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TOTAL QUALITY MANAGEMENT IN THE SOUTH AFRICAN MOTOR INDUSTRY

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ABSTRACT

Quality has become an increasingly important customer decision factor for a growing number of products and services (Feigenbaum 1983). The increased quality awareness amongst consumers, coupled with high levels of competition amongst manufacturers, has led to an upward spiral, in what are considered by increasingly quality-conscious customers to be "acceptable quality standards."

Much controversy surrounds what means will ensure the production of quality products and services. The traditional approach to quality improvement involves the separation of quality responsibility from production responsibility. This means that those who are producing goods and services are not held directly responsible for the quality of those goods or services. According to this approach, quality is seen as a function of the level of inspection, and as such is treated as a post-production function. This approach to quality improvement has many downfalls, its primary drawback is the high cost associated with the maintenance of quality standards.

"Total quality management" is an approach to quality improvement which recognises the weaknesses inherent in the traditional approach to quality improvement and therefore attempts to avoid them. This approach to quality improvement is the topic undertaken in this dissertation.

Whilst it is recognised that total quality management affects the entire workplace, this study concentrates specifically on management. There are two reasons for this. First, total quality management is a process which is management initiated and driven. The extent to which management are aware of and practice the principles of total quality management provides a strong indication of the extent to which employees are aware of and practice these principles. Second, resources at the disposal of the researcher did not permit the study to encompass a larger sample which would have included employees. It was therefore

decided to concentrate on total quality management as viewed and practised by management.

This thesis initially discusses what is meant by quality. It emphasises that quality encompasses both customer requirements and production adhering to specifications.

Much attention is paid to defining total quality management. Total quality management is concerned with the prevention of defective output through building quality into the product or service, rather than by costly, inefficient, after-the-fact inspection. Total quality management, therefore, involves an increased emphasis on self inspection at the point of production, as opposed to post production inspection. It has, as its point of departure, the coupling of quality responsibility with production responsibility. Employees, within certain limits, are responsible for the quality of that which is produced. For this reason, subordinate involvement is central to this approach. Total quality management is concerned with the entire process of participative quality improvement.

Various theories of total quality management have been put forward. Only those theories which hold most relevance for this dissertation are discussed. This discussion will allow the identification of certain factors which should play a part in the total quality management program of any organisation, irrespective of its size or nature. These include:

- Management participation. Total quality management is management-driven, and without the active participation of all levels of management, is unlikely to be successful.
- The organisation structure. Due to the fact that total quality management is a participative form of quality improvement, the structure of the organisation should be one which facilitates and encourages participation in the quality improvement process.
- A quality policy. By means of a quality policy, the quality improvement process in the organisation is given direction.

This policy will also serve to communicate to the entire workforce the status of quality within the organisation.

- **The measurement of quality.** Central to total quality management is the measurement of quality within the organisation. This measurement has two elements, the measurement of a cost of quality and the measurement of attitudes to quality.
- **Education.** The success of total quality management is built around extensive education and training to the entire workforce. This training is primarily aimed at gaining an awareness of quality improvement and placing the entire workforce in a position where they are able to cope with decentralised quality responsibility.
- **The provision of incentives and rewards.** One of the most successful ways of gaining the commitment of the entire workforce to the principles of total quality management is to provide incentives and rewards to encourage this desired behaviour. Research has shown that where these rewards have been forthcoming, performance has been enhanced.

The empirical component of this dissertation concerns itself with an investigation of total quality management in the South African motor industry. The purpose of this investigation is to facilitate a comparison of the extent to which the principles of total quality management, as advocated in the literature, are employed by the various manufacturing plants in the South African motor industry.

The conclusions of this investigation are that conclusive evidence to support adherence to the principles of total quality management can only be found at three of the manufacturers, Toyota, Delta and Nissan. At the remaining three plants, BMW, Samcor and VW, very little evidence to support adherence to the principles of total quality management was found.

DECLARATION

I declare that this dissertation is my own, unaided work. It is being submitted for the degree of Master of Commerce in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in any other university.

_____

MATTHEW JON GROSSETT

October, 1991

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CONTENTS Page

ABSTRACT. i
DECLARATION. iv
ACKNOWLEDGEMENTS. vi

CHAPTER ONE : INTRODUCTION

1 INTRODUCTION 1

2 OBJECTIVES OF THIS DISSERTATION 3

CHAPTER TWO : DEFINING QUALITY AND TOTAL QUALITY MANAGEMENT

1 DEFINITION OF QUALITY. 7

2 THE EVOLUTION OF TOTAL QUALITY MANAGEMENT: 12
2.1 Operator Quality Control 12
2.2 Foreman Quality Control 13
2.3 Inspection Quality Control 13
2.4 Statistical Quality Control 13
2.5 Total Quality Control 15
2.6 Total Quality Management 15

3 DEFINITION OF TOTAL QUALITY MANAGEMENT 16
3.1 Traditional Quality Control 16
3.2 Total Quality Management 18

4 RATIONALE BEHIND TOTAL QUALITY MANAGEMENT 27
4.1 Increased Quality Products and Services 28
4.1.1 *Customers Require Improved Quality* . 28
4.1.2 *Economic Survival* 29
4.1.3 *Productivity* 30
4.1.4 *Costs* 32
4.1.5 *Inventory Control* 37
4.1.6 *Return on Investment* 38
4.2 Increased Employee Involvement 39

CONTENTS CONTINUED Page

4.2.1 *Improved Decisions* 40
4.2.2 *Better Commitment to Quality Improvement* 10
4.2.3 *Increased Job Satisfaction* 43
4.2.4 *Management Employee Ratio* 44
4.2.5 *Labour Relations* 44
4.2.6 *Improved Internal Communication* . . . 45

5 CONCLUSION 46

CHAPTER THREE : THEORIES OF TOTAL QUALITY MANAGEMENT

1 INTRODUCTION 48
1.1 CROSBY. P.B 48
1.2 TOWNSEND.P.L 63
1.3 JURAN.J.M. 68
1.4 FEIGENBAUM. A.V. 81
1.5 DEMING. W.E 91
1.6 ISHIKAWA. K. 102

CHAPTER FOUR : THE PRINCIPLES OF TOTAL QUALITY MANAGEMENT

1 INTRODUCTION 105

2 MANAGEMENT COMMITMENT 105
2.1 Promoting Employee Participation 107
2.1.1 *Organisation Climate:* 108
2.1.1.1 Management Style 110
2.1.1.2 Participative teams 117

3 ORGANISATION STRUCTURE 135
3.1 Requirements of the Organisation Structure. . 136
3.2 Tall Organisation Structure 136
3.3 Flat Organisation Structure. 137

CONTENTS CONTINUED Page

4 COMPANY QUALITY POLICY 138
4.1 Contents of a Corporate Policy 139
4.2 Departmental Policies 139

5 MEASUREMENT OF QUALITY 140
5.1 The Decentralisation of Measurement. 141
5.2 Displaying of Measurement Results. 142
5.3 Methods of Measurement. 143
5.4 Measurement of Attitudes. 145
5.5 Measurement of Quality Costs. 147

6 EDUCATION AND TRAINING 151
6.1 GENERAL AWARENESS TRAINING 152
6.2 Senior Management Education 154
6.2.1 *Training Directed at Securing Commitment* 154
6.2.2 *Training Directed at Minimising Resistance to Subordinate Participation* 155
6.3 Supervisory /Middle Management Training 156
6.3.1 *Training Directed at Minimising Resistance to Subordinate Participation* 156
6.3.2 *Training Directed at Securing Commitment* 160
6.3.3 *Training Role* 161
6.4 Employee Education 162
6.4.1 *Training Directed at Securing Commitment* 162
6.4.2 *Training Directed at Minimising Resistance to Subordinate Participation* 163
6.5 Education of External Parties 163

CONTENTS CONTINUED

Page

7 GOAL SETTING 164
7.1 Method of goal setting 164
7.2 Principles of Goal Setting 165

8 INCENTIVES AND REWARDS 166
8.1 The Rationale for Incentives and Rewards . . . 166
8.1.1 *Employee Commitment* 166
8.1.2 *Management Commitment* 167
8.2 Types of Rewards and Incentives 170

9 INSPECTION 172
9.1 Limited Inspection 172
9.2 What Degree of Inspection Should be Undertaken? 173

10 CONCLUSION 173

CHAPTER FIVE : CHARACTERISTICS OF THE RESEARCH

1 INTRODUCTION 178

2 THE RESEARCH PROBLEM 179

3 HYPOTHESES 179

4 BOUNDARIES OF THE STUDY 183
4.1 THE INDUSTRY 183
4.2 RESPONDENTS 183
4.3 DESCRIPTIVE RESEARCH 184

5 ASSUMPTIONS MADE IN THIS STUDY 185

6 LIMITATIONS OF THE RESEARCH 185

7 RESEARCH DESIGN 186

CONTENTS CONTINUED Page

8 METHODS OF DATA COLLECTION 188
8.1 The Survey Instrument 188
8.1.1 *Design Of The Survey Instrument* . . . 188
8.1.2 *The Pilot Study* 192
8.1.2.1 Description Of The Pilot Study . 192
8.1.2.2 Results Of The Pilot Study . . . 194

9 THE SURVEY SAMPLE 195
9.1 Definition of the population. 196
9.1.1 *The Industry* 196
9.1.2 *Study Limited to Management Representatives* 197
9.2 Identification of the sample frame. 198
9.3 Selecting the sampling method. 200
9.3.1 *Types of Samples* 200
9.3.1.1 Fixed versus Sequential Sampling. 200
9.3.1.2 Probability versus Nonprobability Sampling. 200
9.4 Determining the Sample Size. 201
9.5 Selecting the Sample Elements. 202

10 EFFECTIVENESS OF THE QUESTIONNAIRE AS A MEASURING INSTRUMENT 203
10.1 RELIABILITY 203
10.2 VALIDITY 206
10.2.1 *FACE VALIDITY* 206
10.2.2 *CRITERION VALIDITY* 207
10.2.3 *CONSTRUCT VALIDITY* 208
10.2.4 *INTERNAL VALIDITY* 209
10.2.5 *EXTERNAL VALIDITY* 212

11 RESPONSE TYPES 214

CONTENTS CONTINUED Page

12 USE OF STATISTICS 215
12.1 TYPE OF TESTS USED 215
12.2 RELATIONSHIPS BETWEEN SAMPLES 216
12.3 TWO-TAILED TESTS 216
12.4 LEVEL OF SIGNIFICANCE 216
12.5 STATISTICAL TESTS AND PROCEDURES 216
12.5.1 *DESCRIPTIVE STATISTICS* 217
12.5.2 *INTER-ITEM CORRELATIONS* 217
12.5.3 *ANALYSIS OF VARIANCE* 218
12.5.4 *HYPOTHESIS TESTING* 218
12.6 STATISTICAL PACKAGE 219
12.7 SUMMARY OF THE CHAPTER 219

CHAPTER SIX : PRESENTATION OF EMPIRICAL FINDINGS

1 INTRODUCTION TO PRESENTATION OF THE DATA 220

2 METHOD OF ANALYSIS 220

3 MAIN HYPOTHESIS 221
3.1 SUB-HYPOTHESIS 1. 221
3.2 SUB-HYPOTHESIS 2. 223
3.3 SUB-HYPOTHESIS 3. 226
3.4 SUB-HYPOTHESIS 4. 227
3.5 SUB-HYPOTHESIS 5. 230
3.6 SUB-HYPOTHESIS 6. 231
3.7 SUB-HYPOTHESIS 7. 233
3.8 SUB-HYPOTHESIS 8. 234
3.9 SUB-HYPOTHESIS 9. 236
3.10 SUB-HYPOTHESIS 10 238
3.11 SUB-HYPOTHESIS 11 240
3.12 SUB-HYPOTHESIS 12. 241
3.13 SUB-HYPOTHESIS 13. 243
3.14 SUB-HYPOTHESIS 14 249
3.15 SUB-HYPOTHESIS 15. 254

CONTENTS CONTINUED Page

3.16 SUB-HYPOTHESIS 16. 256
3.17 SUB-HYPOTHESIS 17 260

4 CONCLUSION 262

CHAPTER SEVEN : CONCLUSIONS AND DIRECTIONS FOR FUTURE RESEARCH

1 SUMMARY OF THE RESEARCH 264
1.1 RESEARCH CHARACTERISTICS 264
1.2 SUMMARY OF THE RESEARCH OBJECTIVES 264
1.3 SUMMARY OF EMPIRICAL FINDINGS 265

2 IMPLICATIONS OF RESEARCH FINDINGS 267

3 FURTHER RESEARCH 269
3.1 REPEAT SURVEY BASED ON EMPLOYEES AS WELL AS MANAGERS 269
3.1.1 *HYPOTHESIS* 270
3.2 IDENTIFY THE BENEFITS TO FLOW FROM TOTAL QUALITY MANAGEMENT 270
3.2.1 *HYPOTHESES:* 270
3.3 TOTAL QUALITY MANAGEMENT IN SOUTH AFRICA . . . 271
3.4 COMPARATIVE COMPANIES 271
3.5 OTHER INDUSTRIES 271

REFERENCES 272

APPENDIX 1 Summary of Research Findings. 293
APPENDIX 2 Summary of Research Findings. 294
APPENDIX 3 Summary of Research Findings. 296
APPENDIX 4 Summary of Research Findings. 297
APPENDIX 5 Summary of Research Findings. 298
APPENDIX 6 Summary of Research Findings. 299
APPENDIX 7 Summary of Research Findings. 300

APPENDIX 8	Summary of Research Findings.	301
APPENDIX 9	Summary of Research Findings.	303
APPENDIX 10	Summary of Research Findings.	304
APPENDIX 11	Summary of Research Findings.	305
APPENDIX 12	Summary of Research Findings.	307
APPENDIX 13	Summary of Research Findings.	308
APPENDIX 14	Summary of Research Findings.	313
APPENDIX 15	Summary of Research Findings.	315
APPENDIX 16	Summary of Research Findings.	317
APPENDIX 17	Summary of Research Findings.	323
APPENDIX 18	Statistical Proportion Tests.	324
APPENDIX 19	Questionnaire Used in Survey (Management).	333
APPENDIX 20	Letter From Mercedes-Benz S.A.	343
APPENDIX 21	Malcolm Baldridge National Quality Award.	344
APPENDIX 22	Letter Accompanying Pilot Study.	374
APPENDIX 23	Covering Letters.	376
APPENDIX 24	Questionnaire Used in Survey (Executive Management).	378
APPENDIX 25	Letter to Pilot Study Participants. . . .	386

LIST OF TABLES

TABLE		Page
1	The Four Absolutes of Quality	50
2	The Quality Improvement Process	52
3	Deming's Fourteen Points	94
4	Benefits of Quality Circles to Members	124
5	Benefits of Quality Circles to Managers	125
6	Theoretical Sources Underlying Each Hypothesis	182
7	Findings of Pilot Study	194
8	Survey Population Sizes	199
9	Sample Sizes	202
10	Summary of Sub-Hypotheses Accepted and Rejected	263

LIST OF FIGURES

FIGURE		Page
1	Interrelation Among Quality Parameters	11
2	The Evolution of Total Quality Management	16
3	Factors Influencing the Quality of Products and Services	20
4	Jurans Spiral of Quality	21
5	Functional Responsibility for Quality Within the Total Production System	22
6	The Quality Improvement Process and Resulting Quality Costs	34
7	Model of Optimum Quality Costs	35
8	The Quality Improvement Process	49
9	Quality Costs	150

CHAPTER ONE

1 INTRODUCTION

Quality is believed to be one of the more significant factors leading to organisational success and company growth in national and international markets (Crosby 1979:157; Feigenbaum 1983:xxi; Townsend 1986:1-2). This is so because quality has become an increasingly important customer decision-factor for a growing number of products and services to be found in the marketplace, regardless of whether the buyer is a housewife, an industrial corporation, a government agency, a department chain store or a military defence programme (Feigenbaum 1983:xxi).

The quality of a product is determined by the extent to which it meets certain requirements. Central to the determination of these requirements are the needs, desires and expectations of the final users of the product or service. The design and production specifications required to produce a product or service which will meet the needs and expectations of the customer are determined within the parameters set by customer requirements and expectations (Crosby 1979:14; Deming 1982:221-34; Feigenbaum 1983:xxi; Ishikawa 1985:45-6). The design and production of a product or service which will satisfy customer requirements is likely to include the following activities:

- market research to determine the requirements of the customer;
- design of the product;
- production of the product or service to meet requirements;
- after sales service.

The extent to which an organisation produces a quality product largely depends on the employees and processes involved in its design and production (Feigenbaum 1983:44). These employees and processes are in turn influenced and directed by organisational policy. A reputation for quality, whether good or bad, is not a

thing of chance. It is tied to and directed by the policies of an organisation (Crosby 1984:157).

One such programme of quality improvement is "total quality management". According to Feigenbaum (1983:xxxi), the field of total quality management

> ...provides the structure and tools for managing quality so that there is continuous emphasis throughout the organization on quality leadership, genuine investment in, and implementation of, modern technology for quality throughout [all aspects of the organisation] and top to bottom commitment to quality and productivity.

Total quality management is not about implementing a whole host of control processes to monitor work completed, nor does it amount to some form of post-production inspection. Instead, total quality management is an attempt to instill in every employee a desire and ability to monitor the quality of his own work (Crosby 1984:82). This increased emphasis on self inspection, which lies at the heart of total quality management, amounts to the responsibility for quality being placed as close to its origin as possible (Crosby 1984:82; Lochner 1982:23-5). Such decentralisation of responsibility requires the creation of organisation forms which provide for and encourage broad participation in the quality improvement function by all departments and individuals (Juran 1988b:22.66).

Placing most of the responsibility for quality on the employees involved in producing a particular product or service requires a degree of management intervention. Management must ensure that they have removed any obstacles which might hinder the progress of employees towards producing a product which conforms to requirements. In addition, management must ensure that employees are provided with the tools and knowledge necessary for them to build quality into the product. It is management's responsibility to provide the physical and social environments which will enable and encourage employees to produce output which conforms to requirements. In a nutshell, management's responsibility lies in

ensuring that employees are placed in a position where quality decisions and actions are under their control (Lochner 1982:23-5). Where this is the case, Juran (1988b:17.4-17.5) refers to the employee as being in a state of "self-control".

Total quality management is thus a management discipline which is concerned with preventing quality problems from occurring, by creating the attitudes and controls that make prevention possible (Townsend 1986:21).

2 OBJECTIVES OF THIS DISSERTATION

An advantage over competitors as regards quality and reliability is gained essentially through two components (Rath and Strong, in McArthur 1984:64):

- a technical component, and
- a human component.

Although these two components are interdependent and should be viewed as one, for the purpose of this investigation, emphasis is placed on enhancing the human element of quality improvement. Research has indicated that one of the major barriers to quality improvement is not technical incompetence of the organisations concerned, but factors directly related to the human factor. These include low education and skill levels of operators and management, a lack of awareness as to the effect of poor quality and a lack of commitment and opportunity to become involved in quality improvement. For the above reason, the focus of this dissertation will not concern itself with the technical or statistical checks on quality, but will rather concentrate on the elements of total quality management aimed at improving and enhancing human commitment to quality. Quality is seen in essence to be a style of managing the organisation, and will be treated as such (Crosby 1979; Deming 1982; Feigenbaum 1983; Ishikawa 1985; Juran 1988b; Townsend 1986). Due to organisation specific factors such as size, nature of business, competitive pressures, age of equipment, age and attitudes of the workforce and so on, each organisation may follow a different path towards total

quality improvement (Burnham 1987:10). There are, however, certain factors which will play a part in the quality improvement process in any organisation. These "universally applicable" factors will be the main concern of this investigation.

More specifically, this investigation will take the form of a comparative analysis of the total quality management practices employed in the South African motor industry. These practices will be compared with the practices recommended by the literature surveyed.

The area of total quality management is of importance for two reasons. First, it addresses an issue which is as vital for the survival of an individual organisation as it is for an economy - the production of quality goods and services. Second, total quality management is based on subordinate involvement in the decision-making process, an area which merits further study. Since total quality management is a participative approach to quality improvement, a study of this field will provide an opportunity to address both of the above areas - quality improvement and subordinate participation in the decision-making process.

The focus of this investigation is on the quality control practices employed in the South African Motor Industry. The motor industry has been chosen as the subject of investigation for the following four reasons. First, it is an important segment of many national economies, and in South Africa is one of the largest employers of labour. According to the Central Statistical Services (1990), 5.1 million employees are directly employed in the South African motor industry. Second, one of the prime means of product differentiation and competitive advantage in the motor industry is through the avenue of quality. For this reason, quality has long been a priority in the motor industry, with the

result that quality control practices tend to be relatively well established and tried. Third, the South African motor industry is presently struggling to maintain profitability levels and product quality is being given more and more emphasis as a means to competitive advantage. Fourth, in South Africa, there are a limited number of motor vehicle manufacturers, which permits an investigation of the quality control practices of the entire industry.

CHAPTER TWO is a historical account of the evolution and development of the field of total quality management. A sound understanding of the development of this field of study sets the stage for a detailed discussion of the components of total quality management.

The current debate surrounding the definition of quality is presented. Although many seemingly differing definitions of quality are advanced (Caplan 1980; Crosby 1979; Deming 1982; Feigenbaum 1983; Ishikawa 1985; Juran 1988b), after thorough consideration and comparison of these definitions, it is evident that there are certain elements which are common to most of the definitions. A thorough understanding of what constitutes a quality product or service paves the way for a discussion and definition of total quality management.

Quality improvement has been the subject of debate for many years. Due to the wide variation in quality results achieved in industry, the search for the genuine key to success has become a matter of prime concern to management and academics all over the world. This concern has led to a host of quality improvement theories being advanced over the last few decades. Some of these have been strong in depth and commitment, while others have not. Central to certain theories has been statistical process control and centralised quality responsibility, whilst others advocate the decentralising of quality responsibility.

CHAPTER THREE provides an overview of the theories of total quality management given by a number of leaders in the quality improvement field. These focus on quality improvement through the decentralisation of quality responsibility (Caplan 1980; Crosby 1979; Deming 1982; Feigenbaum 1983; Ishikawa 1985; Juran 1988b; Townsend 1986). The elements central to each of the theories are outlined and discussed.

CHAPTER FOUR provides a recapitulation of the theories reviewed in chapter three. From the review conducted in chapter three, it becomes evident that there are certain common threads which are common to most of the quality improvement theories. These common threads highlight certain factors which play a part in the quality improvement process in any organisation, irrespective of its size or nature. Chapter four provides a detailed analysis of these factors. According to Feigenbaum (1983:xxi),

> A wider variation of effectiveness than ever before...exists among the quality programs of companies. Some are st[illegible]g in depth and in commitment. Others deal in half measures and try to meet fundamental quality requirements with the fireworks display of one-time quality encouragement programs or through dusting off the application of a few traditional quality-control techniques.

Arising from the common threads identified in the literature survey, a hypothesis is set. This hypothesis, along with the survey method developed to test it is described in CHAPTER FIVE.

CHAPTER SIX, by means of an indepth investigation into the quality improvement practices employed in the South African motor industry, investigates the extent to which these practices comply with those recommended in the literature.

The conclusions and recommendations for further research are covered in CHAPTER SEVEN.

CHAPTER TWO

DEFINING QUALITY AND TOTAL QUALITY MANAGEMENT

1 DEFINITION OF QUALITY.

To many people, quality means goodness, or luxury, or glossiness, or weight, or price. In addition, quality is often used to signify the relative worth of things in phrases such as "good quality" or "bad quality" (Crosby 1979:14-8). These are, however, very loose classifications of what quality is and are rejected as being over-simplistic by many authors (Crosby 1979; Deming 1982; Edosomwan 1987; Feigenbaum 1983; Ishikawa 1985; Juran 1988b; Lomas 1986; Wild 1985).

According to Feigenbaum (1983:7), quality

> ...is based upon the customer's actual experience with the product or service, measured against his or her *requirements* - stated or unstated, conscious or merely sensed, technically operational or entirely subjective...

He continues to define product and service quality as:

> The total composite product and service characteristics of marketing, engineering, manufacture, and maintenance through which the product and service in use will meet the expectations of the customer (Feigenbaum 1983:7).

Similarly, Utzig (in Hagan 1984:21) defines quality as

> ...the relative excellence of the composite of all product attributes in fulfilling the needs and reasonable expectations of those whom the product serves, as they perceive such fulfilment from time of offering throughout product life.

Feigenbaum's and Utzig's definitions of quality emphasise the importance of customer requirements in defining a quality product or service. In the same vein, Lomas (1986:216), Sullivan (1986:41) and the British Standard (BS) 4778 (British Standards

Institution. Quality Assurance. BSI Handbook No.22, in Lomas 1986:216) stress the importance of customer requirements in defining quality.

Crosby (1979:14), in his definition on quality, expands on the above definitions. He defines quality as "conformance to requirements." These requirements are determined through the interaction of a number of parties. The final user of the product or service has certain needs and expectations which must be satisfied. The design and production department within the organisation is responsible for designing and producing a product or service which meets the requirements of this final user. To achieve this, production and design requirements will need to be set and met.

In a similar manner to Crosby, Ishikawa (1985:45-6) and McMillan (1982:32) propose that customer requirements are the point of departure when defining quality. Customer requirements, once accurately recorded, are translated into important final product control characteristics that are to be deployed through the product design, development, processing and production control system. Ishikawa (1985:54-5) and Edosomwan (1987:64) refer to these two processes as "quality of design" and "quality of conformance," while Deming (1982:264) and Wild (1985:264) both refer to them as "quality of design" and "quality of production" respectively. Quality of design, often referred to as "target quality", refers to the extent to which the design of the product or service captures the needs of the final user. Quality of conformance, also referred to as "compatible quality", or "quality of production", refers to the extent to which the product or service conforms to the specifications and tolerances required by the design. If there is a discrepancy between quality of design and quality of conformance, it means that there are defects and/or reworks, which result in cost increases. Quality thus incorporates reliability, serviceability, maintainability and overall economy at which a product or service, which satisfies the needs of the final user, is produced.

Townsend (1986:4-5) seems to agree substantially with Ishikawa, Feigenbaum, Utzig, Edosomwan, Sullivan, McMillan and Deming, in that he believes that any definition of quality must cover two distinct, overlapping, interrelated types of quality - "quality in fact" and "quality in perception". Townsend (1986:4) defines quality in fact as follows:

> The provider of goods or services who through dint of hard work and capital expenditures performs up to its own specifications achieves Quality in Fact.

When a product or service meets the expectations of the customer it then achieves "quality in perception." According to Townsend (1986:6), even if a product or service is manufactured to exact internal specifications (quality in fact) the product or service is unlikely to be a success in the market place if it does not meet the quality expectations of the customer.

Juran's (1988b:4) definition of quality is similar, although more comprehensive than those advanced by Townsend, Feigenbaum, Utzig, Sullivan, McMillan, Edosomwan, Ishikawa and Juran. He proposes that two elements of any product or service have a large impact on their quality. The first is "product performance." The extent to which products and services perform and, therefore, meet the needs of customers will influence the degree of "product satisfaction." The primary goal of product performance is to be equal to, or superior to, the quality of competing products. The second is "freedom from deficiencies." Deficiencies result in complaints, claims, returns and rework. They collectively are forms of "product dissatisfaction." Some deficiencies impact external customers and hence are a threat to future sales as well as a source of higher costs. Other deficiencies impact internal customers only and hence are mainly a source of higher costs (Juran 1988a:5).

He continues (Juran 1988b:2.4) to define quality as "fitness for use." Fitness for use is the extent to which a product or service successfully serves the needs of the user, during usage. Fitness

for use is determined by those features of the product which the user can recognise as beneficial to him, and is judged "as seen by the user" and not by the manufacturer. He notes, however, that this definition needs to be qualified, as there are many uses and users. For this reason, a product must possess multiple elements of "fitness for use." In defining the quality requirements, both internal and external consumers must therefore be consulted so as to determine their requirements of "fitness for use" (Juran 1988b:30).

Juran classifies quality characteristics into categories known as parameters of "fitness for use." The major parameters are (Juran 1988b:3.9-2.11):

- Quality of Design;
- Quality of Conformance;
- The "Abilities";
- Field Service.

"Quality of design" is a technical term and it can be regarded as a composite of three separate steps in a common progression of activities:

- identification of what constitutes "fitness for use" to the user;
- choice of a concept of product or service to be responsive to the identified needs of the user;
- translation of the chosen product concept into a detailed set of specifications which, if faithfully executed, will meet the user's needs.

The extent to which a product conforms to the design specifications is called "quality of conformance."

The "abilities" of a product are its availability, reliability and maintainability and are mainly required for long-life products. Short-life products (food, fuel) have their "fitness for use" determined mainly by quality of design and quality of conformance. The "abilities" are closely interrelated and are

vital for "fitness for use."

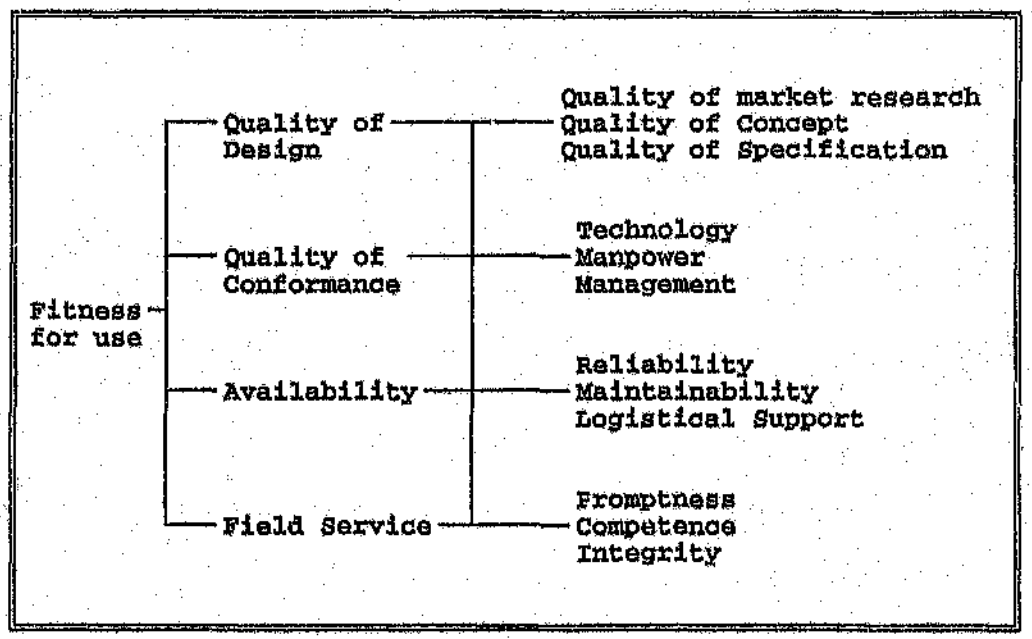
The final parameter is "field service". The usual distinguishing features of this parameter are that:

- it relates to activities that are carried out after the sale rather than before the sale;
- it is performed by organisations regarded as service industries rather than manufacturers;
- it includes extensive contractual and informal contact directly with the user.

The above four parameters can be illustrated in the form of a "tree," as shown in figure 1 (Juran 1988b:chapter 2).

Figure 1. Interrelation Among Quality Parameters.

Source: Juran 1988b:chapter 2.



Due to the central role occupied by the satisfaction of customer needs in defining quality, many authors (Crosby 1979; Deming 1982; Feigenbaum 1983:7-8; Ishikawa 1985:55) hold that quality

is not a static term. They believe that it evolves and changes as the customer's definition of quality evolves and changes over time. This means that quality standards need to be continually reviewed, revised and improved.

The above definitions of quality bring to the fore a number of important elements which define quality. First, customer perceptions and expectations play a central role in determining what constitutes a quality product or service. Second, the quality of a product or service is influenced by the extent to which the production process is capable of meeting the requirements defined by customer perceptions and formalised in the design process. Third, as a consequence of the fact that customer perceptions and expectations are central to defining quality requirements, and that these are continually undergoing modification, quality standards need to be continually reviewed, revised and improved.

2 THE EVOLUTION OF TOTAL QUALITY MANAGEMENT:

According to Feigenbaum (1983:15-7) major changes in the approach to quality work have taken place at approximately twenty year intervals.

2.1 Operator Quality Control

The first step in the development of the quality field was inherent, in most industrialised countries, in the manufacturing field up to the end of the nineteenth century. During this period, which Feigenbaum (1983:15) calls "operator quality control", one, or a very small number of employees was responsible for the production of an entire product and was hence solely responsible for the quality of that product.

2.2 Foreman Quality Control

The early 1900s saw the advent of the modern factory concept, whereby a number of employees all performing similar tasks were grouped so that they could be supervised by a foreman, who then assumed responsibility for the quality of their work. This Feigenbaum (1983:15) calls "foreman quality control."

2.3 Inspection Quality Control

During World War 1, the manufacturing process became more complex as a result of increased technology, complexity and output volumes of the machinery built. This resulted in many more subordinates reporting to each production foreman. Due to the production foreman's inability to control the product quality of all the employees reporting to him, full-time inspectors made an appearance. This period Feigenbaum (1983:15) calls "inspection quality control".

2.4 Statistical Quality Control

Inspection quality control peaked during the 1900s and 1930s in the large inspection organisations. This process, however, was unable to cope with the tremendous mass requirements of World War 2, due to the long time which extensive and detailed inspection took. This fourth phase, which Feigenbaum (1983:16) calls "statistical quality control", was in effect an extension of the inspection phase, and amounted to making the inspection process in the large organisations more efficient. Inspection was now carried out with the aid of statistical sampling methods. The most significant contribution of this method of quality control was that it provided sample inspection, rather than 100 percent inspection as done previously. The concept of quality control, however, remained restricted to production areas. The stumbling block of this stage was the unwillingness or inability of business

to take adequate steps regarding the findings of the statistical inspection. As Feigenbaum (1983:16) puts it,

> Recommendations resulting from the statistical techniques often could not be handled by existing decision-making structures. Certainly, they were not effectively handled by the existing inspection groups, or by what evolved as the one-person statistical quality-control coordinators, or by the individual design engineers who were given part-time duties to evangelise the quality-control subject. The job being done was still basically the shop-floor inspection job, which could never get its arms around the really big quality problems as business management itself saw them.

Ishikawa (1985:18) adds to the problems presented by the above phase:

1. Experienced workers who had always relied on their experiences and common sense complained that they could not use statistical methods...
2. To manage a factory, companies needed to have standards set for the level of technology, work and inspection. They were not available...
3. Data were needed to implement quality control. But there was simply a dearth of data.
4. In collecting data, the sampling method and the method of division were not followed properly. Hence, even when data were available, they seldom were useful.
5. In order to collect data, measuring devices and automatic recorders were sometimes installed. In some instances, workers suspected that these devices were put there to monitor their work and destroyed them.

Ishikawa (1985:18-20) presents two further problems to arise out of a total reliance on statistical quality control. First, middle level managers and their subordinates were to a large degree not involved in statistical quality control, which led them to resent it. Second, too much emphasis was placed on statistical quality control, with other areas of quality control being neglected.

2.5 Total Quality Control

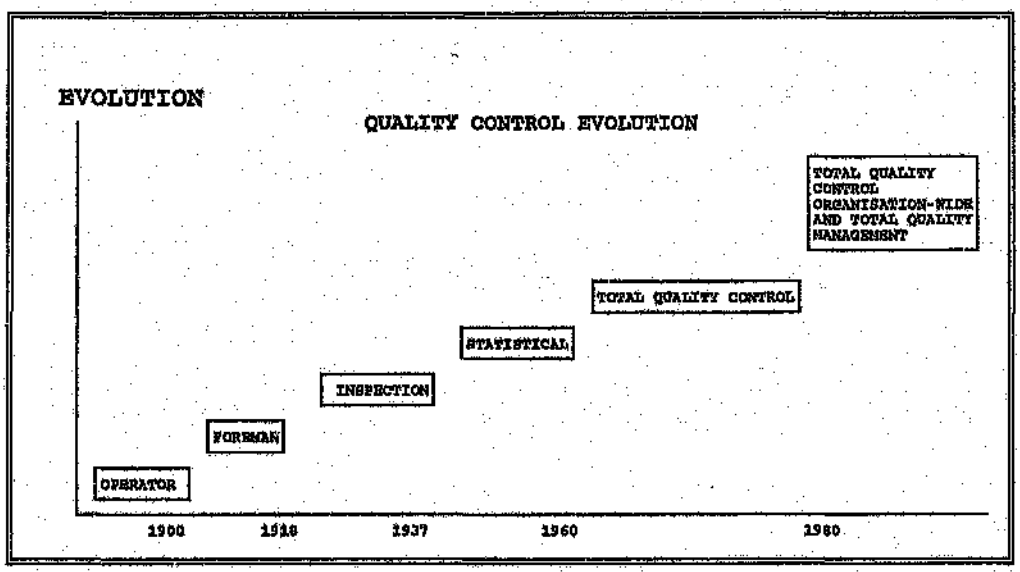
The shortcomings of the above control process marked the advent of the fifth step, in the late 1970's, which Feigenbaum (1983:16) calls "total quality control". This step involved the development of specific decision-making and operating frameworks which were effective enough to take suitable action on the quality control findings. This total quality framework made it possible to review decisions regularly rather than occasionally and to take control action at the manufacturing or supplier source and to stop production when necessary. Further, this framework provided the structure into which the early quality control techniques could later be joined by the many additional techniques of quality control.

2.6 Total Quality Management

Still, under the above process, quality standards were not as high as required, and the cost of quality was unacceptably high. The reason postulated for this was the failure of quality control to be integrated into every aspect of the organisation. Quality needed to be something which every employee was committed to and responsible for, as opposed to something which had to be controlled and ensured through inspection. The 1980's saw the advent of total quality management, with its emphasis on defect prevention, and the involvement of the entire organisation in the quality improvement process (Ishikawa 1985:20). Figure 2 illustrates the evolution of total quality management.

Figure 2. The Evolution of Total Quality Management

Source: Feigenbaum 1983:16.



3 DEFINITION OF TOTAL QUALITY MANAGEMENT

3.1 Traditional Quality Control

Historically, quality control consists of the following (Feigenbaum 1983:44; Ishikawa 1985:77-8; Juran 1988b:4.17):

- inspecting the final product or service against a set of agreed requirements or standards. Quality is seen as a function of the extent of inspection, necessitating a high ratio of inspectors to workers. Due to its size and importance, the inspection department is made an independent department and its authority is enhanced;
- the existence of an independent inspection department effectively means that the responsibility for quality is centralised, and removed from its source;
- quality is seen as a function of worker aptitude, and not the system;

- the attitude that mechanisation, combined with a high degree of job specialisation will result in high productivity, low costs, satisfied workers and high quality.

A number of inadequacies of this approach have been identified (Crosby 1984:7; Ishikawa 1985:77-8; Juran 1988a:24; McMillan 1982:32; Moen and Nolan 1987:63; Sullivan 1986:78). The more prominent of them include:

- the process of information feedback, so central to total quality improvement, from the central quality control department to the point of production, is a time consuming and inefficient one;
- because quality is treated as a post production inspection function, it is only addressed on completion of the product or service;
- quality is obtained at high cost and loss of productivity;
- a "firefighting" approach to problem solving is adopted, which results in short term solutions at the expense of long term improvement;
- departments became autonomous units solely concerned with their own welfare and not that of the organisation as a whole;
- department managers are judged on the extent to which they meet departmental goals, and these goals (with exceptions) continue to perpetuate deficiencies of the past. No provision is made to determine if the existing processes are the most effective;
- the importance of the human element to the quality improvement process is underestimated.

Total quality management is a quality improvement process which recognises the above deficiencies in the traditional approach to quality control, and attempts to redress them. It is concerned with the prevention of defective output through building quality into the product or service, rather than by costly, after-the-fact inspection.

