improve quality of work, to use factual information, to work in teams, and to measure continuous improvement. The 6 questions on

perceived management behaviour verify employees' perception on evidence of management support pertaining to meeting customer expectations, recognition for quality work, facilitating continuous improvement, and frequent review on quality and customer satisfaction performances.

The mean score and standard deviation of individual questions are as tabulated in ***Table 4.5.*** Composite scores and standard deviation of the questions pertaining to values, employee behaviour, and perceived management behaviour are also listed in the same table. Among the 3 key variables, perceived management behaviour across the 3 employee population had the poorest composite scores. Further detailed examination of this observation is made in ***Sections 4.3.2.3.***

Effect of tenure within each employee population is shown in ***Table 4.6*** that lists the composite scores and standard deviation of the 3 survey factors by tenure group. Scores for senior employees with greater that 10 year service were observed to be better than those of the other groups. This is further examined in ***Section 4.3.3.***

Multiple regression of employee behaviour to values awareness and perceived management behaviour is shown in ***Table 4.7.*** Regression outputs provide evidence to explain employee behaviour arising from Total Quality Control values awareness and perceived management action in support of Total Quality Control. The analysis of the regression outputs is covered in ***Section 4.3.4.***

Table 4.4 1994 Allied-Signal Employee Profile

	Directs	Non-Exempts	Exempts
POPULATION	1164	279	222
SEX			
Male	5.7%	58.1%	84.5%
Female	94.3%	41.9%	15.5%
EYHNIC GROUP			
Chinese	36.3%	85.4%	89.4%
Malay	42.4%	9.4%	2.2%
India & Other	21.3%	5.2%	8.4%
EDUCATION			
Primary	52.1%.	6.2%	0.0%
Secondary	45.7%	46.3%	5.5%
A Level	0.1%	6.0%	4.8%
NTC / ITC	2.1%	3.9%	0.0%
Diploma	0.0%	37.6%	8.1%
Degree	0.0%	0.0%	81.6%
TENURE			
< 2 Yrs	24.7%	21.9%	43.6%
3-5 Yrs	8.3%	3.1%	16.7%
6-10 Yrs	7.8%	9.2%	11.3%
>10 Yrs	59.2%	65.9%	28.3%
AGE			
< 30Yrs	30.0%	21.2%	40.2%
30-39 Yrs	43.1%	37.9%	36.0%
40-49 Yrs	25.9%	37.8%	21.9%
>50 Yrs	1.0%	3.1%	1.9%

Note:
- Directs • Operators
- Non-Exempts • Clerical staffs and Technicians
- Exempts • Supervisors, Engineers, Professional Staff & Managers

Table 4.5 *Total Quality Control Survey Scores By Employee Population*

	Directs		Non-Exempts		Exempts	
No. Of Valid Responses	781		244		154	
Survey Questions	**Score**	**Std Dev**	**Score**	**Std Dev**	**Score**	**Std Dev**
Values Awareness						
Question 4	1.985	0.943	2.057	0.919	1.753	0.598
Question 7	2.015	0.875	2.369	0.891	2.084	0.855
Question 8	2.186	0.955	2.270	0.837	2.071	0.923
Question 17	2.149	0.913	2.250	0.769	2.240	0.856
Question 18	2.092	0.926	2.148	0.803	2.370	0.956
Composite	2.085	0.661	2.219	0.619	2.104	0.577
Employee Behaviour						
Question 6	2.056	0.963	2.291	0.876	2.156	0.894
Question 9	2.336	1.067	2.365	0.876	2.065	0.814
Question 12	2.191	0.986	2.447	0.990	2.513	0.985
Question 13	1.988	0.891	2.439	0.884	2.201	0.820
Question 19	2.232	0.984	2.393	0.875	1.929	0.668
Question 20	2.207	0.952	2.447	0.880	2.247	0.803
Composite	2.169	0.703	2.397	0.620	2.185	0.596
Perceived Management Behaviour						
Question 5	2.352	1.046	3.037	1.097	2.773	0.967
Question 10	2.262	1.058	2.676	1.045	2.474	0.998
Question 11	2.102	0.966	2.496	0.988	2.662	0.937
Question 14	2.032	0.847	2.402	0.881	2.513	0.895
Question 15	2.064	0.923	2.652	1.045	2.675	0.983
Question 16	2.305	0.998	2.697	0.892	2.701	0.964
Composite	2.186	0.682	2.660	0.716	2.633	0.690

Note:

1. Strongly Agree
2. Agree
3. Neither Agree Nor Disagree
4. Disagree
5. Strongly Disagree

Table 4.6 TQC Composite Scores Employee Tenure

Tenure (Years)	Responses (n)	Values Awareness		Employee Behaviour		Perceived Management Behaviour	
		Score	Std Dev	Score	Std Dev	Score	Std Dev
Directs:							
< 1	11	2.327	1.049	2.348	1.033	2.258	0.917
1-5	256	2.165	0.646	2.250	0.685	2.283	0.765
5-10	70	2.186	0.587	2.267	0.664	2.267	0.620
> 10	445	2.017	0.659	2.101	0.701	2.116	0.679
Non-Exempts							
< 1	8	2.575	0.751	2.417	0.391	2.708	0.217
1-5	46	2.365	0.691	2.493	0.657	2.707	0.776
5-10	32	2.388	0.485	2.490	0.356	2.880	0.573
>10	158	2.214	0.590	2.349	0.651	2.599	0.728
Exempts							
<1	10	2.360	0.332	2.33	0.597	2.617	0.460
1-5	67	2.173	0.560	2.249	0.585	2.823	0.684
5-10	23	2.287	0.583	2.297	0.518	2.826	0.666
> 10	54	1.893	0.559	2.049	0.611	2.318	0.616

Note:

1. Strongly Agree
2. Agree
3. Neither Agree Nor Disagree
4. Disagree
5. Strongly Disagree

	Directs	Non-Exempts	Exempts
R^2 - Correlation Coefficient Square	0.7380	0.7053	0.5649
M_1 - X_1 Regression Coefficient	0.3906	0.3886	0.3246
M_2 - X_2 Regression Coefficient	0.5669	0.4611	0.4297
C - Constant	0.1147	0.3082	0.3707
E_Y - Std Error of Estimate	0.3605	0.3380	0.3960
E_1 - Std Error of X Coefficient	0.029	0.046	0.078
E_2 - Std Error of X Coefficient	0.028	0.040	0.065

Independent Variable **X_1= Values Awareness**
Independent Variable **X_2 = Perceived Management Behaviour**
Dependent Variable **Y = Employee Behaviour**

Tables 4.7 Multiple Regression of Employee Behaviour to Value Awareness and Perceived Management Behaviour.

The Multiple Regression Analysis Results are shown in ***Appendix F.***

4.3.2. Analysis of Total Quality Control Survey Scores by Employee Population

Table 4.8 shows the summary of composite scores for the 3 employee groups and the One Way **ANOVA** results for the differences of the mean scores at the 1% significance level. The scores are graphically presented in ***Figure 4.5.***

The One Way Analysis of Variance **(ANOVA)** indicates that the mean scores for Total Quality Control Values Awareness are not different at the 1% significance level among the 3 employee populations. However, the mean scores for Expectant Employee Behaviour and Perceived Management Behaviour exhibited significant differences.