3.2 Total Quality Management

At the heart of total quality management is the prevention of defects, rather than costly, post-production inspection and correction of defects (Deming, in McGraw and Dunford 1987:152, Feigenbaum 1983:64; Ishikawa 1985:76-7 & 85; Lomas 1986:218; Main 1980:31). The principle underlying this view is that the sooner a defect is detected, the less costly it is to correct and the greater are the resulting savings (Deming 1982:238; Main 1980:33). If quality is to be reflected in products and services, it must be developed, first of all, in the processes and the people responsible for designing and producing them (Russell and Dale 1989:4). Therefore, central to total quality management is the philosophy that providing a quality product or service cannot be achieved by concentrating quality control and improvement in only one area of the plant. Quality must be viewed as a continuous process, which starts with customer requirements and ends only when the customer is satisfied that the product meets his/her needs. The provision of a quality product or service involves the whole industrial process, beginning with market research, product design and continuing on to the market place (Crosby 1979:19-20; Deming, in McGraw and Dunford 1987:152; Feigenbaum 1983:200; Hagan 1984:22-3; Ishikawa 1985:76-7; Juran 1974:13-4; Main 1980:29; Moen and Nolan 1987:62; Rieker 1983:14; Sullivan 1986:78). This view is confirmed by the South African Bureau of Standards (SABS) 0157 quality standards, which require detailed control of design, purchasing, production and vendors, in order to ensure the quality of the final product or service. The reasoning behind this is that any process involved in producing a product or service will have an influence on its quality. Deming (1982:230-31), Juran (1988b), Riggs (1976) and Wild (1985), amongst others, illustrate the complexity of activities involved in producing a quality product or service.

According to Wild (1985), the production of a quality product or service involves the entire industrial process, beginning with market research, product design and manufacture, and continuing

on to the market place. The multitude of activities involved in the production of a quality product or service are illustrated in figure 3. This figure emphasises that, in the production of a quality product or service, attention must be paid to quality of design as well as quality within the manufacturing process. Figure 3 illustrates that the first stage in the production of a quality good or service is through the marketing function, the identification of customer requirements and expectations. These requirements and expectations are then translated into design specifications, which must be met during the production process.

In a similar manner to Wild (1985), Juran's "spiral of progress" (1988b:2.5) makes it clear that the activities needed to provide a quality product or service are scattered amongst many persons in many departments. Some of these people are in-house, while others are not. The first stage in the production of a quality good or product involves market research to determine customer requirements and expectations. These are then translated into design specifications, which must be met during the production process. The provision of a quality product or service, however, extends beyond the mere production phase. The customer, on receiving the product or service, must remain satisfied with it through its intended life. This means that after sales service must be incorporated into the definition of quality. Marketing research is then undertaken to determine the extent to which the product or service meets the requirements and expectations of the user. This information is used in the design of future products and services. For a more indepth discussion on Juran's spiral of quality refer to pages 69-75.

Figure 3. Factors Influencing the Quality of Products and Services

Source: Wild 1985.

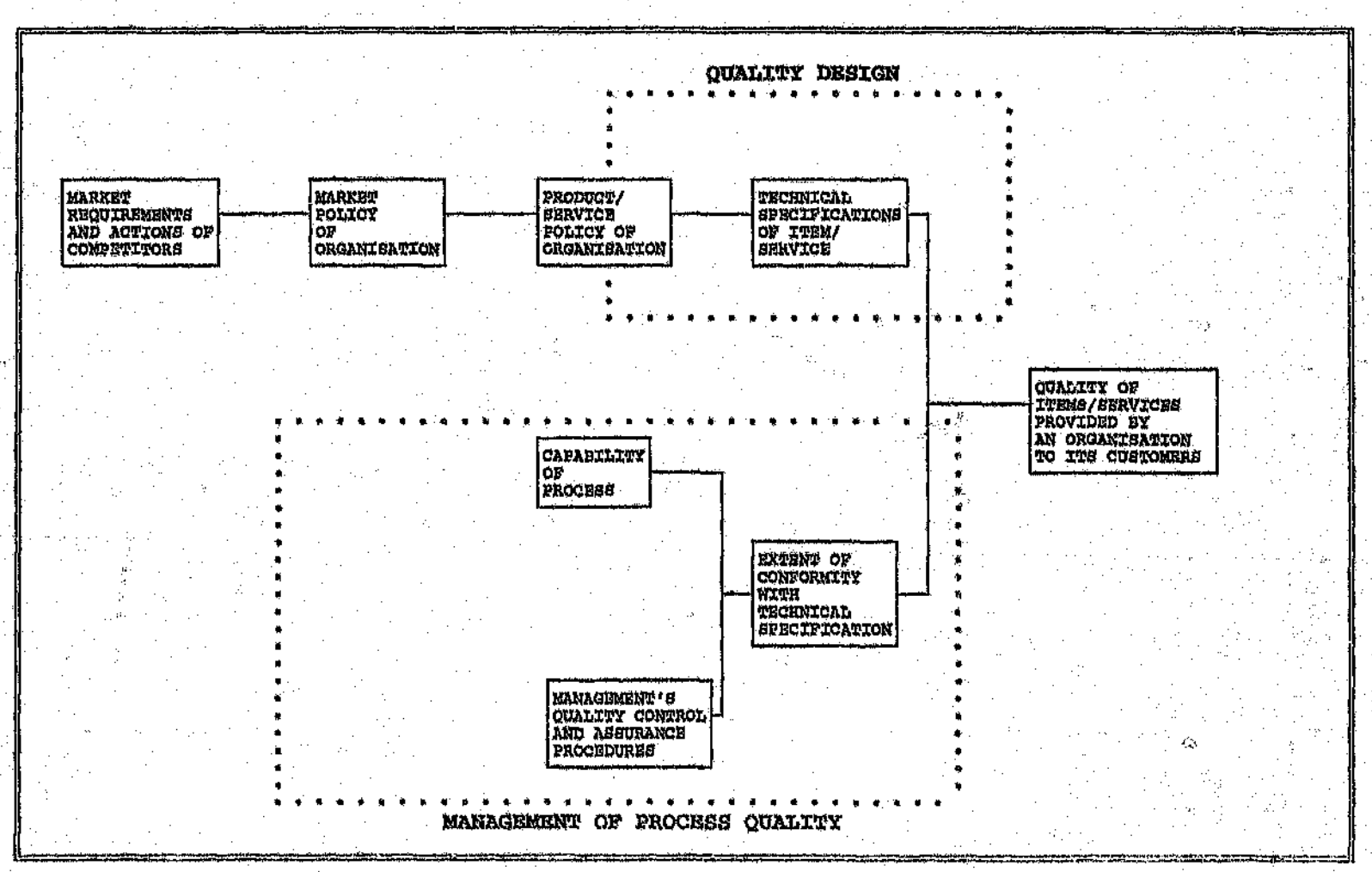
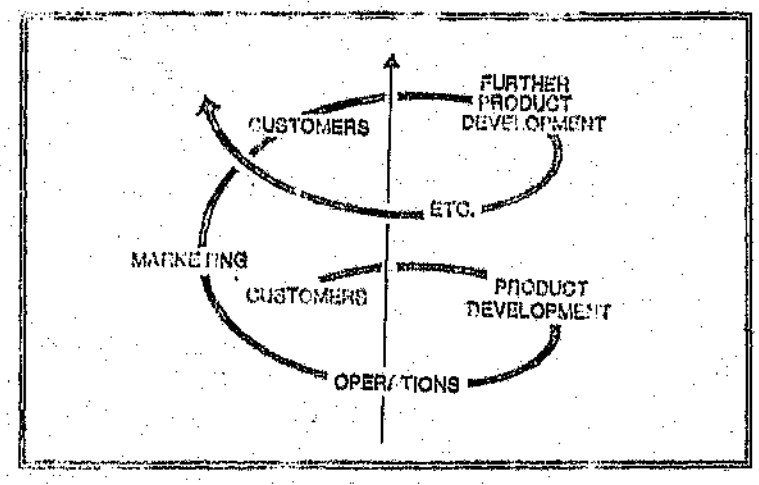


Fig. 4 Juran's Spiral of Quality

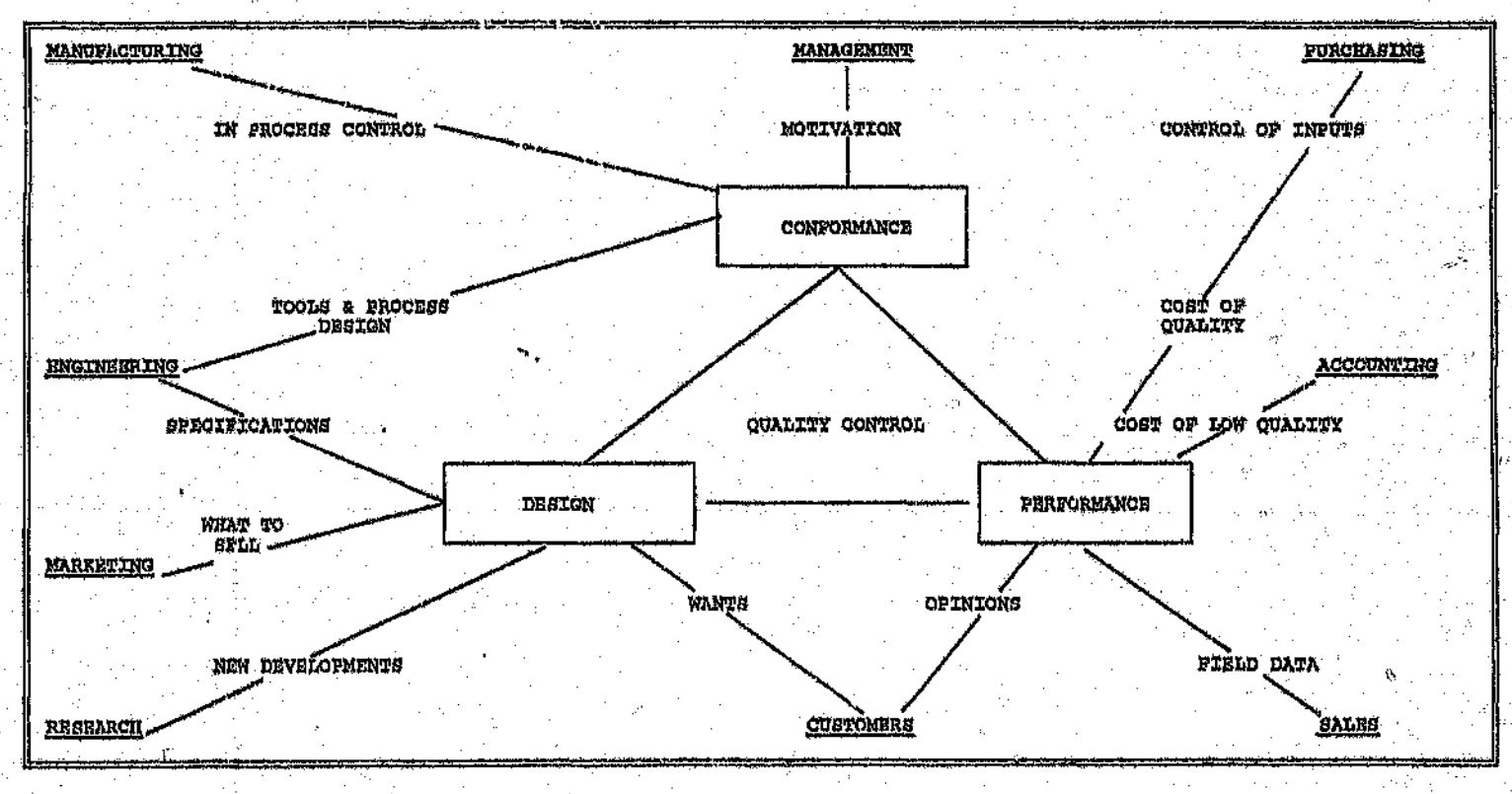
Source: Juran 1988b:2.5.



A similar view to Juran's is presented by Riggs (1976), who represents the quality function as an integral part of the entire production system. Figure 5 illustrates this. The quality sub-system is intimately linked with the governing production system. A quality product is the result of careful design specifications, conformance to specifications and feedback about product performance. Design and performance specifications are set using information from a number of sources, including marketing research which identifies customer requirements and expectations, research which identifies new developments in the field and engineering specifications which provide information on production capabilities. The purpose of the design and performance stages is to develop a product whose design and performance characteristics meet those of the customer. The conformance phase illustrates the importance of producing a product or service which conforms to performance and design specifications. This process involves manufacturing to specification, management commitment and control of the process and monitoring of input materials. The quality of input materials must be controlled as they are used in the production process and will influence the quality of the final product or service.

Figure 5. Functional Responsibility for Quality Within the Total Production System.

Source: Riggs 1976.



The above views are encapsulated in the works of Caplan (1980), who gives the five stages of quality control as:

1. Set the quality standard, or quality of design, required by the customer.
2. Plan to achieve the required quality. This involves:
    a. planning methods
    b. planning equipment
    c. obtaining satisfactory materials
    d. selecting and training operators
    e. planning inspection and shop floor quality control.
3. Manufacture right first time.
4. Correct any quality shortcomings.
5. Provide for long-term quality control and planning.

Factors both internal and external to the entire organisation have an impact on the quality of the product or service being produced and the extent to which it meets the requirements of the final user (Feigenbaum 1983:149-200). Within the organisation, each person is a user, a processor and a supplier (Townsend 1986:22). In addition, incoming inventory control is necessary because the quality of a final product is undoubtably going to be influenced by the quality of the inputs used to manufacture it (Cloer 1984:20; Deming 1982:273; Ishikawa 1985:91; Nemoto 1987:182-83). "Garbage in" means "garbage out" (Garvin 1983:73). Quality requirements, therefore, start with customer requirements and continue until the product or service has been received by the consumer, who thereafter remains satisfied with the product. As is evident, the quality of a product is effected by many stages of the industrial cycle. Because of this, quality improvement cannot be accomplished by concentrating simply on one aspect of the industrial cycle (Feigenbaum 1983:12; Ishikawa 1985:20; Townsend 1986:19; Van Der Merwe 1986:20). In addition, total quality management concerns itself with defect prevention, rather than product or service testing and inspection.

The prevention of defects requires work on and attempts to improve the process that produce the product. According to Moen and Nolan (1987:63)

> Analysis of the process is done by all members of the organization and thus becomes a small part of everybody's job, rather than the total responsibility of a few.

For this reason, the burden of quality proof rests not with inspection, but with the contributors to the quality of the products and services - in short, the entire organisation (Alexander 1981:617; Deming 1982:101; Edosomwan 1987:65; Ishikawa 1985:20-1 & 112-13; Rieker 1983:14; SABS 0157:part 0:2). Total quality management requires the personal participation of all levels of employee, from top management to production-line employees, and all departments of an organisation (Cole 1980:25; Crosby 1979:23; Feigenbaum 1983:13; Marash 1989:122; Townsend 1986:19). Quality work should be seen as a co-operative effort involving both workers and management (Cole 1980:41). Such an approach, says Gow (1980:18), is vital to establish the attitudes required for a positive approach to quality. For the above reasons, quality improvement should be the responsibility of every individual person and department within the organisation, as well as every external supplier and requires their active participation (Feigenbaum 1983:12-3; Garvin 1983:72; SABS 0157 Part 1:2).

The decentralising of quality responsibility in effect makes total quality management a bottom-up approach to defect prevention (Bemowski 1988:65; McMillan 1982:32). According to Rubinstein 1971:24), it

> ...envisions industrial organizations that maximise the opportunity of all personnel, regardless of position in the organization, to utilise their capabilities to improve and control the industrial process and the quality of products and services.

The fact that total quality management amounts to a form of employee participation in the affairs of the organisation brings

about substantive changes in the roles of workers, supervisors and managers (Hoffman 1983:40). Supervisors are seen less as the members of management whose job it is to direct, monitor and create performance among their subordinates. Increasingly they become a member of and resource for the workgroup, a liaison with management and other workgroups. Supervisors are accountable to the groups for providing the services and resources necessary for group success. They are responsible for negotiating "contracts" with upper management. The workgroup "contracts" with management for output and quality. Planning and quality control are carried out by the groups, in consultation with management. As a unit, the group is accountable to management for fulfilling the "contract".

In addition, this decentralising of decision-making responsibility requires an organisation form which provides broad participation in the quality function by all departments and individuals, as opposed to a centralised quality control function (Feeney 1990:28; Juran 1974:13). (For a more detailed discussion on management responsibility, refer to chapter four)..

The decentralisation of responsibility for quality improvement has two central requirements:

- management commitment and action, such that any management controllable obstacles to quality improvement are removed;
- employee commitment and ability to take responsibility for the quality of their products or services.

First, management commitment is necessary due to the fact that many of the obstacles to the quality improvement process fall within the purview of management. It is management's responsibility to ensure that any such obstacles are removed.
Management are also responsible for ensuring that subordinates are equipped and qualified to take responsibility for their own quality (Crosby 1979; Deming 1982; Ishikawa 1985; Juran 1988b). Primar, requirements here include understanding and education (For a more detailed discussion on management responsibility, refer to chapter four).

Second, central to total quality management is the decentralisation of quality responsibility. It is an attempt to instill in every employee a desire to monitor the quality of his own work. Each and every worker must see himself as a quality inspector and be qualified to fulfil his role as one, for self-inspection lies at the heart of this approach (Byron 1981:48). This means that employee attitudes, which are crucial to quality improvement, often need to undergo modification (Hall and Leidecker 1981:16).

As seen by Feigenbaum (1983:6), a major feature of total qualit management is thus

> ...its positive effect in building up employee responsibility for, and interest in, product quality. In the final analysis it is a pair of human hands which performs the important operations affecting product quality. It is of utmost importance to *successful* [Total Quality Management] that these hands be guided in a skilled, conscientious, and quality-minded fashion.

Based on this, he argues that total quality management is a system of quality improvement which pays thorough attention

> ...to the human behavioral and employee-management-relations aspect of modern quality, from recognition of today's worker attitudes to motivation, employee involvement, and the development of genuine and widespread quality commitment (Feigenbaum 1983:xxiii).

Total quality management represents a move away from the old style of Scientific Management, that grew out of Fredrick Taylor's theories, towards a style based on the basic principles of the research of Herzberg (1975), Maslow (1943), McClelland (1976) and McGregor (1960). This style recognises the importance of employee involvement, responsibility for and understanding of his or her own work and work quality . Employees are asked to think about what they are doing and

how it can be done better, in addition to being provided with the tools to do so (Main 1980:32).

In conclusion, Feigenbaum (1983:153) provides the following all encompassing explanation of total quality management:

> Basic quality responsibility rests in the hands of company top management. Over the past several decades, top management, as part of the general industrial trend toward specialisation, had delegated portions of its quality responsibility to such functional groups as Engineering, Manufacturing, Marketing, Product Service, and Quality Control. In addition, the all-important responsibility of each worker for producing quality products has, if anything, increased over this period of years with the increasing complexity both of products and production machinery.
>
> In present-day industry, the...jobs of total quality control cannot be effectively pursued unless those functional quality responsibilities for their various elements are clearly defined and structured. Moreover, there must be an associated mechanism to assist in integrating and measuring these responsibilities. In the larger companies where top management cannot of and by itself act as such a mechanism, present-day management establishes an organisational component as a pivotal point of its total-quality-control organization to provide the required integration and control.
>
> Creation of this quality-control component does not relieve other company personnel of their delegated quality responsibilities, for the discharge of which they are best qualified. The component does, however, make the quality control whole for the company greater than the sum of its individual engineering, manufacturing, inspection, and marketing parts, through the functions of integration and control.

4 RATIONALE BEHIND TOTAL QUALITY MANAGEMENT

There are many benefits which may be expected to flow from a policy of total quality management and which, therefore, help to justify its existence. The more significant of these include

- Improvement in product quality
- Improvement in product design
- Improvement in production flow
- Improvement in employee morale and quality-consciousness
- Improvement in product service
- Improvement in marketplace acceptance (Feigenbaum 1983:22);

The above benefits give rise to certain economic benefits, capable of being measured in monetary terms (Juran, 1988b:22.3; Crosby 1979:103; Feigenbaum 1983:114; Townsend 1986:708; Yager 1979:708). These include:

- reductions in operating costs and losses;
- reductions in after sales service costs;
- reductions in liability exposure;
- higher market share for the manufacturer.

After consideration of the preceding discussion on total quality management, it is evident that in discussing the justification for total quality management, attention must be given to the following two aspects. First, attention needs to be given to the reasoning underlying the need for increased quality of output. Second, the reason for increasing employee involvement in the organisation by decentralising the responsibility for quality must be investigated.

4.1 Increased Quality Products and Services

Many reasons have been advocated as justification for the production of quality products and services. These include increased customer demands for quality, cost considerations, survival, increased productivity and better return on investment.

4.1.1 *Customers Require Improved Quality*

The general consensus is that today's consumer, whether purchasing goods or services, is placing increasing attention on quality as well as price (Deming 1982:349; Edosomwan 1987:64; Feigenbaum, 1983:24; Gardner 1971:241-43; Juran 1988b:xi, 1 & 7.8; Lambert, 1972:35-40; SABS 0157, part 0:1; Shapiro 1986; Townsend 1986:3-5). This trend, according to Feigenbaum (1983:24) and Juran (1988a:1), is likely to be amplified by intense competition in the period ahead. As well as price, quality covering the intended life of the product is what ensures that customers will re-purchase from an organisation and hence ensure

future corporate viability (Deming 1982:349; Ishikawa 1985:96; SABS 0157, part 0:1).

Today's buyers recognise that the purchase price of a produ is only the beginning of the product's cost to the user and that the product's life cycle cost must be a major buyer consideration (Feigenbaum 1983:26). Based on this, customers increasingly expect a product that will provide its function/s satisfactorily and reliably over its intended life and expect the producer to ensure that this is in fact the case. In addition, buyers of products have increasing performance expectations of those products (Edosorwan 1987:64).

Several underlying causes are responsible for this trend of increased consumer demand for quality. Due to the great strides made by modern technology, products are increasing in complexity, whilst markets are becoming broader in scope and yet more functionally specialised in terms of the goods and services offered (Feigenbaum 1983:59). This means that there is increasing opportunity for error to occur, and hence the maintenance of quality standards, even at original levels, requires progressive increases in component-quality levels.

4.1.2 *Economic Survival*

An advantage over competition in the quality field can be a key to survival in the international and domestic marketplace (Edosomwan 1987:64; Feigenbaum 1983:xxi; Gregerman 1979:16; Harrington 1985:44; Ishikawa 1985:104-05; Juran 1988b:xi; Kane 1986:29; Main 1980:28; McMillan 1982:38). One of the reasons proposed for this is that quality can have a major effect on productivity and market share. The effect on market share is that effective total quality management results in the provision of a quality product that is economically produced (McMillan 1982:38).

Empirical support is given to the positive role of quality in building market share (Buzzell and Wiersema 1981:135-44). Buzzell and Wiersema found that competitors who increased relative quality, enjoyed much greater gains in market share than those whose quality ratings remained constant or decreased. Similarly, the work of Kume (1985:16) demonstrates that poor quality can lead to decreases in market share. This view is confirmed by the findings of Juran (1988:3.2 and 3.9-3.19). These findings are supported by Deming (1982:225), who believes that the production of poor quality goods or services will not result in consumers repurchasing. The long term effects of such action will be a reduction in market share.

4.1.3 *Productivity*

Competitive pressures are forcing many organisations to focus on ways to reduce costs of production and improve productivity, while increasing standards of quality. Total quality management is a way to realise these needs (Deming 1982:1; Edosomwan 1987:64; Hayes 1985:42; Ishikawa 1985:54-5; Moen and Nolan 1987:62; Nemoto 1987:22; Wolf 1983:116-23). The increase in competition, coupled with the inefficiencies faced by many industries, together with world-wide economic fluctuations, have shaved profit margins. At the same time, the need for automation and mechanisation have forced large outlays of capital. The resulting increase in plant investment, which must be paid for by increased productivity, has made the minimisation of reworks and warranty costs vital to the continuing success of many organisations (Edosomwan 1987:64-5; Feigenbaum 1983:59).

Improvements in quality can have a positive impact on productivity within the organisation, where productivity is regarded as the ratio of inputs to outputs in the production process (Deming 1982:2-12; Edosomwan 1987:64). The findings of research carried out by Garvin (1983:66-7) show that the highest-quality producers were also those with the highest output per man-hour. This strong association between quality and

productivity is not explained by differences in technology, but by increased efficiency.

Increases in what Townsend (1986:6) calls "quality in fact" can lead directly to increases in productivity. Productivity is increased because quality management offers guidance, based on quality experience in the development of new products and during the planning of production. This results in the design and development of products and services which encapsulate the needs and expectations of the final user. Total quality management further increases productivity by emphasising positive control of quality, rather than after-the-fact detection and reworking of failures. This results in less rework and reduced costs, as prevention is cheaper than cure (Deming 1982:1; Edosomwan 1987:64). The amount of saleable production that comes off the production lines is increased without a corresponding increase in production costs. Further, positive action taken in the incoming-materials area and the elimination of a specific station for inspecting all products frequently reduces the total manufacturing cycle time and increases the production rate of the manufacturing equipment itself. This comes about because defective purchased input materials are prevented from reaching the assembly line where they waste the efforts of skilled workers and expensive machines. Also, production is inspected while being produced, rather than being subject to a separate inspection process on completion of production. In short, error prevention leads to a reduction in rejects, product-recalls and product-reworks, without accompanying cost increases. This leads indirectly to an increase in productivity (Feigenbaum 1983:20; Juran 1988b:17.24; Main 1980:30).

Ishikawa (1985:54-5) differentiates between "quality of design" and "quality of conformance". If there is a discrepancy between quality of design and quality of conformance, it means that there are defects and/or reworks, which are costly. When quality of conformance improves, costs decrease. The effect on productivity comes about as follows. If one raises the quality of design, then

costs will rise accordingly. Similarly, if one relies on inspection to improve quality, then improved quality will increase costs. However, when quality of conformance improves, incidence of defects, reworks, scrap and adjustments decline, resulting in cost decrease and productivity gain. In addition, if quality of design matches consumer requirements, sales will increase (Ishikawa 1985:55).

Townsend (1986:7) however stresses that productivity is not quality. Quality encompasses productivity, but the converse is not necessarily true - productivity may be increased without an accompanying increase in quality.

4.1.4 *Costs*

A major downfall of many quality control practices, is that, although most quality failures continue to be discovered in the factory instead of after shipment, the techniques for finding them are often excessively costly and wasteful (Feigenbaum 1983:5; Juran 1988b:17.24). Further, products which may fail soon after being placed in service, have not always been detected in the factory. Such conditions cannot be tolerated by any industry striving to maintain and improve its position in today's increasingly competitive market place.

The costs of poor quality, including customer complaints, product liability lawsuits, redoing defective work, products scrapped etc. are often huge. Crosby (1979:101-08) and Juran (1988b:1) estimate that in most companies these costs run at about 20 to 40 percent of sales. Improvements in quality can, therefore, lead to a reduction of these costs (Juran 1988b:3.2).

Experience has shown that the major contributors to reductions in operating costs brought about by total quality management programs are cuts in both the internal and external failure costs. These are the costs associated with unsatisfactory quality within and outside the organisation respectively eg: scrap,

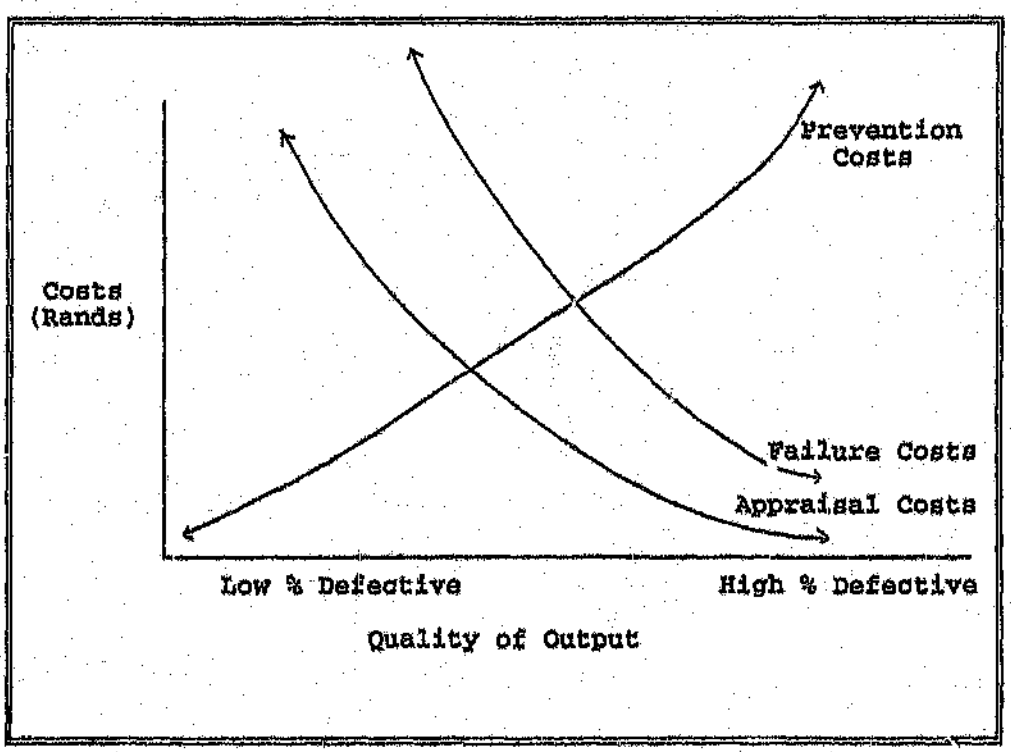
rework, product recalls etc. (For a discussion on these costs, refer to chapter four) (Feigenbaum 1983:112; Juran 1988b:4.8; Townsend 1986:128). This suggests that management should be investing a proportionality higher amount of money and effort on defect prevention, as opposed to quality testing and appraisal. The above phenomenon is explained as follows. The more defects or nonconformities produced in an organisation, the higher the failure costs. The traditional answer to higher failure costs has been more inspection, which of course increases appraisal costs. Now according to Feigenbaum (1983:113) and McMillan (1982:33) this tighter inspection has little effect with regard to the elimination of defects, as opposed to prevention. Some of the defective products are going to leave the plant and end up in the hands of unsatisfied customers. Appraisal costs thus stay up as long as failure costs remain high. And the higher these failure and appraisal costs go, the higher they are likely to go without successful preventative activity.

Feigenbaum (1983:113) and Kane (1986:29) suggest that the manner whereby this spiralling cost cycle could be reduced is by concentrating on preventative measures, whilst supporting the correct, modest amount of inspection. Where this is the case, an increase in prevention costs results in defect reductions, which in turn have a positive effect on appraisal costs because defect reduction means a reduced need for routine inspection and testing activities (Feigenbaum 1983:113; Kane 1986:29). Finally, when there is an upgrading of quality-control equipment, personnel and practices, an additional reduction in appraisal costs occurs. Improved inspection and testing equipment and procedures along with the displacement of many routine inspectors will have a positive downward pull on the cost of appraisal function. A further saving to be made from the decentralisation of quality responsibility is that the costs of a separate inspection department can be reduced (Juran 1988b:17.24). Thus, the effort spent on preventing failures is more than adequately paid for in reductions of other costs and increased customer satisfaction

with the product or service, and hence increased business (Feigenbaum 1983:113; Lomas 1986). The end result according to Feigenbaum (1983:113) is a substantial reduction in the cost of quality and an increase in the level of quality. Figure 6 provides a graphical illustration of the above concept.

Figure 6. The Quality Improvement Process and Resulting Quality Costs.

Source: Adapted from Juran 1988b:4.19.



The findings of Garvin (1983:67), Casbourne (1987:110) and Main (1980:30) support the above views. They found a strong association between cost and quality. Reducing field failures and factory defects through prevention results in lower warranty costs and reduces policing, inspection, rejection and rework costs. The argument that the quality savings might be offset by high expenditures on ensuring the production of a quality product

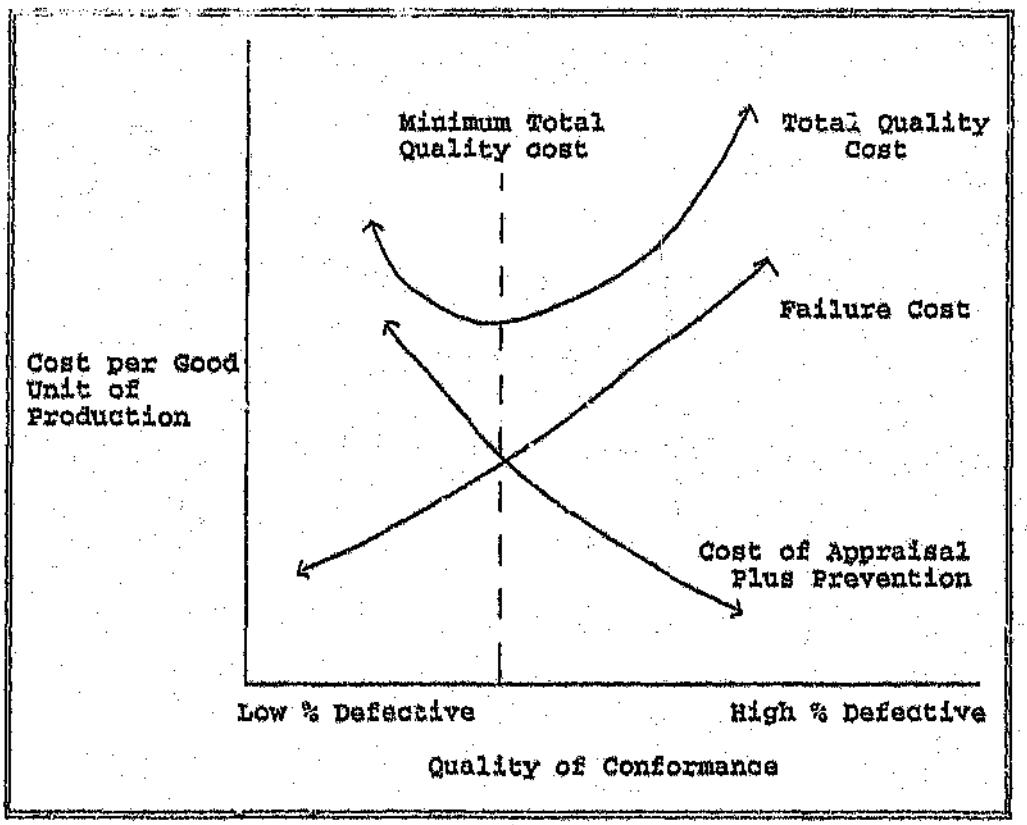
or service are found not to be valid (Garvin 1983:66-7). The reason Garvin (1983:66) put forward for this is that

> ...failures are much more expensive to fix after a unit has been assembled than before. The cost of the extra hours spent pretesting a design is cheap compared with the cost of product recall; similarly, field service costs are much higher than those of incoming inspection.

It has been advocated, however, that a point will be reached whereby an increase in prevention costs will not be compensated by accompanying reductions in other costs (Lomas 1986:216; McMillan 1982:33-4). This process is illustrated in figure 7.

Figure 7. Model of Optimum Quality Costs.

Source: Adapted from Juran 1988b:4.19.



Where minimal time and effort is spent on prevention and appraisal, many defective units are produced. The result is a high failure cost and hence a high total cost. As the percentage of defective units decreases because of the preventative measures being initiated and increased, the failure cost declines. Most importantly the total quality cost decreases until a minimum is reached (Lomas 1986:216; McMillan 1982:33-4). At this point, an increase in prevention costs will not be compensated by accompanying reductions in other costs. Beyond this point the total quality cost increases as it becomes more expensive to prevent further defects than the cost to tolerate them. Thus, while perfection is obviously the goal in the long run, it does not follow that perfection is the most economical goal in the short run, or for every situation. In certain industries and situations, the total cost curve may reach a minimum at a level short of perfection. It is important to note the optimum quality point, as to operate on either side of it is to forfeit profits which can be obtained by operating at the optimum point.

Juran (1988b:4.21) notes that in certain instances perfection, irrespective of the associated cost, should be the goal: These include:

- Industries producing goods that have a critical impact on human safety...
- Highly automated industries...
- Companies selling to affluent clients. These customers are often willing to pay a premium for perfect quality...
- Companies striving to optimise the user's cost... When the user's costs due to product failure are added to such models, the optimum point moves toward perfection. The same result occurs if lost sales income to the manufacturer is included in the failure cost...

These exceptions can make it economical to produce at 100 percent conformance. The reason is that the added sales value of perfect product more than offsets the added cost of attaining 100 percent conformance.

The following are some cost savings reported to have come from total quality management:

- Dow Chemicals (in Bemowski 1988:65) reported the following gains to flow from total quality management:
  - an almost 50% improvement in attendance
  - a 28% reduction in manpower
  - on-time shipment increased to 99.2%.

- Quality circle activities at Lockhead Missile in the United States (Cole 1979:76), are reported to have shown an estimated $120,222 a year cost saving.

- Improvements resulting from suggestions made by an employee group at Ford motor plant in Indianapolis resulted in the reject rate for parts processed through the valve-centering machines to be reduced by about 37% (Tavernier 1981:16). Further, Ford, according to customer surveys, credits its employee involvement plan as a contributing factor in the quality improvements on every single line of its 1981 vehicles (Tavernier 1981:16).

4.1.5 *Inventory Control*

The modern trend in inventory control, just-in-time inventory control (JIT), demands that inventory within an organisation be kept to a minimum. This is because superfluous supply forces an operation to tie up capital that could be invested elsewhere, drives up cost and destroys quality (McArthur 1984:65). The system is premised on consistently high quality. Should a quality problem arise, it needs to be corrected immediately due to the fact that the organisation holds no additional inventory. For the system to work, there is an inescapable pressure for both exposing and solving problems (McArthur 1984:67). The object of the system is to identify corrective action prior to the production of a nonconforming product.

According to McArthur (1984:65):

> JIT is inexorably linked to a preventative quality approach.

If parts, materials or components are to be delivered just before they are needed, the convenience of reworking or scraping unacceptable products is unavailable. JIT, therefore, relies on suppliers, both internal and external, supplying inputs which constantly meet the requirements of their customers.

4.1.6 *Return on Investment*

Management are in business to make a profit. As new capital and technology become more difficult and expensive to obtain, low cost and low risk investment in human resources (with its high potential return on relatively small investment), becomes more viable (Mills 1975:134). Experiences in the USA and Japan, indicate that positive returns on investment is the rule, not the exception, for quality improvement projects (Crosby 1979; Deming 1982; Feigenbaum 1983; Townsend 1986).

The above is confirmed by the research of Schoettler and Buzzell (1974:137), which demonstrated a positive relationship between quality and return on investment. Relatively good quality was found to yield a higher return on investment for any given market share.

In conclusion, the attainment and maintenance of satisfactory levels of customer satisfaction with the quality of products and services are today fundamental determinants for business health, growth, and economic viability, for reasons of improved productivity, decreased costs and increased market share (Edosomwan 1987:64; Feigenbaum 1983:5).

4.2 Increased Employee Involvement

Much attention has focused on the benefits to flow from involving subordinates in the decision-making process within the organisation, as does total quality management.

The case for increased employee involvement in the organisation has been the subject of debate for decades and has received its strongest support over the last ten years as part of the popular yet contentious "Japanese" management philosophy. According to Viljoen (1986:53)

> Worker participation involves the encouragement of employees to actively participate in making and implementing decisions which will directly affect their jobs. It allows employees to add to the planning, controlling and organising functions of their jobs in the belief that this will improve self motivation and will enhance both the performance of the individual and the company. This contention is based on the philosophy that employees are capable of creativity and self control and that they have a right to participate in decisions which affect their lives.

According to Barra (1987), in order to optimise improvements in product or service quality, management are going to have to involve all subordinates. The responsibility for quality is going to have to be decentralised and placed as close to the source of that quality as possible. As described by Townsend (1986:16)

> Traditionally, wisdom comes from the upper echelons of any corporate structure;procedures are devised and then defined for those lower in the ladder. The system applies at all points on the corporate spectrum. An employee, regardless of rank, listens "up" to learn and proclaims "down." It is a rigid, but conceptually simple, system, with the saving grace that it *appears* to work. It does not.

Management today recognises that in addition to subordinates being able to make valuable, direct contributions to the decision-making process, subordinate involvement in decision-making processes may provide many positive indirect spin-offs to the organisation. The more important reasons underlying the

decentralisation of quality responsibility are discussed below.