Factors		**Direct**	**Non-Exempts**	**Exempts**	**F Ratio**	**Diff. at 1% Significance**
	Sample Size	781	244	154		
Total Quality Control Values Awareness	Mean Std Dev	2.085 0.661	2.219 0.619	2.104 0.577	4.076	NO
Expectant Employee Behaviour	Mean Std Dev	2.169 0.703	2.397 0.620	2.185 0.596	10.87	YES
Perceived Mgmt Behaviour	Mean Std Dev	2.186 0.682	2.660 0.716	2.633 0.690	57.53	YES

Between Group Degree of Freedom (V1) = 2
Within Group Degree of Freedom (V2) = 1176
F Statistic at (2,1176) Degree of Freedom at 1% Significance = 4.61

Table 4.8 One Way ANOVA for Equality of Mean Scores among Employee Populations

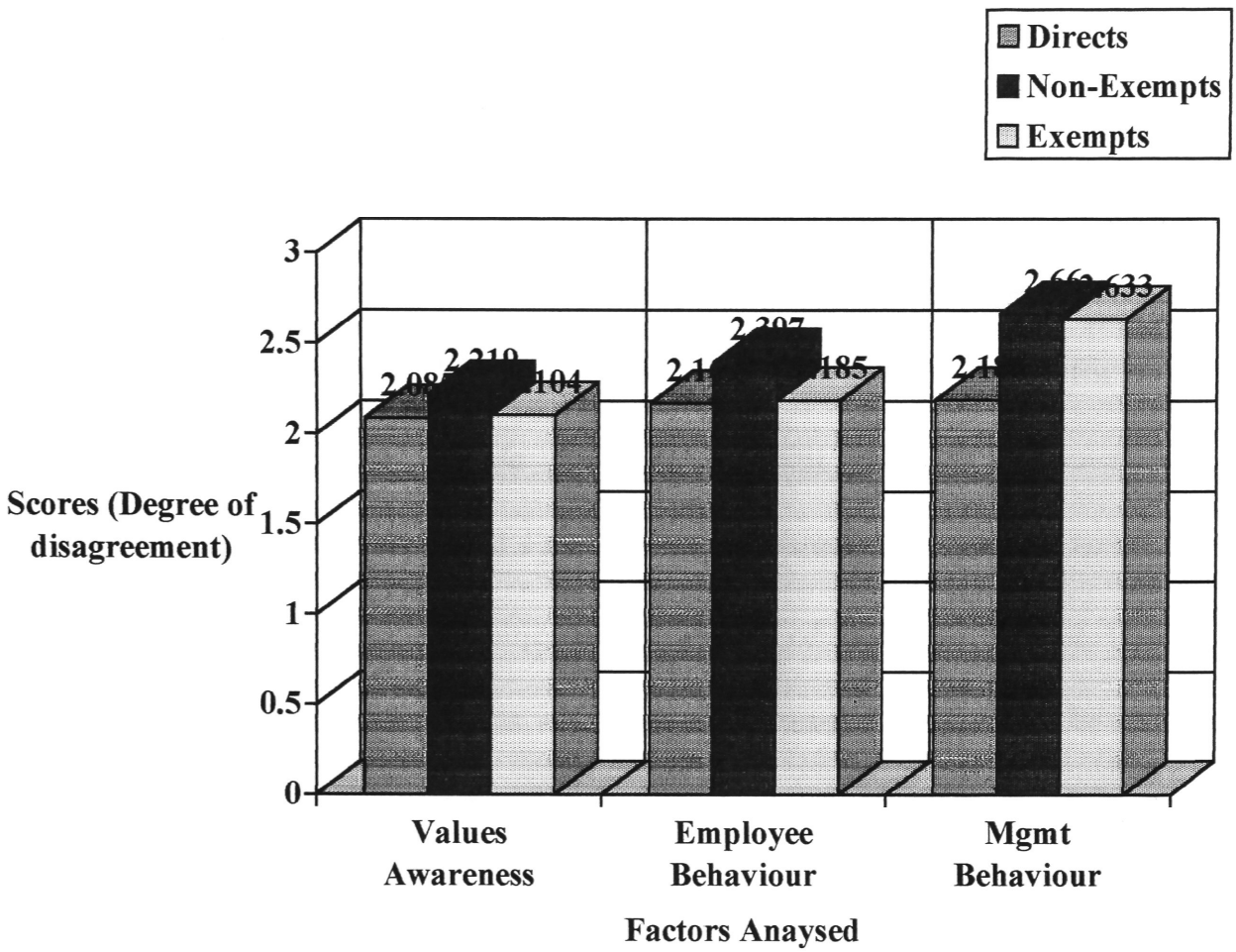

Figure 4.5 Total Quality Control Scores By Employee Population

4.3.2.1. Total Quality Control Values Awareness

The statistics on Total Quality Control values Awareness indicated that less than 10% of all employee disagree with, or lack comprehension of, the company Total Quality Control values as measured by the 5 survey question on

Values Awareness. The differences among the 3 employee populations, as shown in the first 3 bars in ***Figure 4.5*** although apparent were not significant. The results indicated that Total Quality Control Values Awareness was well-established among all 3 employee segments. The 'non-exempted' technicians and clerical staffs, however, had the poorest score. Detailed scores for the individual survey items in ***Table 4.4*** indicate their relative weakness in understanding how to apply Total Quality Control principles and the lack of awareness of Policy Deployment objectives. The lack of understanding of Total Quality Control application reflects on the lack of team participation by this employee segment . Allied-Signal Quality Improvement Team effort is directed at 'exempt' employees while the Effectiveness Team effort has predominantly been targeted at the 'direct' employees. The lack of awareness of Policy Deployment objectives is due to the fact that the Policy Deployment process currently stops at the 'exempt' level.

4.3.2.2. Expectant Employee Behaviour

The statistics on Expectant Employee Behaviour for Total Quality Control indicate differences in employee behaviour among the 3 employee populations, as evident in the Employee Behaviour bar charts of ***Figure 4.5***. 17%, 12% and 8.5% of 'non-exempt', 'direct' and 'exempt' employees respectively, indicated

disagreement to expectant behaviour in support of Total Quality Control. Again, the 'non-exempt' technician and clerical staffs had the least percentage of favourable responses. Detailed scores for the individual survey items ***Table 4.5*** indicate their weaknesses in perceiving cross functional teamwork, in measurement for continuous improvement and in application of Total Quality Control principles in their work. Again the lack of promotion of 'non-exempt' employees in quality team participation might account for the relatively poorer scores in these areas. In addition opportunities for natural work group team activities for clerical function employees is by design, lacking. Departmental secretaries and clerks have little group interaction as they support functional managers individually rather that in a central pool system.

4.3.2.3. Perceived Management Behaviour

The statistics on Perceived Management Behaviour for Total Quality Control also indicated significant differences in perception of managerial support among the 3 employee populations. The "directs" perceived significantly better management behaviour than the "exempts" and 'non-exempts'. The 'non-exempts 'again had the worst score among the 3 employee populations. The 'exempts' score for this factor was however not significantly different from that of the 'non-exempts'. The scores translate to 31.8% and 11.6% unfavourable

responses for the 'non-exempts' 'exempts', and 'directs' respectively, and is exemplified in the Management Behaviour bar charts in ***Figure 4.5***.

Detailed scores for the individual survey items ***Table 4.5*** revealed 2 items of management support that were perceived to be lacking especially for the 'non-exempts' and 'exempts'. The poor scores for the item pertaining to receiving feedback on how employees are meeting customer expectations indicate the lack of a formal system to effectively administer customer feedback. The poor scores for the item pertaining to adequate allocation of time to apply Total Quality Control was likely to be a reflection of the heavy workload situation that employees perceived. Limits imposed on the staffing level of indirect workforce, as part of the company's cost reduction effort since 1993, compounded the issue for 'non-exempts' and 'exempts ' employees.

Common to all 3 employee populations, scores on the Total Quality Control value of Awareness was better than on the value of Expectant Employee Behaviour which in turn was better than on the value of Perceived Behaviour. It is apparent that Perceived Management Behaviour should be the focus of attention for further improvement in Total Quality Control establishment.

4.3.3. Effect Of Tenure On Survey Scores

Employees within each of the 3 populations were classified into 4 tenure groups: less that 1 year; between 1 and 5 years; between 5 and 10 year; and greater than 10 year service. The distribution and detailed scores for each category are as shown in ***Table 4.6***. ***Table 4.9*** shows the summary of F Ratio statistics and the One way ANOVA results for the differences in mean scores among each tenure group at the 1% significance level.

	Directs		**Non-Exempts**		**Exempts**	
Factors	F Ratio	Diff at 1% Sig	F Ratio	Diff. at 1% Sig	F Ratio	Diff. at 1% Sig
Values Awareness	3.92	YES	1.91	NO	4.54	YES
Employee Behaviour	3.26	NO	0.94	NO	1.54	NO
Perceived Management Behaviour	3.72	NO	1.49	NO	6.89	YES

Between Group Degree of Freedom (V1) = 3
Within Group Degree of Freedom for Directs (V2) = 777
Within Group Degree of Freedom for Non-Exempts (V3) = 240
Within Group Degree of freedom for Exempts (V4) = 150
F Statistic at (3.>120) Degree of Freedom at 1% significance = 3.78

Table 4.9 One Way ANOVA Results for Equality of Mean Scores Among Tenure Groups

4.3.3.1. Values Awareness by Tenure

Figure 4.6 shows the mean scores of Values Awareness by tenure groups for the 3 employee populations.