4.2.1 *Improved Decisions*

The quality of management decisions benefits from the impact of employees as interested parties (Johnson and Ouchi 1974; Juran 1988b:17.24; Vaughan 1983:319). This is because employees are actually involved in the production process and should have a valuable contribution to make as regards downfalls and improvements in this process (Candy 1982:45). With reference to quality improvement, at the heart of total quality management is process improvement. This is defined as "the continuous endeavour to learn about the cause-and-effect mechanisms in a process to change the process to reduce variation and complexity and improve customer satisfaction" (Moen and Nolan 1987:63). Improvements in quality are, therefore, based on an understanding of the processes, and hence should be decentralised to those involved in the processes (Cobb, in McClenahan 1981:73).

According to Stanton (1983:211), the traditional manager simply cannot come up with the number of high quality ideas that are required by the organisation. The participative manager can, because everyone has the opportunity to be involved in the thinking process. This is largely because people who do their jobs know their work better than anyone else and are thus more aware of how to develop ways to improve it (Marash 1989:122; Project Free Enterprise Report 1986:19-20).

4.2.2 *Better Commitment to Quality Improvement*

Much has been written on the use of subordinate participation and hence self control, as a vehicle for gaining commitment to quality responsibility at all levels in the organisation (Bradley and Hill 1987:76; Feigenbaum 1983:200 & 212; Gow 1980:18; Hall and Leidecker 1981:14-5; Ishikawa 1985:91; Johnson and Ouchi 1974:62; Juran 1988b:10.29; Kelly 1980:30; Russell and Dale 1989:11-2). Gow (1980:18) postulates that most Japanese employers

go about gaining employee commitment to the quality improvement, not by issuing a memo stating that it is a company objective, but by including the workforce in meaningful discussion and seeking their participation. In his review of the literature on the effects of subordinate participation, Melcher (1976) confirmed the above view of Gow (1980), when he concluded that participation in the decision-making process sharply increases the levels of commitment in the organisation. The basic mechanism by which this is achieved is the feeling of "meaningful contribution" and the ability to influence one's own "destiny" which accompanies a participative system (Juran 1988b:17.24; Likert 1967). Where employees are given the opportunity to influence decisions about their jobs, they will take more interest and pride in their work. More interest and pride means more quality (1986:9). Similar sentiments are expressed by Aubrey and Eldridge (1981:18), who conclude that

> ...people will take more pride and interest in their work if they are allowed to make meaningful contributions which influence decisions made about their work.

This view is confirmed by the Project Free Enterprise Report (1986:19), which states that

> ...the most effective means of gaining understanding and commitment to the process of business as well as ensuring personal development, is the encouragement of worker participation.

Not surprisingly then, the work of Johnson and Ouchi (1974:62) and Hall and Leidecker (1981:14-5) found that in the Japanese organisations with above average standards of quality (and productivity), management believe that change and initiative within an organisation should come from those closest to the problem, whatever the organisational level. These findings are confirmed by a survey undertaken in the U.S.A., which found that 84% of all employees interviewed believe that they would work harder and do a better job if they were more involved in their organisation's decision making process (Johnson 1984:101).

Nosow (1981:19) argues that the views that increased levels of participation in decision-making on quality improvement will result in better understanding and commitment to the quality improvement process are

> ...based on the basic principles of the research of Maslow, McGregor, Herzberg and McClelland and most other motivational experts; a worker must feel responsible for his or her own work and work quality. If this is not accomplished, then we will find no other practical solution for any motivation problem.

The mechanism whereby this operates is that employees and line departments must see these programs as their own, ones for which they take a considerable degree of responsibility (Deming 1982:318; Yager 1979:682). Commitment to quality improvement will be achieved through giving ownership of this process to line functions and employees (Alexander 1981:619; Gow 1980:18; Juran 1988b:10.19). Without this allocation of responsibility and commensurate authority, the required attitudes towards quality are unlikely to be fostered (Sargent 1986:30).

Research has shown that when employees perceive the quality improvement program to be management-directed, their level of commitment to it is less than when they perceive that they "own" the process (Sederberg, in McClenahan 1981:71; Neal, in McClenahan 1981:72). The findings of Bradley and Hill (1987:75-6) confirm the above findings. They found that in organisations where middle managers, (who were involved in quality circles), were given sufficient authority to take action on most issues raised by the circles, these managers were committed to the success of the circles. These managers felt that the quality circles were their property and that they would gain credit for any efficiency gains to arise out of quality-circle activity.

Not only will employee participation in the quality improvement field enhance their commitment to quality improvement, but it will also reduce resistance to the implementation of the decisions, because, presumably, all opposing views have been

heard and hopefully accommodated prior to the making of the final decision (Hatvany and Pucik 1981). The group decision creates commitment of most parties to the chosen solution (Bowen 1977:131; Candy 1982:45; Gregerman 1979:38; Nemoto 1987:27; Vaughan 1983:319). Therefore, in an attempt to gain the commitment of the entire workforces to the quality improvement process, they should be given some responsibility for decision-making within it.

4.2.3 *Increased Job Satisfaction*

Many authors hold that participation may result in increased levels of employee satisfaction and consequently improved motivation and enhanced productivity, as they are increasingly able to influence decisions affecting their jobs (Candy 1982:841-42; Deming 1982:2-12; Feigenbaum 1983:208-09; Ishikawa 1985:95-6; Johnson 1986:10; Vaughan 1983:319).

The research of Dickson (1980), Nurick (1982), Ritchie and Miles (1972), Richter and Tjosvold (1980) and West (1980) all indicates that the introduction of a participative technique may have a positive impact on job satisfaction and job attitudes. The importance of this is that central attitudes are to the quality improvement process, particularly attitudes towards preventative rather than corrective action. The findings of Rubinstein (1971:25-7) suggest that established participative forms of quality control may result in significant, positive attitude changes at all levels in the organisation. These findings are confirmed by the research of Milani (1975), who found a significant relationship between the extent of participation in a job and attitudes to that job. Further confirmation of these findings is provided by Nosow (1981:19).

A word of caution must, however, be added. Although there is much work which indicates that involving employees in decision-making may increase levels of satisfaction and improve decision-making, there has to date not been an exhaustive study to confirm the

above (Juran 1988b:10.7).

4.2.4 *Management Employee Ratio*

The importance of participative management in South Africa now and in the future is summed up by Manning (1987c:16), who estimates that the ratio of managers to non-managers in South Africa by the turn of the century could be of the order of 1:100.

As a result of this he comments:

> Managers will be hopelessly out-numbered. If they don't radically alter the way they work with people, they'll be out of control. If they cling to power, they'll lose power (Manning 1987c:16).

With the high ratio of employees to managers in South Africa, management need to provide employees with the opportunity for greater involvement in their work in order to maximise their efficiency and that of their employees. An unduly high employee-manager ratio puts undue pressure on managers, with the effect that they manage less effectively. Such a situation could have serious negative repercussions on the quality improvement process, where quality responsibility is centralised as opposed to decentralised.

4.2.5 *Labour Relations*

Participative forms of quality improvement are a means whereby employee-management relations can be substantially improved. Constant meetings and contact between management and employees provides an opportunity for each party to discover why the other party behaves as it does (Juran 1981c:60). As Kelly (1980:30) says:

> ...the essential relationships between people at work can only be developed through leadership at the local level.

The experience at the Ford Motor Company with regards to employee

involvement in quality improvement demonstrated a significant improvement in employee-supervisor and union-management relations (Tavernier 1981:16). Such an improvement can at the very least have no effect on quality improvement.

4.2.6 *Improved Internal Communication*

Efficient, effective internal communication is vital to the quality improvement process. Feedback of information on the progress of the quality improvement effort is important, for it is this which enables management and subordinates to identify problems and to take corrective action. Where feedback on the quality improvement process is slow or non existent, process adjustment and corrective action, which lie at the heart of total quality management, will be very slow. By decentralising quality responsibility and encouraging self-inspection, feedback on performance is immediate, thereby facilitating immediate process adjustments (Juran 1988b:17.24). For a more indepth look at the importance of the feedback loop to the quality improvement process, refer to Juran (1988b:chapter 17).

In addition, to ensure an understanding of its quality objectives, policies and practices, a corporation must maintain a two-way communication programme designed to inform employees and give them a means of expressing their views about the process. Such a programme should provide employees with information about the quality improvement process and their role in it (Von Essen 1988:6).

The effect of participative management on communication comes about not only through improved communication between employees and their subordinates at the same level in the organisation, but also as a result of interaction of employees on different levels within the organisation (Neal, in McClenahan 1981:73). For a more detailed discussion of communication in the organisation, refer to Bachanach and Aiken (1977); Basnett (1971); Berman (1986) and Manning (1987a).

For a more detailed investigation of the concept of employee participation, refer to Anthony (1978:3); Beach (1970:553); Douwes Dekker (1987:9); Human (1986:5); Miller (1977:139); Nurick (1982) and Walker (1975:436).

5 CONCLUSION

After a discussion of the various definitions of quality put forward by writers in the area, two important elements emerge which together constitute quality. The perceptions and expectations of the final user of the product or service determine the design requirements of the product or service. Once these design requirements have been identified, production requirements, based on the design requirements, are set and met. A quality product or service is, therefore, one of which the design incorporates the needs and expectations of the final user, and the production of which in turn conforms to the specifications and tolerances required by the design.

The production of quality products and services is becoming an increasingly important factor influencing the prosperity of individual organisations and national economies. Traditionally, the production of quality goods and services was seen as a function of the degree of post-production inspection. In an attempt to build on the downfalls inherent in this approach to quality improvement, total quality management was born.

Total quality management is an approach to quality improvement which is founded on the belief that quality should be built into products and services, rather than be treated as a post-production inspection function. Errors in production should be prevented, rather than corrected once they have been made. Under total quality management, the process of prevention is centred around employees being given responsibility for the quality of that which they produce. For this reason, subordinate involvement is central to this approach to quality improvement.

A number of reasons are advocated for the need to decentralise the quality improvement effort. These include the following, all of which have a positive impact on the quality of production or service produced within the organisation:

- First, by decentralising the quality improvement effort, employees assume greater responsibility for their jobs, which is likely to lead to increased levels of job commitment, specifically in the field of quality improvement.
- Second, the decentralisation of quality responsibility can have a positive effect on productivity. This comes about via the positive effect which it has on reducing costs incurred through rework and scrap, without incurring reciprocal cost increases. Productivity can further be increased through improved levels of employee motivation, which arise as employees are increasingly able to influence decisions affecting their jobs.
- Third, the decentralising of decision-making brings about improved and more accurate decision-making though the involvement in the decision-making process of those with job specific information.
- Fourth, increased levels of subordinate participation may result in increased levels of employee satisfaction and consequently improved motivation, as they are increasingly able to influence decisions affecting their jobs.
- Fifth, the decentralisation of quality responsibility has a positive effect on communication which comes about not only through improved communication between employees and their subordinates at the same level in the organisation, but also as a result of interaction of employees on different levels within the organisation.

CHAPTER THREE

THEORIES OF TOTAL QUALITY MANAGEMENT

1 INTRODUCTION

Various authors (Caplan 1980; Crosby 1979; Deming 1982; Feigenbaum 1983; Ishikawa 1985; Juran 1988b; Townsend 1986) have advanced theories on the subject of total quality management. This chapter presents a brief overview of the theories of total quality management advanced by Crosby (1979), Deming (1982), Feigenbaum (1983), Ishikawa (1985), Juran (1988b) and Townsend (1986). Whilst it is recognised that other theories of total quality management do exist, it is felt that these are the most prominent theories and overlap with most other theories of total quality management.

1.1 CROSBY, P.B

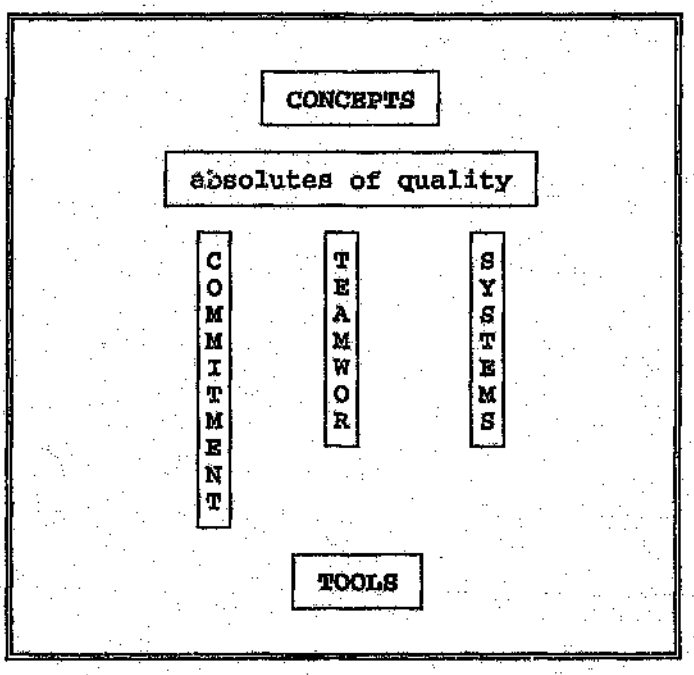
The works of Philip B. Crosby are contained in his books *Quality is Free* (1979) and *Quality Without Tears* (1984).

According to Crosby (1979:14), a quality product or service is one which "conforms to requirements". These requirements are determined through the interaction of a number of parties. The final user of the product or service has certain needs and expectations which must be satisfied. The design department within the organisation is responsible for designing a product or service which meets the requirements of the customer. Thereafter, the manufacturing department must ensure that the product or service which it produces conforms to the requirements determined in the design process. An error in any of the above processes will result in the production of a product or service which does not conform to specifications, initially determined by the end user. Thus, according to Crosby (1984:7), all "nonconformances" are caused, and anything that is caused, can be prevented. As he describes it, the organisation can be

"vaccinated" against nonconformance. Some of these "antibodies" are managerial actions, while others are procedural common sense. The preparation of this vaccine is discussed with the aid of figure 8.

Fig.8 The Quality Improvement Process

Source: Crosby and Associates 1989:39.



Concepts:

Crosby (1984:59-86) builds his quality program on the "four absolutes of quality", where the performance standard is "zero defects", the measurement of quality is the cost of quality, the system is prevention and the definition of quality is "conformance to requirements". The four absolutes are the concepts which are needed to transform the culture of the organisation to one which enhances and supports total quality management.

Table.1 The Four Absolutes of Management.

Source: Crosby and Associates 1989:11.

THE ABSOLUTES OF MANAGEMENT
Definition of quality: Conformance to requirements.
Systems: Prevention.
Performance standard: Zero defects.
Measurement: Cost of quality.

The First Absolute: The Definition of Quality is Conformance To Requirements.

According to Crosby (1984:59) quality improvement is built on getting everyone to "do it right the first time". In this regard, management essentially has three basic tasks to perform:

(1) establish the requirements that employees are to meet,
(2) supply the wherewithal that the employees need in order to meet those requirements, and
(3) spend much of its time in encouraging and helping the employees meet those requirements.

The Second Absolute: The System of Quality is Prevention.

The foundation of Crosby's approach is that defective work must be prevented before it appears, rather than dealing with it once it has occurred. Appraisal is very expensive and is always conducted after the fact, which means that the cause of the defect will not be addressed. The system of prevention allows for the identification and eradication of the factor giving rise to the defective output. For a more indepth look at prevention vs appraisal, refer to chapter two.

The Third Absolute: The Performance Standard is Zero Defects. Crosby (1979:1) states

> Quality is free. It's not a gift, but it is free. What costs money are the unquality things - all the actions that involve not doing jobs right the first time.

What Crosby is emphasising is that quality will not evolve naturally. Successful quality improvement requires active steps to make quality certain. Managers of any operation or function must take steps to improve quality in their organisation or department.

The first of these steps is the setting of performance standards. These performance standards are the device for ensuring that the organisation meets its quality requirements. For Crosby, the only acceptable performance standard is zero defects.

Zero defects is a performance standard which needs to be understood and met by all individuals within the organisation. It does not mean that one has to be perfect. It means that requirements must be met first time, every time, and that errors are not acceptable. Where zero defects is not met, the reason for this failure must be identified and rectified. Zero defects is an attitude of defect prevention.

The Fourth Absolute: The Measurement of Quality is the Price of Nonconformance.

Quality must be measured by calculating the cost of doing things wrong, or the "price of nonconformance". For a more indepth discussion of the price of nonconformance, refer to chapter two.

Crosby advocates that the absolutes of quality are realised through paying attention to the areas of "commitment," "teamwork," and "systems." These three areas in turn are addressed by Crosby's (1984:97-104) fourteen steps to the quality improvement process. These steps are illustrated in table 2.

Table 2. The Quality Improvement Process.

Source: Crosby 1984:99.

QUALITY IMPROVEMENT PROCESS
STEPS
1. Management Commitment
2. Quality Improvement Team
3. Measurement
4. Cost of Quality
5. Quality Awareness
6. Corrective Action
7. Zero Defects Planning
8. Employee Education
9. Zero Defects Day
10. Goal Setting
11. Error Cause Removal
12. Recognition
13. Quality Councils
14. Do it All Over Again

The fourteen steps in table 2 are clustered and classified further into three areas: Commitment, teamwork and systems.

Under commitment fall: Management Commitment.
Zero Defects Planning.
Zero Defects Day.
Do It All Over Again.

Contained in teamwork are:
Quality Improvement Teams.
Quality Awareness.
Employee Education.
Goal Setting.
Quality Councils.

Under <u>systems</u> fall: Measurement.
Cost of Quality.
Corrective Action.
Error Causes Removal.
Recognition.

Step One: Management Commitment.

According to Crosby, management commitment at all levels of the organisation is vital to the success of a total quality improvement process. Management are responsible for a number of actions. First, they must decide that they want a zero defects strategy, and must develop and announce a clear, specific quality policy to this effect. Second, their commitment to the zero defects concept and the quality improvement process must be displayed through action. In order for this to happen, management must:

- develop and communicate a quality policy;
- develop a comprehensive zero defects strategy to provide determination, education and implementation of quality improvement;
- establish an organisation to carry out the quality improvement process;
- ensure that every manager, and eventually every employee, understands and practices the absolutes of quality;
- provide the resources needed to ensure that quality is built into every function of the organisation;
- ensure that all management communication contains a message denoting their commitment to the zero defects policy, and explaining the policy;
- put quality at the top of the agenda.

For a more detailed investigation of management commitment, refer to chapter four.

Step Two: Quality Improvement Team.
The early establishment of a quality improvement team is vital to the success of the quality improvement process (Crosby 1979:152). This team will promote, supervise and coordinate the planning and implementation of the quality improvement process throughout the organisation. Team members will need to be formally trained to run the quality improvement process.

The quality improvement team is cross-functional, comprising of an administrative representative from each department or major area of operation in the organisation and an administrator. The members of the team would be nominated by department managers and approved by the senior executives. The chairperson would be selected by the team members. The quality improvement team will report to and receive its overall direction from a steering committee.

The objectives of the quality improvement team are (Crosby 1979:152-62):

- to provide the framework for the overall co-ordination of the quality improvement process;
- to provide a vehicle which can remove the roadblocks to quality improvement;
- to provide a formal communications medium to ensure that the quality improvement efforts are coordinated throughout the organisation;
- to ensure continuity of the quality improvement process.

The responsibilities of the quality improvement team are (Crosby 1979:152-62):

- to develop key quality related issues and a detailed strategy;
- to set a timetable for all quality improvement process activities;
- to establish the need for resources such as administrators, training programs, etc;
- to monitor results, and make adjustments where necessary.
- to assign each member the responsibility of overseeing one or more of the 14 steps;
- to develop a complete 14-step implementation plan. To meet regularly to administer the plan and review progress.

The responsibilities of each individual member of the team include (Crosby 1979:153):

- representing their department on the team;
- ensuring that the decisions of the team are executed in their department.

Step Three: Measurement.

The purpose of the measurement step is to provide a display of the current and potential nonconformance problems in a manner that permits objective evaluation and corrective action (Crosby 1979:169).

The objectives of the measurement stage are (Crosby 1979:169-78):

- to communicate openly that nonconformances exist;
- to establish an atmosphere that allows the honest reporting of errors;
- to ensure that all employees understand the purpose of measurement and the system used to provide for it;
- to help all departments understand their responsibilities to quality through the display of nonconformances;
- to document actual quality improvement as it occurs.

An important source of measurement data is provided by observations of actual rejections and the results of inspection. A more general form of measurement is provided by Crosby's (1979:21-34) Quality Management Maturity Grid. This grid provides management with a measure of the exact quality status of the organisation, and, depending on the present status of the organisation, recommend steps which can be taken to improve the position.

For a more detailed discussion on measurement, refer to chapter four.

Step Four: Cost of Quality.

The cost of quality is a management tool which is used to measure quality improvement. This facilitates the identification of which areas in the organisation need corrective action. The reduction of the concept of quality to a cost figure renders it intelligible to all. Crosby (1979:105-07) provides the following categories of costs:

1. PREVENTION COSTS
   These are the costs of all activities undertaken to prevent defects in design and development, purchasing, labour and other aspects of creating and initiating a product or service.

2. APPRAISAL COSTS
   These are costs incurred while conducting inspections, tests and other planned evaluations used to determine whether hardware, software or services conform to requirements.

3. FAILURE COSTS
   These are the costs associated with output which does not conform or perform to requirements. Included is the evaluation, disposal, and consumer-affairs aspects of such failures.

For a more detailed discussion on quality costs, refer to chapter four.

Step Five: Quality Awareness.

The purpose of this step is to raise the level of personal concern felt by all employees towards the production of quality products and services. An awareness of the importance of the quality reputation of the organisation needs to be engendered in the workforce. Employees will be made aware of the need, the status of the process and the continuous commitment of management to quality and quality improvement.

The objectives of this step are (Crosby 1979:181-91):

- to develop a plan to share information about quality, including need, status and successes;
- to establish a mechanism to encourage departmental meetings on a regular basis.

The quality awareness activity has two essential ingredients (Crosby 1979:182):

> - Regular meetings must be held between management and employees to discuss specific nonconformance problems and to attempt to arrive at some steps which can be taken to remove these problems. These meetings should not only be between workers and their supervisors but also between the supervisors and their managers... They must take place on a regular basis...
> - Information about the quality program must be communicated through posters, articles in the house organ, and special events. The purpose of this is to provide reassurance that the company is serious about the emphasis on quality and to keep the message constantly in front of the people...

Step Six: Corrective action.

Crosby (1979:65) has the following to say regarding measurement:

> It isn't what you find [that is important], it's what you do about what you find.

In other words, the measurement of quality alone is insufficient.

The results of the measurement process must be used to identify and resolve the causes of nonconformances.

The purpose of this step is to provide a systematic method of permanently resolving the problems that are identified through the previous action steps. Corrective action should operate on the Pareto Principle, which states that problems should be tackled in descending order of importance. Scrutiny and analysis of the various processes in the organisation are essential to corrective action.

Corrective action systems have to be based (1) on data that show what the problems are, and (2) analyses that show the causes of the problems. Once the root cause has been determined, it can be eliminated. The corrective action step thus involves studying existing processes in which problems have been identified, and making alterations to these processes in order to prevent the recurrence of the problem. The corrective action process involves all employees and external suppliers involved in the process under investigation.

Crosby (1979:67) suggests that one of the most effective ways of identifying the causes of defective output is the quality audit. The quality audit, is defined by Crosby (1979:67) as

> ...a planned examination of a function, carried out either by determining conformance to procedures in process or by critical analysis of the product or service that is the result of the process.

Step Seven: Zero Defects Planning.

The purpose of this step is to examine the various activities that must be conducted in preparation for formally launching zero defects day (see step-nine for an explanation of zero defects day).

A quality improvement task team, which reports to the quality improvement team, should be established to do the planning for

zero defects day. At least one representative of each department will sit on the task team.

Step Eight: Education.
The purpose of this step is to provide training to all employees within the organisation as well as the organisations external suppliers. This education will provide individuals with the tools and techniques to support their company's quality improvement process. Other objectives of the education process include (Crosby 1979:68):

- the provision of a common understanding throughout the organisation of the absolutes of quality management;
- ensuring that all employees are properly educated so they can effectively carry out their roles in the quality improvement process.

Crosby (1979:68) stresses that the education process is a continuous one beginning with top level management and working down through the entire organisation. Due to the central role played by management and team leaders in the quality improvement process, special, intensive education must be provided to them, since they will drive the process. For a more indepth discussion of education, refer to chapter four.

Step nine: Zero Defects Day.
The purpose of this step is the creation of an event which will make each employee realise that there has been a change of culture and attitude within the organisation and the extent to which management is serious about these changes. On zero defects day management publicly affirms its commitment to zero defects. This day is in essence a public relations exercise.

Crosby suggests that the signing of a pledge by all employees would enhance their commitment to the concept of zero defects.

Step Ten: Goal Setting.
The goal setting process can be initiated once measurements are established, and should be tied to the nonconformances revealed. It would involve the establishment of improvement goals by individuals and groups. Once goals are met, they should be publicised.

Step Eleven: Error Cause Removal.
Error cause removal will enable individual employees to communicate to management what obstacles impede upon their ability to improve quality. Error cause removal is not a suggestion system in that employees only need to identify the problems, they need not provide solutions to the problems. It is a formalised procedure that, when effective, provides a systematic way of identifying problems.

Step Twelve: Recognition.
Recognition is the means whereby rewards are given to those who actively participate in the quality improvement process. Crosby (1984:117-19) suggests that those who are to be recognised should be elected by their peers. Crosby stresses the importance of intrinsic rewards, since he feels extrinsic rewards are not entirely effective. For a more indepth investigation on rewards, refer to chapter four.

Step Thirteen: Quality Councils.
Through quality councils, professional quality people are regularly brought together. Their purpose is the provision of a forum in which the appropriate people can explore their understanding of the quality improvement process and communicate both successes and problems encountered. An added responsibility of the quality council is to provide feedback and make recommendations to the quality improvement team.

Step Fourteen: Do It Over Again.
This step emphasises that the quality improvement process is a continuous process. It involves the selection of a new quality

improvement team, since the retiring team often feels that there is little left to do in the quality improvement process and, therefore, it amounts to an injection of enthusiasm into the process. The new quality improvement team will start the whole quality improvement process again. This step involves two important elements, selecting a new team and reviewing present quality improvement activities.

Crosby (1984:136) does not insist that the fourteen steps have to be carried out in any particular order, with the exception of steps one and two. Education, for example, is seen as an ongoing process which needs to be undertaken right from the inception of the process. The following could be the order of events (Crosby 1984:136-37):

> 1. Determine the price of nonconformance.
> 2. Educate the senior management.
> 3. Select the quality improvement team and send them to receive education.
> 4. Lay out the improvement strategy.
> 5. Educate the other personnel internally....
> 6. While this is going on, we can establish the first six steps of the quality improvement process. This will lead us in choosing the building blocks of the necessary system analysis. The corrective action will then be to identify and eliminate the problems forever.

According to the above, the establishment of an environment which will facilitate improvement is primary. This is done through education, formalising management commitment and measuring nonconformances.

Since he focuses on first changing the management culture, Crosby's (1979) approach is clearly a top-down process.

It is evident that Crosby (1979) believes that the responsibility for quality does not lie with the quality professionals or the quality function within the organisation. The quality function is responsible for guiding the program. Training and motivation

are the main functions of this umbrella body. The execution of quality is the obligation and responsibility of all operators and employees. Quality improvement is therefore seen to be a line function with quality responsibility being decentralised. However, total quality improvement is a process which is directed and guided by management policies and actions. Managers at all levels of the organisation are responsible for removing the obstacles to and promoting the decentralisation of quality responsibility. In addition, there are a number of elements which are central to Crosby's theory. These are:

- the involvement in, and responsibility for, the quality improvement effort by all levels within the organisation;
- the constant measurement of the status and progress of the quality improvement effort. Any deviations from requirements should be highlighted;
- a continuous, company-wide education process, designed to enable all members of the organisation to fulfil their roles in the quality improvement process;
- recognition for participation and achievements in the quality improvement process;
- the setting up of processes designed to remove any factors responsible for quality not meeting requirements.

1.2 TOWNSEND.P.L

In his book, *Commit to Quality*, Townsend (1986) pays particular attention to quality improvement in a service environment. It will become evident that all theories of total quality management involve many of the same principles, regardless of the industry concerned.

Townsend (1986:4-8) sees quality as an organisation-wide concept. He argues that the prevention of defective output requires the decentralisation of responsibility for quality improvement to the point of production. According to Townsend, preventative quality improvement requires the involvement and commitment of the entire organisation and the prevention of nonconformances, requires the active participation of all those involved in production. For this reason, quality responsibility needs to be decentralised to each individual and department (Townsend 1986:53-7). The importance of quality to the organisation, and the fact that every employee influences quality, are motivating factors behind Townsend's belief that employee involvement should be compulsory (Townsend 1986:53-7). However, this philosophy of employee intervention is often seen as a threat by those whose commitment is crucial to the success of the process - middle management. These are the people who are required to lead, and, therefore, must be committed to, the process. According to Townsend (1986:172), those in middle-management positions

> ...will have to display a combination of faith in the process, faith in their subordinates, and the courage to be leaders rather than mere managers. A process can survive without them for a limited period, but there will come a time when a choice will have to be made - quality or obstinate managers.

According to Townsend (1986:7-8), the responsibility for ensuring total management commitment lies with senior management. He, therefore, views senior management commitment as the first and most critical requirement to the success of the quality improvement process (Townsend 1986:8). This is because the

quality improvement process since it is not a process is not simply going to unfold on its own, but needs to be driven and enabled. Senior management are responsible for ensuring that subordinate management understand and actively support the participative quality improvement process since the quality improvement process can only be sustained by a conducive organisational environment. A central determinant of this environment is the extent to which management elicit and allow decision-making to be decentralised throughout the organisation. The philosophy of the participatory quality improvement process requires that employees are actively involved in this process. Where management style resists this intervention, the process is unlikely to be sustained.

Townsend makes provision for the establishment of a mechanism for steering the quality improvement effort. This "steering committee" is responsible for the co-ordination of the quality improvement effort, and it must both lay the foundation for and guide the quality improvement process. In order to assume this responsibility, the steering committee should have the authority to substantially influence the direction and definition of the quality improvement process (Townsend 1986:12). Each department would have a representative on the steering committee (Townsend 1986:114). For a more indepth discussion on steering committees, refer to chapter four.

The steering committee cannot be expected to oversee the day-to-day functioning of the quality process. A chief mechanic will have to be chosen for this purpose. The chief mechanic and his trained team will track the progress of the work teams. The chief mechanic should be the most obvious and visible proponent of, and spokesperson for, the quality improvement process. The main task of this team will be to ensure the continuity of the process and, the practical application of the theory defined by the steering committee.

Townsend (1986:20) suggests that a network of quality teams,

called "value teams", should be established, with each employee belonging to a team. The teams should average ten members, and shadow the traditional organisational structure. Preferably, value teams should be composed of people who work in the same area. The team leader would either be the normal leader of that work area or one of the team members, as voted for by the team. Team leaders would also be members of the quality team that is at the next structural level. The value teams would promote contact within the same hierarchical level and between different hierarchical levels.

Townsend (1986:20) recommends that these teams should not only consider how to "do it right"(streamline existing processes), but should also consider "doing the right thing". This involves the analysis of existing processes to ensure that they are effective and efficient. The analysis of existing processes will take place in all departments, irrespective of whether or not a problem with existing processes is envisaged. This is referred to as the "quality has value process". Each team is given autonomy in terms of the implementation of changes which fall within their jurisdiction, since the responsibility for defining and solving a problem cannot be separated from the responsibility to implement the solution. The mechanisms for the implementation of solutions differs from the quality circle approach which involves presentations to management, followed by approval, followed by implementation. The quality team approach is (1) to define the area to be improved, (2) implementation of the improvement, (3) notification of implementation, and (4) certification (Townsend 1986:59). In short, by virtue of the fact that value teams are responsible for identifying and implementing solutions, they are given ownership of the process. The delegation of this responsibility relies on management trust of their subordinates.

It is, therefore, evident that Townsend (1986:61) believes that one of the most important philosophies of the team approach to quality improvement is an emphasis on low level decision-making.

However, before any individual can be involved in the quality improvement process, he/she needs to be trained for their new role. Training is needed both in preparation for the process and in order to sustain it. Management needs to receive training in order that they understand and are committed to it and so that they are able to rally the support of those reporting to them. Management also need to be trained in the new role which they are to perform, namely one of consultation and involving their subordinates in decision-making. Team leaders also need to receive training for the new role which they are to occupy. Townsend (1986:56) suggests that because of the vast resources required to train every employee, team leaders should be used to do this training. They, therefore, need to be trained for both their leadership role and their training role. They need to be exposed to a course which will teach them to conduct participatory meetings and to guide a group through systematic problem solving. Employees must also be subject to training, as it will provide them with an understanding of their role in the quality improvement process and equip them to fulfil their responsibility to the process.

Townsend (1986:2) suggests that it is possible to measure quality, and that this should be routine in every organisation. One element of measurement which he (Townsend 1986:14) sees as vital to the quality improvement process is the cost of quality. For an indepth study on the costs of quality, refer to chapter four.

Measurement without ensuring action is seen by Townsend to be a waste of resources. He believes that the findings of the measurement process must be used to identify and remove the causes of any problems, actual or potential. Further, the process of measurement may be used to identify individuals or teams who, due to their achievements in the quality improvement process, should receive some recognition.

This recognition includes both intrinsic and extrinsic

recognition, that is, both public acclaim and honour, and monetary incentives such as a percentage of any savings realised (Townsend 1986:77-8). Townsend (1986:60) stresses that, given the compulsory nature of the quality teams, recognition needs to exceed the satisfaction which comes from controlling ones own work environment and the interaction with management. The purpose of recognition for involvement and accomplishment is twofold. First, to recognise and acknowledge achievement and participation and second, to provide an incentive for future participation and achievement.

In order for the recognition program fully to realise its potential, all participants have to be aware of the requirements which need to be fulfilled so that certain rewards are forthcoming (Townsend 1986:85-7).

In conclusion, Townsend's (1986) theory on total quality management centres on the prevention of defects through the decentralisation of quality responsibility. The decentralisation of responsibility in turn requires a number of actions, including:

- the adoption of a participative style of management by all levels of management;
- training directed at quality improvement;
- the establishment of quality improvement teams;
- the establishment of a steering committee to oversee the quality improvement process;
- monitoring the progress of the quality improvement process through the calculation of a cost of quality.

1.3 JURAN.J.M.

Juran's (1988b) approach to quality improvement focuses on management leadership and organisation, as opposed to statistical tools and techniques (Lodge 1989:118). Juran's thoughts on total quality management are contained in his books, *Juran's Quality Control Handbook* (1988b) and *Juran on Planning for Quality* (1988a).

According to Juran (1988b:2.6), managing for quality improvement is done by means of a "quality trilogy" consisting of three managerial processes: planning, control and improvement.

Quality planning is the process of developing products and processes required to meet customers' needs. It involves a series of universal steps (Juran 1988b:2.6):

- Determine who are the customers.
- Determine the needs of the customers.
- Develop product features which respond to customers' needs.
- Develop processes which are able to produce those product features.
- Transfer the resulting plans to the operating forces.

Quality control is a process used by the operating forces as an aid to meeting product and process goals. It is based on the feedback loop, and consists of the following steps (Juran 1988b:2.6):

- Evaluate actual operating performance
- Compare actual performance to goals
- Act on the difference

This quality improvement process aims to attain levels of performance which are significantly better than any past level.

When such levels of performance are attained, Juran (1988b:5.20) refers to the process as a "breakthrough". The quality improvement process is composed of a sequence of activities (Juran 1988b:22.6-22.12):

- awareness: Awareness is the phase of convincing managers that there is a need to do something different with respect to quality;
- setting goals: Goals for the quality improvement process must be set. These goals should be set at an organisation level and at department level and should provide the basis against which the quality improvement program can be measured;
- organising the overall program: This involves a number of activities, all of which are dependent on top management support and involvement.

Juran (1988b:2.4) defines quality as "fitness for use". Fitness for use is the extent to which a product or service successfully serves the needs of the user, internal or external, during usage. For a more indepth discussion on Juran's definition of quality, refer to chapter two.

The entire cluster of activities through which fitness for use is achieved, irrespective of where these activities are performed, are contained in Jurans (1988a:6) quality spiral (see figure 4, on page 21).

The spiral shows a typical sequence of activities for putting a product or service on the market. The first turn of the spiral of progress starts with product research and development to create an improvement in fitness for use. At the end of that turn the experience of use creates new ideas which start a new turn of the spiral for further achievement. The more important stages in the cycle include:

1. Market Research

Market research for the quality parameter is needed (a) for the development of new products and (b) for monitoring the performance of current products (Juran 1988b:12.2). The main purpose of this step is to identify user needs, to query if they are being met, and if not, to determine why not. The information gathered during this stage amounts to the identification of customer requirements, and is used in the next step of the spiral - product development.

2. Product Development

Product development relates to the process of translating the needs of the user (learned from market research), into a set of product design requirements for manufacturing (Juran 1988b:13.2). This activity is also called product development, research and development, engineering or design. Market research identifies the requirements, and it is the role of product development to develop a product which meets those requirements. According to Gryna (in Juran 1988b:13.3) there is increasing evidence that many fitness-for-use problems can be traced to the design of the product. For a more indepth discussion of product development, refer to Juran (1988b:13.1-13.78).

3. Supplier Relations

The quality of items purchased for use in the production process is very important as it will directly impact on the quality of the final product. Where the quality of purchased materials is poor, either inspection costs or after sales failure rates will be unnecessarily high (Juran 1988b:15.2).

The overall objective is the creation of a relationship with a supplier that guarantees that the purchased goods are of sufficiently high quality to ensure that a minimum of incoming inspection or corrective action is needed. The primary activities concerned are (Juran 1988b:15.3):

- Define product and program quality requirements
- Evaluate alternative suppliers
- Select suppliers
- Conduct joint quality planning
- Cooperate with the supplier during the execution of the contract.
- Obtain proof of conformance to requirements
- Certify qualified suppliers
- Conduct quality improvement programs as required
- Create and utilise supplier ratings

For a more detailed description of supplier analysis refer to Juran (1988b:15.1-15-44).

4. Manufacturing Planning.

Manufacturing planning refers to the sum of activities which place a factory into a state of readiness to meet quality and other standards (Juran 1988b:16.2). A major objective of these activities is defect prevention.

Manufacturing planning begins with the examination of the design concept to identify alternative approaches to manufacture. It ends when all is in readiness for the factory personnel to take over and produce (Juran 1988b:16.3).

The major planning activities include (Juran 1988b:16.4):

- Review design for clarity of specifications and for producibility; recommend changes
- Choose process for manufacture: operations, sequences
- Provide machines and tools capable of meeting tolerances
- Provide instruments with accuracy adequate to control the process
- Provide manufacturing information: methods, procedures, cautions
- Provide systems of quality controls: data collection, feedback, adjustment
- Define responsibilities for agreed pattern of quality
- Select and train Production personnel
- Prove adequacy of planning: tryouts, trial lots
- Provide protection for material during handling and storage
- Provide proper environment
- Provide system for disposition of nonconforming product

For a more indepth study of manufacturing planning, refer to Juran (1988b:16.1-16.59).

5. Production

Production is the activity of running the processes, machines and tools, and of performing the associated mental and manual operations to make products from basic materials and components (Juran 1988b:17.2).

Juran (1988b:17.4-17.5) emphasises the importance of having decisions and actions related to quality under the control of the production workers themselves. However, the creation of such a state of "self-control" requires that certain essential criteria must be met (Juran 1988b:17.4-17.5). Employees must be provided with a means of:

- Knowing what they are supposed to do
- Knowing what they are actually doing
- Regulating the process

The three basic criteria for self-control make possible a separation of defects into categories of controllability. The most important of these categories are "worker controllable" and "management controllable". If all three criteria for self control have been met, a defect or nonconformity is the responsibility of the worker, since it is considered to be "worker controllable". A defect or nonconformance is considered management controllable or managements responsibility if one or more of the criteria for self-control have been met.

The theory behind these categories is that only management can provide the means for meeting the criteria for self-control. Hence, any failure to meet these criteria is a failure of management, and the resulting defects are, therefore, beyond the control of the workers. Juran (1988b:17.5) notes that this needs to be qualified. Workers have a duty to call management's attention to deficiencies in the system of control. Thus, the extent to which workers can be made responsible for their own quality depends on the extent to which their jobs are in a state of self-control.

Juran (1988b:17.24-17.25) lists certain requirements which must be met prior to the adoption of self-inspection:

1. Quality must be the number 1 priority within an organization. If this is not clear, the worker may succumb to schedule and cost pressures and classify, as acceptable, products that should be rejected.
2. Mutual confidence is necessary. Managers must have sufficient confidence in the workforce to be willing to entrust to them the responsibility of deciding whether the product conforms to specification. In turn, workers must have enough confidence in the management to be willing to accept this responsibility.
3. The criteria for self-control must be met. Failure to eliminate the management-controllable causes of defects suggests that management does not view quality as a high priority, and this may bias the workers during inspections.
4. Workers must be trained to understand the specifications and perform the inspection.
5. Specifications must be unequivocally clear.

6. Workers should understand the use that will be made of their products (internally and externally) in order to grasp the importance of a conformance decision.
7. The process must be of a nature which permits assignment of clear responsibility for decision making...

6. Inspection and Test

By inspection is meant evaluating the quality of some characteristic in relation to a standard (Juran 1988b:18.4). Inspection cannot ensure quality, is can only determine whether or not products conform to specification, and where variation occurs, to identify reasons for this. Juran (1988b:18.25) states that the extent of inspection will depend on the amount of prior knowledge on the product eg: control charts, audits etc. Inspection consists of the following actions (Juran 1988b:18.4):

1. Interpretation of the specification
2. Measurement of the quality of the characteristic
3. Comparing 1 with 2
4. Judging conformance
5. Disposing of conforming cases
6. Disposing of nonconforming cases
7. Recording the data obtained

Juran considers inspection as part of a preventative approach to quality improvement, rather than as the sole means to ensure quality. As the causes of defects are identified and removed, through, amongst others, inspection, inspection costs can be reduced. This reduction in costs can take several forms (Juran 1988b:18.109):

1. Use sampling instead of sorting.
2. Transfer inspection to the production operators while retaining an audit.
3. Use test data from suppliers to abolish incoming inspection. Assurance is provided by an audit.

For a more indepth study of inspection and test refer to Juran (1988b:18.1-18.115).

7. Marketing Phase

This phase of the Spiral of Progress is concerned with the process of persuading customers to buy products for reasons related to product quality (Juran 1988b:19.1). This step forms part of the broader marketing activity which affects all steps on the spiral. For a more indepth study of marketing, refer to Juran (1988b:19-19.18).

8. Customer Service

This section concerns post-production activities. These activities may be classified into "pre-use" and "use" phases (Juran 1988b:20.2). After production and prior to customer use of the product, is the pre-use phase, which includes activities such as packing, shipping, receiving and storage. The use phase includes activities such as installation, checkout, operation and maintenance.

Juran (1988b:20.18-20.34) recommends the establishment of a corrective action system to identify and correct the actual cause of product failures, either in the pre-use or use stage. The main steps of this system involve, first, information collection, through the use of field and in-company reports (on failures of complaints), second, information processing (designed to identify the actual cause of the complaint or failure), and lastly corrective action. For a more indepth study of customer service, refer to Juran (1988b:20-20.36).

9. Administrative and Support Operations

According to Juran (1988b:21.2), activities which only have an indirect influence on quality, such as those carried out by administrative departments, must be included in the quality improvement process. For a more indepth study of administrative and support operations, refer to Juran (1988b:21-21.22).

In large organisations, the above activities are departmentalised. As a result, each department carries out an operating process, produces a product, and supplies that product

to other departments (their internal customers) or clients (external customers). The result is that each department within an organisation will be both a client and a supplier.

A company-wide quality function arises from the fact that product quality is the work of all departments (Juran 1988b:2.4). Each department not only has a responsibility to carry out its special function but also has a responsibility to do its work correctly. This is due to the fact that the output of each department will be the input of another department.

An important element of the spiral is that it is a process, indicating the continuous nature of quality improvement, as opposed to the static nature of quality control. Juran (1988b:5.2) refers to the continual improvement of quality in terms of a "breakthrough", as opposed to control.

Central to Juran's theory is the principle of prevention as opposed to inspection (Juran 1988b:ch9). The mechanism whereby this is ensured is quality assurance. Quality assurance is intended to provide protection against quality problems through early warnings of trouble ahead. Such early warnings play an important role in the prevention of both internal and external problems. These early warnings take two major forms (Juran 1988a:264):

- quality audits and;
- managerial reports.

A quality audit refers to a review of performance. This review is conducted independently, which means that it is conducted by persons who bear no close responsibility for the performance under review. A managerial report consist of periodic, structured summaries by management of what is taking place with respect to quality in the various departments within the organisation.

The quality control department has traditionally been responsible for all aspects of quality, such as inspection, testing,

information, auditing, quality engineering, documentation control etc., within the organisation (Juran 1988b:7.3-7.5). Juran (1988b:7.6) recognises, however, that such an approach is outdated and inefficient. The modern trend is toward assigning quality management work elements to the functional line departments, rather than the quality departments. The role of the quality department will thus be reduced to one of co-ordination and overseeing the quality improvement effort. The reasons for this shift are (Juran 1988b:7.7-7.9):

- the need to increase the expertise in carrying out the quality related work elements;
- the quality department generally had the expertise, but lacked the authority to apply it.

Juran (1988b:7.6-7.7) stresses that such shifts in responsibility must be preceded by training to qualify the line personnel to be able to perform the newly assigned work. Quality training is central to the process of quality improvement.

This trend to decentralise quality responsibility does not result in the redundancy of the quality department. In the absence of some recognised organisation mechanism for assuring co-ordination, it is easy for departments to emphasise departmental results to the detriment of company results. This is the prime responsibility of the quality department within the organisation (Juran 1988b:7.21-7.22). The quality department will pass over responsibility for certain aspects of quality once it perceives that the line department is in a position to take charge of this responsibility itself. It, therefore, has an important role to play as regards developing new quality improvement techniques, handing these over to the line departments, and then withdrawing to the role of providing a consulting service. According to Juran (1988b:7.32), a vital element of this process is that responsibility for operations rests with line management, not staff management. For this reason the line managers must be given the discretion to either accept or reject the advice of the

quality department. As Juran (1988b:7.32) puts it

> If managers are to be held responsible for results, they should have authority over the means for obtaining those results. To require them to accept staff advice is equivalent to transferring part of that authority to the staff (a form of authority without responsibility).

According to Juran's (1988b:7.28-7.31) concept of the "product life cycle of staff quality activities", a staff quality department is able to live on despite continuous transfer of its activities to line departments. It does this by, first, continuing with the development of new products (concepts, tools or techniques), which, once fully developed, and once relevant training is given to the people concerned, will be passed on to the line department and second, through acting in an advisory capacity to the line departments. For a further discussion of the above principles, refer to Brown (1971:161-68) and Juran (1988b:ch7).

In addition to the quality department, Juran (1988a:250) recommends the establishment of a company-wide quality committee. The main purpose of such a committee is to give the quality improvement process direction and guidance. The roles of the committee are:

- to co-ordinate the establishment of quality goals in the organisation;
- to co-ordinate the preparation of plans to carry out the goals;
- to review actual progress against these goals;
- to co-ordinate the administration of the reward system for goal achievement;
- to create the infrastructure required to run the above system.

A further element of total quality management given considerable attention by Juran (1988b, ch7) is the identification of quality responsibility for every aspect of the organisation. He

(1988b:7.25-7.28) recommends the use of a responsibilities matrix as a means to summarise quality responsibilities within the organisation. The minimum information required in order to adhere to quality assurance systems is to know who must do what. This system will tell the individual at a glance what he is responsible for doing and will guide him in locating supplementary information on how, when and why. This information is provided by a responsibilities matrix. The matrix of quality-related responsibilities can be defined as a tabular document, forming the core of the quality assurance system, and which lists the basic responsibilities, authorities and co-operating tasks of each discipline in the organisation. Initially, most of the information is aimed at middle-management level and above. The responsibilities matrixes can then be made more specific, for use at departmental levels. For further reading on responsibility matrixes, refer to Juran (1988b, ch7).

As regards the tools required for quality improvement, Juran (1988b) acknowledges the importance of statistical methods, particularly in process improvement and process control. He stresses that statistical methods are not a cure-all, and need to be regarded as part of an integrated approach to quality improvement. He warns against relying solely on statistical methods as a means to quality improvement (Feigenbaum et al 1984:34). For a more detailed discussion of the role of statistics in the quality improvement process, refer to Juran (1988b:23.1-24.40).

In conclusion, three major concepts emerge from the work of Juran (1988a) and (1988b). The first is the quality spiral, which indicates the total quality concept. The second is that of a management breakthrough. The third is that of self control, based on the role of management in attaining the breakthrough.

The quality spiral conveys two messages. The first is that quality is a total approach. There are certain steps which have to be executed in striving to produce a quality product.

The quality of output can only be as good as the weakest link in this chain of steps. One could have the best quality of design, but with a poor quality of manufacture, quality of the final product would be poor.

The second message is that quality is a continual process. The organisation has to move continually through the spiral to ensure fitness for use.

According to Juran, the prime objective of total quality management is the production of quality products and services, through the decentralisation of quality responsibility. The successful decentralisation of quality responsibility relies on the workforce being placed in a state of self-control. Once, and only once, employees are placed in a state of self control will management be able to hold them entirely responsible for the quality of their output.

1.4 FEIGENBAUM. A.V.

Feigenbaum's thoughts on total quality management are contained in his book *Total Quality Control* (1983).

According to Feigenbaum (1983), the quality program of an organisation must be integrated into the management system of the organisation. He sees quality as a way of managing the organisation. Feigenbaum (1983:83) views total quality improvement is a management philosophy which needs to be driven and enabled by a deliberate set of management activities. These activities amount to the creation of an organisation environment in which total quality improvement will thrive. Management's actions should be such that every employee understands, is capable of, and encouraged to meet their responsibility toward the total quality improvement process. In short, management are responsible for creating the required quality attitudes and the environment necessary to sustain the quality improvement process and the provision of resources to ensure both of the above. This conceptualisation of the organisation, coupled with the many complexities encountered in managing an organisation, make it logical for Feigenbaum to approach the quality improvement process in a systematic and co-ordinated manner. This he does through adopting a systems approach to total quality management. This approach organises the total spectrum of quality and quality related activities that are needed to achieve customer satisfaction into subsystems and elements. It thus becomes possible visualise how the quality activities interlink with each other.

Feigenbaum (1983:149) is of the opinion that the establishment

of a successful program of total quality management requires the

establishment of what he calls "total quality organisation". This involves three steps:

> The first is the identification and conformation of the specific quality work and teamwork-including the responsibility, authority, accountability, and relationships for quality-of each of the key individuals and groups in the company and plant.
>
> The second consederation is the identification and confirmation of these same areas for the quality-control function itself so that it may help the company achieve its quality objectives.
>
> The third consideration is the leadership of company and plant management itself in the establishment and ongoing maintenance of quality organizatica.

The basic managerial and technological foundation for the work and interrelationships of this organisation is provided by what Feigenbaum (1983:77-90) calls the "quality system" of the organisation. The purpose of the system is to initiate, record and drive all the key activities required to ensure the success of the total quality management process in the organisation (Feigenbaum 1983:77-8). Feigenbaum (1983:78) defines the quality system as

> ...the agreed companywide and plantwide operating work structure, documented in effective, integrated technical and managerial procedures, for guiding the coordinated actions of the workforce, the machines, and the information of the company and plant in the best and most practical ways to assure customer quality satisfaction and economical costs of quality.

According to Feigenbaum (1983:78), in the absence of such a quality system, quality can be a consequence rather than the result of carefully planned objectives and activities.

He argues (Feigenbaum 1983:78-80) that strong quality systems provide a management basis for effective prevention orientated

control. Feigenbaum (1983:92) describes the systems management objective as one which is

> ...to make the quality system for the plant and company the most effective work pattern of people, machines, and information for assuring customer quality satisfaction and minimum quality costs throughout the entire customer-order to customer-delivery scope of the key quality activities of the plant or company.

The hallmark of Feigenbaum's (1983) quality system is therefore twofold:

- its effectiveness in providing a strong foundation for the management of quality;
- it represents an attitude to quality - that quality is something which should be built into the product and that quality is a continuous work process.

Feigenbaum (1983:94-109) lists the key system activities (for total quality management) as follows.

- Preproduction quality evaluation, which involves the establishment of procedures to formally analyse both the product design process design. This is done in order to ensure that the resultant product will fulfil the customer's requirements and expectations. This evaluation is undertaken with final user conditions in mind. During this evaluation stage, any unsatisfactory elements identified must be noted. This facilitates the taking of corrective action. The advantage of preproduction quality evaluation is that quality problems and potential future failure costs may be ironed out prior to the manufacture and sale of the product.

- Product and process-quality planning. Before production starts and during the product and process designing phases, plans must be formalised to measure, attain and control the desired product quality. This requires an analysis of product quality requirements, to determine quality needs and expectations. In addition, this process will determine which quality characteristics should be measured, how they should be measured,

to what extent measurement should be undertaken and what the acceptable quality limits should be. This process amounts to the setting of acceptable quality standards. Measurement is necessary to provide an indication of when and where corrective action is necessary. The measurement process also facilitates the monitoring of the progress of the quality improvement effort.

• Purchased-material quality planning, which provides the procedures to control incoming purchased materials. This process relies on constant communication with suppliers. The purpose of this communication is to ensure that suppliers are aware of the quality requirements of the organisation. In addition, it provides feedback to the suppliers as to the extent to which their materials are meeting quality requirements and aids the supplier in pinpointing the sources of any nonconformance.

• Product and process-quality evaluation and control. This step establishes the procedures for implementing the product-and process-quality plans. The major thrust of this step is the implementation of the various evaluation and control procedures which are used to ensure conformance to quality specification. These procedures are used for the day-to-day control of quality.

• Quality information feedback, which involves the establishment and implementation of procedures to analyse the information needs of all involved in the quality improvement process, both internal and external to the organisation. These parties include suppliers, purchasers, production-control people, designers, planners, management and customers. When analysing information needs, areas addressed include content, frequency and permissable time delay of information.

• Quality training, orientation and workforce development, which develops the procedures to provide the means for developing the "people capability" required to optimally participate in and understand the quality improvement process. This training and development involves the entire workforce and is a continuous

process. The purpose of this phase is to provide the attitudes, knowledge and understanding required to participate in the quality improvement process. In addition, the education process must define the individual's role in the quality improvement process and provide the tools and knowledge to fulfil their role in this process (Feigenbaum 1983:200-06).

Feigenbaum (1983:215-16) stresses that different training is required by management and employees. For a more indepth discussion of this training refer to chapter four.

- Post-production quality service, which involves the establishment of post-production procedures to ensure customer satisfaction. This process provides an important source of information to the organisation regarding the nature and causes of product failures or of failure to meet customer expectations. This information will then provide the basis on which corrective action can be taken.

- Special quality studies, which provide the procedure and techniques for identifying specific solutions for specific quality problems.

From the above discussion, it is possible to classify the quality improvement process as seen by Feigenbaum (1983) into four categories, "new design control", incoming material control", "product control" and "special process studies" (Feigenbaum 1983:65-8):

- New-design control.

This concept is contained in the following definition by Feigenbaum (1983:65):

> New-design control involves the establishment and specification of the necessary cost-quality, performance-quality, safety quality, and reliability-quality for the product required for the intended customer satisfaction, including the elimination or location of possible sources of quality troubles before the start of formal production.

• Incoming-Material Control.

As described by Feigenbaum (1983:67), incoming-material control involves the

> ...receiving and stocking, at the most economical levels of quality, of only those parts whose quality conforms to the specification requirements, with emphasis upon the fullest practical vendor responsibility.

• Product Control.

According to Feigenbaum (1983:67)

> Product control involves the control of products at the source of production and through field service so that departures from the quality specification can be corrected before defective or nonconforming products are manufactured and the proper service can be maintained in the field to assure full provision of the intended customer quality.

• Special Process Studies.

Special process studies are directed at product and process improvement, not only in improving quality characteristics but in reducing quality costs.

In order for the employees of an organisation to implement their individual responsibilities towards quality improvement, they have to draw upon aspects of a body of disciplines which Feigenbaum (1983:231-300) collectively refers to as the "engineering technology" of quality. This is a group of disciplines required by the workforce at every stage of the production process. The technology disciplines highlighted are "quality-engineering technology", "process-control-engineering technology" and "quality information equipment engineering technology."

1. *Quality-Engineering Technology*, is defined as (Feigenbaum 1983:234):

> The body of technical knowledge for formulating policy and for analyzing and planning product quality in order to implement and support that quality system which will yield full customer satisfaction at minimum cost.

The range of techniques used in quality-engineering technology may be used for: quality objective definition, feedback, quality policy formulation, quality system organisation and management, policy documentation and product analysis. The actual techniques may be grouped as follows:

- Formulation of policy. Included here are techniques for identifying quality objectives and the quality policy of the organisation. This serves as a foundation for quality analysis and system implementation. A clear quality policy is seen by Feigenbaum as being vital to guiding the entire organisation-wide quality improvement process.
- Product-quality analysis. Techniques for analysing include those which identify the factors that relate to the quality of the product or service in its served market. These factors are then studied so as to produce a product or service which meets the expectations of the final user. Typical factors would include user needs, vendor evaluation, cost optimisation, measurement, etc. These factors are listed according to their relative importance to the final quality of the end product (Feigenbaum 1983:253). This process amounts to the establishment and documentation of quality requirements which need to be met in order for a product or service to satisfy the expectations and requirements of the end user.
- Quality-operations planning, which includes the techniques for implementing the quality system prior to a proposed course of action and methods of achieving the final, desired result. The final output of the planning process is a set of detailed instructions identifying the courses of action required to meet the quality objectives of the business.

2. *Process-Control-Engineering Technology* is defined as (Feigenbaum 1983:276):

> The body of technical knowledge for analysis and control of process quality, including direct control of the quality materials, parts, components, and assemblies as they are processed throughout the entire industrial cycle.

The techniques employed by this technology are designed to provide workers with immediate quality information, thereby enabling them to make parts correctly the first time, and know when this has been accomplished. The actual techniques used by this technology may be grouped under the following four headings (Feigenbaum 1983:277-99).

- Process-quality analysis. Included here are the techniques for gathering and monitoring the processes within the organisation. Included are incoming materials testing, production testing, scrap and rework analysis, field complaint rating and vendor rating.
- In-process control. Included here are the techniques for actually using the results of the process analysis to adjust and improve processes.
- Implementation of the quality-program plan. Involved here are the techniques for adjusting and revising parts of the quality plan to take into account the dynamic changes of the day to day production situation.
- Quality-effectiveness audit. Included here are the techniques for performing the constant monitoring of the quality improvement process, as planned. The purpose of this is to ensure that requirements are not deviated from, and where they are, to identify the areas for corrective action.

3. *Quality Information Equipment Engineering Technology* is defined as (Feigenbaum 1983:302)

> The body of technical knowledge relating to techniques and equipment which measure quality characteristics and which process the resulting information for use in analysis and control.

The techniques contained in this technology are used for quality cost optimisation and quality information feedback and control. The actual techniques fall under (Feigenbaum 1983:302-04,

- advanced equipment development, which include the techniques for creating measurement practices and control procedures required to satisfy those information requirements that are established by quality-engineering and process-quality-engineering techniques;
- equipment-specification planning. This includes the techniques for establishing the actual specification of the quality information equipment, as required within the framework of the quality plan;
- design, procurement and construction. Included here are the techniques for the design and procurement of the individual components for the specified equipment;
- installation, checkout and follow-up. This includes the techniques for the installation and application of the quality information following its construction.

In conclusion, Feigenbaum's (1983:106-07) views on total quality management are encapsulated by his "quality system." The main components of this system are:

- it controls quality on an integrated, organisation-wide basis, which begins with the development of the product and ends with after-sales customer satisfaction;
- it provides for primary quality decision-making ties with upper management;
- it fosters a preventative rather than corrective attitude;
- it establishes quality control as a set of disciplines to be applied by functions throughout the business systematically rather than as a single functional organisation in one part of the business;
- it clearly structures and reports quality costs;
- it makes quality improvement and motivation a continuous process;
- it adds a major, company-wide workscope to the quality function;

- it provides the resources necessary to permit preventative effort;
- it recognises the importance of customer requirements to product design and ultimately quality;
- it recognises that the quality improvement effort is not only dependent on human contributions, but that equipment and technology play an important role in the quality improvement process.

1.5 DEMING, W.E

The Deming (1982) philosophy on total quality management has its origins in statistical process control. Deming's (1982) approach to total quality management is based on four philosophies. The first philosophy is that of the continual improvement of product and service. This centres on the elimination of any obstacles which stand in the way of achieving higher quality and involves testing and statistical feedback at various stages of manufacturing and marketing in order to improve a system which involves design, production, merchandising and service. The purpose of this is to provide a product or service which will meet the needs and expectations of the end user. The argument underlying this is that Deming views the customer and the level of customer satisfaction as the most critical elements in the entire production process (Deming 1982:225).

The second philosophy is that of the division of work between the workers and management. Deming (1982:36) advocates that there are different roles for management and workers to fulfil in the quality improvement process. Responsibility for the quality improvement process is shared between management and workers. The worker, who is in contact with the process, should control it and aid management to improve it. After all, subordinates who work in the system are the ones who really know where the potential for improving the system lies. Workers are, therefore, not only required to work in the system, but to help management improve it. This requires that employees are provided with the correct tools to enable them to fulfil their responsibility. This is the responsibility of management. It is management's responsibility to work on the system so that the workers will be in a position to fulfil their responsibilities. Contained in this philosophy is the basic view that one can rely on the worker, that one can trust them and that if given responsibility they will do their best for the organisation (Deming 1982:36).

The third philosophy is that of the utilisation of statistics as

the language of communication between the worker and management. If management are to control the variation in a factory or other place of work, they need to learn the language of statistics.

The fourth philosophy is that of the causes of error or variation. Deming (1982:111-20) provides two causes of error or variation, which need to be corrected or reduced in different ways.

First, "special causes" of error or variation (Deming 1982:111-15), occur when a measurement is made which falls outside the normal limits for the activity being measured. A special cause is one that is specific to some group of workers, or to a particular production worker, or to a specific machine or to a specific local condition. The discovery of a special cause of variation, and its removal, are usually the responsibility of someone who is connected directly with some operation. Their responsibility is to find the cause, and remove it. Second, "common causes" of error or variance (Deming 1982:115-20), occur when a measurement is made which falls within a certain permissable range. In other words, such variance is contained within certain limits. Common causes of error or variance are faults of the system, and will remain until corrected or reduced. Elimination or reduction of common causes can be effected only by action of management, since the system is under the control of management.

Improvement of a process then, according to Deming (1982:115), can come from the removal of a special cause of variation and then from action on the system or process. Deming (1982:124) stresses that the removal of a special cause of variation in order to move toward statistical control, does not constitute an improvement of the process. Removal of a special cause only brings the system back to where it should have been. The important problems of improvement only commence once statistical control has been achieved. Deming (1982:116) highlights the importance of identifying the difference between special and

common causes of variance in order that the relevant corrective action can be taken.

For analytical purposes, with a view to improving a process, distributions and calculations of mean, mode, standard deviation, chi-square, t-test, etc., serve no purpose, unless the data are produced in a state of "statistical control ". The first step in the examination of data is, therefore, to determine the state of statistical control that produced the data. Stability in a system is seldom a natural state. It is an achievement, and results from eliminating special causes of variations, leaving only the random variation of a stable process. A stable process, or a system with no indication of a special cause of variation is said to be in a state of statistical control. The behaviour of such a system in the future is predictable. According to Deming (1982:319), a system that is in statistical control has a

> ...definite capability, expressible as the economic level of quality for that process.

The fifth philosophy involves the attitudes of the management of a company towards quality, productivity and competitive position. This philosophy is encapsulated in his fourteen cardinal points, (Deming 1982:13-59). These fourteen points are seen by Deming as being vital to the organisation wide quality improvement process.

Table 3. Deming's Fourteen Points.

Source: Deming 1982:16-17.

DEMING'S 14 POINTS
1. Create constancy of purpose for improvement of product and service. 2. Adopt the new philosophy of refusing to allow defects. 3. Cease dependence on mass inspection and rely only on statistical control. 4. Require suppliers to provide statistical evidence of quality. 5. Constantly and forever improve production and service. 6. Train all employees. 7. Give all employees the proper tools to do the job properly. 8. Encourage communication and productivity. 9. Encourage different departments to work together on problem solving. 10. Eliminate posters and slogans that do not teach specific improvement methods. 11. Use statistical methods to continuously improve quality and productivity. 12. Eliminate all barriers to pride in workmanship. 13. Provide ongoing retraining to keep apace with changing products, methods, etc. 14. Clearly define top management's permanent commitment to quality.

Deming (1982:15) stresses that the responsibility for these fourteen points lies with top management. Management must understand and have the authority to carry them out. By placing responsibility for these points with management, Deming is not suggesting that quality is only managements job. As he describes it (Deming 1982:16),

> Quality is everybody's job, but quality must be led by management.

It is possible to summarise Deming's fourteen points into two main sub-philosophies as follows.

(i) A certain management value system and approach for managing a company is required (Points 1-5 and 14).

(ii) The worker is the most important asset of a company in attaining excellence in quality. This fact requires specific management actions in supporting the worker (points 6-13).

Deming (1982:16) holds that the 14 points apply anywhere, to any organisation, irrespective of its nature or size. The first five points are aimed at management, urging them to adopt a new culture in the organisation, while the rest concentrate on the worker and what management style or approach is needed to utilise the potential of the worker to its fullest. The points are not intended to be a sequence. Rather they are a list of management responsibilities (Deming 1982:16):

1. Create constancy of purpose for improvement of product and service.

This step (Deming 1982:17-8) forwards two types of problem which management must address. First, "problems of today", which are concerned with the regulation of present quality standards and output and second, "problems of the future". These command first and foremost constancy of purpose and dedication to improvement of competitive position to ensure the company's future viability and existance.

The establishment of constancy of purpose according to Deming (1982:18-19) means the acceptance of obligations such as:

- innovate. Allocate resources for long term planning;
- put resources into research and eduction;
- constantly improve design of product and service;
- put resources into maintenance of equipment, furniture, fixtures and new aids to production.

2. Adopt the new philosophy.

According to Deming (1982:19-22), traditional attitudes to quality tend to be that it is inevitable to make mistakes, and that some degree of rework and error is inevitable. He argues that no level of defects is acceptable. No longer are the commonly accepted levels of mistakes, defects, material not suited to the job, handling damage, defective material, lack of training and inadequate supervision, acceptable. Zero is the only acceptable level of defects. He cautions that simply shouting "zero defect", accomplishes nothing. Improvement in the quality field will only take place where a "road map", or direction is provided.

3. Cease dependence on mass inspection.

Deming (1982:22 & 70-1) argues that routine 100 percent inspection is synonymous with planning for defects.

Inspection which occurs only after production is ineffective and costly. Once a product has been produced, it is too late to improve its quality. Scrap, downgrading and rework are not corrective action of the process. Post-production inspection does not result in the cause of the problem being eliminated, and does not amount to corrective action of the process which is producing the poor quality output. Inspection treats the cause and not the symptom. He argues that quality does not come from post-production inspection, but from improvement of the process. Improvement of the processes will decrease the need for inspection.

Deming (1982:71) adds that inspection is never unnecessary or ineffective. Certain products require extremely high degrees of quality and chances cannot be taken on their quality being below standard.

4. End the practice of awarding business on a price tag alone.
Deming (1982:23-30) argues that price has no meaning without a measure of quality. Without adequate measures of quality, business drifts to the lowest bidder, with low quality and high cost being the inevitable result. Deming (1982:23) feels that a large portion of quality problems arise out of poor quality inputs into the process. Decisions to purchase inputs should be made on the basis of quality and price. The involvement of everyone who is to be effected by the quality of the input is necessary. These people are responsible for informing the purchasing department of their quality requirements.

Vendors qualify in terms of the quality of their product and the extent to which they are involved in preventing poor quality.

5. Constantly and forever improve the system of production and service.
Deming (1982:30-1) advocates that all employees in the organisation must strive towards continual reduction in waste and continual improvement of quality in every activity. He argues that systems and processes must be continually evaluated to ensure that they are the most effective.

Measurement of the status of the quality improvement process must continually be undertaken. However, Deming emphasises that figures on quality alone do not help to improve quality. They simply tell one about the level of quality, but do not provide a means whereby the level of quality is improved. Guidance must be given as to the means to actually improve quality.

6. Institute modern methods of training on the job.
The quality improvement process requires a dramatic change in attitude and often in work systems. All employees within an organisation need to receive training to enable them to understand and be able to fulfil their roles in the quality improvement process. Without adequate training, the theory behind

total quality improvement will not be put into action (Deming 1982:31-2).

7. Institute modern methods of supervision.
Deming (1982:32-3) suggests that the responsibility of foremen must be changed from sheer output targets to incorporate a quality component. Foreman must be responsible for identifying barriers to the quality improvement process. This relies on management being prepared to take immediate action on reports from foremen concerning obstacles to the quality improvement process.

8. Drive out fear, so that everyone may work effectively for the company.
Many employees in organisations are afraid to ask clarifying questions if or when misunderstandings arise. Overcoming such fears is vital to the success of the quality improvement process. Employees must be encouraged to contribute and must not be afraid to ask for clarification. The quality improvement process is founded on employee involvement and understanding, two factors which are unlikely to emerge where employees are fearful of their jobs (Deming 1982:33-5).

9. Break down barriers between staff areas.
Every department and individual in the organisation is a customer and a supplier. They receive materials from their colleagues in the process and after working on the product, pass it on to the next stage in the process. Prior to reaching its final user, a product or service is worked by many individuals or departments, all of whom will have an effect on its quality. It is therefore important that each department or individual in the production process is aware of the quality requirements of the next department or individual in the process. An internal client attitude must prevail (Deming 1982:33-5).

10. Eliminate numerical goals for the workforce.
Numerical goals, posters and slogans for the workforce which ask

for improved levels of quality without providing the methods must be eliminated. Where the methods are not provided, there is little hope of them stimulating an improvement in quality (Deming 1982:36-40).

11. Eliminate work standards and numerical quotas.
Deming (1982:40-3) recommends that where numerical quotas or work standards are set, they must include a quality component. This is because numerical quotas only take account of quantity, and ignore quality.

12. Remove barriers that hinder the hourly worker.
Deming (1982:43-7) stresses the importance of treating and involving hourly paid employees in the quality improvement process. These employees have an important role to play in the quality improvement process, and must be provided with the understanding and tools required by the quality improvement process. The fact that they are hourly paid or temporary staff does not mean that their role in the quality improvement process is any less important than that of the weekly or monthly paid staff.

13. Institute a vigorous program of training and education.
Deming (1982:47-9) stresses that education on quality improvement must be provided to the entire workforce. This education is aimed at providing an awareness of quality and providing the workforce with the tools and knowledge to take responsibility for their own quality. Due to the importance he places on statistical process control, much emphasis is placed on education directed at this.

14. Create a structure in top management that will push every day on the above thirteen points.
Deming (1982:49-50) views the quality improvement process as one which needs to be driven by management. Management are responsible for establishing the basic quality attitudes required for a positive approach to quality improvement and for creating an organisational environment which will be supportive of this

new form of intervention by the entire workforce. Total quality improvement is a management philosophy, and needs to be driven and enabled by a deliberate set of management activities. These activities amount to the creation of an organisational environment in which total quality improvement will thrive. Management action should be such that every employee understands, is capable of, and encouraged to meet his/her responsibility toward the total quality improvement process. Where management do not constantly drive the process, Deming is sceptical of its chances of success.

In conclusion, the more important elements of Deming's approach to total quality management are as follows.

- First, every process has variation. By applying statistical techniques it is possible to establish whether the variation is natural and caused by natural causes of variation. Unnatural variation is due to assignable causes. The quality of product and service can be greatly improved by eliminating the assignable causes and by reducing the variation of the process.

- Second, in this process of controlling the variation both the worker and management have their own respective responsibilities. Management must improve the system and eliminate the assignable causes of variations. The worker is in direct contact with the process. When properly trained and employing the correct equipment, he plays a vital role in detecting out of control variation (assignable causes). He personally can take action, or report deviations to management for action.

- Third, management should set the objectives of continual improvement of products and services with a long term view to customer satisfaction. Both management and workers must work together in attaining this objective. In this system of mutual responsibilities, it is important that management should have a certain approach and work towards achieving certain objectives (Deming's first five points and point 14).

• Fourth, management must create a certain atmosphere of trust and mutual confidence whereby obstacles that stand in the way of the worker are removed (Deming's last eight points).

• Fifth, Deming recommends different roles for management and employees in the quality improvement process. The worker who is in direct contact with the process is best qualified to improve it. In order to be in a position to execute this responsibility, they need to be provided with the necessary tools. This is a task solely in the hands of management. Contained in this phi. phy is the basic assumption that management can rely on employees, that they can be trusted and, if they are placed in a position of responsibility, they will do their best for the or,· nisation.

1.6 ISHIKAWA, K.

Ishikawa (1985) does not present a model of total quality improvement in the mould of Crosby (1979), Feigenbaum (1983), Juran (1988b) or Deming (1982), but his book, *What is Total Quality Control? The Japanese Way* (1985), provides some insights as to his views on total quality management as practised in Japan.

Ishikawa (1985:172-84) stresses the importance of product design to the quality improvement process. According to him, the essence of quality improvement is providing the customer with a product or service which meets his expectations and requirements. Central to this view is the awareness that producing a product which is free from defects is not necessarily sufficient to attain customer satisfaction. This is ascribed to the fact that, although the final product may be defect free, its design requirements may not satisfy those of the final user. The production of a quality product or service necessitates attention being paid to both quality of design and quality of manufacture. This will ensure that the product is fully functional in the way the final user expects. As he (Ishikawa 1985:44) describes it, to develop a quality product means that one has to

> ...develop, design, produce and service a .... product which is most economical, most useful, and always satisfactory to the consumer.

Ishikawa (1985:44) advocates that, since ensuring the production of a quality product or service is impacted on by the entire organisation, and since the essence of total quality management is the prevention of defects,

> ...everyone in the company must participate in and promote quality control, including top executives, all divisions within the company, and all employees.

The rationale for this is that post production inspection is seen as being inefficient and ineffective. First, it only addresses

quality problems once they have been committed, resulting in costly rework and scrap. Second, no degree of inspection will ensure the quality of a product or service, where the quality of design is poor. Quality assurance must be strictly executed during the stages in which the new products are being developed. If defective products are produced at different stages of manufacture, even strict inspection cannot eliminate them. Inspection is seen as a very expensive and ineffective form of quality assurance. Within the organisation, the responsibility for quality assurance rests with the divisions of design and manufacturing, and not inspection. Quality is built into the products through building it into each process, as opposed to inspecting it into the final product.

Where outside suppliers are used, they must also be involved in the quality improvement process. This is because the purchaser cannot guarantee quality to its customers if the raw materials or parts purchased from the supplier are substandard or defective, without undertaking expensive inspection. Poor quality inputs result in high costs and delays and should be avoided through involving suppliers in the quality improvement process (Ishikawa 1985:156). He (Ishikawa 1985:159-160) provides a list of ten principles for vendee-vendor relations, designed to ensure cooperation between the two parties as regards quality improvement. The above reflects:

- extensive cooperation between the two parties directed at the setting of quality specifications, and;
- constant feedback between the parties to monitor the extent to which inputs satisfy quality requirements.

The decentralisation of quality responsibility means that responsibility is not being left with a central quality department. It assumes that all individuals and functions are now responsible for their own quality. Ishikawa (1985:50-88) stresses that this process of decentralising quality responsibility needs to be promoted and directed by management. The participative quality improvement process which not will develop on its own.

A number of deliberate actions on the part of management are required to ensure that it is supported and encouraged. First, in order to facilitate the decentralisation of quality responsibility, management must adopt a management style which will allow intervention in decision-making by subordinates. Where they do not, the workforce will not participate in the quality improvement process and the decentralisation of quality responsibility will not yield any improvements in the quality of output. Second, training aimed specifically at quality improvement must be provided. Prior to employees being in a position to assume responsibility for the quality of their own output, they must be subject to education on the principles and tools of quality improvement (Ishikawa 1985:35). This education needs to be provided at all levels within the organisation and must be given on a continuous basis. Third, management are responsible for establishing and distributing a quality policy throughout the organisation. This policy should make clear the intentions of management regarding the importance of quality and the decentralisation of quality responsibility. Fourth, Ishikawa (1985:140-43) recommends that the vehicle whereby employees will participate in the quality improvement process is through the establishment of quality improvement teams. He recommends that these teams contain themselves to a particular work area.

In conclusion, it is evident that Ishikawa (1985) considers total quality management to be a participative form of quality improvement, whereby quality responsibility is decentralised to the point of production. In facilitating this decentralisation of responsibility, he acknowledges that management have certain responsibilities to the quality improvement process. Management intervention is required in order to ensure that the process is encouraged and promoted.

CHAPTER FOUR

THE PRINCIPLES OF TOTAL QUALITY MANAGEMENT

1 INTRODUCTION

After consideration of the theories advanced by Crosby (1979), Deming (1982), Feigenbaum (1983), Ishikawa (1985), Juran (1988b) and Townsend (1986), it is evident that while each theory possess certain unique characteristics, a number of elements are common to most of the theories, irrespective of their point of origin. The objective of this chapter is to highlight and discuss these commonalities. Where applicable, the opinions of other authors are included.

To develop a framework for total quality management, there is almost universal agreement that there are a number of areas within the organisation which require attention (Beard 1989:9; Crosby 1979; Edosomwan 1987; Feigenbaum 1983; Garvin 1983:68; Juran 1988b; Kenworthy 1986:21; Marash 1989; Townsend 1986). These are:

- management commitment and competence;
- organisational structure;
- employee commitment and competence;
- communications;
- customer orientation;
- ownership;
- trust.

2 MANAGEMENT COMMITMENT

Many authors hold that management commitment is the most important ingredient of effective total quality management (Alexander 1981:617; Babbit 1981:28; Bradley and Hill 1987:74; Beard 1989:10; Candy 1982:45; Cole 1980:25; Crosby 1979:21-34; Crosby 1984:59 & 100; Dale 1984b:7; Deming 1982; Edosomwan 1987:67; Ingle 1982:57; Ishikawa 1985:122-28; Juran 1988b:8.7;

Kane 1986:28; Marash 1989:121; Townsend 1986:8-9; Tribus 1988:29). Research has shown conclusively that where management are not committed to the quality improvement process, their subordinates are unlikely to be committed to the process either (Bradley and Hill 1987:72; Cole 1979:77; Dale 1984b:7; Deming 1982:62; Feigenbaum 1983:205; Ingle 1982:55; Juran 1988b:10.51; Kenworthy 1986:21; Marash 1989:122; McGraw and Dunford 1987:157; Neal et al, in McClenahan 1981:73; Peters 1980:205).

The importance of management commitment to the participative quality improvement process is two-fold. First, the workforce receives its work standards from its leadership (Crosby 1979:132; Deming 1982:62; Ishikawa 1985:122; Juran 1988b:8.3; Lomas 1986:218; Project Free Enterprise Report 1986:19; Rieker 1983:16). Through their actions and behaviour, management set the standards for the rest of the organisation. As Crosby (1984:59) puts it:

> They [employees] will take [quality] requirements as seriously as the management takes [quality] requirements.

For this reason, (Barra 1986:7) recommends that

> ...management must view quality as an attitude that starts with them and spreads throughout the organisation. This means a commitment from the top of the organisation down, in which management demonstrates, by its actions and behaviours, that quality, not quantity, is the issue that guides decision making.

Throughout the organisation management's attitudes must be orientated towards defect prevention rather than corrective action (Crosby 1979:132). This requires that management, through their own actions and behaviour, erase the attitude in most employees that error is inevitable and should be anticipated (Crosby 1979:132; Kane 1986:28; Rieker 1983:16).