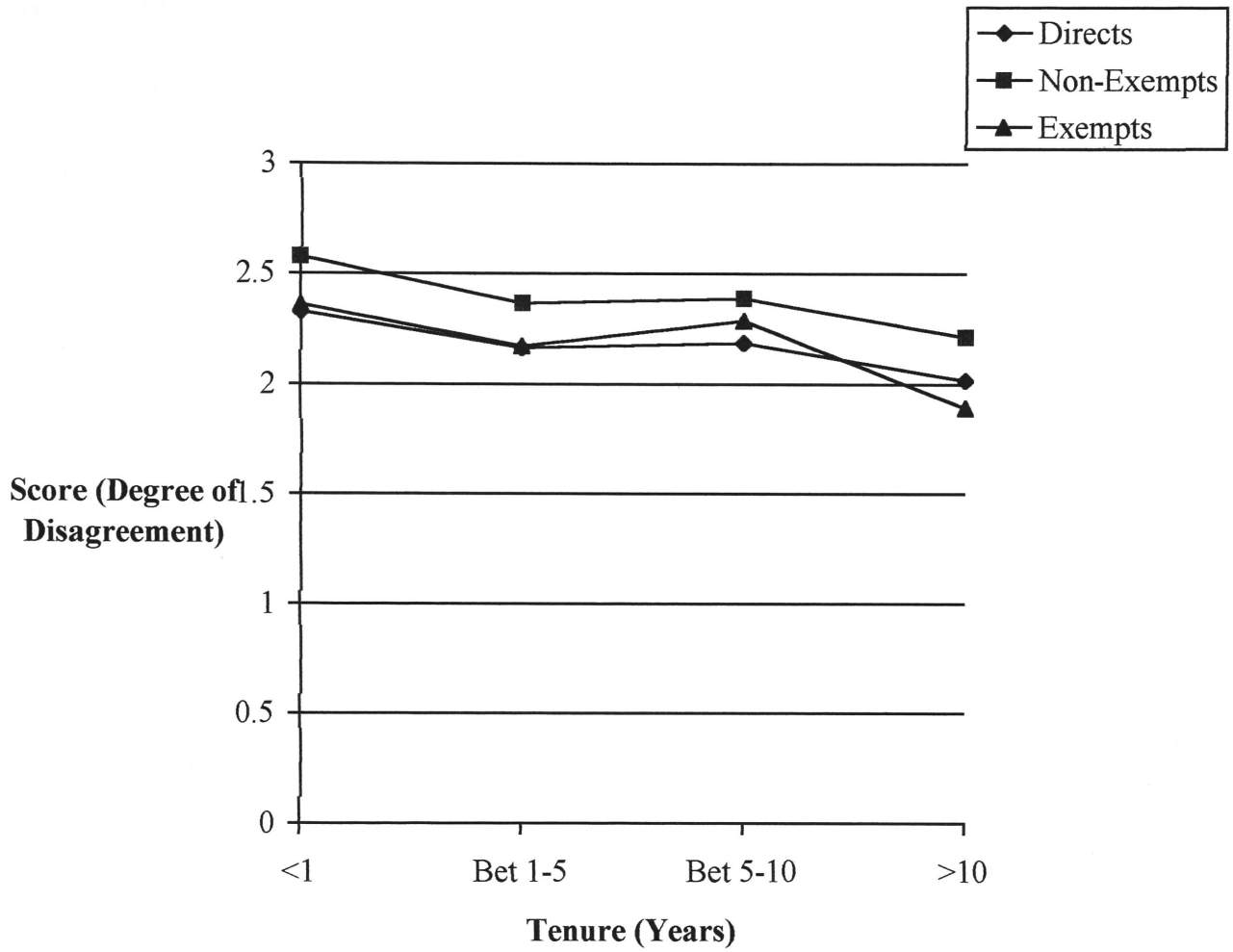

Figure 4.6 Values Awareness By Employee Tenure

The One Way ANOVA results indicate significant differences in mean scores of Values Awareness for the 'direct' and 'exempt' employees, but not the 'non-exempt' employees. The scores indicate that employees with > 10 years service had the best score among the 4 tenure groups, while employees with <1 year tenure had the poorest score.

The poorer score registered by new employees with < 1 year tenureship was likely to be the result of lack of exposure to the Total Quality Control concepts and practices. It was possible that a significant proportion of these employees have no Total Quality Control training and little team participation experiences given the short association with the company.

The significantly better score registered by the older employees with > 10 years experience was likely to be due to 2 factors. Firstly the greater exposure to Total Quality Control concepts, practices and supporting systems established since the early 1980's. Secondly the higher tendency of such employees to identify with the company's values, similar to the positive correlation seen between tenure and commitment. Employees who have a lower tendency to accept changes with the company's policies or values invariably would have been attrited over time.

4.3.3.2. Employee Behaviour by Tenure

Figure 4.7 shows the mean scores of Employee Behaviour by tenure groups for the 3 employee populations.

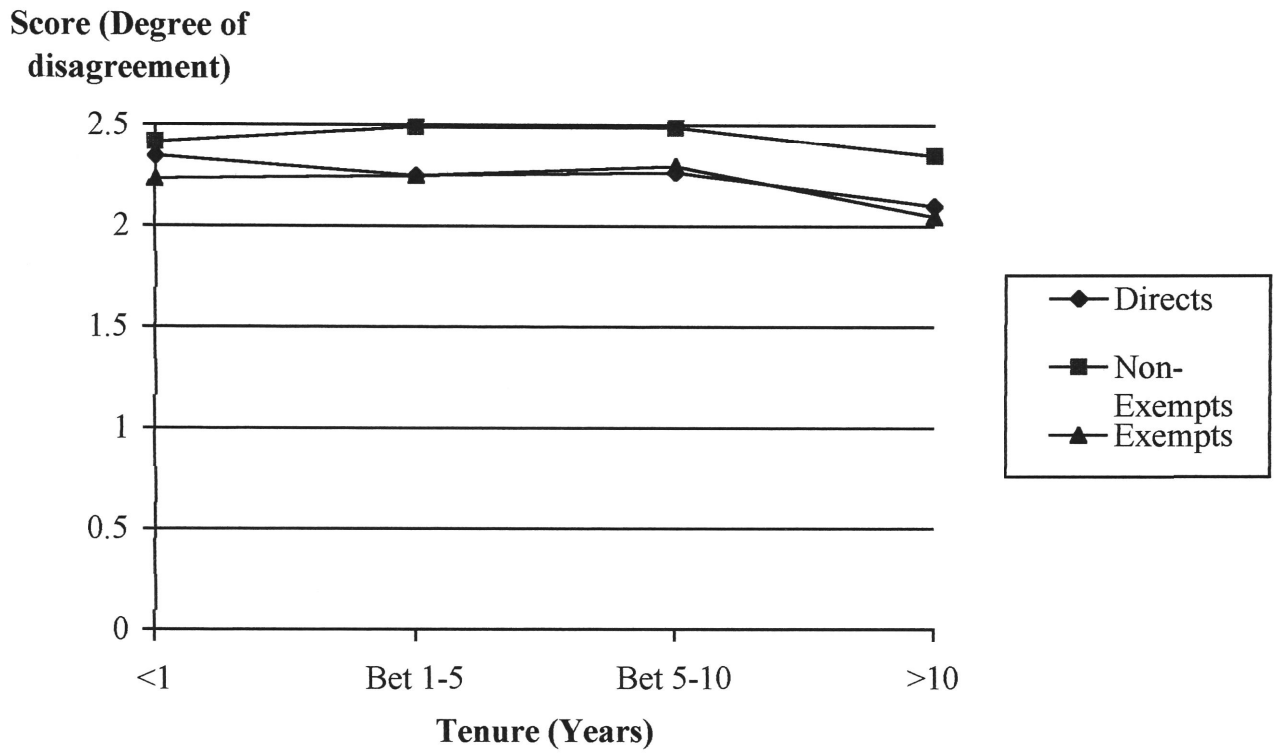

Figure 4.7 Employee Behaviour By Employee Tenure

The one way ANOVA results did not indicate significant differences in the mean scores of Employee Behaviour for all 3 employee segments. Tenure was therefore not a significant moderator to the expectant employee Total Quality

Control behaviour. However, the data again revealed that employees with > 10 years service had significantly better scores than the other tenure groups. Although for all 3 employee populations, employees with >10 years tenure exhibited higher scores than other tenure groups. The group with the poorest score was different for each of them.

4.3.3.3. Perceived Management Behaviour by Tenure

Figure 4.8 shows the mean scores of Perceived management Behaviour by tenure group for the 3 employee populations.

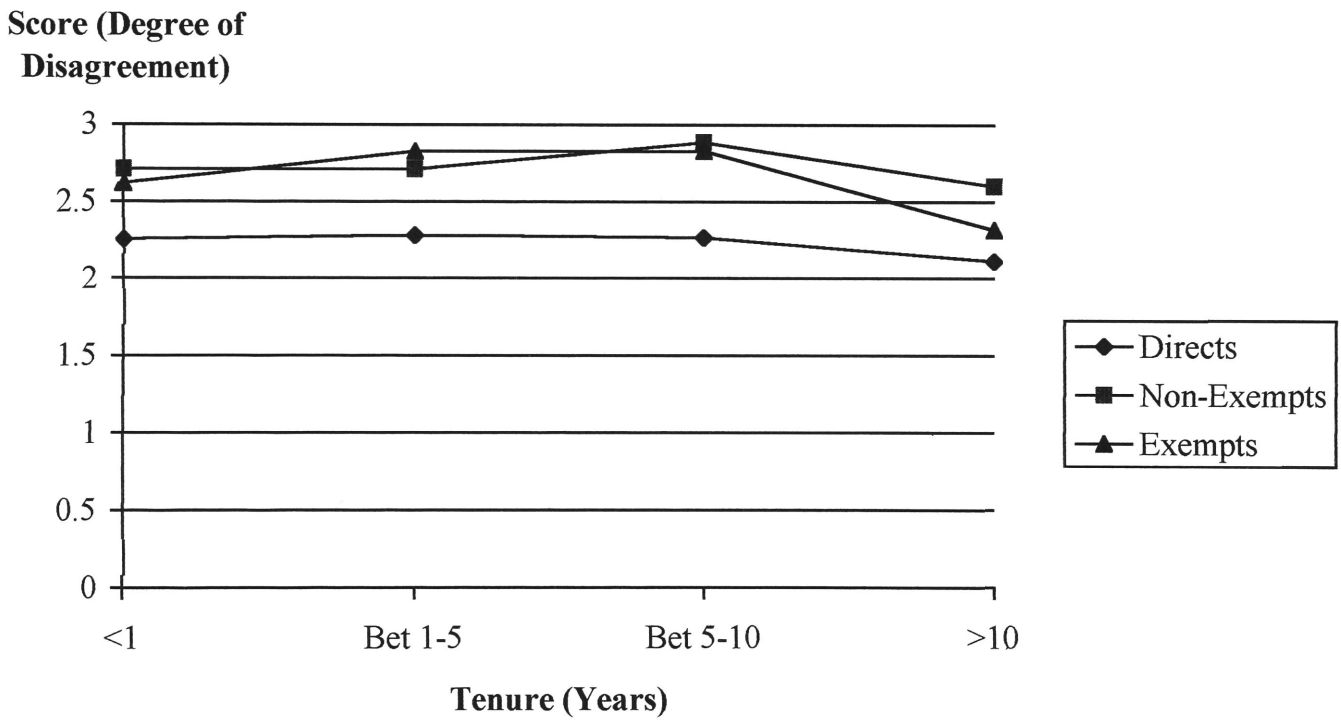

Figure 4.8 Management Behaviour By Employee Tenure

One Way ANOVA results showed significant differences in Perceived Management Behaviour only for the 'exempt' population. This then suggests that tenure was not a significant moderator to Perceived Management Behaviour for the majority of employees.

For the 'exempts' the score for employee with >10 years service was significantly better than the other 3 tenure groups, similar to the results seen for Values Awareness and Expectant Employee Behaviour. Excluding this tenure group, the differences in scores among the remaining 3 tenure groups became less apparent. In fact the scores for Perceived Management Behaviour resembles the scores for Employee Behaviour for the 'non-exempts' and 'directs' in that degradation of scores with tenureship was evident for employees with <10 years service.

The results for the 'exempts' where employees with >10 years service had significantly better scores was likely to be due to the inclusion of managers, the majority of whom have >10 year service within this group. The inclusion of managers' scores for this factor which measures management's performance was likely to have biased the score favourably. Overall, the results suggested that other factors, such as the retrenchment of workers in 1994 and the other

cost reduction measures, were of greater influence to Perceived Management Behaviour.

4.3.4. Multiple Regression Analysis

Multiple regression analysis with Employee Behaviours the dependent variable and Values Awareness and Perceived Management Behaviour as the 2 independent variables produce the results summarised in ***Table 4.10*** below.

	Regression Outputs	**Directs**	**Non-Exempts**	**Exempts**
R^2 -	Coefficient of Determination	0.7380	0.7053	0.5649
R -	Correlation Coefficient	0.8544	0.8398	0.7516
M_1 -	Value Awareness Regression Coefficient	0.3906	0.3886	03246
M_2 -	Perceived Management Behaviour Regression Coefficient	0.5669	0.4611	0.4297

Table 4.10 Summary of Multiple Regression Outputs Employee Behaviour to Values Awareness and Perceived Management Behaviour

For the 'directs' the coefficient of determination R^2 of 0.7380 showed that 73.8% of the variability in Employee Behaviour scores was explained by the

linear association to Total Quality Control Values Awareness and Perceived Management Behaviour. This was relatively higher than for the 'non-exempts' (R^2 of 0.7053) and significantly greater that for the 'exempts' (R^2 of 0.5649).

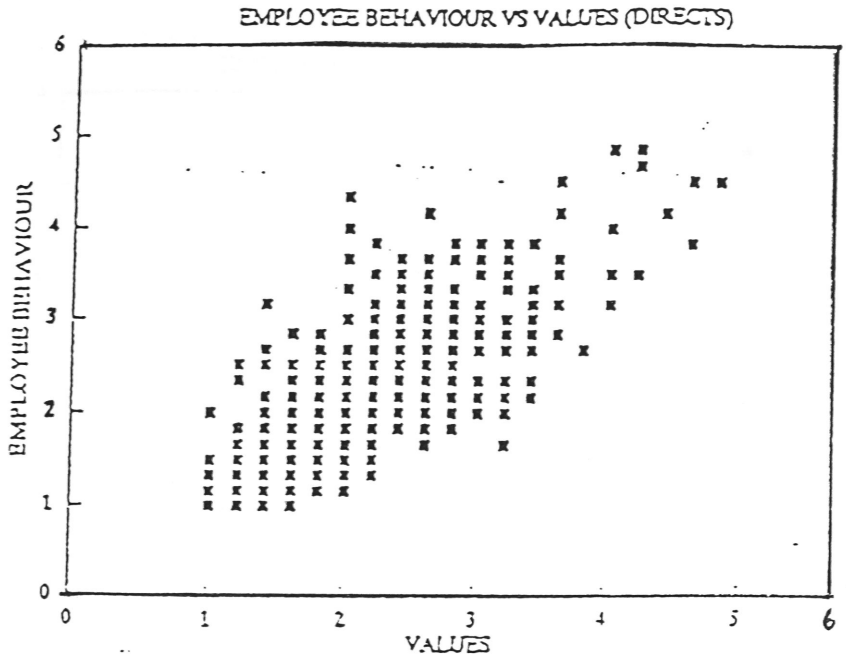

Figure 4.9 Employee Behaviour VS. Values (Directs)