Second, management are responsible for motivating the entire organisation towards a participatory style of management, in which problems, organisational information, decision-making and recognition are shared with the entire workforce (Burnham 1987:9; Cole 1980:41; Crosby 1984:10; Feigenbaum 1983:201; Gow 1980:18; Ishikawa 1985:112; Juran 1988b:10.1-10.55; Lees and Dale 1985:21; Main 1980:32; Shaw 1982:36; Townsend 1986:61-7). This involves the development and introduction of the structures and framework required of the participative quality improvement process (Crosby 1979:35-54; Deming 1982:68; Feigenbaum 1983:200; Garvin 1983:68; Juran 1988b:10.31 & 22.5; Townsend 1986:171-73). These actions will facilitate and encourage subordinate participation. Also, they will serve as an indication to subordinates that management are not only preaching participative quality improvement, but practising it. That such a perception is held by subordinates is seen by a number of authors as being vital to the success of the participative quality improvement process (Crosby 1979:7; Juran 1988b:22.9; Koopman 1987:22; Nemoto 1987:63; Project Free Enterprise Report 1986:21). As Juran (1988b:22.5) describes it

> ...subordinate managers are guided more by the actions of upper managers than by their words.

Other management responsibilities include: leadership of the process; the drawing up of a formal quality policy; the creation of a corporate-wide quality organisation; a management review structured from the top down; the provision of top to bottom quality education; the installation of supplier quality programs; the incorporation of quality specific items in individual performance plans and the use of reward and incentive structures to recognise and enhance quality improvement.

2.1 Promoting Employee Participation

Management are to a large degree responsible for the creation of an environment or climate, within the organisation, which will encourage and facilitate the participative process.

2.1.1 *Organisation Climate:*

One of the main responsibilities of management is the creation of an environment which will be conducive to the development and survival of participative forms of quality improvement.

The findings of Garvin (1983:65) conclude that

> ...superior levels of performance come not from national traits or cultural advantages but from sound management practices deliberately and systematically applied.

This view is supported by Gregerman (1979:160); Hagan (1984:22) and Ishikawa (1985:5-11). Similarly, McMillan (1980:26) credits much of Japan's success in the quality field to management practices. He says:

> ...the Japanese "system" of management is neither unique nor theoretically novel in itself - what is different is that the Japanese are applying textbook management principles in everyday work life. Such principles are economically sound, managerially rational, and equally applicable to any industrial society...

The Project Free Enterprise Report (1986:72), reports the following regarding the role of personal culture in the success of forms of participative management:

> Culture plays no significant deterrent role. The only culture that could prevent the successful implementation of participative systems is the internal culture of the company.

A similar view is forwarded by Feigenbaum (1983:208-09), Ingle (1982, VII) and Ishikawa (in Ingle 1982:13).

Thus, what is being said is that where the wider social structures of the organisation are not supportive of consensus-based decision making and organisational cultures are not congruent with cooperative workplace decision-making, participative forms of quality management are unlikely to succeed (Crosby 1979; Dale 1984a:52; Deming 1982; Feigenbaum 1983; Juran

1988b; Project Free Enterprise Report, 1986:18; Lees and Dale 1985:21-2; Evans 1986:9). Viljoen (1986:54) puts it as follows:

> It should be noted that although [improved decision-making, industrial democracy and increased motivation] are logically independent, they are by no means mutually exclusive and taken together form a convincing foundation for the support of worker participation as an effective and m[illegible]al management technique. However, if participative management is applied in isolation from the prevailing corporate e[illegible]hos, these arguments, both individually and collectively, [illegible]re considered eroded.

Participative quality improvement impacts on and is impacted upon by the structure and climate of the organisation (Carroll 1987:66; Cole 1979:78; Dale and Hayward 1984:475-84; Juran 1988b:10.17-10-18 & 10.49; McGraw and Dunford 1987:150; McMillan 1982:35). Total quality management does not exist in a vacuum and is a function of the organisational climate to which it is subject (Crosby 1984:45-52). According to Bradley and Hill (1983:308-09) and the research of Lees and Dale (1985:15), one of the prime reasons for the failure of quality circles is that they are not considered one part of a coherent set of management practices which are based on the philosophy of consultation and cooperation. Therefore, the decentralisation of quality responsibility, through participative quality improvement, implies a comprehensive management philosophy.

Fundamental to the long-term success or failure of participative forms of quality improvement is the philosophical readiness of the organisation (Project Free Enterprise Report 1986:19). As described by Brooke (1982:76-7)

> ...does management philosophy support, in theory and practice, an intervention in the form of employee involvement?

Of the atmosphere required to sustain quality circles Hoffman (1983:40) says that:

> For circles to survive, they must be part of an operating atmosphere where participation is a preferred way of managing, not something just reserved for circles.

Where the tools of participative total quality improvement are viewed in isolation from the rest of the organisation, rather than seen as only part of a total approach to quality improvement, the only likely long term outcome will be disillusionment and malperformance (Dessler 1984:175; Ingle 1982:57; Rieker 1983:14; Russell and Dale 1989:3; Viljoen, 1986:53).

The very nature of participative forms of quality improvement, which entrusts employees with problem-solving responsibility, presumes an organisational philosophy of employee involvement and participation (Brooke 1982:77). However, given the tradition and characteristics of South African management and labour relations, employee participation is unlikely to emerge spontaneously, and needs to be enabled if the process is to unfold. This would require a set of deliberate and specific management decisions to set the process in motion (Hagan 1984:22; Manning 1987:16c; Work Station Participation Guidelines 1985). The purpose of these decisions is the developing of an organisational climate which will be capable of sustaining a participative program (Manning 1987c:20). This climate is in reality a perception. These perceptions should be that employees ideas are welcomed and sought by management (Crosby 1984:97; Tribus 1988:30). The creation of this perception among the workforce is to a large degree dependent on management style.

2.1.1.1 Management Style

Brooke (1982:77) and Cole (1979:77) stress that a philosophy of involving subordinates must be held and promoted not only by top management, but by management throughout the organisation.

While it is recognised that different management styles are applicable to different situations (Hersey and Blachard 1977:322; Koontz and Weihrich 1988; Plunkett and Attner 1983), the total quality improvement process and accompanying management style need to be seen in perspective.

The decentralisation of quality responsibility and the participation of subordinates in the quality improvement process is central to total quality management (see chapter two). Added to this, the Project Free Enterprise Report (1986:67-8) had the following to say:

> The major priority in ensuring that participative systems work within an organisation is to ensure that they are viewed and practised as a total philosophy of management. This requires that managerial structures, practices and goals are all related to the common theme of participation within the work place.

Similarly, Juran (1981a:57) reports that,

> ...[management] will not succeed [in total quality management] if it does not engage the participation of the workforce and avoid pseudosolutions.

Engaging the participation of the workforce in the organisation does not go hand-in-hand with an autocratic (Koopman et al 1987:145), centralized or traditional management style (Work Station Participation Guidelines 1985). Under an autocratic style of leadership, management reserves the right over power, decision making, authority, accountability, innovation and the dissemination of information. Rigid control systems in turn are administered by layer upon layer of managers each with their own rules and authorities, each a potential source of information distortion. Rigid control systems and creativity are incommensurate (Russell and Dale 1989:6).

Where management style is not democratic, a more democratic, participative/people building style is going to have to be adopted in order to enlist the participation of the workforce in

quality improvement (Alexander 1981:619; Koopman et al 1987:94-112; Russell and Dale 1989:10). As Barra (1986:8) says of the management style required by quality circles:

> Quality circles [require] a people-orientated management style that respects the intelligence of employees and encourages creativity; a style that credits employees with the capacity to absorb training and the motivation to use it constructively; a style that listens to employees' recommendations and recognises achievements in a personal way.

The adoption of a participative style of leadership means that those who occupy positions of power in the organisation must open themselves up to influence from below (Thompson 1982:116). The work of Johnson and Ouchi (1974:62) showed that in Japanese organisations with above average quality and productivity levels, the role of a leader in the decision-making process is little different from that of others in the organisation. Senior managers do not perceive their task to be one of setting objectives and issuing orders. Instead they responded actively to the ideas resulting from the bottom-up process. A key role of middle-management is helping subordinates and colleagues shape a composite plan before presenting it to superiors. These findings are confirmed by the work of Bowen (1977); Drucker (1981); Drucker (1971); Rehder (1979); Tavernier (1981) and Whitehill and Takezura (1978).

A management style which encourages and involves the entire organisation in the quality improvement process is central to its success. A participative style of management must allow universal participation, provide leadership by example and give information, facts and ownership to all levels in the organisation (McMillan 1980:30; Tribus 1988:30; Walker 1975:14; Work Station Participation Guideline 1985). Management needs to provide employees with the means to become actively involved in the quality improvement program.

Various models of participative management have been advanced over the years (Hall and Leidecker 1981; Plunkett and Attner 1983). The more prominent of these include:

- Human Relations;
- Tannenbaum and Schmidt's Leadership Continuum;
- Greiner's Participative Management;
- Likert's System;
- Blake and Mouton's 9,9 style;
- Japanese Style Management.

It is beyond the scope of this thesis to investigate all of these models. This study will provide an overview of the Japanese style model, as this is seen to encapsulate the essence of the other participative models. For a discussion on the other models, refer to Blake and Mouton (1964), Greiner (1973), Hall and Leidecker (1981), Plunkett and Attner (1983) and Tannenbaum and Schmidt (1958).

Much attention and study has been focused on the "Japanese" style of management, due to their astoundingly high levels of quality and productivity. It is possible to group the studies undertaken into three groups. Those which centred on "Japanese" management as practised in Japan (Bowen 1977; Drucker 1971, 1981; Rehder 1979; Whitehill and Takezura 1978), those which studied "Japanese" management techniques in the United States (Hatvany and Pucik 1981; Johnson and Ouchi 1974; Tavernier 1981), and those undertaken by Ouchi (1981) and Ouchi and Jaeger (1978). Ouchi and Jaeger describe a management style, "Type Z", which is a version of the Japanese style but one which has evolved simultaneously in a few American organisations without the involvement or ownership of the Japanese.

Drawing on the above sources, Hall and Leidecher (1981:15) developed a model which they call "Japanese Style Management" (JSM). This management style is best described as a participative management style and, whether located in Japan or abroad,

typically has several distinguishing characteristics (Hall and Leidecher 1981:15-6):

- bottom-up process;
- senior management - the facilitator;
- middle manager - the moulder;
- openness;
- consensual decision making;
- holistic orientation;
- management by walking around.

Each of these characteristics are discussed as they are presented in the Japanese style management model, and where applicable, are supplemented by the works of other authors.

- Bottom-up Process:

JSM emphasises and encourages information flow and initiative from the lower levels of the organisation to the upper levels. Subordinate contributions are recognised as having an important contribution to make regarding the successful operation of the organisation. By encouraging initiative at the lower levels of the organisation, responsibility for product quality is placed as close to its source as possible. In addition, decentralisation of the responsibility for quality, which involves encouraging the involvement of subordinates in the production process, is likely to have a positive effect on the level of their commitment to the quality improvement process.

An important element of Japanese style management is that management, through attitudes and behaviour, provide the structures and incentives to encourage this flow of information.

- Senior Manager - The Facilitator:

According to Hall and Leidecher (1981:15),

> Senior managers do not perceive their task to be one of setting objectives and issuing orders. Instead, they respond actively to the ideas resulting from the bottom-up process.

This typically involves asking questions, providing encouragement and support and making suggestions.

• Middle Manager - The Moulder:
A key role of middle managers is to help and guide subordinates and colleagues in the quality improvement process. They are not perceived as functional specialists, who work on directives from their superiors, but as facilitators whose primary role is to encourage the participation of their subordinates.

• Decision by Consensus:
An important element of Japanese style management is that the predominant means of decision-making is done by consensus. As many people as possible who will be, or are likely to be, affected by a decision are involved in reaching the particular decision. According to Hatvany and Pucik (1981:4-21), all that is meant by "consensus" is that each participant involved in the decision-making process feels satisfied that his/her point of view has been given a fair hearing, and that the participant is willing to accept and support whatever decision is finally reached.

• Holistic Orientation:
Japanese style management includes a concern for the welfare of all employees. Management are concerned about the whole employee, and not just those aspects which affect immediate performance. According to Hall and Leidecker (1981:16):

> The holistic orientation emphasises and fosters an egalitarian atmosphere.

This atmosphere implies the presence of trust: trust that employees can work autonomously without close supervision (Ouchi 1981).

Japanese style management places emphasis on shaping and influencing employees' attitudes towards the job. Attitudes are considered vital to quality output and productivity (Hall and

Leidecker 1981:16). These attitudes are influenced in a number of ways. By management letting employees know that they count; through management setting an example; and by stressing that employees will not be dismissed or heavily punished for honest mistakes, employees are encouraged to learn from mistakes. A further advantage according to Hall and Leidecker (1981:16) is that

> Consensus decision-making and the bottom-up process also support the wholistic orientation element by demonstrating that the company values the employees' contribution to decision-making.

• Openness:

Japanese style management relies on and fosters openness. Honesty and criticism are encouraged by an atmosphere of trust. A belief in the potential of all levels of employees in the organisation is necessary to build a commitment to the quality improvement process. This is evident in many Japanese organisations. As Cole (1980:25) puts it,

> *Japanese management believe in their labour force.* They believe that given the opportunity, their labour force can and wants to contribute to organizational goals.

The belief of management in their workforce is a matter of trust (Alexander 1981:616; Cole 1979:74), and quality improvement programs based on employee participation are trust-based (Alexander 1981:616). Management needs to trust in the desire and ability of their subordinates to resolve quality problems in a manner advantageous to themselves and to the organisation. Low degrees of trust between management and employees is cited as one element responsible for the high failure rate of quality of Working Life experiments of the seventies (Likert 1961).

• Management by Walking Around (MBWA):

Japanese style management pays attention to management familiarity with their personnel and their tasks at all levels in the organisation. This is to a large degree achieved through management by walking around, as underlying management by walking

around is the importance of management visibility to subordinates.

In conclusion, management are responsible for the adoption of a style of management which will encourage and promote a participative form of quality improvement. Participation in the decision-making process is not something which can develop in a vacuum. It is influenced by management style, and where this style does not encourage subordinate participation, there is little hope that such participation will be forthcoming.

Where management style and the prevailing organisational climate are supportive of intervention in the form of subordinate decision-making, it is necessary to create some vehicle whereby subordinates can actually become involved in the decision-making process. Participative teams are the most common vehicle used to achieve this.

2.1.1.2 Participative teams

Since every individual and function within the organisation is a contributor to defect levels, every individual and function must participate in the quality improvement effort. The vehicle for promoting such participation is usually some form of quality improvement team (Crosby 1979:152-69; Deming 1982:107-10; Ishikawa 1985:137-53; Juran 1988b:10.1-10.49; Koopman 1987 et al:14-45; Townsend 1986:44-5).

There are many types and forms of quality improvement team, the more common being task forces, quality circles and quality improvement teams. Due to the fact that most participative teams are based on similar principles, these will only be addressed in the discussion on quality circles. The coverage given to the other forms of participative teams will contain themselves to the way in which they differ from the other teams.

Task Forces

Task forces, also referred to as project teams or ad hoc committees, are teams of employees established to deal with specific projects, and are usually disbanded once the assigned project has been completed (Juran 1988b:10.10). The project team usually consists of about six to eight persons. Team members may be drawn from multiple company departments or from within one department, depending on the scope of the project (Juran 1988b:22.26; Kenworthy 1986:23; Nemoto 1987:51). Kenworthy (1986:23) found that where team members are drawn from various departments within the organisation, departmental boundaries were eroded and understanding between departments enhanced.

Although the projects to be tackled by the task forces may either be cross-functional or departmental specific, task forces are created primarily to deal with projects which span more than one department (Juran 1988b:10.10-10.11).

Projects to be tackled are usually identified by management, and passed down to the task force. Task forces therefore provide management with a top-down approach to manage within the ambit of subordinate involvement (Project Free Enterprise Report 1986:72).

Quality Circles.

Quality Circles are not always referred to by this name, but it is convenient to use this general term for descriptive purposes. Their precise design varies from organisation to organisation, but all circle-like groups follow an essentially standard pattern of approach to problems.

Although numerous writers have advanced different definitions of quality circles, their definitions have many similarities (Cole 1979:74; Cox 1981:7; Gibson 1983:487; Ishikawa 1985:139-40; Klein 1981; Koopman et al 1987:150; Mcgraw and Dunford 1987:150;

Rendall 1981:29). Mcgraw and Dunford (1987:151) define quality circles as

> ...voluntary groups of workers who meet regularly in paid time to identify, analyse and make recommendations to management on problems in their immediate workplace...

Quality circles may be formed anywhere in an organisation where people work together and experience similar problems (Dale 1984a:60). For this reason, members of quality circles are normally from the same work area (Daniel et al 1987:9) and the same hierarchical level (McMillan 1982:35).

Membership of quality circles is usually voluntary and no pressure is exerted on members to join (Alexander 1981:616; Dale 1984a:56). Thompson (1982:116) suggests that it should also be voluntary for a manager to decide whether to volunteer his workforce or not. The reason for this view is that, where management or their subordinates feel uncomfortable with participation, but are forced to participate, they may sabotage the project (Thompson 1982:116). However Thompson (1982) recommends that before managers can volunteer or refuse to partake in a project, they should undergo training as to the workings, benefits, problems and skills required to partake in the operation of a quality circle.

The quality circle is set the task of identifying problems resulting in poor quality in its part of the factory, and presenting recommendations for correction directly to management, who may then implement them (Lawler and Mohrman 1985:65).

The average size of these groups varies between five to fifteen members, which is large enough to allow each member an opportunity to be heard and yet not so large as to be intimidating to members (Dale 1984a:59; McCarthy 1984:100; Yager 1979:683). Dale (1984a:59) found that the larger the circles, the more prone they are to personality clashes and prolonged arguments.

Leadership of quality circles is usually assumed by the supervisor of the work group in the early stages of the program. The findings of Dale (1984b:2) indicate that, in the U.K., the trend regarding the leadership of circles is for it to pass, in time, from the supervisor to shop floor employees. This suggests that after supervisors have derived the benefits from their role as a leader, namely building a team and emphasising their position in the workplace, they show their willingness to pass on the role of leader. This step enhances the potential of personal development.

Quality circles meet on a regular basis, for a relatively short period of time - the exact regularity being determined by the nature of the organization and the maturity of the circle. The findings of Dale (1984a:3) show that as a circle matures and it undertakes more complex projects, the frequency of circle meetings will decrease. The findings of Lees and Dale (1985:13) show that the most popular circle meeting frequency is once a week for one hour, during company time. At Nissan S.A, quality circles meet on a daily basis, for a period of ten minutes, to review the previous day's performance and make decisions on how to meet daily targets (Todd 1988).

Quality circles are a means of providing subordinates with the opportunity to identify and resolve problems related to the quality of their work (Gow 1980:18; Koopman 1987 et al:150). The quality circle concept is based on the premise that people who are involved in a particular job know more about it than anyone else. For this reason, they are in a better position to identify and improve problems within it (Barra 1986:8). Quality circles, therefore, provide subordinates with an opportunity to become involved in meaningful decision-making in the organization.

Quality circles may scrutinise a diversity of issues relating to their immediate workplace (Cole 1979:74; Dale 1984b:3). The selection of projects to be tackled by the circles may be undertaken in a number of ways. It may be made by the circle

members themselves, it may be allocated to the circles by management, or it may be done by some combination of the above. The findings of Dale (1984b:3) identify the method of project selection in the U.K. as that which is done by the circle members. The philosophy underlying such an approach is that circle members should be given as great a degree of ownership of the project as possible.

Consistency is found amongst quality circle theorists concerning the techniques used by quality circles to solve problems . The two most common techniques are cause and effect analysis and brainstorming (Agnew 1982; Arbose 1980; Donovan 1979; Ingle 1982; Mohr and Mohr 1983).

Cause and effect analysis involves defining the problem so that all group members are aware and understand it. The group develops a cause effect-diagram. Subsequent to brainstorming the causes are categorised, and the major causes are identified and ranked.

The experience of Lees and Dale (1985:6) suggests that any circle program must be a subset of a wider approach with an emphasis on quality and participation. Without such a backdrop, they see a quality circle program as only having a transient effect. Similar sentiments are expressed by Bradley and Hill (1983:294), who conclude that quality circles do not on their own represent a radical shift in organisational structuring. The management philosophy must support the involvement of employees in decision-making in the organisation. Where quality circles are viewed as a parallel organisational structure which operates independently from the existing organisation, their potential long term survival will come under extreme pressure (Bradley and Hill 1987:68; Daniel et al 1987:9-10; Ishikawa 1985 94 & 140; Kellas, in Boart News 1988; Lawler and Mohrman 1985:66-69). According to Todd (1988) recognition for involvement in, and achievement of the circles, must be provided. The reward system of the organization must be adapted to reward excellent achievements by quality circles. This recognition should include

both extrinsic and intrinsic rewards. In addition to the above, Todd (1988) recommends that quality circle members must receive training aimed at quality improvement and participative techniques.

Uses for Quality Circles:

Quality circles have been used in a number of different ways in organisations. The following are some of the more common uses of quality circles in the quality improvement field, each demanding a different degree of management involvement and commitment.

1. Group Suggestion Program:

This approach is adopted where management has no interest in shifting its style toward participation. The approach involves creating quality circles, capturing the ideas they produce, and then stopping them. This approach recognises the strengths and weaknesses of the quality circle process, and capitalises on its strengths. It relies on the initial enthusiasm and knowledge of workers who are given an opportunity to make suggestions. It also recognises that circle programs are difficult to obtain and, therefore, plans on abandoning them.

This approach is dangerous in that employees may feel that they have been manipulated. They have saved the organisation money, but have experienced no change to their daily work lives or their opportunity to get involved in decision-making on an ongoing basis. Employees may also become cynical about management and the organisation when they discover the difficulty of getting suggestions accepted and implemented. This approach is unlikely to result in the development and reinforcement of the attitudes which a program of total quality management requires of employees (Lawler and Mohrman 1985:69). In fact the research of McGraw and Dunford (1987:159) indicated that where the circles ceased to function, for the perceived reason of management inaction, considerable hostility resulted.

2. Special Projects:

Quality circles may also be used to deal with temporary or critical organisational issues, as identified by management. This approach implies a limited degree of movement toward participative management. Employees benefit from influencing change, which affects their work lives, and from contributing to quality improvements. However, the structure and content of their jobs does not shift significantly towards increased responsibility. Circle activity is also limited to management defined problems. This approach, while being less deceptive than the first approach and hence more acceptable to employees, is unlikely to result in the required permanent attitude shift (Lawler and Mohrman 1985:70).

3. Transitional Vehicle:

Quality circles may be used as a transitional device in moving toward a more participative management system. As Lawler and Mohrman (1985:70-1) describe it:

> Employees often want to work on issues that extend beyond their work group. In our experience, many of the issues that groups identify in their brainstorming sessions involve questions of intergroup relations and of organization-wide policies and practices. Group members become frustrated when the are unable to initiate needed changes in these areas, particularly when they see a close relationship between the problems they identify and organisaticnal performance. The quality QC ativity may lead group members to want to transcend their status as a parallel suggestion system to become an integral part of the decision-making system.
>
> Management can move from quality circles to other forms of group activity in one or both of two directions. It can expand participative activities by establishing task forces composed of people from different work groups and at different organizational levels. The groups can be mandated to work on organizationwide problems. It can also transfer decision-making authority to the quality circles and task forces by providing them with the information, expertise, and resources needed to make and implement decisions.

This step is a difficult one, depending on alterations in job design, personnel policies, the reward structure, additional

training and the willingness of management to trust the groups with important issues for its success (Lawler and Mohrman 1985:71). Lawler and Mohrman (1985) argue that circles can best be used strategically in moving organisations to a more participative culture, rather than as permanent features of organisational life. This view is supported by the findings of McGraw and Dunford (1987).

Benefits of quality circles

The research of Lees and Dale (1985:32-3) identified the following management and employee benefits to flow from involvement in quality circles.

Table 4. Benefits of Quality Circles to Members.

Source: Lees and Dale 1985:32-3.

BENEFITS TO MEMBERS	NUMBER OF ORGANISATIONS
Circles provide the opportunity to become involved in the organisation	19
Better team work within the department	19
Increased job satisfaction	16
Circles help relieve frustration by ensuring that something is done to remedy a bad situation	16
Better relationships with management	15
Increased feeling of "belonging" to the organisation	15
Recognition for achievements	12
Increased pride in work	9
Gives them a voice in their own future	8
Enables more learning about the job to be done	5
Improved job security by helping the organisation to operate in a more cost effective manner	3

Table 5. Benefits of Quality Circles to Managers

Source: Lees and Dale 1985:32-3.

Benefits to management	Number of organisations
Circles provide an opportunity for future managers to emerge	16
Circles make management easier since they solve problems at grass roots level, allowing management to concentrate on higher priority areas	15
Circles place junior management in a leadership role in relation to the circles	13
Improved communications	4

A study by Tortorich et al (1981:23-4) which measured the organisation impact of quality circles, found that quality circles had a profound positive impact on quality through improvements in organisational variables such as production rates, defect rates, scrap rates, attrition rates and lost time, amongst others. Similar findings were obtained by Dale's research (1984a:59 and 1984b:12-5), which highlights the following quality related benefits to emanate from quality circles: cost reduction, productivity improvements, wastage, service processes, safety, paperwork, energy savings, working conditions, work layout and product improvements.

Dale's (1984a:61) research found the estimated benefit/cost ratio of circles to vary from 2:1 to 6:1, with an average of 3,6:1.

Stanton (1986:98) suggests that one of the major benefits to flow from quality circles is the improvement of internal communication. The positive effect on communication comes about because organisational members, who would not normally communicate with one another, do so during quality circle meetings. Also, quality circles promote direct communication between themselves and management (McGraw and Dunford 1987:163; Stanton 1986:111-12). The effect, however, goes further. Because projects are circle efforts and not individual efforts, and

because circles are only a part of the whole, interaction must take place not just within circles, but also between them (Yager 1979:684).

Many authors attribute the effect which quality circles have on quality to the fact that involving employees in the decision-making process creates an environment in which everyone is conscious of quality and the need to improve it (Cox 1981; 1987:17; Dale 1984a; Daniel et al 1987; Ingle 1982). In addition, giving ownership of quality to subordinates tends to increase their commitment to quality improvement.

Objections to quality circles.

Arguably one of the major drawbacks or problems associated with the role of quality circles in the quality improvement process is that membership of them is voluntary (Lawler and Mohrman 1985:65-71; Townsend 1986:53). This can create a "them and us" attitude, not only between management and employees, but also between employees who are participating and those who are not (Dale 1984a:62; Townsend 1986:53). A further drawback of the voluntary membership of quality circles is that actual participation in the decentralisation of quality responsibility is only undertaken by a minority of employees. This is problematic since the entire workforce is responsible for quality.

The actual decision making power of quality circles is a further point of contention. According to Koopman et al (1987:150-53) quality circles often do not give subordinates enough

decision-making power. This view is supported by Bradley and Hill (1987:77) who write:

> They [quality circles] do provide participation, in the form of involvement in the decision making-process and consultation with management, but they do not provide an area of autonomous decision making which allows members both to formulate and to implement "need satisfying," work-related decisions.

Quality circles are given the responsibility of identifying areas in need of improvement and to devise solutions to those problems. A presentation is then scheduled with a management committee to which the problem and the proposed solution must be presented for approval. This process is problematic in that often managers have to act on the suggestions of the circles are many of them have no role in the circles and do not fully understand their aims (Lawler and Mohrman 1985:65). Middle management often feel threatened by quality circles, and resist any suggestions advanced by them. Where such an attitude exists, quality circles are doomed to fail (Lawler and Mohrman 1985:68). Townsend (1986:54) has the following to say about the lack of decision making power of quality circles:

> Putting the definition of a problem and the solution into one group's hands, while putting the decision to implement into another's, institutionalizes an employee versus management, us versus them approach. The members of quality circles no longer belong to either group. To management, they are still part of the workforce; but to their fellow employees, they are a subset of management. The divisions are exacerbated.

Vital to the success of both quality circles and participation schemes is that subordinates or participants should have the authority to investigate and implement solutions to the various problems with which they are authorised to deal (Alexander 1981:616).

In an attempt to avoid certain of the above problems, Townsend (1986:55-76) recommends that quality circles should be subject to certain modifications.

- One hundred percent involvement is a necessity. This means that the involvement of the entire workforce must be compulsory. Such a modification would mean that the problems encountered by individuals, who have raised aspirations when working with quality circles and then lose that status when working with non-circle employees, is eliminated (Townsend 1986:72-3).

- The authority to implement a decision must be placed as close as possible to those who are to be affected by that decision. Implementation must be kept as close to the source of problem and solution definition as is possible. This would mean that management will have to sacrifice some control. Townsend (1986:56) believes the gain in speed of implementation and in the number of ideas considered, discussed and implemented make the risk worth taking. As he (Townsend 1986:56) describes it

> If management truly wants all employees to be active participants in the quality process, it will have to relinquish formal control over implementation of ideas. The operative word is trust.

A further advantage of this process of decentralisation of authority to the workforce, is that middle management resistance becomes far less of an issue (Townsend 1986:73).

In an attempt to avoid the pitfalls of quality circles while still involving employees in the quality improvement process, a number of authors (Edosomwan 1987:68; Garvin 1983:68; Peters 1980:196; Townsend 1986:61-3) advocate the establishment of participative teams called quality teams.

Quality Teams

Quality teams are interlocking teams with an average of ten people to a team, preferably from the same unit or function. Participation in quality teams is compulsory. The teams shadow the traditional organisational structure (Townsend 1986:61-3).

Team leaders would either be the normal supervisors/managers of the units or an individual voted to the position by the team members. Team leaders are also members of the quality team next up on the organisational ladder. Since the unit heads would be both a team leader and a member of their superiors team, it is possible for ideas to rise or fall to the proper level of implementation.

Regarding the frequency of meetings, Garvin (1983:68) suggests that the greater the frequency of meetings to review quality performance, the fewer the undetected errors.

The major point of divergence between quality teams and quality circles is the authority given to quality teams. Townsend (1986:20) believes that quality teams must be given a great deal of autonomy to implement any ideas which fall within their area of responsibility. Recommendations must be the sole property of the participants (Edosomwan 1987:68). In other words, team members must be given ownership of the process. The importance of this is twofold. One is to strengthen the participant's commitment to the resulting recommendations. The other is to stress that quality improvement is not something being done to participants, but something that they would do (Townsend 1986:37). In a study of decision-making in 37 "well run" organisations, autonomy in decision-making was a common attribute (Peters 1980:196).

For this reason, Townsend (1986:66) describes the relationship

between quality teams and quality circles as follows:

> ...Quality Teams are the next evolutionary step beyond quality circles. They are a blend of quality circles, suggestion systems, participative management, and...ingenuity.

A further important distinction between quality circles and quality teams is that membership and participation in quality circles is entirely voluntary. According to Lawler and Mohrman (1985:65-71) low volunteer rates is a major reason for quality circle failure. Membership and participation in the quality improvement process being outlined here is compulsory. Townsend (1986:53) feels that this avoids many of the underlying difficulties associated with quality circles. He believes the most obvious of these drawbacks is the reinforcement of an "us and them" mentality between management and subordinates. Such an attitude is avoided since management and employees participate in this process together.

An added advantage of quality teams over quality circles is that the opportunity for middle management to block initiative and change is limited. Presentations cease to be a problem, since there are none. Poor suggestions still arise, but are an insignificant proportion of the whole. Quality teams are self-policing (Townsend 1986:72).

Many authors suggest that some type of steering mechanism must be established to guide and provide the quality improvement teams or quality circles with direction and assistance where necessary (Casbourne 1987:109; Crosby 1984:106; Dale 1984a:54-5; Ishikawa 1985:113-19; Juran 1988b:10.49-10.50; Klein 1981:19; Tavernier 1981:18; Townsend 1986:5-12). This mechanism has been referred to as the steering committee of quality improvement teams.

Steering Committee

A steering committee (also referred to as an overall screening committee or quality improvement council) is usually set up to oversee, direct and review the entire quality improvement process

(Juran 1988b:10.49-10.50; Klein 1981:19; Tavernier 1981:18). The committee does not implement quality assurance. Nor does it assume direct, day-to-day responsibility for quality assurance.

These tasks are performed by each of the line divisions in the organisation.

> The responsibility of the committee is to let the woof be woven into the warp to strengthen the entire organization, (Ishikawa 1985:116).

The steering committee is a corporate level committee and is usually made up of senior management representatives, selected line and staff managers, and, where applicable, union representatives (Juran 1988b:22.7; Russell and Dale 1989:13). It may also include a limited number of participants from the circle programme (Lees and Dale 1985:9). As many departments as possible must be represented on the steering committee (Casbourne 1987:109; Crosby 1984:106; Edosomwan 1987:67; Klein 1981:18).

The reason for this high level involvement is that one of the prime responsibilities of the committee members is to represent and be able to commit their departments to action. Functional management representation and commitment is likely to lead to a greater commitment by their respective departments than representation by a department member (Crosby 1984:105-07).

Other responsibilities of the members of the steering committee include (Crosby 1984:106 and 1979:153):

- to lay out the entire quality improvement program;
- to represent their department on the team;
- to cause the decisions of the team to be executed in their department;
- to contribute creatively to the implementation of the improvement activity.

The overall steering committee serves as (Klein 1981:19; Ishikawa 1985:113-19):

- a forum for consideration of operational improvements which are likely to affect more than one department, and which may exceed a certain sum of money to implement;
- a court of appeal for ideas or suggestions not accepted by the area committees, and;
- a forum whereby management can raise issues which it wishes to communicate to all employees.

More specifically, the major functions of the steering committee are to (Juran 1988b:22.7-22.8):

- formulate the quality policy;
- estimate the major dimensions eg: cost of quality, return on investments from prior improvements, quality versus competition;
- establish a project system; choose project to be tackled and the teams to tackle them. Assign responsibility for appointing facilitators, team members and team leaders;
- identify needs for training;
- plan the training;
- establish support for the quality improvement teams;
- provide for coordination of the quality improvement process, specifically the teams involved;
- revise merit rating for managers to reflect quality of operations and improvement in quality;
- design the quality recognition program;
- recommend roles for upper management.

Of the organisations questioned by Dale (1984a:54), 70.2% had set up a steering committee to oversee and guide the quality improvement process. Similar results emerged from another study conducted by Lees and Dale (1985:9).

Many organisations establish facilitators to oversee and guide the quality improvement process, thereby assuming a role similar to that of the quality steering committee. Of the organisations questioned by Dale (1984a:54), 95% have a facilitator. Similar results emerged from a study conducted by Lees and Dale (1985:9).

Facilitator

The role of the facilitator(s) in the quality improvement process is primarily one of identifying and eradicating the factors inhibiting the development and progress of the quality improvement process (Dale 1984a:55; Juran 1988b:22.28-22.29). The facilitator, who is usually a member of the organisation, acts as a consultant to the quality improvement teams. The facilitator acts as a point of liaison between the various participants and supporting elements in the quality teams process. According to Dale (1984b:5), a facilitator is vital to the success of a quality team program since they are

> ...responsible for monitoring and sustaining a participative problem-solving process that requires [cooperation] between a number of organisational levels....

The spectrum of facilitation, therefore, cuts across the total organisation structure.

The more important functions of facilitation are listed below. They provide an indication of the all-embracing nature of facilitation (Van Eeden 1986:18):

- to undertake research into the nature of quality improvement programs, in order to become an inhouse expert, adviser, and coordinator of the program;
- to make suggestions as to how the organisation should go about implementing the programs;
- to assist senior management in briefing and orientating their staff regarding the program;
- to train managers for their role and the application of quality improvement techniques;
- to administer the program;

- to assist team leaders in establishing teams;
- to assist leaders in preparing for team meetings;
- to attend meetings, ensuring that the team leader handles them effectively and keeps on developing until he can run a meeting by himself;
- to evaluate team progress with team leaders, and removing any factors inhibiting its effectiveness;
- to report back to the steering committee regarding the development of the program against initial goals set;
- to indicate strengths, weaknesses and problems experienced and to recommend action for improvement.

It is important to note that it is not the responsibility of the facilitator to drive the process. The facilitator merely acts as a consultant to the quality improvement teams. Depending on the size of the organisation, facilitators may be appointed at various levels in the organisation.

Should Participation be Compulsory or Not?

A number of authors propose the compulsory participation of employees in the quality improvement process, whether directly or indirectly involved in the production process (Cole 1980:25; Crosby 1979:23, Feigenbaum 1983:149-200; Melcher 1976; Townsend 1986:20).

Melcher (1976), in his review of the literature on the effects of subordinate participation, concludes that the process of participation only affects the attitudes of those actually consulted, those who stand outside the process are apparently not influenced. For this reason, he is in favour of compulsory participation. Similar sentiments are expressed by the Project Free Enterprise Report (1986:18). Total quality management is all-embracing, involving all members of the organisation. Developing a quality orientated mindset with the accompanying commitment to implementation requires the active participation of all affected employees. The exclusion, therefore, of workers

from meaningful participation undermines both quality and the very essence of organisational survival (Project Free Enterprise Report 1986:18).

In a similar manner to Melcher (1976), Townsend (1986:75), compares the introduction of a quality improvement process into the organisation to a revolution. Revolutions, which come from the "bottom up," require that all the troops must be enlisted. Where this is not the case, the "revolution" is unlikely to succeed.

Management style, and in particular the introduction of participative teams into the organisation is influenced by the company structure. The structure of the organisation is influenced by, and, more importantly, influences the extent and success of participation in the organisation. For this reason, any attempt at increased levels of participation in the organisation should include a study of the appropriateness of the existing organisation structure.

3 ORGANISATION STRUCTURE

Research has shown that the structure of the organisation can have a substantial bearing on the success of participative management in the organisation (Bradley and Hill 1987:77; Brownell 1982:38-43; McMillan 1982:37; Thompson 1982:115). As described by Sargent (1986:30), organisational structure can pose a major obstacle to improvements in processes or relationships with people. The reason for this is that the structure of the organisation impacts on and is influenced by the participative process.

3.1 Requirements of the Organisation Structure.

In the case of an intervention into the organisation in the form of subordinate participation, the structure of the organisation should permit, or at the very least not retard, a number of things:

- First, the structure of the organisation must permit the formation of participatory groups and must allow the decentralisation of responsibility to the point at which participation takes place (Bradley and Hill 1987:68-77; Burnham 1987:9; Feigenbaum 1983:156; Juran 1988b:10.19; Klein 1981:18; Project Free Enterprise Report 1986:72). Further, in line with the philosophy of involving all employees in the quality improvement process, the structure of the organisation should promote interaction and integration of the various organisational departments. It should discourage the formation of autonomous departments (McMillan 1982:37).

- Second, the structure of the organisation should also promote the flow of information within the organisation. A decision to promote subordinate participation in the organisation while not establishing effective, efficient channels of communication between management and subordinates amounts to a contradiction in terms.

- Third, trust between management and subordinates is a central issue in participative management. Trust is something which, to a large extent, will be fostered through regular contact between the parties concerned. This regular management-employee contact is something which should not be discouraged by the structure of the organisation.

3.2 Tall Organisation Structure

A very hierarchical or "tall" structure generally will not facilitate effective group interaction, information flow and decision making. The reason is that a very hierarchical structure

creates distance between managers and their subordinates (Peters 1980:196). According to Johnson and Ouchi (1974:63)

> This distance inhibits the free flow of information and initiatives from below and can create situations in which a manager feels threatened by a subordinate's suggestion or criticism.

Mechanistic or bureaucratic structures would appear to foster social systems that are incompatible with the demands of participation. Lynas and O'Neill (1987:54) feel that in such organisations, participation tends to be characterised by

> ...sporadic and non-reciprocal information sharing.

As Bendix (1989:243) says of the classical organisational design,

> ...it provide[s] mainly for management-initiated communication.

Subordinate participation is, however, concerned with initiating the involvement of those lower down the organisation structure. In their study, Johnson and Ouchi (1974:62-3) found that the majority of successful Japanese organisations had an open-door policy. In terms of such a policy, employees have access to any manager, regardless of the chain of command and they regularly made use of this channel of communication. In an organisation with a rigid hierarchical structure, such contact would be made very difficult.