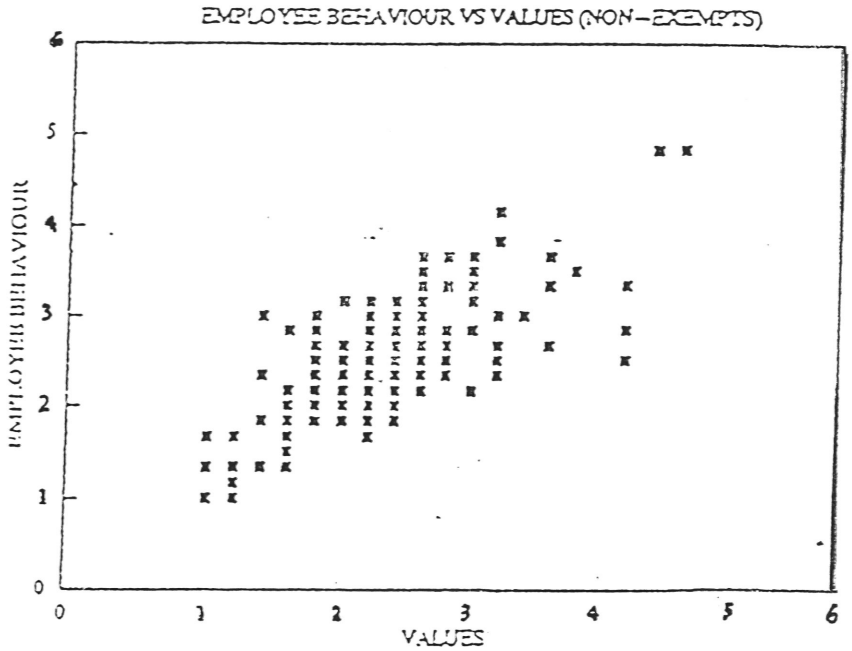

Figure 4.10 Employee Behaviour VS. Values (Non-Exempts)

Scatter Plots Of Employee behaviour vs. Values vs. Management Behaviour

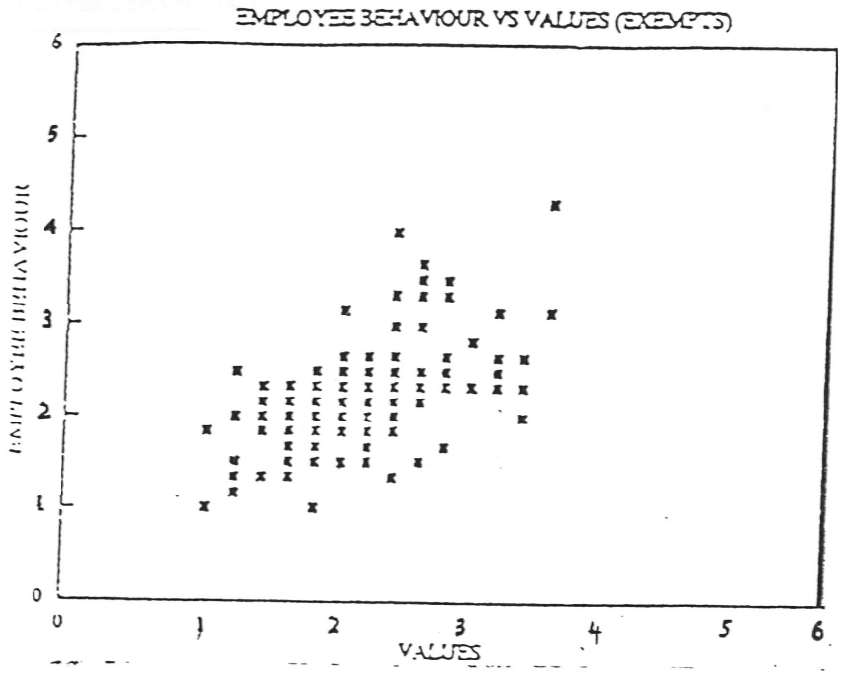

Figure 4.11 Employee Behaviour VS. Values (Exempts)

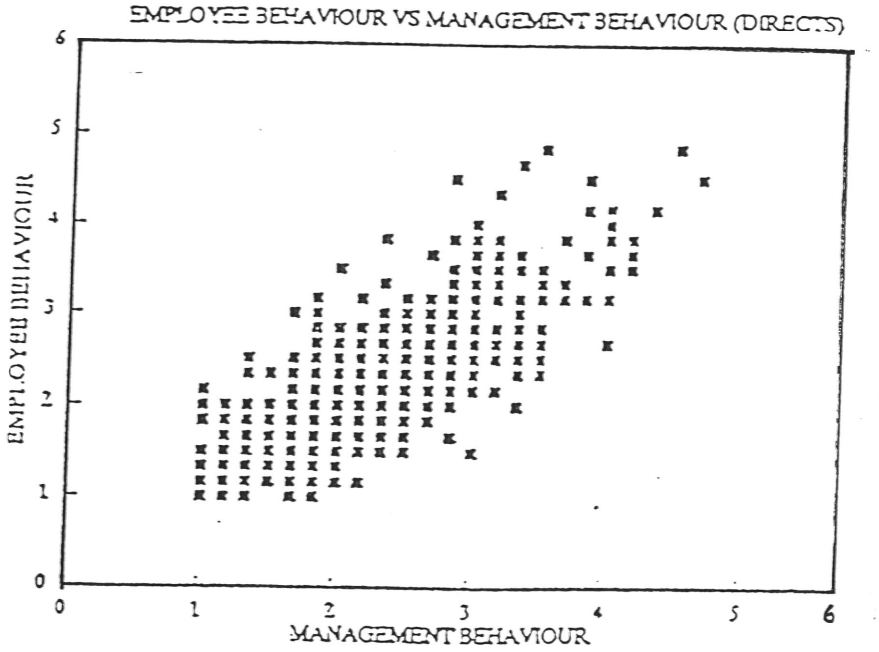

Figure 4.12 Employee Behaviour VS. Management Behaviour (Directs)

Scatter Plots Of Employee behaviour vs. Values vs. Management Behaviour

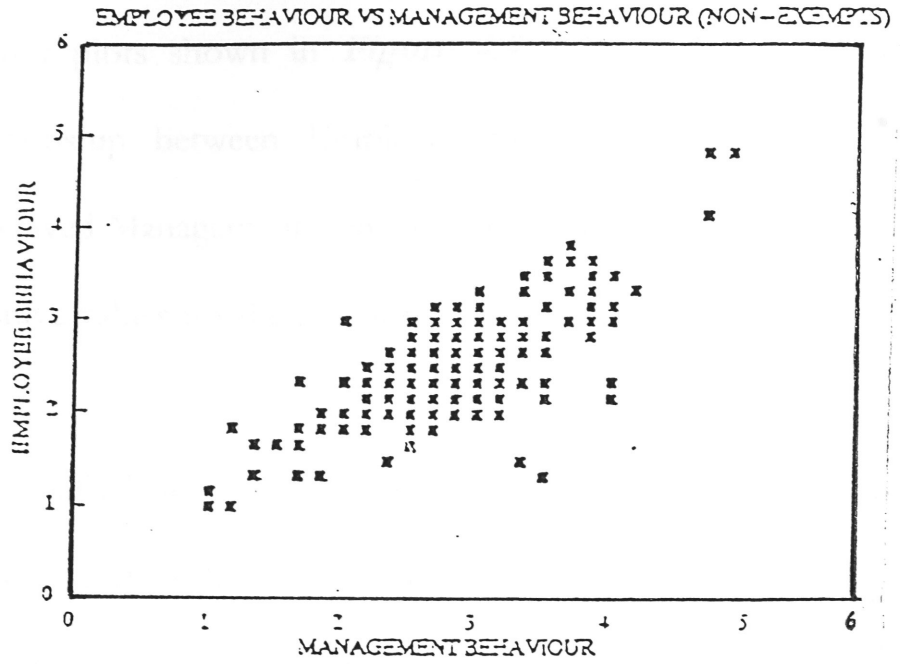

Figure 4.13 Employee Behaviour VS. Management Behaviour (Non-Exempts)

Figure 4.14 Employee Behaviour VS. Management Behaviour (Exempts)

Scatter Plots Of Employee behaviour vs. Values vs. Management Behaviour

Scatter plots shown in ***Figure 4.9*** through ***Figure 4.14*** indicate that the relationship between Employee Behaviour to Values Awareness and to Perceived Management Behaviour were positive. This was also reflected in the positive values for the partial regression coefficients.