3.3 Flat Organisation Structure.

A relatively "flat" structure, with fewer hierarchical levels, will be more accommodating of worker participation in decision-making. The reason for this is that such a structure will provide more opportunities for employees to participate in decision making - a structure which will allow, amongst other things, regular supervisor-employee contact (Lynas and O'Neill 1987:54; Sullivan 1986:81). According to Gow (1980:18) much of Japan's success in the quality

improvement field is attributed to the fact that most organisations have a structure which

> ... avoid[s] the rigid demarcation lines of authority which tend[s] to operate with functional specialists and an acquiescent work force and where all responsibility is removed from the work force.

Even where the prevailing management style and organisation structure facilitates employee participation in the quality improvement process, employee commitment to the process must be increased. This can be done through the distribution of a quality policy throughout the organisation. This policy should document, among others, management's commitment to participative quality improvement and the employee's role in it.

4 COMPANY QUALITY POLICY

Management need to understand and communicate to the workforce their commitment to defect prevention (Edosomwan 1987:67). Such a commitment must be contained in a quality policy, which should be distributed throughout the organisation, for all to see (Carroll 1987:50-1; Crosby 1979:150; Juran 1988b:5.2-5.14; Nemoto 1987:48-50; SABS 0157 Part 0:1). The South African Bureau of Standards 0157 (Part 0:1) defines a quality policy as

> ...the overall quality intentions and direction of an organisation as regards quality, as formally expressed by management.

This policy must be stated and established by the top executives in the organisation with the aid of subordinate management. This top management commitment will pull those lower down the organisation along (Carroll 1987:50-1; Cole 1980:25; Crosby 1979:150; Juran 1988b:5.2-5.14; Nemoto 1987:48-50).

4.1 Contents of a Corporate Policy

This corporate policy statement usually sets out (Juran 1988b:5.5-5.6):

- the purpose of writing and publishing quality policies;
- a brief statement of corporate intent as to quality;
- the minimal actions to be taken by company divisions with respect to quality;
- interdivisional relationships concerning quality;
- quality standards policies for overlapping markets;
- provision for corporate audit of compliance with quality policies;
- relationship of quality policies to other company policies.

The policy statement should be explained and distributed to every manager such that it is agreed with and understood by them. Subordinate management must understand and agree with the quality policy before they will support and implement it successfully (Cole 1980:25). The South African Bureau of Standards 0157 (Part 1:2) requires that the organisation ensures

> ...that this policy is understood, implemented and maintained at all levels in the organisation.

4.2 Departmental Policies

In large companies it is common and advisable for the corporation to require that divisions and specific functions establish divisional and functional quality policies, within the framework of corporate policies (Juran 1988b:5.8-5.9).

Vital to the success of any quality policy is that it complement, and be complemented by, the philosophies and culture of the organisation (Lochner 1982:39; SABS 0157, part iv:2).

There is wide consensus that central to the success of the

decentralisation of quality responsibility, is the measurement of quality.

5 MEASUREMENT OF QUALITY

There is much agreement that the measurement of quality is vital to the ongoing success of the quality improvement process (Crosby 1979:170-78; Deming 1982:288; Hagan 1984:22; Ishikawa 1985:49-50; Juran 1988b:4.0-4.30; SABS 0157, part 2:7; Townsend 1986:125-28). The process of measurement is important for a number of reasons. First, it determines the status of quality in the organisation, by providing an indication of the strengths and weaknesses of the present quality program. This will provide an indication of where improvements can be made and what the next course of action in the quality improvement process should be (Crosby 1984:95-6; Ishikawa 1985:186; Lochner 1982:23-5; Lomas 1986:217; Project Free Enterprise Report 1986:76; SABS 0157, part 2:7).

Second, calculating a cost of quality promotes an awareness of the cost associated with introducing a defect into a product or service (Deming 1982:285). According to Nattrass (1973:11), wastage in an organisation is often due to the lack of appreciation by workers of the value of equipment and materials. In order to instill an appreciation of the costs of these wastages they need to be calculated and brought to the attention of these workers.

Third, measurement provides a common language for quality, the language of money (Ishikawa 1985:92; Juran 1988a:70). The calculation of a cost of quality in monetary terms facilitates easy understanding of what quality is costing the organisation.

Fourth, quality measurement provides actual documentation of improvements, which facilitates the recognition of achievements in the quality improvement process (Crosby 1979:169-70; Dale 1984a:61; Ishikawa 1985:92 & 109-12; Juran 1988b:9.4).

5.1 The Decentralisation of Measurement.

An important element of the quality measurement process is that it must produce information which people can understand, use and trust (Crosby 1979:170; Deming 1982:65-6; Edosomwan 1987:67; Ishikawa 1985:109; Juran 1988a:70). It has been suggested that the means to provide such information is to decentralise the measurement process (Aubry and Eldridge 1981:16; Crosby 1979:173-78; Day 1984:19-24). They suggest that the measurement process should be a line function and should be carried out by the individual departments which are being measured. Their reasons for advocating the decentralisation of the responsibility for measurement threefold. First, to minimise any discrepancies regarding the results. This will ensure that the cost of quality figures are accepted and respected by those who have to act on them. In short, ownership of the process will generate commitment to it (Bradley and Hill 1987:76; Feigenbaum 1983:200 & 212; Ishikawa 1985:91; Juran 1988b:10.29; Kelly 1980:30; Russell and Dale 1989:11-2). According to Aubry and Lawrence (1981:16)

> The participative approach to formulating the quality measures helps assure the success of the quality program since the employees doing the work are instrumental in developing the means by which the quality of their finished product is evaluated.

Second, broad participation and involvement in formulating quality costs will help communicate the meaning and objectives of total quality throughout the organisation. Third, broad participation is necessary in order to achieve an accurate assessment of the organisation's quality status.

Juran (1988b:4.15) is not in favour of the decentralisation of quality measurement. According to him the calculation of the cost of quality should be undertaken by an "independent" source. His reasoning for this is that, in order to ensure the accuracy and credibility of the exercise, the reviewer should have no close responsibility for the adequacy of the performance. Juran recommends that the measurement be undertaken by a department

which has no close responsibility for the process being measured, but nonetheless will serve as a credible source of information. He advances the accounting department as one such department.

5.2 Displaying of Measurement Results.

An important aspect of the measurement process is that the results of the exercise should be displayed for all concerned to see (Crosby 1979:170; Feeney 1990:31; Ishikawa 1985:50; Juran 1988b:9.2; SABS 0157, part iv:16). Garvin's (1983:73) findings highlight the fact that organisations which record lower than average failure rates of products rely heavily on the disclosure of measurement results to subordinates. The reasons advocated for the need to disclose the results of the measurement process are many and varied.

The decentralisation of quality responsibility is central to the total quality management approach to quality improvement. A vital requirement of this decentralisation is that it be supplemented by the information necessary for it to be effective. In order for employees to be able to monitor their own performance, the measurement process must provide them with information on the quality of their output (Carroll 1987:57). The provision of such information will enable subordinates to identify areas of their work which require attention and to single them out according to their frequency or magnitude. This will allow those singled out to be classified in terms of seriousness, cause and responsibility. Such classification will allow prioritisation of the effort to rectify the defects (Crosby 1979:170; SABS 0157, part iv:14). For this reason, the results of the measurement process must be continually displayed for all concerned to see. Measurement of performance in the quality field without the accompanying disclosure of results to those concerned is a pointless exercise.

Further, displaying information on quality performance will encourage individuals and their departments to produce quality

output (Project Free Enterprise Report 1986:21). An additional use of displaying the measurement results is to establish improvement goals and to expose these on a continuous basis to the personnel (Crosby 1979:170; Juran 1988b:10.53; SABS 0157, part iv:16).

An important element regarding the displaying of measurement results is that they must be presented in a form which is digestible to those concerned. Graphic representations tend to be the most common and accepted means of such disclosure (Carroll 1987:57; Garvin 1983:73). In addition, this measurement process must provide workers with a means of monitoring quality performance (Feeney 1990:31; Ishikawa 1985:50; Juran 1988b:9.2). Where this is not the case, many defective items will be produced before they are identified and corrective action taken.

An important element in gaining the commitment and support of the workforce towards the measurement process (whether it is centralised or decentralised), is that the people who are subject to measurement must be assured that the purpose of measurement is not to provide management with information which enables it to discipline departments or individuals who are out of line. Rather, the purpose is to get individual departments to identify problems which they are encountering and then to initiate some form of prevention against such errors (Feeney 1990:32; Nemoto 1987:8-9). The attitude should be one of "developmental evaluation" (Project Free Enterprise Report 1986:103). Where employees are scared to make their mistakes known, for fear of the consequences, it is unrealistic to expect the quality improvement process to result in the identification and prevention of the actual causes of defects (Nemoto 1987:9-10).

5.3 Methods of Measurement.

The method of quality measurement utilises some form of quality control audit, which audits the quality improvement process. These audits provide an indication of how well the existing

system of quality improvement is functioning by identifying the strengths and weaknesses of the system. The identification of these enables the organisation to pay attention to those areas of the existing quality improvement process which are at present functioning below the required standard (Ishikawa 1985:186; SABS 0157, part iv:5). Juran (1988b:9.2) differentiates between three forms of quality control audit which are used to monitor the quality improvement process:

1. Quality Audits.

A quality audit is an independent review conducted to compare some aspect of the organisation's quality performance with a standard for that performance. Quality audits usually supply information on:

- the extent to which quality plans are being met;
- the extent to which specifications are being conformed with;
- the adequacy of existing procedures and the extent to which they are being followed;
- the identification of deficiencies so that corrective action can be taken;
- opportunities for improvement.

2. Quality Surveys.

A quality survey is broader in nature and goes beyond the scope of a quality audit. Quality surveys include items not covered by agreed criteria and also discover opportunities and unexpected threats to the quality improvement process. Quality surveys are company-wide, and hence provide an overall view of the quality status of the organisation. They provide information on matters such as:

- the relative standing of the organisation in the marketplace with respect to quality;
- opportunities of reducing the costs of poor quality;
- employee perceptions on quality.

3. Product audit.

Product auditing is an independent evaluation of product quality to determine its fitness for use and conformance to specification. Product auditing takes place after inspections have been completed. The purposes of product auditing include:

- estimating the quality level of the final product as delivered to customers;
- evaluating the effectiveness of the inspection decisions in determining conformance to specifications;
- providing information useful in improving outgoing product quality level and improving the effectiveness of inspection;
- providing additional assurance beyond routine inspection activities.

For a more detailed discussion of quality control audits, refer to Feeney (1990:28); Ishikawa (1985:185-96) and Juran (1988b, chapter 9).

The measurement of the attitudes of the workforce to quality and the cost of quality is central to total quality management.

5.4 Measurement of Attitudes.

The attitudes of management and employees towards both quality and subordinate involvement are central to the success of a participative quality improvement process (Crosby 1979:132; Kane 1986:28; Rieker 1983:16). It is therefore important for there to be some means of measuring these attitudes and any change in them. Once the existing levels of employee and management attitudes has been established, action can be taken to influence these in the desired direction.

According to Marks (1982:684) and Sargent (1986:30), attitude surveys are the most effective and efficient means of collecting information on management and employee attitudes. These surveys provide data on the perceptions of management and subordinates

towards the quality improvement process. These perceptions are important as they drive the behaviour of the parties to the quality improvement process (Sargent 1986:30). The findings of the attitude surveys allow senior management to monitor the trends in quality attitudes of their employees and subordinate management, and to identify departments where the attitude change is insufficient or below par. A well designed survey will, in addition, allow management to identify the reasons for below par improvement in attitudes (Marks 1982:684-91). For a more indepth look at conducting an attitude survey, see Marks (1982:684-91).

Crosby's Quality Function Maturity Grid (Crosby 1979:32-3) is a measure which enables management to identify the organisations present status or maturity level regarding the quality improvement process. It does this by measuring management and subordinate attitudes to quality. These results may then be compared with those which existed on a previous occasion. The grid breaks down the continuum of maturity levels (attitudes to quality) into five categories and lists the categories by which each can be measured. The maturity grid emphasises the change in attitude toward meeting product requirements or quality that takes place in the progression through the stages of a quality improvement process. Perceptions are the instrument used to identify the organisations position on the grid. The data used in the measurement process is collected by means of an attitude survey (Sargent 1986:30). With this information, management can identify where the organisation is on the maturity grid and what their next course of action ought to be. A possible constraint of the maturity grid is that it does not provide an explanation of why the organisation is at this position on the grid (Sargent 1986:30).

5.5 Measurement of Quality Costs.

Management needs to be able to measure quality for economic reasons, just as they need to be able to measure any other organisational expense (Juran 1988b:4.2). Quality costs provide the economic common denominator by which management can evaluate, in business terms, quality improvement programs (Crosby 1979:102-03). By calculating the cost of quality, the business of quality is taken out of the abstract and brought into focus as cold, hard cash (Marash 1989:123). This is seen to be one of the most effective ways of obtaining management and subordinate attention to the problem of poor quality (Juran 1988b:4.3). Publication of the costs of quality can be a healthy stimulus to quality improvement and cost reduction (Juran 1988b:4.4). Further, the measurement of the degree of success or failure of a quality improvement activity provides the members of those activities with a measure of their current performance and abilities in this field (Alexander 1981:618).

A further important reason for calculating a cost of quality is that once a set of measurements have been developed, opportunities and strategies for improvement can be identified (Aubry and Lawrence 1981:17; Edosomwan 1987:65; Juran 1988b:4.3; SABS 0157, Part iv:6). As Juran (1988b:4.3) describes it:

> Costs of poor quality do not exist as a homogeneous mass. Instead, they are the result of some specific segments, each traceable to some specific cause. These segments are unequal in size, and a relative few of the segments account for the bulk of costs. A major by product of evaluation of costs of poor quality is identification of these vital few segments.

Crosby (1979:104), Juran (1988b:4.10-4.13) and Kume (1985:16-7) stress, however, that management should not be pre-occupied with attempting to obtain an exact cost figure for quality as this is likely to be a timeous and subjective exercise. All that is required is a consistent, reasonably accurate estimate of the cost of quality. After all, the purpose of calculating the cost of quality is essentially to draw attention of the organisation

to the cost of poor quality, to identify high cost centres and to provide a measurement base for seeing how quality improvement is progressing (Aubry and Lawrence 1981:17). As Kume (1985:17) puts it,

> ...the important thing about [quality costs] is not the total, but the way they are used.

Kume (1985:16) provides an additional reason for avoiding a total reliance on accurate quality costs. He suggests that only certain of the losses caused by poor quality can be evaluated by quality cost. Certain of these losses, such as loss of market share and loss from poor quality design, although being very important, are less visible and tangible. If quality of design is poor, the chances are the product won't sell, and a loss will be incurred (Feigenbaum 1983:136). Kume (1985:17) feels that the costs of actual or potential loss of market share and those of quality of design cannot be evaluated by quality cost, as such costs are intangible and largely hidden.

Quality costs in organisations may be thought of as consisting of the following two broad categories (Broh 1983; Caplen 1981; Crosby 1984:84-6; Deming 1982:263-64; Feigenbaum 1983:110; Juran 1988b:4.3; Townsend 1986:110 & 126):

1. the costs of control and
2. the costs of failure.

The South African Bureau of Standards 0157 (Part iv:6) refers to these costs as "operating quality costs" and "external assurance quality costs" respectively, while Crosby (1984:85) refers to them as the "price of conformance" and the "price of nonconformance," respectively. The price of nonconformance is composed of all the expenses associated with manufacturing defects, while the price of conformance includes the costs necessary to ensure conformance to requirements.

The cost of control, or the costs of ensuring conformance to requirements, can be subdivided into "prevention" and "appraisal" costs.

(1) Prevention costs: Crosby (1979:105) defines these as

> ...the cost of all activities undertaken to prevent defects in design and development, purchasing, labour, and other aspects of beginning and creating a product or service. Also included are those preventative and measurement actions conducted during the business cycle.

Included in prevention costs are the cost of activities such as quality planning, new-products review, process planning, quality audits, supplier quality evaluation and training (Townsend 1986:126).

(2) Appraisal costs are those costs incurred in obtaining company quality levels. Crosby (1979:105) claims that they are the

> ...costs incurred while conducting inspections, tests, and other planned evaluations used to determine whether produced hardware, software, or services conform to their requirements. Requirements include specifications from marketing and customer, as well as engineering documents and information pertaining to procedures and processes.

Included in these costs are the costs of activities such as incoming inspection and test, in-process inspection and test, final inspection and test and obtaining accuracy of test equipment (Deming 1982:263-64; Feigenbaum 1983:111-12; Juran 1988b:4.5-4.6).

The cost of failure of control, also referred to as the "cost of nonconformance", are defined by Crosby (1979:106) as those costs which are

> ...associated with things that have been found not to conform or perform to the requirements, as well as the evaluation, disposition, and consumer-affairs aspects of such failures.

These costs may be subdivided into "internal failure costs" and

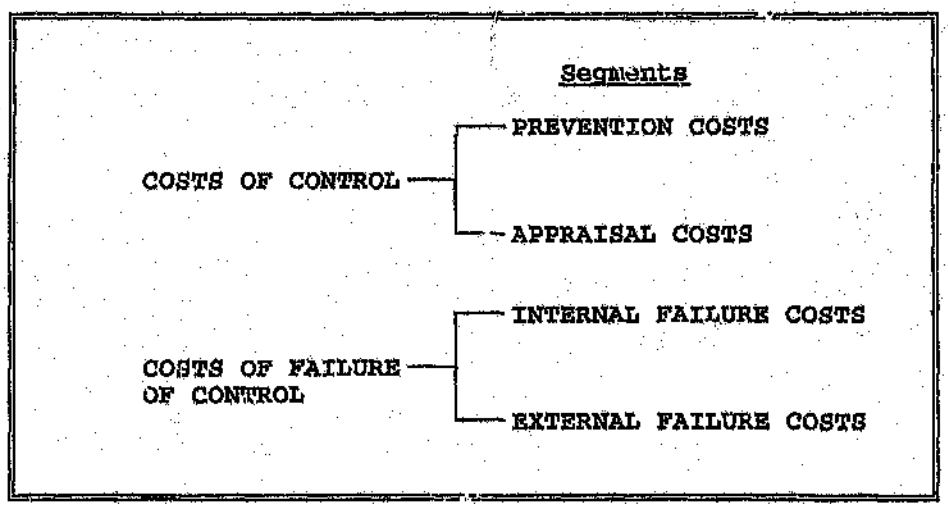
"external failure costs" (Deming 1982:263-64; Feigenbaum 1983:112; Garvin 1983:66; Juran 1988b:4.5-4.12).

(1) Internal failure costs include the costs of unsatisfactory quality within the company, such as scrap, wastage, reworked material, downgrading, avoidable process losses etc.

(2) External quality costs are the costs of unsatisfactory quality outside the company. These include costs such as product-performance failures, returned material, allowances and customer complaints. Crosby (1984:106) does not differentiate between internal and external failure costs, although the sum of Crosby's failure costs is the equivalent of the sum of the internal and external failure costs of Deming, Feigenbaum and Juran. The total quality cost is the sum of preventative, appraisal and failure costs, or alternatively the sum of the costs of control and the costs of failure of control (Broh 1983). Figure 9 provides a diagrammatic representation of quality costs.

Figure 9. Quality Costs

Source: Feigenbaum 1983:111.



Due to the fact that participative quality improvement represents

a shift away from the more traditional management styles and inspection methods, the workforce must be subject to extensive training and education. This education is necessary as the move away from inspection-based quality assurance towards preventative quality assurance results in a role change for many employees.

6 EDUCATION AND TRAINING

The majority of authors on the subject of total quality management identify the importance of education to the success of the quality improvement process (Carroll 1987; Casbourne 1987; Crosby 1979; Deming 1982; Edosomwan 1987; Ishikawa 1985; Juran 1988b; Lomas 1986; Marash 1989; Townsend 1986). As identified by them, the major thrust of the education phase of the total quality improvement process is three-fold.

- Initial awareness training, designed to make the workforce aware of the importance of quality to the future success of the organisation. Awareness training is also used to show individuals how quality can be integrated into their own positions within the organisations (Casbourne 1987:108; Crosby 1979:68 & 181; Juran 1988b:10.51 & 11.4; Lomas 1986:218; SABS 0157, part iv:16; Townsend 1986:23);
- To provide employees with an understanding of what not to do and why, as well as what to do to ensure quality improvement (Crosby 1979:68; Deming 1982:285);
- To provide the workforce with the tools to manage their own quality (Casbourne 1987:109; Crosby 1979:68; Juran 1988b:11.5).

Prior to the commencement of any quality training, an audit must be undertaken to determine the present status of quality and quality training in the organisation (Feigenbaum 1983:203-05; Juran 1988b:11.5). The status of the existing program will play an important role in shaping the new quality training program (Juran 1988b:11.9).

Most authors recommend that training should be provided separately to executive management, line management and

employees. This enables the training to focus on the role to be taken by the group being trained (Carroll 1987; Casbourne 1987; Crosby 1979; Deming 1982; Edosomwan 1987; Ishikawa 1985; Juran 1988b; Lomas 1986; Marash 1989; Townsend 1986). There is, however, one type of training which should be provided to the entire organisation, in the same form, irrespective of position occupied. This is training aimed at stimulating awareness.

6.1 GENERAL AWARENESS TRAINING

One of the purposes of the training process is to gain the commitment of the entire workforce to the quality improvement process. According to Marash (1989:123)

> ...one of the principal means of influencing a behavioral pattern that seeks quality improvement is for training and education to take place at all levels.

Central to gaining the commitment of the workforce to the quality improvement process, is providing it with an understanding or awareness of the importance and need for quality improvement (Crosby 1979:181; Day 1984:18; Edosomwan 1987:67; Hagan 1984:24; Ishikawa 1985:37; Juran 1988b:10.51; Kenworthy 1986:22; Koopman, in Project Free Enterprise Report 1986:20; Lomas 1986:218; Marash 1989:123; SABS 0157, part iv:16; Townsend 1986:23). Commitment and motivation to quality improvement will only be achieved where all employees understand what quality means to the organisation and to themselves. For this reason, the entire workforce must be made aware of the cost of poor quality and consequences to the organisation of such poor quality (SABS 0157, part iv:16; Townsend 1986:118-19). Further, they must know how to go about achieving the required quality standards (Edosomwan 1987:67; Townsend 1986:13). The reasoning behind this is that the motivation and commitment of personnel begins with their understanding of the tasks they are expected to perform and how those tasks support the overall activities in the organisation.

A vital element of this process is the clear assignment of

responsibility for quality. This involves that every person in the organisation be made aware, in no uncertain terms, that they are responsible for the quality of their own output. Workers must be instilled with the notion that each one of them is a quality control inspector. If a faulty item is spotted in the production process, they must be encouraged to stop the process until the error has been fixed and the cause addressed (Byron 1981:51). Tied to this is the establishment of what is termed an internal client attitude (Deming 1982:313; Ishikawa 1985:106-09; Juran 1988b:10.23-10.25; Marash 1989:122; Townsend 1986:22).

This attitude is based on the idea that within a process, each stage is a supplier to subsequent stages and a customer of previous stages. The adoption of an internal client attitude requires making each employee aware of who their internal customers are. More importantly, it entails making each employee aware of what relationship exists between the quality of their output, and the quality of the final product which is sold to an external customer (Carroll 1987:54; Feigenbaum 1983:83-4; Ishikawa 1985:107; Juran 1988b:21.10). Marash (1989:122) argues that the adoption of such an attitude requires that the output of each employee

> ...exceed the rigorous requirements of employees who perform the next function, and they should accept nothing less from those who perform previous duties.

Aside from the above awareness stimulation which is applicable to the entire organisation, the overall education process requires: executive education, wherein senior management can learn its role; line-management or supervisor education, wherein those who must implement the process learn how to do it; and employee education, wherein all the employees in the organisation learn how to comprehend their roles (Crosby 1984:88).

6.2 Senior Management Education

Due to the fact that the quality improvement process is a process which is largely driven by top management, many authors suggest that they should be the first category of people to be subject to quality education (Casbourne 1987:110; Juran 1988b:10.51; Kenworthy 1986:21; Marash 1989:122-23; Pavsidis 1984:28-9).

The training which needs to be provided to senior management can be divided into the following categories:

- that needed to gain their commitment to the quality improvement process, and
- that needed to equip management to succeed in their new role in the organisation, namely that of involving the workforce in the quality improvement process (Tavernier 1981:18).

6.2.1 *Training Directed at Securing Commitment*

Research has shown conclusively that where senior management are not committed to the quality improvement process, their subordinates are unlikely to be committed to the process either (Bradley and Hill 1987:72; Feigenbaum 1983:205; Ingle 1982:55; Juran 1988b:10.51; Kenworthy 1986:21; Marash 1989:122; McGraw and Dunford 1987:157; Peters 1980:205). A vital element of the quality improvement process is therefore management commitment as this is a strong pre-requisite to subordinate commitment

The initial objectives of management training should therefore be to provide executive awareness, so as to gain commitment and involvement from the top of the organisation (Ishikawa 1985:39; Kane 1986:28; Kenworthy 1986:21; SABS 0157, part iv:16). Commitment at the top of the organisation must be used to, and usually does, generate awareness and hence commitment lower down the organisation. As described by Crosby (1979:185) and Peters (1980:205), the "awareness campaign" has to reach every employee, through the people who are really important to them - their

superiors. The findings of Kenworthy (1986:21) confirm this view. Senior management are responsible for ensuring that the message which continually cascades down the organisation is that nonconformance is expensive and that executive management are serious about quality improvement (Peters 1980:205).

6.2.2 *Training Directed at Minimising Resistance to Subordinate Participation*

The decentralising of quality responsibility is central to total quality management (see chapter two). This decentralisation of quality responsibility is synonymous with the adoption of a participative style of management (Alexander 1981:619; Bowen 1977; Brooke 1982:77; Cole 1979:77; Drucker 1981 & 1971; Hoffman 1983:40; Juran 1981:57; Koopman 1987 et al: 4-112; Project Free Enterprise Report 1986:67-8; Rehder 1979; Russell and Dale 1989:10; Tavernier 1981; Whitehill and Takezura 1978).

Vital then to the success of a participative system of quality improvement is that senior management is made aware of the fact that total quality management will require an open, participative style of management.

An element which is vital to management's commitment to the adoption of a participative style of management, is their understanding of the participative process. Where management feels threatened, does not understand, or is unaccustomed to the principles of participative management, they are unlikely to support this philosophy. The reason for this is that where any of the above conditions exist, their is a strong possibility that management will view the decentralisation of responsibility as an erosion and dilution of their power in the organisation, and will therefore not support it (Manning 1987c:18). Through the training process, management fears and misperceptions regarding employee involvement need to be quelled. The education process should attempt to increase management understanding of the

process and, as a result, decrease their resistance to it (Kenworthy 1986:22; Van Eeden 1986:19-20).

There is wide consensus that training and education are the surest ways of overcoming any reservations, misperceptions or negative attitudes which management may have regarding the involvement of employees in the quality improvement process (Amm 1988; Botha, in Boart News 1988; Manning 1987c:18; Stevens 1987; Viljoen, in Boart News 1988; Work Station Participation Guidelines 1985).

6.3 Supervisory /Middle Management Training

The training which needs to be provided to middle management or supervisors can be divided into the following categories:

- that needed to gain their commitment to the quality improvement process;
- that needed to equip management to succeed in their new role in the organisation, namely that of involving the workforce in the quality improvement process (Tavernier 1981:18);
- that needed to equip them to train their subordinates in the field of participative quality improvement.

6.3.1 *Training Directed at Minimising Resistance to Subordinate Participation*

Much support is given to the view that the middle manager or supervisor is one of the key figures in any quality improvement process (Cole 1980:40; Deming 1982:62; Feigenbaum 1983:206; Klien, in Mutch 1986; Neal, Johnson and Sederberg, in McClenahan 1981:73; Van Eeden 1986:20). The importance of middle or supervisory management support stems from the guiding, coordinating, educating role which they are required to play in the quality improvement process (Feigenbaum 1983:206; Ishikawa 1985:131). They are the level of management who get involved in the quality improvement process at shop floor level, and who are to a large degree responsible for involving and obtaining the

support of their subordinates in the process. Extensive research has shown that, aside from their importance to the participative process, one of the major barriers to successful employee participation in the organisation is middle management resistance (Bradley and Hill 1987:72-4; Cole 1979:77; Dale 1984a:52; Dale 1984b:7; Lees and Dale 1985:7; Levitan and Clifford 1983:8-16; Marash 1989:122-23; Project Free Enterprise Report 1986:76; Van Eeden 1986:19). The reasons for this resistance by middle management to participate in and facilitate the participative process are many. One of the findings of the Project Free Enterprise Report (1986:76) was that all the organisations surveyed encountered resistance from middle level white management to the introduction of employee participation. This resistance was invariably characterised by white managerial insecurity and perceptions that their authority would be undermined. Similarly, the findings of Lees and Dale (1985:7) show that one of the major objections of management towards quality circles is that the involvement of employees will result in some loss of control by themselves. They feel threatened by quality circles. These findings are confirmed by the work of Marash (1989:122-23), who writes:

> As production workers take increased responsibility for quality in their own roles, supervisors and middle-level managers may feel their jobs are in jeopardy.

The findings of Dale (1984a:52) confirm the above results. In 27,9% of the companies which he researched, management resistance to quality circles was encountered. Around 30% of these objections involved a fear of loss of control and a threat to their power. Other objections arose from a fear that these participatory groups would solve previously unsolved problems and bring about large savings, which would reflect negatively on the past job done by management. Similar experiences have been recorded by Cole (1979:77) and Bradley and Hill (1987). The findings of Bradley and Hill (1987:72-4) conclude that in every company which was researched, which employed quality circles, there were negative attitudes among the middle managers who dealt

with the circles. They found that, in these organisations, there was a complete rejection of democratic leadership by middle management. Three common factors emerged from their research. First, initial reaction to quality circles was unfavourable. Middle managers were sceptical about the desirability of participative management, and considerable pressure from above had to be exerted on individuals prior to the introduction of quality circles. Second, middle managers felt that good management was synonymous with the efficient use of human and technical resources, and that participation was unnecessary if managers were operating effectively. Third, managerial prerogative concerned all respondents. Middle management emphasised that they wished to restrict quality circle participation in managerial decision-making to research and consultation.

The work of Cole (1979:40 & 78) at General Motors in the United States, identifies an additional factor as being one of the more important factors leading to middle management indifference and hostility to quality circles. They found that middle management who were bypassed when the new participative program was being designed and set up, opposed it.

Van Eeden (1986:19) suggests that a factor often leading to middle management not supporting quality circles is that they agree to them being implemented in their departments without really believing in the concept or without understanding their role in the program.

According to Klein's research (in Mutch 1986:57), middle management generally view employee participation programmes as good for the company and its workers. However, very few of them perceive such programs as being beneficial to themselves. Where such views are held by middle management, there appears to be little incentive for them to be committed to employee involvement.

Manning (1987c:18) introduces a further possible obstacle to gaining the commitment of middle management in South Africa to the participative process:

> Now consider the "mental baggage" with which South Africans come to the workplace. Most of our managers [supervisors] are Whites who have, by and large, been brought up on racial principles. They've been taught from birth that Whites are entitled to take decisions for Blacks. They have also been taught that Blacks will accept their decisions and their orders humbly and without question. Blacks, on the other hand have been brought up to reinforce this view - thus to ensure that it is a self fulfilling prophecy. Nor does social and legal separation outside of the workplace do anything to give either group a different perspective. So the world view of South Africans, the paradigm which shapes our behaviour, is hardly conducive to participative management.

Manning concludes by saying that decision sharing is not a reality until these perceptions change.

The above research findings highlight a number of possible causes of middle management resistance to subordinate participation in the organisation:

- middle managers feel that the increased involvement of employees will undermine their position in the organisation and will result in some loss of control by themselves;
- middle managers feel that good management is synonymous with the efficient use of human and technical resources, and that participation is unnecessary if managers are operating effectively;
- middle managers are afraid that subordinate involvement may result in certain previously unsolved decisions being solved, reflecting poorly on the manager;
- middle managers agree to participation schemes being implemented in their departments without really believing in the concept or without understanding their role in the program;

- through lack of understanding of the principles underlying subordinate participation, middle managers felt that there were no benefits to be gained by them through subordinate involvement.

There is widespread agreement that one of the most effective ways to overcome the above potential barriers to participative management involves a concerted education program involving all middle management. This education program should serve to provide them with an understanding of the process, its needs, benefits and operations (Cole 1980:40; Crosby 1984:87-96; Deming 1982:47-9; Ingle 1982:57; Klien, in Mutch 1986:57; Project Free Enterprise Report 1986:76; Russell and Dale 1989:8). Goodfellow (1981:32-33) studied twenty-nine companies in the United States which were utilising employee involvement schemes, and found only eight were unquestionably successful. All eight had a common element, which was the provision of specialised middle management training. The courses mentioned included courses in leadership principles and effective human relations. The research of Hegland (1981:28) confirms these findings.

Russell and Dale (1989:8) warn against trying to exclude autocratic managers from the participatory process. Such an approach is seen to have disastrous results. According to them, these managers need to be involved once they have been subject to intensive, mostly attitudinal, training to help them understand the participative process.

6.3.2 *Training Directed at Securing Commitment*

Not only is middle management's commitment to the participative process required, but so is their commitment to quality improvement. Where middle management are not committed to quality improvement their is little chance that their subordinates will be either.

6.3.3 *Training Role*

An additional important role of line management in the quality improvement process is that of the training of subordinates. Middle management should be trained to cascade the quality education as quickly as possible to the rest of the organisation (Ishikawa 1985:39; Kane 1986:28; Kenworthy 1986:21; SABS 0157, part iv:16).
Alexander (1981:618), Pavsidis (1984:28-9) and Townsend (1986:7) argue that the resources needed to train every individual in an organisation would be excessive. They recommend that this training be done by training management or quality team leaders intensively, and relying on them for both leadership and additional training at team level. The findings of Lees and Dale (1985:12) confirm that, in organisations where the total quality approach has been adopted successfully, training has followed the above lines.

Regarding the particular training to be given to line management, the findings of a study conducted by Dale (1984a:57) reported the following categories of training as being the most commonly provided to line management: problem solving techniques, creative thinking and brainstorming, statistical techniques, leadership methods, quality control techniques, group dynamics and presentation techniques. In addition, the work of Crosby (1979:204-05); Goodfellow (1981); Hegland (1981:28) and Juran (1988b:11.20) identifies the following topics to be covered in a quality training course for line managers and supervisors:

- what is quality control?
- role of the supervisor;
- cause and effect diagrams;
- control charts;
- process improvement and control;
- sampling concepts;
- quality circle activities;
- leadership principles;
- effective human relationships.

The training of middle management must therefore ensure that, first, all have the technical know-how required for quality improvement and that they transfer this knowledge to their subordinates and second, that middle management actively go about creating a climate which will motivate employees to be quality conscious and participate in the quality improvement process

6.4 Employee Education

In addition to management education, employee education is vital for the ongoing success of the quality improvement process. Its absence is held to be one of the major barriers to the success of a participative quality improvement program (Ingle 1982:55). In order for employees to be totally committed to the system, they must understand it and their role in it (Crosby 1984:87-96; Deming 1982:47-9; Ingle 1982:57). There is wide consensus that education is the most successful means to foster and promote the required level of understanding (Amm 1988; Botha, in Boart News 1988; Manning 1987c:18; Stevens 1987; Viljoen, in Boart News 1988; Work Station Participation Guidelines 1985).

6.4.1 *Training Directed at Securing Commitment*

The first type of education which an employee should be subject to is awareness education. One of the purposes of this type of education is to gain the commitment of the workforce to the quality improvement process.

Further, employees must be exposed to and trained how to use the tools which will be required for them to manage their own quality problems, such as flow charts, measurement, cause and effect diagrams, control charts and the like (Juran 1988b:11.5; Kenworthy 1986:23). Deming (1982:319) and Garvin (1989:72) strongly advise that employees be given tuition in basic statistical methods, such as control charts.

The findings of an extensive survey by Dale (1984b:10) identified

the types of education and training provided to team members as being:

- creative thinking and brainstorming;
- cause and effect diagrams;
- communication and presentation techniques;
- Pareto analysis.

6.4.2 *Training Directed at Minimising Resistance to Subordinate Participation*

In addition to being trained on the tools of total quality management, employees must be given training in the participative philosophy (Tavernier 1981:18). Because total quality management is based on a participative philosophy, employees need to be trained and made aware of what their role in the participative process is.

6.5 Education of External Parties

Juran (1988b:11.21) advises that quality training be extended to people outside of the organisation. This includes clients, suppliers and others. This training is important in that these parties do have an impact on the quality output of the organisation. For a more indepth discussion of the role of these external parties t the quality improvement process, refer to chapter two.

An important element of the participative quality improvement process, about which there is much agreement, is that the entire workforce should be encouraged to set quality goals. The purpose of this is to help ensure the continuity of the process.

7 GOAL SETTING

In order to obtain consistent quality improvement, a formal system of quality goal setting is recommended by a number of authors (Crosby 1979:212-15; Deming 1982:35-41; Garvin 1983:70; Ishikawa 1985:59-61; Juran 1988b:10.51; Nemoto 1987:24-5). All the above authors stress that the important factor is that these goals must be quality goals, and not numerical output goals.

The purpose of this quality goal process is to turn pledges, commitments and knowledge into action by encouraging individuals to establish quality improvement goals for themselves and their groups (Crosby 1979:212).

7.1 Method of goal setting

Top management ought to produce vague policy announcements regarding quality, which will be further defined by department heads and middle managers. Actual quantitative quality goals are set jointly by quality teams and middle managers (Garvin 1983:70; Juran 1988b:10.51; Nemoto 1987:45-54). Middle managers must encourage teams of employees to establish quality goals towards which they are prepared to work. According to Hodgetts (1975:483) participative goal-setting entails special kinds of meetings between superiors and their teams of subordinates. They jointly establish a plan of action: what the subordinate will do, the period in which he aims to complete the task, and how his performance will be evaluated. At the end of the allotted period, they meet again, review results, and set further, more challenging goals. These goals should be specific, realistic, measurable and above all personal. Deming (1982:36-40) stresses that establishing goals without providing the means to achieve them is a purposeless exercise. Similarly, Nemoto (1987:54) recommends that quality goals should be interfaced with the methods to attain them.

7.2 Principles of Goal Setting

According to Garvin (1983:70) and Hodgetts (1975:483), two principles underlie the participative goal setting approach: the "self-commitment principle" and the "quantifiable principle". The first principle is based on the fact that where goals are set by the individuals or teams responsible for their fulfilment, these individuals or teams will be more motivated to achieve them and the goals will earn wide support. The reason for this commitment is that the subordinates concerned have been given ownership of the process (Garvin 1983:70).

The requirement that quantifiable goals must be formulated is of great significance to the quality improvement process. Even when most clearly defined, quality improvement remains a principle, a philosophy and an abstract conception. It is not easy to persuade people to accept an ideology or an abstract principle. They also need clear, tangible results and evidence. For this reason, numeric quality goals capable of being measured should be established. When goals are attained, as measured against stated quantifiable objectives, they act as a stimulant for further improvement. Success is then associated with the quality improvement programme.

A commonly held view is that employees are only likely to be committed to the participative quality improvement process when there is some incentive for them to be committed. For this reason, it is recommended that incentives and rewards be provided to help ensure active participation in the participative quality improvement process.

8 INCENTIVES AND REWARDS

Many authors suggest that rewards and incentives for participation and achievement in the quality improvement process should be provided (Casbourne 1987:111; Cole 1980:41; Crosby 1979:218; Juran 1988b:22.5; Lochner 1982:23-5; Townsend 1986:61)

8.1 The Rationale for Incentives and Rewards

8.1.1 *Employee Commitment*

The increased complexity involved in providing a quality product to the market, coupled with the large output volumes required has magnified the importance of the quality contribution of every employee. Incentives, although expensive in terms of money and time, are necessary to encourage the required employee participation and commitment. As Koopman et al (1987:157) say of the need for an incentive-reward system,

> It is unlikely that organisations will achieve meaningful participation and involvement from their workforce if they are not willing to be innovative in establishing reward systems that are commensurate with their people's efforts and aspirations.

The Project Free Enterprise Report (1986:76) had the following to say regarding the importance of incentive-reward systems:

> The successful organisations all pay a great deal of attention to the necessity of ensuring a positive feed-back loop which links employee performance directly to output and in turn links the benefit of output directly back to the efforts of employees.

The provision of an incentive reward-system is based on the principle that people will increase those behaviours for which they receive positive consequences (Feaney 1990:31).

Due to the fact that total quality management is dependent on the commitment and participation of the entire workforce, the reward structure of the organization should be structured in such a way

that it is in the interests of, and of benefit to, the entire workforce to participate (Haridy 1985:43). Because of the fact that the quality improvement process stresses the concept of using teams to identify opportunities and make improvements, methods of compensation should compensate individuals for their team participation, rather than strictly on an individual or organisation-wide basis (Bowen 1977:128; Haridy 1985:43-4; Koopman et al 1987:95-112 & 161-62; Lomas 1986:218; Marash 1989:123; Project Free Enterprise Report 1986:21 & 26; Townsend 1986:84-5). In South Africa, a policy of rewarding group behaviour would be consistent with what Silberbauer (1978) identifies as the cultural inheritance of most South African blacks - a need for affiliation. This view is supported by Coldwell and Moerdyk (1981:70-6) who point out that Africans in general tend to show a need for group orientation and affiliation.

8.1.2 *Management Commitment*

Research has shown that there is a strong correlation between management commitment to a participative process and the success of the process (refer to chapter four). Total quality management, as a participative process, is dependent on management support. Extensive research in this area indicates that much management resistance to the introduction of some form of participative management into the organisation is encountered (Bradley and Hill 1987:72; Cole 1980:40; Crosby 1979:185; Dale 1984b:7; Deming 1983:62; Feigenbaum 1983:206; Ishikawa 1985:131; Klein, in Mutch 1986:57; Levitan and Clifford 1983:8-16; Marash 1989:122-23; Neal et al, in McClenahan 1981:73; Peters 1980:205; Project Free Enterprise Report 1986:76; Van Eeden 1986:20).

Two means have been advocated as possible methods of overcoming this resistance: (1) the education of management (for a more detailed discussion of management education, refer to chapter four), and (2) the provision of incentives to encourage management to participate in the process (Alexander 1981:618;

Bradley and Hill 1987:75; Garvin 1983:70; Haridy 1985:45; Juran 1988b:7.8 & 22.10).

Many authors agree that in order to enhance management commitment to the participative quality improvement process, their related success should form part of the job evaluation process (Alexander 1981:618; Bradley and Hill 1987:75; Garvin 1983:70; Haridy 1985:45; Juran 1988b:7.8 & 22.10).

The research of Bradley and Hill (1987:75), which focused on management commitment to quality circles, concluded that where the performance of managers in dealing with their circles is incorporated into the management appraisal system, management commitment was higher than where management were not appraised in terms of their success with quality circles. Similar findings were obtained by Garvin (1983:70) who found that of the organisations researched, the producers with low quality failure rates evaluated both supervisors and managers on the quality of output - supervisors, in terms of defect rates, scrap rates and the amount of rework attributable to their own operations, and managers, in terms of service call rates and their plants' total costs of quality.

Bradley and Hill (1987:75) found that the absence of incentives resulted in positive disincentives: the time and effort spent on quality circles was seen to possibly impair performance in other job areas which are considered in the appraisal of middle management, such as meeting deadlines and production targets. Compensation and promotion should be related to good performance in the participative quality improvement process.

Haridy (1985:45) argues that the appraisal incentive applies equally to all employees in the organisation. He stresses that the incentive system for all employees in the organisation is important to the outcome of participative quality improvement programs. This incentive system should be such that participation in the quality improvement process and improvements in quality

become part of the job evaluation process.

The research of (Bradley and Hill 1987:75-6) identifies an additional incentive to encourage management commitment to the process. They found that in organisations where middle managers, who were involved in quality circles, are given sufficient authority to take action on most issues raised by the circles, these managers were committed to the success of the circles. These managers felt that the quality circles were their property and that they would gain credit for any efficiency gains to arise out of quality-circle activity.

The findings of Berg (Berg et al, in Bradley and Hill 1987:69) provide a further explanation for the close relationship between management support for participative intervention and management being given "ownership" of the process. From their findings, Berg et al (in Bradley and Hill 1987:69) advocate that incongruence between the roles management pursue in their work and the roles required for quality of working life interventions explain management's reluctance to support the participative process. This underscores the potential importance of the role of managers in promoting participative programs. Their results showed that management commitment to quality circles was greater in organisations which linked the manager's own objectives to those of the quality circle program than in those which did not. These findings are confirmed by the research of Bradley and Hill (1987:76).

The research findings of Bradley and Hill (1987:75) conclude that the extent of management commitment to the quality circle program, is decided by the way in which the companies organised responsibility and rewards, and this therefore determined managements incentive to make circles work.

From the above research it is evident that in order to enhance management commitment to participation, management needs both a reason to make participation work and the power to ensure that

it does (Berg et al, in Bradley and Hill 1987:69; Bradley and Hill 1987:76-7; Haridy 1985:45).

8.2 Types of Rewards and Incentives

Because of the importance of rewards and incentives to the participative quality improvement process, it is not surprising that a great many theories exist as to the manner in which employee achievement and participation should be recognised and encouraged. At the one extreme is a method which emphasises recognition, that is public acclaim and honour, without accompanying financial rewards or incentives. At the other extreme, is the financial incentive approach, whereby the only incentive or reward is financial (Townsend 1986:77). Many authors recommend that in order to maximise the effect of the incentive reward system, both financial and non-financial rewards and incentives should be provided (Cole 1980:39; Klein 1981:14-6; Lawler and Mohrman 1985:69; Project Free Enterprise Report 1986:21; Todd 1988:10; Townsend 1986:79-100). According to Cole (1980:39), Japanese employers rely heavily on providing non-financial recognition for participation in quality improvement through a variety of techniques. Such an approach, according to Cole (1980:39), makes sense in the context of long-term employee commitment. In the absence of such commitment, managers will need to provide greater financial rewards for participation. For this reason, employees in the U.S.A. and most Western economies, according to Cole (1980:39), want to be recognised both financially and otherwise. This view is supported by Lawler and Mohrman (1985:69) who claim that

> In American culture, people who have contributed to gains perceive that they have the right to share in them.

According to Lawler and Mohrman (1985:69), in addition to a demand for financial recognition, there is a demand on the part of employees for recognising their dignity as individuals and their ability to make meaningful contributions to their organisations.

Townsend (1986:10) recommends that the individuals or teams to be rewarded should be chosen by their peers, and not by management.

According to the findings of the Project Free Enterprise Report (1986:40-1) workers in South Africa perceive that there is little or no correlation between performance/effort and reward. For this reason, and in order to maximise the effectiveness of the reward incentive system, it must provide for prompt recognition. The time between accomplishment and recognition must be minimised (Bowen 1977:127; Cole 1980:39; Townsend 1986:87-8). In this regard, the experience of Cole (1980:39) in the United States indicates that employees expect the time lapse between action and accompanying reward to be minimal. In addition to the minimisation of the time lapse between performance and reward, after extensive study of black workers, Silberbauer (1978:63), proposed the following as means towards increasing the effectiveness of a reward incentive system aimed at or including black employees:

- the first essential is that the black worker must understand the scheme. This may take longer than with their colleagues of other races. They must be given time to mull over the system, and to return with their comments and suggestions;
- a means to link the reward to performance may be to pay the reward bonus separately from the basic pay so that the worker can see that his extra effort and application bring him a direct, measurable reward.

Although total quality management is a process which aims to eradicate a reliance on inspection as the means to ensure quality, certain writers on the subject do recognise that in certain circumstances, varying degrees of inspection may be necessary.

9 INSPECTION

9.1 Limited Inspection

Although much of the emphasis of total quality management is directed at defect prevention, most authors on the subject agree that in certain instances limited inspection is a necessary activity (Crosby 1979:27-8; Deming 1982:204-08; Ishikawa 1985:76-81; Juran 1988b:ch18; SABS 0157, part 1:5; Wild 1985). The more important elements justifying limited inspection are that:

- although the inspection process in itself is unable to attend to the cause of any nonconformance, it does provide valuable information which can be used to identify and correct the process which is causing the nonconformance;

- quality problems could occur in the designing or development stage which could not be solved by the manufacturing or inspection division. For this reason, it is recommended that inspection during the new product design stage is be undertaken.

- most organisations purchase products, supplies or services that amount to approximately 50% of their sales (Crosby 1979:61-2). For this reason the quality of these imported components is very important to the quality of the final product or service. Irrespective of the level of competence of the production process, if faulty parts or materials are used in production, the quality of the final product will be impaired. Therefore, in order to monitor the quality of the parts supplied by external suppliers, inspection of incoming materials is recommended.

9.2 What Degree of Inspection Should be Undertaken?

An important element regarding the process of inspection is what degree of inspection should be undertaken. The degree of inspection is dependant on a number of factors, such as the level of competence of the process, both internal and external, and the use of the particular product being inspected.

- No inspection will take place when there is adequate evidence that the process is in a state of "self control" and that the product which it produces consistently conforms to specification.

- Small samples will be inspected where there is a high, but not complete degree of "prior knowledge", so as to verify the continuing validity of this "prior knowledge". Juran (1988b:18.24) defines prior knowledge to include the level of knowledge and training and previous quality records of the process operators and suppliers.

- One hundred percent inspection is recommended where the nature of the part being inspected is such that were it to fail the result could be critical, or in instances where such a level inspection is required to satisfy legal requirements (Juran 1988b:18.25). Such parts are normally referred to as safety critical parts.

10 CONCLUSION

The theories of total quality management advanced by Crosby (1979), Deming (1982), Feigenbaum (1983), Ishikawa (1985), Juran (1988b) and Townsend (1986), while each possessing certain unique characteristics, cover much common ground. These common factors span management style, organisational structure, the drawing up and distribution of a quality policy, the measurement of quality, goal setting, education and training and the provision of rewards

and incentives for participation in the quality improvement process.

Management commitment is held to be the most important ingredient of effective total quality management (Crosby 1979; Deming 1982; Feigenbaum 1983; Ishikawa 1985; Juran 1988b; Townsend 1986). This importance is two-fold. First, employees receive their work standards from their leadership. Management must view quality as an attitude which starts with them and spreads throughout the organisation. Where management demonstrate, by their actions and behaviour, that quality through prevention and not through inspection is the issue that guides decision-making, they will set the standard for the rest of the organisation. Second, management are responsible for the introduction of a number of actions which are central to the development and growth of a participative process. These responsibilities include the creation of an organisational climate which will enhance the participative process. The importance of this lies in the fact that where the wider social structures of the organisation are not supportive of consensus-based decision making and the organisational culture is not congruent with co-operative workplace decision-making, participative forms of quality management are unlikely to succeed. An element of this climate is the prevailing management style. In order to cultivate subordinate participation, management themselves must adopt a participative style of management. The importance of the adoption of such a style of management to the participative process is captivated by the following quote from the Project Free Enterprise Report (1986:67-8):

> The major priority in ensuring that participative systems work within an organisation is to ensure that they are viewed and practised as a total philosophy of management. This requires that managerial structures, practices and goals are all related to the common theme of participation within the workplace.

Where management fail to adopt a participative style of management, there is little hope that such a style will be

adopted by their subordinates.

Even where a participative style of management is evident within the organisation, a vehicle for installing and promoting decentralised quality responsibility is necessary. The vehicle advanced by most authors is some form of quality improvement team. These teams range from task forces, to quality circles, to quality improvement teams. Task forces are established to deal with specific quality problems, and are usually disbanded once the assigned problem has been rectified. Quality circles and quality improvement teams are teams of employees, usually from the same work area, who meet regularly to analyse, solve or make recommendations to management on quality problems in their immediate workplace. The co-ordination of these teams is overseen by a steering committee. A steering committee is a high profile committee, set up to oversee, direct and review the entire quality improvement process.

Another factor which can either hamper or facilitate the introduction of participative decision-making, is the structure of the organisation. Subordinate participation is concerned with initiating the involvement of those lower down the organisation structure. For this reason, the structure of the organisation must encourage, rather than discourage such involvement. It is recommended that a relatively "flat", flexible organisation structure best satisfies this requirement.

Most authors agree that the intentions and requirements of the organisation as regards quality must be contained in a quality policy. This policy must be distributed throughout the organisation, for all to see. The purpose of such a policy is to provide direction to the quality improvement process and to communicate to all the status of quality within the organisation.

The importance to total quality management of the calculation of a cost of quality is an issue about which there is much agreement. The more important reasons advocated for the calculation of a cost of quality are:

- it determines the status of quality in the organisation;
- it promotes an awareness of what poor quality costs the organisation;
- it translates quality into a common language;
- it provides documentation of where actual improvements have taken place.

An issue which is central to the ongoing success of total quality management is the continual provision of education directed at the entire organisation. The purpose of this education is primarily to stimulate an awareness of the cost associated with sub-standard quality, to make the workforce aware of its role in improving quality and to equip them to fulfil this role.

An important mechanism driving the participative quality improvement process is that the entire workforce must be encouraged to set and strive towards quality goals. Where goals are set and met, new, more challenging ones must be set. This process will help to ensure the continuity of the quality improvement process. In addition to goal setting, a further element likely to ensure the continuity of the quality improvement process is the provision of rewards and incentives for contributions to quality improvement. Research has shown conclusively that where rewards are provided, the level of participation in the quality improvement process has increased.

Although total quality management is based on ensuring quality output through the prevention of defective output and not inspection, limited inspection is advocated. There is agreement that as long as a particular process produces defective products, there is a need for inspection. Through continual process control and improvement, defective output should decrease along with the need for inspection.

Chapter four indicated that the decentralisation of quality improvement is a process which will not evolve over time. It is a process which requires a high degree of intervention in the form of management style, organisational structure, the drawing up and distribution of a quality policy, continual quality education, the measurement of quality, limited inspection and the provision of rewards and incentives.

CHAPTER FIVE

CHARACTERISTICS OF THE RESEARCH

1 INTRODUCTION

Chapters one and two introduced and defined the concepts of quality and total quality management. Chapter three provided an in-depth discussion of total quality management, as articulated by a number of authorities in the area (Crosby 1979; Deming 1982; Feigenbaum 1983; Juran 1988b; Townsend 1986). Chapter four, drawing on the theories presented in the previous chapter, focused on the elements central to the management of participative quality improvement. The most important of these factors were:

- management commitment;
- the decentralisation of responsibility for quality;
- the establishment of quality improvement teams;
- training and education of the entire workforce;
- the provision of rewards and incentives;
- the drawing up and distribution of a quality policy;
- the calculation of a cost of quality.

Chapters six and seven will present and discuss the findings of an empirical survey which was undertaken to determine the extent to which the principles of total quality management identified in the literature are being followed by the various manufacturers of the South African motor vehicle industry. In this chapter, the purpose and objectives of the research are outlined and a comprehensive account is given of the research methodology used. Further, the design, boundaries and limitations of the research are presented. The chapter closes with a description of the statistics used at various stages in the study.

2 THE RESEARCH PROBLEM

The object of this research component is an investigation of total quality management as practised in the passenger vehicle manufacturers of the South African motor industry. This investigation aims to compare the extent to which the principles of total quality management advocated in the literature are followed by management in the various manufacturing plants. Such a comparison is made possible by identifying the extent to which the principles of total quality management are evident at the various manufacturing plants.

The approach taken in this study follows the pattern of building a hypothesis from an in-depth literature survey, which could then be tested by collecting and analysing empirical data (Campbell 1954:8 & 86).

3 HYPOTHESES

The literature review suggests that hypotheses may be formulated from the findings of other researchers. The main hypothesis and corresponding sub-hypotheses are summarised as follows:

Main Hypothesis: Total quality management, as advocated in the literature, is being practised by all six of the passenger vehicle manufacturers in the South African motor industry which were surveyed. This main hypothesis has a number of sub-hypotheses: (For the purposes of the sub-hypotheses, a majority is defined as being more than fifty percent).

Sub-Hypothesis 1: The majority of management agree that less th ⁊ fifty percent of the output of their department is inspected.

Sub-Hypothesis 2: The majority of management agree that their department is responsible for at least fifty percent of the quality of production of that department.

Sub-Hypothesis 3: The majority of management agree that in their organisation a cost of quality is calculated.

Sub-Hypothesis 4: The majority of management agree that their organisation has a formal quality policy.

Sub-Hypothesis 5: The majority of management have signed a copy of their organisation's formal quality policy.

Sub-Hypothesis 6: The majority of management personnel agree that their department has drawn up its own more detailed and specific quality policy based on the original quality policy.

Sub-Hypothesis 7: The majority of management and their subordinates have easy access to a quality manual which explains expected quality responsibilities, quality procedures and quality expectations.

Sub-Hypothesis 8: The majority of management perceive their organisation to monitor managements and their subordinates attitudes on quality.

Sub-Hypothesis 9: The majority of management agree that their superiors participate in at least one half of their quality team meetings.

Sub-Hypothesis 10: The majority of management are aware that they have both internal and external customers.

Sub-Hypothesis 11: The majority of management are aware of what the key quality requirements of their customers are.

Sub-Hypothesis 12: The majority of management personnel personally give their subordinates training directed at quality improvement.

Sub-Hypothesis 13: The majority of management agree that specific training, directed at the tools and techniques of total quality management, is provided to them and their subordinates, on an ongoing basis.

Sub-Hypothesis 14: The majority of management agree that they are evaluated on their performance in the quality improvement field, with particular reference to participative quality improvement.

Sub-Hypothesis 15: The majority of management agree that they and their subordinates are provided with incentives to participate in the quality improvement process.

Sub-Hypothesis 16: The majority of management agree that they and their subordinates belong to a quality improvement team.

Sub-Hypothesis 17: The majority of management agree that their organisation has cross-functional quality improvement teams.

These sub-hypotheses represent a synthesis of the contributions of the works of the authors reviewed in the previous chapters. Table 6, while not claiming to be exhaustive, provides an indication of the major theoretical sources which lead to the formulation of each hypothesis:

Table 6. Theoretical Sources Underlying Each Hypothesis.

HYPOTHESIS	MAJOR THEORETICAL SOURCES
Main Hypothesis	Bredenkamp / Crosby / Deming / Feigenbaum / Juran / Lochner / SABS / Whalley / Wild
Sub-Hypothesis 1	Crosby / Deming / Feigenbaum / Juran / Lochner / Whalley / Wild
Sub-Hypothesis 2	Crosby / Deming / Feigenbaum / Garvin / Juran / Lochner / Townsend / Whalley
Sub-Hypothesis 3	Crosby / Dale / Deming / Feigenbaum / Ishikawa / Juran / Lochner / Lomas / SABS / Townsend / Whalley
Sub-Hypothesis 4	Carroll / Cole / Crosby / Ishikawa / Juran / Lomas / Nemoto / Townsend
Sub-Hypothesis 5	Carroll / Casbourne / Crosby / Deming / Edosomwan / Ishikawa / Juran / Lochner / Lomas / Marash / Townsend
Sub-Hypothesis 6	Crosby / Juran / Lochner / Townsend
Sub-Hypothesis 7	Crosby / Juran / Townsend
Sub-Hypothesis 8	Crosby / Deming / Juran / Marks / Sargent / Townsend
Sub-Hypothesis 9	Crosby / Juran / Nemoto / Townsend
Sub-Hypothesis 10	Crosby / Deming / Edosomwan / Feigenbaum Ishikawa / Juran / McMillan / Sullivan / Thurston / Townsend / Wild
Sub-Hypothesis 11	Crosby / Deming / Edosomwan / Feigenbaum Ishikawa / Juran / McMillan / Sullivan / Thurston / Townsend / Wild
Sub-Hypothesis 12	Carroll / Casbourne / Crosby / Deming / Edosomwan / Ishikawa / Juran / Lomas / Marash / Townsend
Sub-Hypothesis 13	Carroll / Casbourne / Crosby / Deming / Edosomwan / Ishikawa / Juran / Lochner / Lomas / Marash / Townsend / Whalley
Sub-Hypothesis 14	Cole / Crosby / Juran / Lochner / Townsend
Sub-Hypothesis 15	Cole / Crosby / Juran / Lochner / Townsend
Sub-Hypothesis 16	Cole / Crosby / Dale / Deming / Edosomwan / Garvin / Ishikawa / Juran / Stanton / Townsend

4 BOUNDARIES OF THE STUDY

An awareness of the boundaries within which the research is undertaken is an important element of understanding and being able to place research in context. The purpose of this section is to present and discuss these boundaries.

4.1 THE INDUSTRY

The research component of this dissertation was limited to the manufacturing sector of the South African passenger vehicle industry. While it is recognised that the manufacturing sector is only one sector of the industry, it is felt that total quality management practises in this sector will provide a fair reflection of the approach to total quality management in other areas of the industry. Of the seven manufacturers in the South African passenger vehicle industry, access was gained to all of the plants baring the Mercedes-Benz plant. The reasons cited by management at this plant for refusing access were that

> Economical, technical and IR matters require the full attention of the entire management (see APPENDIX 20).

In addition, at the time that this research was being undertaken, employees at Mercedes-Benz of South Africa were involved in what was to be a lengthy strike. For this reason, access to the plant would have been very difficult.

This study is therefore limited to the manufacturing plants of BMW, Delta, Nissan, Samcor, Toyota and VW.

4.2 RESPONDENTS

Due to the fact that the purpose of this dissertation is to investigate total quality management as practised in the South African passenger vehicle industry, the survey is limited to management personnel. No attempt is made to elicit opinions and responses from non-managerial personnel.

The reason that management personnel and not non-management personnel are chosen as the study objects is four-fold:

(i) The purpose of the research is to investigate the management of total quality in the industry.

(ii) Time and financial constraints limited the size of the survey sample.

(iii) Management personnel are more accessible to the author. This is essentially due to trade union reluctance for its members to be the subjects of such research. There was, however, little resistance on the part of the union to management being the subjects of the research (this problem was discussed at numerous meetings held between the author and representatives of NUMSA).

(iv) It is the opinion of the author that, by virtue of their positions in the organisation, management will be able to provide an accurate picture of total quality management in their organisation.

4.3 DESCRIPTIVE RESEARCH

The data used to establish the research findings of the research are empirical, collected using a structured questionnaire. The questionnaire was used in an attempt to establish the total quality management practices employed in the South African passenger vehicle industry. This type of study is what has been called a "descriptive study" (Bailey 1982:38). Its exploratory nature is characterised by an attempt to identify the situation. In common with this category of research, the purpose of this thesis is to investigate and provide a description of

total quality management as practised in the South African passenger vehicle industry. No attempt is made to identify or predict any causal relationships.

5 ASSUMPTIONS MADE IN THIS STUDY

The assumptions on which the research is based include:

- the majority of management constituted more than fifty percent of management;
- participants in the empirical research consistently understood the basic terminology and words used consistently;
- participants in the empirical research would, and could, express their considered opinions.

6 LIMITATIONS OF THE RESEARCH

While much time and effort was invested in keeping the limitations of this research to a minimum, it is recognised that it has the following limitations:

- The research was purely descriptive in nature and no attempt was made to investigate causal relationships.

- The research was limited to the manufacturing sector of the South African passenger vehicle industry (see section 4.1 and 9.1). While it is thought that this sector provides a good indication of the practices in other sectors of the industry, little factual evidence of this could be found.

- The objective of this dissertation (see pages 3 and 179) was to investigate the management of total quality in the South African passenger vehicle industry. For this reason, coupled with budget and time constraints, the survey was limited to management personnel (see section 4.2 and 9.1.2). No attempt was made to elicit opinions and responses from non-managerial personnel. The research results could have been enhanced had the opinion of subordinates been elicited.

- This dissertation followed the pattern of building a number of hypotheses from an in-depth literature survey which could be tested by collecting and analysing empirical data (see section 2). By far the greater proportion of literature which formed the basis of the hypotheses was not South African based, but was from Britain, Japan and the United States. An attempt was made to limit the scope of this limitation through the use of as much local literature as could be obtained and through the use of a local firm of total quality management consultants.

- According to Leedy (1989:166-67)

> Data in descriptive survey research are particularly susceptible to distortion through the introduction of bias into the research design. ...In the research environment, the researcher cannot avoid having data contaminated by bias of one sort or another.

While it is recognised and accepted that this study will have been influenced by some form of bias, during the design of the research every attempt was made to minimise the influence of such bias (see sections 7 and 6).

7 RESEARCH DESIGN

It has been proposed that there are three main types of research design, namely causal research, descriptive research and exploratory research (Weiers 1984:64-70; Churchill 1979:49-54).

Exploratory research is essentially concerned with developing a more comprehensive understanding of research problems.

Causal research involves the conducting of highly formalised studies which utilise experimental manipulation in an attempt to establish the exact causal relationship among variables.

Descriptive research has as its main purpose the description of "something." This was the route taken in this thesis. The approach taken in this study followed the pattern of hypothesis

building from an in-depth literature survey which could be tested by collecting and analysing empirical data (Campbell 1954:8 & 86). For the purpose of this study what is to be described is the management of total quality improvement in the manufacturing sector of the South African motor industry.

It is suggested that for research designs to produce results which are valid and reliable, they should be characterised by the following (Wimmer and Domenick 1987:31):

- Research should be conducted in surroundings which are as close as possible to those normally encountered by the respondent. For the purposes of the present research this did not pose a problem as the respondent was free to complete the questionnaire where he wished.

- Intervening relationships must be ruled out such that clear cause-and-effect relationships might be established. This point did not pose a major problem to the validity of the study due to the descriptive nature of the research.

- Unobtrusive and valid measurements should be utilised so that respondents will be unable to identify the purpose of the study. The purpose of this is to avoid the respondents responding in a manner which they feel would satisfy the researcher, rather than providing their true views on the questions. This potential bias was realised and the questions were phrased (with the help of a two professional research organisations, Quality Management Associates and TWS Communications) in such as manner as to minimise this potential pitfall.

- The research design must be realistic. This was ensured through extensive consultation with two professional research organisations, Quality Management Associates and TWS Communications.

8 METHODS OF DATA COLLECTION

The accuracy and validity of any research results are to a large degree influenced by the manner in which the data were collected. The purpose of this section is to describe in detail how the data for this research was collected.

8.1 The Survey Instrument

The data to be used in this study were collected by means of a structured questionnaire which was distributed to the chosen sample.

8.1.1 *Design Of The Survey Instrument*

The actual questionnaire used in the study is based on the guidelines used to evaluate applicants for the Malcolm Baldridge National Quality Award (see APPENDIX 21). In addition to this, much attention was given to the types and structure of questions used in previous research of a similar nature (Bredenkamp 1988; Dale 1984a & 1984b; Lochner 1982; Whalley 1986).

The Malcolm Baldridge National Quality Improvement Act of 1987, Public Law 100-107, signed by President Reagan on August 20, 1987, establishes an annual United States National Quality Award. The purposes of the award is to promote quality awareness, to recognise quality achievements of U.S. companies and to publicise successful quality strategies. This annual award is managed by the National Institute of Standards and Technology, United Stated Department of Commerce. This award is the highest level of national recognition for quality which a U.S. company can receive.

The examination process of the Malcolm Baldridge National Quality Award is composed of two phases. First, applicants are required to submit a report providing, amongst other things, an overview of the quality improvement process in their organisation.

Guidelines on the content of such a report are provided to applicants by means of the Malcolm Baldridge National Quality Award Application Guidelines. This application is reviewed by a Board of Examiners. Award recipients are nominated from all of the written applications. Hereafter, those nominated candidates undergo site visits by members of the board of examiners, who investigate prescribed areas of total quality improvement.

At no stage during the examination process are specific, structured questionnaires put to the applicants. Applicants are merely required to submit reports of their practices and progress in certain areas of total quality control. Guidelines as to these areas is provided by means of the application guidelines which are distributed to all applicants.

The examination areas used in the Malcolm Baldridge National Quality Award were developed in the United States by the National Institute of Standards and Technology in co-operation with many organisations and individual quality experts. The examination areas were so structured as to provide information on the following a as of total quality improvement:

- leadership;
- information and analysis;
- quality planning;
- human resource utilisation;
- quality assurance of product and services;
- quality results;
- customer satisfaction.

- The "leadership" category examines how the executive management create and sustain a clear and visible quality value system along with a supporting management system to guide all activities of the organisation. Also examined are the senior executives' and the company's leadership and support of quality developments within the organisation.

- The "information and analysis" category examines the scope, use and management of data and information that underlie the company's total quality system. Also examined is the adequacy of the data and information to support a prevention-based approach to quality.

- The "quality planning" category examines the organisation's planning process for achieving quality improvement. Also examined is the process of quality goal setting within the organisation.

- The "human resource utilisation" category examines the effectiveness of the company's efforts to develop and utilise the full potential of the work force for quality and to maintain an environment conducive to full participation and continuous improvement.

- The "quality assurance of products and services" category examines the systematic approaches used by the company for total quality control of goods and services based primarily upon process design and control. Included in this category is the control of procured materials, parts and services.

- The "quality results" section examines quality levels and quality improvement based upon objective measures derived from analysis of customer requirements and expectations. Also examined are the current quality levels of the organisation in relation to those of competing firms.

- The customer satisfaction category examines the company's knowledge of the customer and overall customer service systems.

Each of the above examination areas is subdivided into a set of "areas to address." The purpose of these is to provide the applicant with greater information and clarification on the requirements and intent of the examination area in question. The examination areas and accompanying areas to address formed the basis of the questionnaire used for the purpose of this research.

The design of the questionnaire used in this dissertation had to be such that the questions it contained would provide information on the areas to address, which in turn would describe the broad examination areas. In an attempt to ensure that this was the case, and also to ensure the validity and reliability of the study, the drawing up of the questions was done in collaboration with two professional research organisations - Quality Management Associates, who specialise in the field of total quality management and TWS Communications, who specialise in organisational communication.

An important element of questionnaire design is whether structured or unstructured questionnaires and responses are used (Nel et al 1988:231-32; Weiers 1984:220-24). For the purposes of this research, it was decided to make use of a structured questionnaire which would elicit structured responses (see APPENDIX 19 and APPENDIX 24).

The measurement techniques utilised for the purpose of this research can be classified into the following two categories:

(i) dichotomous questions, requiring a simple yes, no or don't know response (Nel et al 1988:237; Weiers 1984:236), and

(ii) those which required the respondent to indicate his opinions on a rating scale. More specifically, use was made of both a descriptively anchored five point Likert-type scale and a graphic rating scale (Nel et al 1988:241-45; Weiers 1984:300,308-11).

This questionnaire is composed of six sections (see APPENDIX 19 and APPENDIX 24):

Section 1 - This section was designed to identify two elements of the quality improvement process:
(i) the extent of the respondents understanding of what constitutes a quality product, and (ii) whether the organisation has a specific quality policy and the extent to which this policy has been distributed to management.

Section 2 - This section was designed to identify the importance which management attach to customer requirements as a component of quality. A further important objective of this section was to identify the extent to which management were aware of the requirements of their customers.

Section 3 - This section was designed to identify the extent to which the responsibility for quality has been decentralised or to the point of production. The extent to which this has taken place is an important indication of managements attitude to quality.

Section 4 - Management style is central to total quality improvement. The purpose of this section is to shed some light on the management style being adopted in the various plants.

Section 5 - The calculation and utilisation of a cost of quality is vital to monitor trends and identify problem areas in the quality improvement process. The purpose of this section is to investigate the level of understanding and utilisation of the cost of quality in the various plants.

Section 6 - The purpose of this section is to investigate the effectiveness of the organisation's efforts to develop and involve the work force in the quality improvement process. Included will be an investigation of the extent and nature of employee involvement in quality improvement, recognition for achievements in the quality field and the nature and extent of quality education provided.

8.1.2 *The Pilot Study*

8.1.2.1 Description Of The Pilot Study

A pilot study, mirroring the procedures of the main study, was conducted during July 1990. This study was conducted in an

organisation which specialised in the manufacture of washing machines and fridges. The reason for this choice of industry was that the process used to produce fridges and washing machines is not markedly different from that used in passenger vehicle production. Both are essentially assembly operations.

A typical assembly company forms components into subassemblies, subassemblies into major assemblies and major assemblies into systems ranging from simple products to complex systems. Assembly companies generally have a product design and development phase and a production phase. They acquire piece parts - either as discrete units, or as functional modules. To provide a product which it is considered "meets requirements", the product assembler must rely on numerous suppliers - from those supplying raw materials to those supplying the components or modules used in the final product assembly. The diversity of raw materials ranges from rubber compounds and moulded parts to sheet metal and materials that form an integral part of internally fabricated subassemblies and/or subassemblies, which are procured on a contract basis.

The actual participants in the pilot study were four executive management personnel (A1-A5 group on the Paterson scale) and fourteen functional managers (D1-D5 group on the Paterson scale) (Paterson 1972, vol 1 & 2). In addition to these participants, two consultants from Quality Management Associates and one of the directors of TWS Communications participated in the pilot study. A verbal explanation of their role in the research programme was given to the participants. Each participant was then handed the questionnaire, a covering letter and a list of specific points to consider when completing the questionnaire (see appendix 22 and 23).

Those participating in the pilot study were asked to provide comment on the following points:

- the time it took to complete the questionnaire;
- the effectiveness of the format and wording of the questions in procuring the required information.
- the clarity of the questions.
- the extent to which they believed that the questions asked provided the information which the author intended them to. In order to enable the respondents to do this, they were provided with an explanation of the information which each section, or where necessary question, was intended to provide (see APPENDIX 22 and APPENDIX 25).

8.1.2.2 Results Of The Pilot Study

The findings of the pilot study are highlighted in the Table 7.

Table 7. Findings of the Pilot Study

ITEM ON WHICH TO COMMENT	YES	NO
1. Were any spelling or grammatical errors found?	6	12
2. Did the questionnaire take you more than fifteen minutes to complete?	0	18
3. Did you understand all the questions asked?	17	1
4. Do you think that the questions provided the information that the author intended them to?	18	0
5. Were the questions asked applicable to your position in the organisation?	10	8
6. Do you feel that the questionnaire is effective in procuring the required information?	16	1
7. Did you experience any other difficulties with the questionnaire?	2	16
8. Did you experience any problems with the format of the questionnaire?	0	18

The findings of the pilot study highlighted a number of areas of the original questionnaire which needed to be modified.

- The results of question four identified a problem regarding the applicability of the questionnaire to the entire sample. The questionnaire which was distributed to functional management needed to undergo minor modification before it could be presented to executive management (APPENDIX 24). The reason necessitating this modification was that the wording of certain of the questions relied on the management being questioned being in a subordinate position, to some other level of management. With executive management this was obviously not the case. This position necessitated the rephrasing of certain of the questions. During this rephrasing, however, every attempt was made not to detract from the original purpose of the question.

- The results of question one indicated that there were a number of minor spelling mistakes in the questionnaire.

- In response to question seven, two respondents replied that they would have found the questionnaire a little more manageable were it presented in Afrikaans. For this reason the questionnaire was also made available in Afrikaans. In an attempt not to lose any of the meaning during the translation process, a professional organisation was hired to do the translating.

9 THE SURVEY SAMPLE

When it is not possible to study the entire population the survey sample has to be chosen with a great deal of caution in order to be able to generalise research results across a population with any degree of confidence.

Nel (et al 1988:292) provide the following five steps as composing the sampling process:

Step 1 - Defining the population.
Step 2 - Identifying the sample frame.
Step 3 - Selecting the sample method.
Step 4 - Determining the sample size.
Step 5 - Selecting the sample elements.

Each of the above steps will be applied to the present research and discussed in the following section.

9.1 Definition of the population.

9.1.1 *The Industry*

The South African motor industry has been chosen as the industry which is to be researched for the purposes of this dissertation. The motivation for this choice is based on the following reasons: First, it is an important segment of many national economies, and in South Africa it is one of the largest employers of labour after the mining industry. Second, the motor industry, after the aerospace and computer industry, is one of the leaders in technological advancement and internationally is at the forefront in the development of new quality control practices. One of the prime means of product differentiation and competitive advantage in this industry is through the avenue of quality. For this reason, quality has long been a priority in the motor industry, with the result that quality control practices tend to be relatively well established and tried. Third, in South Africa, there are a limited number of motor vehicle manufacturers, which allows the quality control practices of the entire industry to be investigated. Finally, the author has a number of contacts in the South African motor vehicle industry, which facilitated the research undertaken.

Due to the scope of the South African motor vehicle industry, this investigation was limited to total quality improvement as

practised by management in the passenger vehicle manufacturing sector. It is felt that total quality management practices used in this sector will provide a fair reflection of the general approach to total quality management in other areas of the industry.

9.1.2 *Study Limited to Management Representatives*

Research has shown that the success of total quality improvement is to a large degree dependent on the commitment and involvement of the entire organisation, irrespective of occupation or hierarchical position. (Crosby 1979; Deming 1982; Feigenbaum 1983; Ishikawa 1985; Juran 1988b; Townsend 1986). Management are responsible for directing the process and ensuring that employees are placed in a state of "self-control." This means that management need to ensure that any management controllable obstacles to quality improvement are removed in order that employees are in a position to affect the quality of their production. Employees need to be committed to the quality improvement process and be aware of their role in the process. Should either management or employees not fulfil their responsibilities to the quality improvement process, there is little hope of it succeeding.

Although it is recognised that the involvement of the entire organisation is vital to the success of the total quality improvement process, the present study concerns itself with the management of total quality improvement in the South African passenger vehicle industry. The justification for concentrating on the management of total quality improvement process is found in the importance of management commitment and involvement to the process.

As illustrated in chapter four, the total quality improvement process is built on management commitment and involvement (Alexander 1981; Crosby 1979; Deming 1981; Feigenbaum 1983; Ishikawa 1985; Juran 1988b; Townsend 1986). The importance of

anagement commitment is contained in the fact that management are responsible for the introduction of a number of factors which are central to the participative quality improvement process. Research has shown conclusively that where management are not committed to the quality improvement process and hence do not intervene through the introduction of these factors, there is a remote chance that their subordinates will be committed to the process either (see chapter four).

The population, or "aggregate of elements from which the sample is drawn" (Nel et al 1988:291), of this investigation, is therefore composed of all the managers in the various manufacturing plants of the South African motor industry. The identification of the research population facilitated the specification of the sample frame.

9.2 Identification of the sample frame.

Nel (et al 1988:291) define a sample frame as

> ...a record of all the sample units available for selection at a given stage in the sampling process.

For the purposes of this research the sample frame consisted of all management personnel above a certain level in each of the manufacturing plants in the motor industry. It was decided that the sample frame would consist of all management who were involved in the manufacturing division of each plant and who occupied a position of or above that of a foreman. The position of foreman is defined as the lowest level of management to be found in the plant, and would occupy a D1 to D5 rating on the Paterson Grading System (Paterson 1972, vol 1 & 2). The reasons underlying this choice of sample frame were as follows:

Lists containing the names of these managers were provided to the author by each of the manufacturing plants. The total size of this population was 1187. The precise breakdown of this population by manufacturing plant is presented in table 8.

Table 8. Survey Population Sizes

ORGANISATION	NUMBERS OF MANAGEMENT PERSONNEL
B.M.W	110
Delta	191
Nissan	150
Samcor	267
Toyota	334
Volkswagen	135
TOTAL	1187

It should be evident that as far as this study was concerned, the sample frame and the survey population were one and the same thing - all management personnel employed in the manufacturing division of the South African motor industry. According to Weiers (1984:107) this is an ideal sampling frame.

On identification of the primary sample frame or population, the choice had to be made whether the whole population or a sample of that population was going to be surveyed. The author decided against surveying the entire population. The reasons for this decision were based on the following two points.

- The cost associated with surveying the entire population was beyond the budget of this dissertation.
- The author, after much consultation with TWS Communications, a professional research organisation, and reference to a number of texts (Bailey 1987; Nel et al 1988; Weiers 1984:103-04) decided that the information required for the purpose of this dissertation would be equally accurate were it collected by surveying the entire population or a sample of that population. To say that a sample can yield information that is as accurate as information received from a survey of the entire population assumes two things: (a) a carefully drawn sample (Bailey 1987:84). The sampling frame used in this research has already been discussed and is representative of

the total population for the reason that the population and the sampling frame are the same and (b) the respondents, by virtue of the positions they occupy, considered to be experts in their field. Management at the various manufacturing plants are considered in this light.