The coefficients of determination translated to correlation coefficients of 0.86, 0.84 and 0.75 for the 'directs' 'non-exempts' and 'exempts" respectively, indicating a strong positive relationship of Employee Behaviour to Values Awareness and to Perceived Management Behaviour.

The partial regression coefficients for Perceived management were higher than that for Values Awareness for all 3 employee populations. This implied that the influence of management behaviour was stronger than the awareness of values. This result is consistent with the views of Atkinson (1990) and Beers (1988), that management commitment to quality as demonstrated by 'deeds" rather than by 'words' and quality leadership by examples is the vital success factor for Total Quality Management establishment.

The multiple regression analysis results provided strong evidence for the antecedent that Employees with high Total Quality Control value awareness

and who perceived a higher degree of expectant management behaviour are more likely to exhibit expectant Total Quality Control behaviour. Furthermore, the results indicated that the influence from Perceived Management Behaviour was stronger than Total Quality Control Values Awareness in determining Expectant employee Behaviour.

CHAPTER 5.CONCLUSIONS AND RECOMMENDATIONS

5.1. CONCLUSIONS FROM THE CASE STUDY

"Total Quality Control is no panacea. But thoughtfully applied and modified, total quality's principles still represent a sound way to run a company." Those who learn to implement it properly will truly reap the benefits of quality, justify the huge amounts of money invested on it, and prove that Total Quality Control is not just another expensive, unproductive quality fad. The main conclusions drawn from the case analysis for the establishment of Total Quality Control in Allied-Signal are as follows:

a) Total Quality Control Concepts

Allied-Signal's Total Quality Control concept, although having strong content coverage for 3 of the 4 established Total Quality Management core values viz. customer satisfaction. Employee Involvement and Continuous Improvement, is however not directly aligned to the established terms of Total Quality Control core values which are more definitive and encompassing in generic values than those terms employed by the Company. Furthermore the value of Management Commitment to Quality is only implied rather than explicitly specified, leading to possible ambiguity of management's leadership in this effort.

Allied-Signal's Total Quality Control program and supporting systems show presence of activities in all 8 critical Total Quality Management success factors established by Saraph et al (1989), but adequacy of each factor has yet to be quantified, without which improvement action items cannot be effectively defined nor prioritised.

b) Influence On Employee Behaviours and Commitment

Allied-Signal's Total Quality Control effort has had positive influence on employee attitudes towards Employee Involvement and Company Commitment but has had no influence on Management Commitment to Quality and Continuous Improvement based on the relevant dimensions surveyed.

Allied-Signal Total Quality Control influence on employees' attitudes towards core values of Total Quality Control is likely to have been eroded by the parallel and strong emphasis on cost reduction and return-to-profitability actions that would explain the adverse 1994 attitude survey results. The Total Quality Control effort if not aligned to the Company's critical needs is likely to result in employees perceiving conflict of priorities.

c) Focus of Attention

Allied-Signal employees registered higher scores on Total Quality Control Values Awareness than on Expectant Employee Behaviour and had poorer scores on Perceived Management behaviour. Percent of unfavourable responses for these 3 Total Quality Control factors surveyed were 8.1%, 12.4% and 28.7% respectively. This highlights to the management of the Allied-Signal that Perceived Management Behaviour in support of Total Quality Control should be the focus of attention.

No questions were found to be related to determining the employee's attitude towards the value of customer satisfaction; a value not emphasised prior to the adoption of the Total Quality Control operating philosophy. This variable was therefore excluded from the analysis. Three questions were related to quality commitment, 2 questions were related to continuous improvement, 9 questions were related to employee involvement, and 2 questions were related to company commitment. The 16 questions are listed in ***Appendix E.***

One way ANOVA of the Total Quality Control survey mean scores show differences in Total Quality Control awareness, behaviour and perception of management behaviour among the 3 employee populations. The "directs"

consistently had the best results for all 3 Total Quality Control factors while the "non-exempts" clerical staffs and technician population consistently had the worst results indicating a need to focus attention on this segment of the population.

The effect of tenure was positive for Total Quality Control Values Awareness but less apparent for Employee Behaviour and Perceived Management Behaviour. However employees with >10 years service consistently gave more favourable responses in all 3 Total Quality Control factors across all 3 employee populations, suggesting the benefit of having long service employees towards Total Quality Control establishment.

Regression analysis provided strong evidence that showed that employees with high Total Quality Control values awareness and who perceived a higher degree of expectant Total Quality Control behaviours. Furthermore Perceived Management Total Quality Control behaviours had stronger influences than Total Quality Control Values Awareness on Employee Total Quality Control Behaviour. This is consistent with literary works that maintained that exemplary management quality leadership as demonstrated by deeds is the vital critical success factor for Total Quality Management establishment.

5.2. RECOMMENDATIONS FOR THE COMPANY

Some recommendations that are made for Allied-Signal include:

a) Total Quality Control Concepts

Align Allied-Signal's Total Quality Control concepts with established Total Quality Management core values by explicitly specifying "Management Commitment to Quality" as a cornerstone, substituting "Operational Excellence" by "Continuous Quality Improvement", and "Teamwork" by "Employee Involvement."

To combine "Policy Deployment" and "Management By Fact" into a cornerstone of "Quality Systems". This should encompass structural elements for execution of Total Quality Control, such as policy deployment, accreditation to quality standards and the set of statistical-scientific methods and tools to process data factually.

Quantify the inadequacies of Total Quality Management critical success factors by use of Malcolm Baldrige Award type assessment as was done by its parent division in the United States. They find that applying the Malcolm Baldrige is a highly enriching and education process. This is because during the evaluation

process, they are made to look critically at their internal quality management processes and more importantly, the areas for improvement. Applying for the award will thus be an invaluable learning process for Allied-Signal Singapore, helping them to fine-tune their company's quality management system and foster a quality culture throughout their organization. (The Malcolm Baldrige Award assessment is a 32 criteria, point scoring, total quality audit instrument developed by the American National Institute of Standards Technology).

b) Influence On Employee Behaviour & Commitment

Continue to raise participation levels in quality teams given the positive correlation of improved organisational commitments to QCC activities established by Foo (1989).

Meet the training and education expectations of employees to improve attitudes on Continuous Improvement. Allied-Signal needs to identify its education and training needs to support the organization's objectives and the employee's development. They also need to implement the system to review the employee's education, training and development plans and demonstrate the trends in the education and training of staff. They need to address more in these areas.

Align Allied-Signal's Total Quality Control programs to the company's critical needs viz. improving customer satisfaction, reducing cost and maximising output while ensuring employees understand that quality improvements in these areas do not contradict Total Quality Control practices.

c) Focus of Attention

The case findings clearly identify that while Perceived Management Total Quality Control Behaviour is the most influential factor to determining expectant employee Total Quality Control behaviour, it is at the same time the weakest link in the company's Total Quality Control effort. Recommendations for improvement include developing formal systems to facilitate execution of stated expectant management roles in promoting Total Quality Control. While "what to do" is specified, the "how to do" aspect of fulfilling management roles is lacking. Areas of attention include internal customer quality performance feedback, recognition for matrix team leaders, performance reviews based on Total Quality Control attitudes and continuous improvement indices for every employee. Also measure and reward management performance based on "quality deeds" accomplishment.

The "non-exempt" population's distinct weakness in Total Quality Control values awareness, expectant Total Quality Control behaviour and perceived management Total Quality Control behaviour, suggests structural weakness within the organization that limits Total Quality Management establishment for this employee segment. This can be addressed by promoting technician participation in the voluntary effectiveness team, in the organised Total Productive Maintenance Teams and Quality Improvement Teams. Further extend Policy Deployment down to the "non-exempt" work teams to acknowledge their capability to contribute to critical operational objectives. Also, dedicate facilitators to support and promote clerical team activities, to offset the limited work group interaction opportunities of clerical staffs.

d) Total Quality Control Survey

The case analysis revealed various shortcomings in the survey instruments in use by the company. The following improvements are recommended, in order to draw maximum benefit from its use.

1) Integrate the Attitude Survey with the Total Quality Control Survey since Total Quality Control is the accepted operating philosophy.

2) Establish the reliability and validity of the combined instrument to eliminate ambiguity. Borrow from established and tested constructs such as Porter et al's (1970) commitment scale.

3) Develop a more comprehensive personal factor matrix that includes age, educational level, language proficiency, sex, quality training exposures and quality team experiences for better personal factors to Total Quality Control analysis.

4) Analyse the survey results quantitatively to draw maximum benefits.

5) Conduct a separate survey for managers.

5.3. IMPLICATIONS OF THE STUDY

Drawing from the company's experience in implementing Total Quality Control, the following lessons are relevant for companies intending to embark on Total Quality Control. While some lessons have only case specific application values, most of the lessons listed have generic relevance:

GENERIC APPLICATIONS

1) The need for Total Quality Control must be clearly identified in order to mobilise the employees for change. The top management must focus their attention on creating clarity and commitment to the organization's

direction. They must create a vision of organizational greatness and then inspire the employees to achieve it. This is not only the secret ingredient in leadership, it is also the key to managing change.

2) Demonstrating management commitment to quality by deeds is critical to influence expectant employee behaviours and to establishing effective Total Quality Control. By setting appropriate values top management can influence people throughout the organization. Top management accepts ownership and provides constancy of purpose. Their ownership ensures personal, active involvement and responsibility. By adopting the principles inherent in Total Quality Management, they change the way they manage and, therefore, they change their own behavioural patterns. Top management who accomplish this naturally lead the Company to adopt the same management philosophy by promoting a value system and by setting an example.

3) Once the organization has implemented its strategies and objectives and has begun to develop a new culture, it is important to assess whether the organization is moving in the desired direction. Putting key strategic

measures in place and checking progress can go a long way to keeping the organization moving toward its purpose.

4) Profiling of workforce by personal factors such as language proficiency, quality training exposures and job status is important. This will ensure appropriate communication and facilitation of Total Quality Control activities. It is unlikely that a single Total Quality Control package will work well for all segments of employees.

SPECIFIC APPLICATIONS:

1) Detailed preparation to ensure adequate and relevant Total Quality Control content as well as an appropriate implementation process is needed. Consultancy help is useful. They can consult on quality or on other managerial concerns, such as:

   ⇒ Overcoming mind sets.

   ⇒ Facilitating cultural change.

   ⇒ Deal with the mind-set that quality begins when production begins. In reality, quality begins when the product and its manufacturing process are being designed.

⇒ Being catalysts, not commanders. To help employees create their own solutions, systems, and concepts. In doing so, the employees will work hard to make them succeed because they are the originators or owners of those solutions, systems, and concepts.

2) Total Quality Control must be aligned to the company's critical path to avoid conflicts of priorities perceived by employees. Establishing Total Quality Management while turning around an adverse business performance situation is all the more difficult. It is advisable to institute Total Quality Management while business performance is still healthy.

3) For a multi-national company, corporate designed Total Quality Control programs should be further tailored to suit the local subsidiary's business priorities as well as the local workforce profile, before implementation. They should not negate the uniqueness of the local subsidiary's business by adopting an off-the-shelf quality program from the corporate. In all organizations, they work with people from a diversity of background. Thus, building the cross-cultural skills for handling this diversity is important.

4) Language and medium of Total Quality Control instruction are important considerations given our multilingual workforce; and

5) Bi-Yearly Quantitative surveys are useful to help measure the organization's progress to change towards a Total Quality Control culture. The surveys serve two important functions:-

   a) It is useful in diagnosing the source or cause of large, abrupt changes. They serve as an improvement tool.

   b) They serve as an effective communication tool. They facilitate dialogue between managers and employees.

5.4. SUGGESTIONS FOR FUTURE RESEARCH

Although the Total Quality Management concept has been around for about two decades, its application is still relatively new in Singapore. More researchers are encouraged to investigate the state of Total Quality Management application in Singapore. It will be very beneficial to employers and managers in Singapore to understand the differences and similarities that Singapore has with both Japan and America (with regards to Total Quality Management applications in Japanese and American companies operating in Singapore and

what had to be modified to successfully implement Total Quality Management in these Singapore operations.

Another interesting study is to research if Total Quality Management can help, and/or, be adopted by Singapore-owned companies. Further study based on personal factor dimensions such as language proficiency, quality training exposures and quality team experience which was lacking in this study should provide better insights in Total Quality Management implementation effectiveness. We must understand that by using an inappropriate language can hinder creativity in problem-solving.

Another area of investigation that will help understand the establishment of Total Quality Management is in the effect of intrinsic versus extrinsic motivation in promoting Total Quality Management values. To place greater emphasis on intrinsic motivation in particular career development seems to be of great importance and attention must therefore be paid to delegation, challenge, training and development. In addition, the extrinsic motivation such as monetary rewards, gifts, tokens or vouchers critical in sustaining Total Quality Management interests for shop floor employees, would be a relevant question for many a company to answer.

Appendix A. Total Quality Management Critical Success Factors Quality Management

	Critical Factor of Quality Management	Explanation of the Factor
1	**Divisional top management leadership for quality**	Acceptance of quality responsibility by General Manager and Department Heads. Evaluation of management on quality. The degree of participation by management in quality improvement efforts. Specificity of quality goals. Importance attached to quality in relation to cost and schedule. Comprehensive quality planning.
2	**Role or the quality department**	Visibility and autonomy of the quality department. The quality department's access to top management. Use of quality staff for consultation. Co-ordination between quality department and other departments. Effectiveness of the quality department.
3	**Training**	Extent of statistical training, trade training, and quality-related training for all employees.
4	**Product/ Service design**	An in-depth understanding of customer requirements. Thorough scrub-down process, extensive involvement of all affected departments in design reviews, emphasis on producibility, clarity of specifications, emphasis on quality-not roll-out schedule and avoidance of frequent redesigns.

5	**Supplier quality management**	Fewer dependable suppliers reliance on supplier process control, strong interdependence. Purchasing policy emphasizing quality rather that price. Supplier participation in quality control and product design.
6	**Process management**	Clarity of process ownership. Boundaries and steps: less reliance on inspection. Use of statistical process control. Selective automation. "Fool-proof" process design. Preventative maintenance, employee self-inspection. Automated testing. Effective management of customer contact.
7	**Quality data and reporting**	Use of cost of quality data, feedback of quality data to employees and managers for problem solving, timely quality measurement. Evaluation of managers and employees based on quality. Customer perceptions of quality.
8	**Employee relations**	Implementation of employee involvement and quality circles, open employee participation in quality decisions. Responsibility of employees for quality, employee recognition for superior quality performance, effectiveness of supervision in handling quality issues on-going quality awareness by all employees.

(Source: Saraph et al (1989), " An Instrument for Measuring the Critical Success Factors (CSFs) of Quality Management.)

APPENDIX B. Allied-Signal Attitude Survey Questionnaire

1. Job Grade : (please circle only one category)

Production & Maintenance	Administration	Technical	Front End	Exempt Supervisor	Exempt Individual Contribution
1-13	52-62	70-78	83-87	22-30+	22-30+
1	2	3	4	5	6

2. Years of Service at Allied-Signal: (please circle only one response)

Less than 1	Greater than 1 and less that 5	Greater than 5 and less than 10	10 and more
1	2	3	4

3. Shift: (please circle only one choice)

Shift A	Shift B	Shift C	Shift D
1	2	3	4

5. There is enough co-operation among the people I work with.

Agree	Disagree
1	2

13. I have as much freedom as I need to do my job well.

Agree	Disagree
1	2

14. I feel free to tell my immediate supervisor what I think.

Agree	Disagree
1	2

17. During the past year, I have not applied for another job outside Allied-Signal.

Agree	Disagree
1	2

21. **Allied-Signal is a good company to work for.**

Agree	Disagree
1	2

23. **Management is concerned with improving the quality of Allied-Signal products and service.**

Agree	Disagree
1	2

24. **I received adequate training for my present job.**

Agree	Disagree
1	2

25. **In Allied-Signal, my work group each other to do a better job.**

Agree	Disagree
1	2

26. **My supervisor and I talk with each other as often as necessary about job related problems.**

Agree	Disagree
1	2

27. **My supervisor stresses quality as an important factor in doing my job.**

Agree	Disagree
1	2

34. **I take pride in the results produced by my work group.**

Agree	Disagree
1	2

35. **My supervisor listens to my suggestions about how work should be done.**

Agree	Disagree
1	2

37. **Management is interested in the opinions and thinking of people who work here.**

Agree	Disagree
1	2

44. **Training is available to employees to help them get ahead.**

Agree	Disagree
1	2

49. **The materials provided for me are adequate to produce quality work.**

Agree	Disagree
1	2

54. **There is not a great deal of friction between the people I work with.**

Agree	Disagree
1	2

APPENDIX C. Allied-Signal Total Quality Control Survey Form

ALLIED-SIGNAL TOTAL QUALITY CONTROL SURVEY

The purpose of this survey is to get your input on the use of Total Quality Control in the Aerospace Division of Allied-Signal Aerospace.

1. **Job Grade : (please circle only one category)**	Administration	Technical	Front End	Exempt Supervisor	Exempt Individual Contribution
Production & Maintenance 1-13	52-62	70-78	83-87	22-30+	22-30+
1	**2**	**3**	**4**	**5**	**6**

2. Years of Service at Allied-Signal: (please circle only one response)

Less than 1	Greater than 1 and less that 5	Greater than 5 and less than 10	10 and more
1	**2**	**3**	**4**

3. Shift: (please circle only one choice)

Shift A	Shift B	Shift C	Shift D
1	**2**	**3**	**4**

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
4. It is clean to me who customers are (internal and/or external)	**1**	**2**	**3**	**4**	**5**
5. I regularly receive feedback on how well I am meeting my customers' expectations.	**1**	**2**	**3**	**4**	**5**
6. My work group is taking steps to achieve a higher level of customer satisfaction.	**1**	**2**	**3**	**4**	**5**

7.	I understand how to apply the principles of Total Quality Control to my specific job function.	1	2	3	4	5
8.	I am aware of the policy deployment objectives of my organization.	1	2	3	4	5
9.	I am able to take action as required to improve the quality of processes, products or services provided by my work group.	1	2	3	4	5
10.	Employees in my work group are recognised for producing high quality work (products, processes or services.)	1	2	3	4	5
11.	The effective use of Total Quality Control is an important part of my performance review.	1	2	3	4	5
12.	People from different organizations work together to satisfy customer needs.	1	2	3	4	5
13.	I am making use of Total Quality Control principles in my own work group.	1	2	3	4	5
14.	Overall the working environment at Allied-Signal is conducive for motivating people to continuously improve the quality of their work.	1	2	3	4	5
15.	My manager review our department performance on quality and customer satisfaction at department meetings.	1	2	3	4	5
16.	My manager allows me time necessary to apply Total Quality Control to my job.	1	2	3	4	5

17.	I am convinced Allied-Signal management is committed to making changes to achieve total quality.	1	2	3	4	5
18.	I believe Allied-Signal management places a higher priority on customer satisfaction than on achieving short-term business goals.	1	2	3	4	5
19.	In my work group, we are encouraged to support our views and beliefs with factual information and data.	1	2	3	4	5
20.	There is a measurement for Continuous Improvement of processes, products or services in my work group.	1	2	3	4	5
21.	How would you rate the overall quality of work done in your work group?	1	2	3	4	5
22.	What is the most important thing that Allied-Signal could do it to improve customer satisfaction (internal and/or external)?					

APPENDIX D. Total Quality Control Survey Questions For Values Awareness, Expectant Employee Behaviour And Perceived Management Behaviour.

Total Quality Control Values Awareness Or Congruency.

4. It is clean to me who customers are (internal and/or external)
7. I understand how to apply the principles of Total Quality Control to my specific job function.
8. I am aware of the policy deployment objectives of my organization.
17. I am convinced Allied-Signal management is committed to making changes to achieve total quality.
18. I believe Allied-Signal management places a higher priority on customer satisfaction than on achieving short-term business goals.

Expectant Employee Behaviour Related To Total Quality Control

6. My work group is taking steps to achieve a higher level of customer satisfaction.
9. I am able to take action as required to improve the quality of processes, products or services provided by my work group.
13. I am making use of Total Quality Control principles in my own work group.
19. In my work group, we are encouraged to support our views and beliefs with factual information and data.
12. People from different organizations work together to satisfy customer needs.
20. There is a measurement for continuous improvement of processes, products or services in my work group.

Perceived Management Behaviour Related To Total Quality Control

5. I regularly receive feedback on how well I am meeting my customers' expectations.
10. Employees in my work group are recognised for producing high quality work (products, processes or services.)
11. The effective use of Total Quality Control is an important part of my performance review.
14. Overall the working environment at Allied-Signal is conducive for motivating people to continuously improve the quality of their work.
15. My manager review our department performance on quality and customer satisfaction at department meetings.
16. My manager allows me time necessary to apply Total Quality Control to my job.

APPENDIX E. Total Quality Control Related Attitude Survey Questions.

Management Quality Commitment.

23. Management is concerned with improving the quality of Allied-Signal products and services.
27. My supervisor stresses quality as an important factor in doing my job.
49. The materials provided for me are adequate to produce quality work.

Continuous Improvement

24. I received adequate training for my present job.
44. Training is available to employees to help them get ahead.

Employee Involvement

5. There is enough co-operation among the people I work with.
13. I have as much freedom as I need to do my job well.
14. I feel free to tell my immediate supervisor what I think.
25. In Allied-Signal, my work group help each other to do a better job.
26. My supervisor and I talk with each other as often as necessary about job related problems.
34. I take pride in the results produced by my work group.
35. My supervisor listens to my suggestions about how work should be done.
37. The Management is interested in the opinions and thinking of people who work here.
54. There is not a great deal of friction between the people I with.

Company Commitment

17. During the past year, I have not applied for another job outside Allied-Signal.
21. Allied-Signal a good company to work for.

APPENDIX F. Multiple Regression Analysis Results

(I) Directs- Employee Behaviour

Regression Output

Constant		0.114723
Std Error Of Y Estimate		0.360493
R Squared		0.738012
No. of Observations		781
Degrees of Freedom		778
	Management Behaviour	**Values Awareness**
X Coefficients	0.566918	0.390554
Std Error of Coefficient	0.028332	0.029228

(I) Non-Exempts- Employee Behaviour

Regression Output

Constant		0.308239
Std Error Of Y Estimate		0.337983
R Squared		0.705346
No. of Observations		244
Degrees of Freedom		241
	Management Behaviour	**Values Awareness**
X coefficients	0.461109	0.388555
Std Error of Coefficient	0.040144	0.046398

(I) Non-Exempts- Employee Behaviour

Regression Output

Constant		0.37074
Std Error Of Y Estimate		0.399599
R Squared		0.564893
No. of Observations		154
Degrees of Freedom		151
	Management Behaviour	**Values Awareness**
X Coefficients	0.429691	0.324587
Std Error of Coefficient	0.065275	0.077974

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Glossary of Acronyms

1) **Business Process Management (BPM)**
A management system in which major interdepartmental problems are assigned a process who is responsible for solving the problem regardless of what organizational boundaries are crossed.

2) **Design of Experiments (DOE)**
A statistical method to discover how selected operating variables affect particular product characteristics.

3) **Effectiveness Teams (ET)**
Teams comprising members of natural work groups that voluntarily form to identify and solve problems to address and follow a prescribed problem solving process. ET a re supported rather than directed by their managers.

4) **Failure Mode Effect Analysis (FMEA)**
An analysis technique to rank prioritise potential failure modes of new designs or processes and identify solutions to prevent such failure occurrences.

5) **Juran Quality Improvement (JQI)**
The managerial processes of quality planning, control and improvement.

6) **Quality Function Deployment (QFD)**
A system for translating specific customer needs into detail product requirements which are deployed throughout design, production, marketing and support operations.

7) **Quality Improvement Teams (QIT)**
A team appointed by a Quality Steering Team (QST) to work on a specific quality improvement issue. Membership is typically cross-functional with the leader appointed by the QST.

8) **Statistical Process Control (SPC)**
The statistical use of data to document, correct and improve process performance.

9) Statistical Quality Control (SQC)

Statistical methods and procedures used to document and assure compliance to requirements.

10) Taguchi Methods (TM)

A statistical method using a truncated experimental design (called an orthorgonal array) to determine which process inputs have the greatest effect or process variability and which have the least.

11) Total Productive Maintenance (TPM)

A quality improvement program focused on the effective operation, maintenance and management of equipment.