9.3 Selecting the sampling method.

9.3.1 *Types of Samples*

Sample designs can be categorised in a number of ways, including fixed versus sequential and probability versus nonprobability sampling (Weiers 1984:109).

9.3.1.1 Fixed versus Sequential Sampling.

Fixed sampling involves a predetermined sample size, and all sample data is collected before the results are analysed. With sequential sampling, however, the number of units to be sampled is not decided upon in advance, but is determined by a decision rule. After each sample is taken, a decision is take as to whether (a) to continue sampling or (b) to use the collected data as the sample to be studied (Weiers, 1984:109). For the purpose of this research, the fixed sampling method was utilised. Once the sample frame had been identified, it was decided that a fixed percentage of it would compose the sample to be researched.

9.3.1.2 Probability versus Nonprobability Sampling.

Sampling methods can be classified into those that yield probability samples and those that yield non-probability samples (Bailey 1987:87). A probability sample is one in which the members of the sample are chosen through some random process. Further, every element has an equal chance of being selected and this chance is known. Probability sampling is said to be the most accurate form of sampling, since the sample which is drawn is one which is a mirror reflection of the population (Sinclair

1985:164; Weiers 1984:110). An additional advantage of probability sampling is that it permits the calculation of the sampling error of our measurement (Weiers 1984:107).

With nonprobability sampling, the probability of selection is not known (Bailey 1987:87; Nel et al 1988:293). Non-probability sampling relies on the judgement of the researcher and is only as representative as the researcher's luck and skill permit (Nel et al 1988:292). It is therefore a subjective exercise. One of the major drawbacks of nonprobability sampling is the inability to determine the sampling error (Weiers 1984:108). For this reason the sampling method used in this research was that of probability sampling.

Arguably the best known and most reliable form of probability sampling is the random sample. In a random sample each person in the population has an equal chance of being chosen for the sample. This holds true regardless of the similarities or differences among them, as long as they are members of the same population. All that is required for a random sample is (a) the construction of an adequate sampling frame which is representative of the population and (b) the selection of respondents without showing bias for any personal characteristics. With respect to the present research, the above conditions were satisfied in that first, a complete listing of the population was obtained, which facilitated the selection of a representative sample frame and second, the selection of the individual respondents to be given a questionnaire was done on a random basis, with each element having an equal chance of being selected.

9.4 Determining the Sample Size.

For the purpose of this study there were two major constraints on the sample size: time and money. Working within these constraints, the sample used in this study consisted of as close to ten percent of the sample population as was possible.

The actual number of respondents questioned in this study was 118. The composition of this figure by manufacturer is presented in table 9.

Table 9. Sample Sizes

ORGANISATION	SAMPLE SIZE
B.M.W	11
Delta	19
Nissan	15
Samcor	27
Toyota	33
Volkswagen	13
TOTAL	118

9.5 Selecting the Sample Elements.

The selection of sample elements for this research was conducted in the following manner. The population and sample frame was established in the manner described above. The next step in the sampling process consisted of placing the elements of the sampling frame in alphabetical order. This process was conducted for each of the seven manufacturers. The author, based on the calculation conducted in the previous stage and after consultation with a number of professional research organisations, TWS Communications, the National Institute of Personnel Research and Quality Management Associates, decided that a sample composed of 10% of the population would be sufficient not to skew the results of the research. The method of selection of the 10% consisted of selecting every tenth manager on each of the alphabetically arranged lists.

10 EFFECTIVENESS OF THE QUESTIONNAIRE AS A MEASURING INSTRUMENT

With any type of measurement, two considerations are very important. The first is that the measuring instrument must be effective in measuring what it sets out to measure (validity) and the second is the accuracy with which the measuring instrument measures what it sets out to measure (reliability) (Leedy 1989:28-9).

This section establishes the contribution which the reliability and validity of the questionnaire as a measuring instrument made to the levels of confidence of the research results.

10.1 RELIABILITY

According to Dillon et al (1987:290-91), reliability essentially

> ...denotes stability or consistency; that is, reliable measures are consistent - stable from one administration to the next.

In confirming the above, Bailey (1987:70) defines the reliability of a measure as "its consistency".

Adding to these definitions, Dillon et al (1987:290-91) claim that unreliability is caused primarily by the items making up the measurement scale not actually measuring the same construct.

According to McGrath and Watson (1970:72-6) the ideal controlled experiment is endowed with both strong internal and external validity. The same, however, can not be said for a survey. According to them, the nature of a survey is such that internal reliability will tend to be weak while external validity may be strong. Taking this view into consideration, an attempt was made to ensure the internal reliability of this study.

It is suggested (Ives et al 1983:788; Shaw and Wright 1967:16; Wimmer and Domenick 1987:59-61) that the following are the main

ways to measure reliability: intercoder reliability, stability and equivalence.

- Intercoder reliability. This refers to the ability of different researchers to come to the same result. In the ideal situation, different researchers, administering the same survey instrument under similar conditions should come up with similar results.

Dillon et al (1987:292) present the following problems with intercoder reliability: First, the measure is affected by the time interval and the longer is the interval between test and re-test, the lower is the reliability coefficient. Second, it is often difficult to isolate real changes in the measured phenomenon between tests. The outcome of this is that a low reliability coefficient may not necessarily indicate low reliability. Third, each item on the scale will necessarily be correlated with itself. The effect of this is that the correlation coefficient is inflated because an item would be expected to correlate highly with itself but this may disguise poor correlation between different scale items.

- Stability. This refers to the amount of consistency between results when the same sample is measured at different points in time. One way to measure stability is to administer the same instrument at two different times and test the correlation between the scores. Test-retest reliability requires that different tests be administered and the scores from the tests be correlated using the reliability coefficient.

  Stability can also be measured by examining the internal consistency of the study. The technique employed here is the "sub-divide" or "split-half" technique (Bailey 1987:71). This involves splitting the measurement scale in two, usually through some random process, and then comparing correlation coefficients of the two subsamples.

In attempting to measure the stability of the study much the same difficulties were experienced as was the case while attempting to establish the degree of intercoder reliability. For this and the following reasons neither of the above approaches to reliability was used in this research:

- time and financial constraints on the research, made the test-retest approach impossible;
- Bailey (1982:179) suggested that because a questionnaire measures multiple concepts, the sub-divide test is difficult, if not impossible to administer for the questionnaire as a whole.

The methods used to establish the reliability of the measuring instrument in this research, therefore, were to:

- ensure that reliability was built into the questionnaire at the time at which it was designed;
- measure the reliability of the questionnaires after the event, through inter-item correlations.

An attempt was made to build reliability into the questionnaire in the following ways:

- the questionnaire was based on the internationally recognised Malcolm Baldridge Questionnaire (see section 8.1.1);
- The help of a number of experts was enlisted during the design and testing of the questionnaire (see section 8.1.1);
- A pilot survey was undertaken in which respondents were asked to identify any factors which could influence the internal validity of the study (section 8.1.2);
- Extensive research was conducted into questionnaire design prior to the drawing up of the questions (Bailey 1987; Brislin et al 1973; Kerlinger 1973; Dillon et al 1987; Nel et al 1988; Sellitz et al 1976; Sinclair 1985; Webb et al 1966; Weiers 1984; Wimmer and Domenick 1987).

10.2 VALIDITY

The validity of a measuring instrument may be defined as

> ...the extent to which differences in scores on it reflects true differences among individuals on the characteristic that we seek to measure, rather than constant or random errors (Sellitz et al 1976:168-69).

To help establish the degree of certainty which can be attributed to the conclusions of this research, the questionnaire was assessed as a measuring instrument in terms of its (Bailey 1987:67):

- Face validity.
- Criterion validity.
- Construct validity.

10.2.1 *FACE VALIDITY*

Face validity is also referred to as content validation (Kerlinger 1973:445-46; Weiers 1984:166).

Face validity results from the careful and systematic building of the questionnaire (Goode and Hatt, 1952:237; Ives et al 1983:788). The extent to which this has been achieved for any particular measuring instrument is based on a subjective assessment and excludes the use of statistics (Weiers 1984:166). As defined by Sellitz et al (1976, in Bailey 1987:67) face value is ultimately a matter of judgement:

> Two major questions must be considered: (1) whether the instrument is really measuring the kind of behaviour that the investigator assumes it is, and (2) whether it provides an adequate sample of that kind of behaviour.

The following steps were undertaken during the design of the questionnaire to ensure its face validity:

- In an attempt to minimise the subjective nature of face validation, Weiers (1984:166) suggests that the judgement of experts should, where possible be used. For this reason, before the questionnaire was distributed to the chosen sample, it was thoroughly discussed with two professional research organisations, TWS Communications and Quality Management Associates (see section 8.1.1).
- Before the questionnaire was distributed to the chosen sample, each individual question was evaluated for content, validity and clarity by those participating in the pilot study (see section 8.1.1).
- The dimensions of each question were derived directly from the practitioner and academic experts and from the Malcolm Baldridge Quality Award (see section 8.1.1).
- Each section logically led to the next to help focus the respondent's attention on the manner in which they managed total quality assurance (see section 8.1.1).

On the strength of these judgemental issues, face validity was claimed for the questionnaire.

10.2.2 *CRITERION VALIDITY*

Criterion validity, also referred to as predictive validity, refers to

> ...the ability of our measurement to predict some future value associated with the variable we have presumed to measure (Weiers 1984:166)

Because of the exploratory nature of this research (see section 4.3) the criterion validity of the questionnaire could not be established by comparing the results of the survey with currently known facts (Kerlinger 1973:460). Although a comparison was made between the management of total quality assurance as identified

in the empirical study with that identified through the literature survey, the following points must be borne in mind:

- The management of total quality assurance as identified in the literature could not be regarded as representing the management of total quality assurance in the South African motor industry. Consequently, even if their had been a high level of agreement, it could not have been used to substantiate content validity.
- This study was not intended to measure future behaviour.

10.2.3 *CONSTRUCT VALIDITY*

According to Weiers (1984:166)

> ...construct validity is present whenever our measure of a particular concept is related to measures of other related concepts in a theoretically expected way.

Bailey (1982:178) argues that it is extremely difficult, if not impossible, to establish the existence of construct validity for a questionnaire as a whole. Ives et al (1983:788-89) add:

> ... a final claim of construct validity cannot be made until the questionnaire and theory (underlying the questionnaire) have been subject to several alternative forms of testing with consistent findings.

Due in part to the following two factors, construct validity of the questionnaire could not be established:

- the purpose of this theory was not to test a specific theory, but to explore the nature of the management of total quality assurance, and
- the limitations of funding and time.

In addition to face validity, criterion validity and construct validity, the issues of internal and external validity deserve consideration.

Internal validity asks whether a difference exists at all in any given comparison. It asks whether or not an apparent difference can be explained away as some measurement artifact. As described by Webb et al (1966:10-11):

> External validity is the problem of interpreting the difference, the problem of generalization. To what other populations, occasions, stimulus objects, and measurements may the obtained results be applied.

It should be evident that the above terms do not refer to the end result of a validation process, as do the terms face validity, criterion validity and construct validity. Internal and external validity apply to sources of error within the experiment (internal validity) and to the problems of generalising from the experiment to a larger population (external validity) (Bailey 1987:70; Nel et al 1988:225-27).

10.2.4 *INTERNAL VALIDITY*

Wimmer and Domenick (1987:34-8) and Dillon et al (1987:167-70) suggest some common threats to internal validity that create methodological artifacts. Artifacts refer to any extraneous variable which results from the failure to isolate the test variable.

Dillon et al (1987:167-70) suggest that the more common sources of artifacts are:

1. Demand Artifacts: Artifacts are created during the experiment when respondents answer questions in a manner which they think will appear to be professionally or socially acceptable. Due to the nature of this study this was a real threat. In an attempt to minimise the effect of demand artifacts, the following steps were undertaken:

- on the instruction sheets provided to respondents, they were specifically asked to indicate their own responses;
- the senior management who helped the author coordinate the

response were asked to stress t , respondents that they should provide their own responses to the questions to the questions posed.

2. Experimenter Bias: Artifacts can be created through observation, data recording, mathematical computational or interpretation errors on the part of the researcher. This threat to validity was minimised due to the fact that researchers were not required for purposes of this research.

3. Evaluation Apprehension: Artifacts arise from the respondent's fear of appearing "different" or of being measured. Most people are not eager to appear different in the light of prevailing norms. This artifact is one which is more common to group research.

This research design did not at any stage make use of group interviews. An additional means whereby this threat to validity was minimised involved stressing to the respondents that their individual responses would be treated in the strictest of confidence.

4. Experimental Mortality: Artifacts can be created through respondents failing to complete the required questionnaires. Longitudinal research is most prone to this threat to validity. This research reported a one hundred percent response rate from the sample. The reasons for this response are believed to be:

- the respondents were all management personnel;
- most of the respondents, due to their positions, were interested in quality and quality improvement;
- the research had the backing of executive management;
- certain members of senior management were asked by the author to coordinate the research at their plants and t. please ensure that all the respondents completed the questionnaires.
- the length of the questionnaires allowed for them to be completed in a short period of time.

5. History: Artifacts can be created by events that occur simultaneously with the experiment when the research design does not control for their presence. Had some extremely strong event occurred that could have altered the manner in which the respondents manage total quality improvement, an historical artifact would have been created. In an attempt to minimise the occurrence of such an artifact, the following steps were undertaken: (a) The entire study was completed within two weeks and (b) the study was conducted during the latter quarter of the year when the motor vehicle industry is traditionally in a lull. To the knowledge of the author, no major activities which could have had a significant influence on the respondents management of total quality occurred during the investigation period.

6. Instrumentation: Artifacts can be created due to inconsistency in setting the calibration of measurement in the study. Due to the fact that the nature of the study did not necessitate the use of researchers, this threat to validity was minimised.

Instrumentation may pose a threat where the respondents attach different meanings to the same questions put to them. This element was investigated in the pilot study and no such problems were recorded.

7. Maturation: Artifacts can be created as people become tired, bored or hungry during the administration of the survey instrument. In an attempt to minimise the occurrence of this artifact, the length of the survey instrument was kept to the minimum possible length which still ensured that the necessary information could be gathered. None of the respondents in the pilot study indicated that the questionnaire took them longer than fifteen minutes to complete.

8. Selection Bias: Bias in the selection of respondents results in non-representative groups. The means whereby this threat to validity was minimised are discussed in section 10.2.

9. Statistical Regression: Outliers, or respondents who achieve extremely high or low scores on a test, tend to regress to the sample or population mean during subsequent testing sessions. However, due to the fact that this study is not a longitudinal study and does not make use of before-and-after exposures, this artifact is not an issue in this study.

10. Testing: Artifacts can be created by respondents who try to maintain consistency in their responses to the questions posed before-and-after exposure to a stimulus. Due to the fact that this research was not a longitudinal study, this artifact did not exist.

10.2.5 *EXTERNAL VALIDITY*

External validity refers to the extent to which the obtained results may be generalised to "other populations, occasions, stimulus objects, and measures..." (Webb et al 1966:10-11).

It is argued by Christensen (1985) that population validity involves a two-step inferential process. The first step involves generalising the survey sample to the survey population or universe. The second step involves generalising from the survey population to the target population. The sampling process used in this study is described in section 9 and suggests that the two-step process of generalisation can be inferred from the data.

It has been suggested that external validity can be increased in the following ways (Cook and Campbell, in Wimmer and Domenick 1987:38):

- by using random samples which are representative of the population;
- by selecting a sample which is representative of the population to which the results will be generalised;
- by using heterogeneous samples and replicating the study a number of times.

From the discussion on the sampling techniques employed in this study, presented in section 9.3, it is fair to claim that these techniques adequately satisfy the first two requirements of the above suggestions.

Christensen (1985) advances the following threats to external validity:

1. The Hawthorne Effect: Artifacts are created when respondents behave differently due to the fact that they are aware that they are the subject of a test. A similar kind of artifact can be created by novelty or disruption. The following elements of this research minimised the effect of this threat to validity:
   - respondents completed a questionnaire in their own time in a self chosen location;
   - the research was conducted by means of a structured questionnaire, which is not a novelty to most management.

2. The Experimenter Effect: Artifacts can be created through intentional or unintentional observation, data recording, mathematical computational or interpretation errors on the part of the researcher. This threat to validity was minimised in the following ways:
   - researchers were not required for purposes of this research;
   - the data capturing and much of the data analysis was conducted by the National Institute of Personnel Research.

3. Time Effects: Seasonal variation, cyclical variation, economic variation and personological variation can all create artifacts which can influence the applicability of the survey results over different time periods. This threat to the validity of the findings was minimised by completing the study within a two-week period.

Dillon et al (1987) advance the following threats to external validity:

4. Reactive or Interactive Effects of Testing: Artifacts can arise from the respondent's heightened sensitivity toward one test stimulus as a result of being exposed to another stimulus earlier. Due to the nature of this research this threat to external validity did not exist. In addition, the pilot study for this research was conducted on a separate population.

5. Interactive Effects of Testing: Incorrect sample selection techniques can be a factor contributing towards misleading results. The selection process utilized in this study was highlighted in section 9. This process suggests that this threat to external validity did not exist.

6. Surrogate Situations: A further source of artifacts is the use of artificial test situations. Due to the nature of this research, respondents could choose where they wished to complete the questionnaires and so this threat to external validity was minimised.

11 RESPONSE TYPES

The questionnaire design resulted in the following response types (APPENDIX 19 & 24):

- either a yes, no or don't know response;
- either a strongly agree, agree, neither agree nor disagree, disagree or strongly disagree response;
- a numeric response ranging from 0% to 100%.

From the above response types it should be evident that the nature of the responses will result in an extremely high proportion ties in the data (Blalock 1960:201 & 321; Siegel 1956:125).

12 USE OF STATISTICS

Based on the nature and characteristics of the data collected, certain statistical tests were used to analyse the data. This section will further elaborate on which statistical tests were chosen and why.

12.1 TYPE OF TESTS USED

Due to the fact that the opinions of the respondents were reflected on a descriptively anchored five point Likert-type scale or required a yes, no or don't know response (see section 11), the data collected via the questionnaires were regarded as ordinal in nature (Bailey 1982:365; Blalock, 1960:13; Leedy 1989:24; Nel et al 1988:355).

In an attempt to ensure that the statistical tests used are as powerful as possible, some authorities have advocated the use of parametric statistical procedures on ordinal data (Alavi 1985:174; Harty et al 1984:304; Ivancevich et al 1983:802; Parisian 1984:46-64; Perez and Schuler 1982:163;).

In this research a more conservative approach was taken. Following the example set by a number of authorities (Alavi 1984:561; Bailey 1982:402; Blalock 1960:188; Drury 1983:63; Leedy 1989:24), non-parametric tests were used to analyse the ordinal data. This approach has the added advantage of not requiring assumptions that are made about the homogeneity of variance or normality of the sample population (Freund and Williams 1977:361).

12.2 RELATIONSHIPS BETWEEN SAMPLES

In every case when a comparison between manufacturers was made, the assumption was that the manufacturers represented independent samples. The reasons for this conclusion are (Siegel 1956:61 & 95):

- each sample was drawn at random from different populations;
- there was no evidence that the samples were related or matched;
- in each case, the sample populations were of different sizes.

12.3 TWO-TAILED TESTS

Due to the fact that identifying the direction of the differences of opinion was not of primary concern in this thesis, two-tailed tests were used (Siegel 1956:13).

12.4 LEVEL OF SIGNIFICANCE

There is a restraint on setting the level of significance too low because the smaller the probability of rejecting the true hypothesis, the larger the probability of accepting a false hypothesis, particularly if the sample size is small (Freund and Williams 1977:284). To limit any detected differences as being due to chance to less than 5%, the level of significance for the statistical procedures was set at 0.05.

12.5 STATISTICAL TESTS AND PROCEDURES

Statistics were used in this thesis in the following ways.

- Descriptive statistics were used to indicate the location and spread of the data.

- The reliability and validity of the questionnaire as a measuring instrument was tested by calculating inter-item correlations.

• Statistics were used to compare total quality management between each of the manufacturers who participated in the research. These comparisons were not made for every response, but were limited to the questions which were felt to provide insight into total quality management at each plant (see chapter 6). In each case, the degree of confidence with which the opinions of the individual manufacturers could be regarded as representing the opinion of the entire industry was determined, using a simple proportion test.

• Related to the previous use of statistics, hypothesis testing was conducted through the use of statistics.

12.5.1 *DESCRIPTIVE STATISTICS*

Descriptive statistics were used in the following two ways. First, they provided full details of the raw data collected in response to the questionnaire, and second, they were used to provide an indication of the dispersion of opinions expressed in the responses. These descriptive statistics included:

- frequency counts;
- proportion tests;
- percentage based frequency tables.

Descriptive statistics from all the relevant responses to each hypothesis are provided in summarised form, in APPENDIX 1 through 17. In the percentage based frequency tables the responses have been calculated to one decimal point, where applicable. This has in certain circumstances resulted in the count not summing to exactly 100%.

12.5.2 *INTER-ITEM CORRELATIONS*

Using a simple proportion test, an "inter item correlation" was done between all the variables in sections II, III, IV, V and VI (APPENDIX 18). These correlations were used to demonstrate the reliability and validity of the questionnaire as a measuring

instrument. From the responses to the proportion test, all the questions which were intended to correlate with each other, did correlate (see APPENDIX 18 and chapter 6).

12.5.3 *ANALYSIS OF VARIANCE*

An important element of the research component of this dissertation is a comparison of the total quality management practices of the various manufacturers (see section 1). However, as Siegel (1956:184) says

> Samples values almost invariably differ somewhat, and the question is whether the differences among the samples signify genuine population differences or whether they represent merely chance variations...

In an attempt accurately to identify the cause of any variation, and taking into account the nature of the data collected (see section 11) a proportion test was used where the responses of two or more groups were being compared (see APPENDIX 18).

12.5.4 *HYPOTHESIS TESTING*

Varying with the response type (section 4.1) hypothesis testing was conducted in a number of ways.

- Where the response required a yes, no or don't know response, percentage based frequency counts were utilised.

- Where the opinions of respondents were reflected on a descriptively anchored five point Likert-type scale, hypothesis testing was conducted using one or a combination of frequency counts and percentage based frequencies.

- Where the opinions of respondents were reflected on a sliding scale ranging from 0% to 100%, hypothesis testing was conducted by using both the Students t-test and the binomial-test. The purpose of using both these tests was to ensure the validity of the outcome.

12.6 STATISTICAL PACKAGE

All statistical calculations used in the analysis of data were computed on an IBM mainframe using Release 5 of SAS Institute Incorporated's Statistical Analysis System.

12.7 SUMMARY OF THE CHAPTER

In this chapter, the characteristics of the research program are presented in order to provide a comprehensive account of the research methods used in this study.

As a result of the literature survey, the research problem was clearly identified.

The factors which determined the research approach were identified and their influence on the choice of research strategy were noted. These factors underlay the choice of a research paradigm from the social sciences and the characteristics of the research were a direct result of this choice.

Drawing on the literature survey, a number of hypotheses were formulated. These hypotheses played an important role in shaping the research design of this study.

The next section of the chapter presented a comprehensive account of the research design. Included in this section was a description of the survey instrument and the selection of the sample which was to be researched.

The chapter closed with a discussion of how statistics were used to analyse the empirical data collected during the study and to ensure the validity and reliability of the survey instrument.

CHAPTER SIX

ANALYSIS OF RESEARCH FINDINGS

1 INTRODUCTION TO PRESENTATION OF THE DATA

The purpose of this section is to present the data collected during the research component of this dissertation (see chapter five). This analysis will facilitate a comparison between total quality management as practised at the various passenger vehicle manufacturing plants in the South African motor industry, and that advocated in the literature (see chapters two, three and four). Such a comparison will meet the objectives of this dissertation (see chapter one).

2 METHOD OF ANALYSIS

The questions in the research questionnaire are all particular to one or more of the sub-hypotheses (see chapter five). This facilitates an analysis of one sub-hypothesis at a time, across the industry.

The research findings are analysed one sub-hypothesis at a time, for all of the manufacturers in the industry. This enables one to compare the responses received from each of the manufacturers, per sub-hypothesis.

The actual method of analysis varies according to the nature of the response required. Where the questions require a yes, no or don't know response, frequency counts are used. The extent to which the responses received from the sample represent the population are tested using a statistical proportion test (see APPENDIX 18). Tests are two-tailed and are conducted at the 95% level of significance. Where responses are indicated on a sliding percentage scale, responses are analyzed using both the Students-t test and a proportion test (see APPENDIX 18). These tests facilitate either the rejection or acceptance of each sub-

hypothesis, for the individual manufacturers. For the purpose of hypothesis testing, a majority is defined as being greater than fifty percent.

3 MAIN HYPOTHESIS

The main hypothesis is that total quality management, as advocated in the literature, is being practised by all six of the passenger vehicle manufacturers in the South African motor industry which were researched.

In an attempt to prove or disprove this hypotheses, for each manufacturer, a number of sub-hypotheses are established (see chapter five). These sub-hypotheses are considered in the light of the data collected from each of the manufacturers.

3.1 SUB-HYPOTHESIS 1.

Historically, quality control in many organisations has consisted of inspecting the final product or service against a set of agreed requirements or standards. Quality was seen as a function of the extent of inspection, necessitating a high ratio of inspectors to workers. Due to its size and importance, the inspection department was made an independent department and its authority was enhanced. The existence of an independent inspection department effectively meant that the responsibility for quality was centralised, and removed from its source. The adoption of such an approach to quality has a number of inherent downfalls, most of which centre around the fact that inspection is a reactionary rather than preventative approach to quality improvement and alone will not serve to improve levels of conformance. The total quality management approach to quality improvement views quality as something which needs to be built into the production process, rather than be treated as a post-production, inspection function. Thus, in terms of total quality management, detailed inspection in most instances is rejected as being uneconomical and inefficient, and should not

be the dominant means of ensuring quality (see chapter two).

The first sub-hypothesis contends that the majority of management agree that less than fifty percent of the output of their department is inspected. The questions and responses applicable to this sub-hypothesis are summarised in table 1.1 (see APPENDIX 1).

Consider the responses to question K7 .B. Toyota, Delta and Nissan, inspect, on average, 16,8%, 19.44% and 19.33% of output respectively. Testing against the critical 50% of output, z scores are 4.85, 3.27 and 3.00 respectively. This means that these averages are significantly less than 50%. These results are confirmed by the student's-t test (see APPENDIX 1). For VW, Samcor and BMW, the average levels of inspection of output are 87.5%, 89.5% and 91.0% respectively. Testing at the critical 50% of output, z scores are -3.92, -6,34 and -4.53 respectively. This means that these averages are significantly greater than 50%. The above findings are confirmed using the Students-t test (see APPENDIX 1). It is thus possible to accept the hypothesis that the majority of management at the Toyota, Delta and Nissan plants, agree, that less than fifty percent of the output of their departments is inspected. This is not the case at BMW, Samcor and VW. At these plants, more than fifty percent of the output of individual departments is inspected. Sub-hypothesis one is accordingly accepted for Toyota, Delta and Nissan and is rejected for BMW, Samcor and VW.

The above responses indicate that the industry is evenly divided between those manufacturers which appear to have decentralised quality responsibility and those which appear to rely on inspection as the means to ensure quality.

At BMW, Samcor and VW, it appears that inspection could be relied upon as the prime mean, to ensure quality, with more than fifty percent of the output of individual departments being inspected.

The apparent reliance by these plants on inspection could be related to a number of factors such as:

- a lack of resources required to train subordinates to assume responsibility for the quality of their output;
- a fear that by decentralising quality responsibility quality standards may be compromised;
- a lack of suitably qualified management required to drive the quality improvement process;
- a fear and resistance by management to adopt the participative style of management required for the decentralisation of quality responsibility.

At Toyota, Delta and Nissan, quality responsibility appears to have been decentralised to the point of production, thereby reducing the need for independent, centralised inspection. This could be as a result of management at these manufacturers being aware of the possible savings, which ensue from improved quality, brought about through the decentralisation of quality responsibility.

3.2 SUB-HYPOTHESIS 2.

One of the central themes of total quality management is that the responsibility for quality must not be separated from the origin of that quality. The responsibility for quality must be placed at the origin of that quality - the point of production (see chapter two). Most authors agree that a separation of the responsibility for production, from the responsibility for the quality of that production, is unlikely to result in any significant continual improvements in the quality of output. For this reason, most authors on total quality management suggest that individual departments should be responsible for the quality of their output (see chapter two). This does not negate the need for a central quality department. The role of this department will, however, not be that of assuming quality responsibility. Its role will be one of aiding and assisting individual departments to assume responsibility for their own quality.

Without the applicable tools and education to ensure quality output, individual departments cannot be held responsible for their output. Thus, while most authors on the subject of total quality management advocate the decentralisation of quality responsibility, they recognise that a small degree of quality responsibility still lies outside the individual departments (see chapter four).

Sub-hypothesis two holds that the majority of management at the various manufacturers in the South African motor industry agree that their departments are responsible for at least 50% of the quality of the output of those departments. The questions and responses applicable to this sub-hypothesis are presented in tables 2.1, 2.2 and 2.3 (see APPENDIX 2).

Consider the responses to question III.A (i). Individual departments at Toyota, Delta and Nissan, are responsible for, on average, 95.75%, 96.31% and 91.4% of the quality of their output respectively. Testing against the critical 50% of output, z scores are -13.04, -10.71 and -5.7 respectively. This means that these averages are significantly greater than 50%. Similar results are obtained using the Students-t test. These responses are supported by the findings of question III.A(ii). The central quality departments at Toyota, Delta and Nissan are responsible for, on average, only 6.36%, 6.05% and 10% of the quality of the output of the individual departments respectively. Testing against the critical 50% of output, z scores are 10.26, 8.03 and 5.16 respectively. This means that these averages are significantly less than 50% (see APPENDIX 2). Using the Students-t test, the results of question III.A(ii) are confirmed. The above responses provide a strong indication, that at these three plants, individual departments are responsible for at least 50% of the quality of their output. In view of these findings, sub-hypothesis two is accepted for Toyota, Delta and Nissan.

The responses of the remaining three manufacturers do not support this sub-hypothesis. Individual departments at BMW, Samcor and VW, are responsible for, on average, 43.90%, 47.42% and 48.49% of the quality of their output respectively. Testing against the critical 50% of output, z scores are 0.40, 0.26 and 0.09 respectively. This means that these averages are significant. Support is given to these findings by the responses to question III.A(ii). The central quality departments at BMW, Samcor and VW are responsible for, on average, 56%, 51.38% and 51.53% of the quality of the output of the individual departments' respectively. Testing against the critical 50% of output, z scores are -0.40, -0.14 and -0.11 respectively. These averages are, therefore, significant. This means that at these three plants individual departments are not responsible for more than 50% of the quality of their output. The findings of questions III.A(i) and III.A(ii) for BMW, Samcor and VW, are confirmed using the Students-t test. In view of these findings, sub-hypothesis two is rejected with respect to BMW, Samcor and VW.

The above findings indicate that the South African passenger vehicle industry is divided evenly between those manufacturers which appear to have decentralised quality responsibility to the point of production, and those which appear not to have done so.

At BMW, Samcor and VW, individual departments are responsible for one half or less of the quality of their output. This provides a strong indication that at these plants the responsibility for quality is not treated as a line function, but as the responsibility of a central quality department. This is a dangerous policy to follow as there is much evidence which indicates that a separation of the responsibility for production from the responsibility for the quality of that production is unlikely to result in any significant, continual improvements in the quality of output.

At Toyota, Delta and Nissan, it appears that quality is treated as a line function and is decentralised to the point of

production. This policy provides a strong indication that these manufacturers are aware of the downfalls of centralised quality responsibility.

3.3 SUB-HYPOTHESIS 3.

Most authors on the subject of total quality management advocate the calculation of a cost of quality as integral to the quality improvement process (see chapter four).

Sub-hypothesis three contends that the majority of management at the various manufacturing plants in the South African motor industry agree that their organisation calculates a cost of quality. The responses to question V.A, applicable to sub-hypothesis three, are summarised in table 3.1 (see APPENDIX 3).

On average, 93.9% of managers at Toyota agree that a cost of quality is calculated in their organisation. At Delta, the corresponding figure is 78.9%, while at Nissan it is 73.3%. Testing against the critical 50% majority, z scores are 9.68, 3.88 and 2.97 respectively (see APPENDIX 18). This means that these averages are significantly greater than 50%. These responses support sub-hypothesis three. At VW, on average, 61.5% of respondents hold that a cost of quality is calculated. Testing at the critical 50% response rate, the z score is 1.29. This result is significant, indicating that it is not possible to disprove that fifty percent or less of management at VW agree that a cost of quality is calculated in their organisation. At Toyota, Delta, Nissan and VW it is, therefore, accepted that a cost of quality is calculated. Sub-hypothesis three is accepted for these manufacturers (see APPENDIX 18).

The responses of managers at the other three manufactures do not support this sub-hypothesis. On average, 30.8% of management at BMW agree that a cost of quality is calculated in their organisation. At BMW, none of the management indicated that a cost of quality is calculated in their organisation. Testing

against the critical 50% majority, these averages are significantly less than fifty percent (see APPENDIX 18). Based on the above responses, a cost of quality is not calculated at BMW or Samcor. Sub-hypothesis three is rejected for these manufacturers.

Two thirds of the passenger vehicle manufacturers in the South African motor industry calculate a cost of quality. This response indicates that there is an awareness of the need to bring quality out of the abstract, into something tangible. By calculating a cost of quality, manufacturers are acknowledging that the cost of quality is an important cost component, which is capable of being measured and reduced.

A possible explanation for BMW and Samcor not calculating a cost of quality is that:

- they may not be aware that quality can be calculated as a cost;
- they may not possess the know-how to do such a calculation.

In adopting such a policy, these two manufacturers may be failing to create an awareness amongst their workforces of what poor quality is costing their organisation. Where the workforce are unaware of the high costs of poor quality, there is little chance that they will make an effort to reduce them.

3.4 SUB-HYPOTHESIS 4.

Much has been written in the literature on the importance and need for an organisation to have a formal quality policy (see chapter four). Such a policy should be drawn up and distributed throughout the organisation. In order to focus attention on the

principles of total quality management, this policy should provide, amongst others:

- a brief statement of corporate intent as to quality;
- the minimal actions to be taken by company divisions with respect to quality;
- quality as an organisation-wide concept;
- producing a quality product involves both quality of design and quality of conformance.

Sub-hypothesis four contends that the majority of management agree that their organisation has a formal quality policy. The questions and responses which are applicable to this sub-hypothesis are summarised in table 4.1 (see APPENDIX 4).

The majority of management at all of the manufacturing plants agree that their organisation has a formal quality policy (see table 4.1, question I.A). On average, the positive responses to the existence of a formal quality policy are 94.7% at Delta, 93.9% at Toyota, 93.3% at Nissan, 92.3% at VW, 90.9% at BMW and 73% at Samcor. Testing against the critical 50% majority, z scores are 8.07, 9.68, 6.52, 5.58, 4.42 and 2.64 respectively (see APPENDIX 18). This means that these averages are significantly greater than 50%.

The mere existence of a quality policy, however, does not signify its competence in terms of the recommendations of the literature on total quality management (see chapter four). In order to assess the competence of a quality policy to the requirements of total quality management, the contents of this policy need to be considered. In response to question I.B(i), 96.8%, 94.7%, 78.6%, 90%, 73.7% and 75% of management at Toyota, Delta, Nissan, BMW, Samcor and VW respectively, replied that the policy contained a brief statement of corporate intent as to quality. Testing at the critical 50% positive response rate, z scores are 13.27, 8.07 2.52, 4.21, 2.58 and 2.00 respectively. This means that these responses are all significantly greater than fifty percent (see APPENDIX 18).

In response to question I.B(ii), on average, 89.5%, 87.5% and 78.6% of management at Delta, Toyota and Nissan respectively, replied that the quality policy contained the minimal actions to be taken by company divisions with respect to quality. Testing at the critical 50% positive response rate, the z scores are 5.43, 6.22 and 2.52 respectively. This means that these averages are significantly greater than fifty percent. The same cannot be claimed for the remaining three manufacturers. On average, only 36.4%, 26% and 20% of management at VW, Samcor and BMW respectively, replied that the quality policy contained the minimal actions to be taken by company divisions with respect to quality. Testing at the critical 50% positive response rate, the z scores are -3.21, -2.38 and -2.37 respectively. This means that these averages are significantly less than fifty percent (see APPENDIX 18).

The responses to questions I.B(iii) and I.B(iv) follow the same pattern as those to the above question. The averages of Toyota, Delta and Nissan are significantly greater than fifty percent, while those of BMW, Samcor and VW are significantly less than fifty percent (see APPENDIX 18).

The responses to question I.A suggest that sub-hypothesis four be accepted for all the manufacturers. In the case of Toyota, Delta and Nissan, support is given to this view by the responses to question I.B, concerning the contents of this policy. The majority of management at these three plants agree that the quality policy of their organisation contains the essentials of a quality policy, as suggested in the literature. Based on these responses, sub-hypothesis four is accepted for these manufacturers.

A different picture emerges from the responses to question I.B received from VW, Samcor and BMW. Although the majority of management at these plants responded positively to question I.A, the majority did not respond favourably to question I.B, on the contents of this quality policy. It is possible to conclude, with

respect to these manufacturers, that although their organisation does have a quality policy, it does not encompass the essentials of total quality management. For this reason, the fourth sub-hypothesis is not accepted with respect to VW, Samcor and BMW.

The above responses, not surprisingly, indicate that quality is high on the agenda at all of the passenger vehicle manufacturers in the South African motor industry. This is evidenced by the fact that all of the manufacturers have a specific quality policy. What is surprising is that in the policies of only half of these manufacturers, in Toyota, Delta and Nissan, are the principles of total quality management emphasised. That these principles are contained in a quality policy is an indication that at these manufacturers, executive management are aware of and wish quality to be ensured, using the principles of total quality management.

The quality policies of the remaining three manufacturers did not emphasise the principles of total quality management. A possible explanation for this is that at BMW, Samcor and VW, quality is ensured through inspection and not through the decentralisation of quality responsibility. Accordingly, the principles of total quality management would not be contained in their quality policies.

3.5 SUB-HYPOTHESIS 5.

Most authors on the subject of total quality management agree that management is able to demonstrate its commitment to the formal quality policy of the organisation by signing a copy of this policy (see chapter four).

Sub-hypothesis five contends that the majority of management have signed a copy of the formal quality policy of their organisation. The questions and responses relevant to this sub-hypothesis are summarised in table 5.1 (see APPENDIX 5).

At Toyota, Delta and Nissan, on average, 93.5%, 89.5% and 73.3% of management respectively, have signed a copy of the formal quality policy of their organisation. Testing at the critical 50% positive response rate, z scores are 9.38, 5.43 and 2.00 respectively. This means that these averages are significantly greater than 50% (see APPENDIX 18). It is, therefore, concluded that the majority of management at Toyota, Delta and Nissan have signed a copy of the formal quality policy of their organisation.

The responses from the remaining three manufacturers are less positive than the above. On average, 30.8% of management at both Samcor and VW have signed a copy of the quality policy of their organisation. The corresponding figure at BMW is 20%. Testing against the critical 50% response rate, z scores are -2.22, -2.31 and -2.37 respectively (see APPENDIX 18). These scores indicate that the averages for these manufacturers are significantly less than 50%. This means that less than fifty percent of management at BMW, Samcor and VW, have signed a copy of the quality policy of their organisation. Based on the above responses, sub-hypothesis five is rejected for these manufacturers.

3.6 SUB-HYPOTHESIS 6.

An important element in ensuring that the quality policy of an organisation filters down through the organisation hierarchy and is applicable and relevant to the lower levels in the organisation, is for each department, within the ambit of the original quality policy, to establish its own more detailed policy (see chapter four).

Sub-hypothesis six holds that the majority of management personnel agree that their department has drawn up its own more detailed and specific quality policy based on the original quality policy. The responses to question I.D, applicable to sub-hypothesis six, are summarised in table 6.1 (see APPENDIX 6).

On average, 50.3%, 89.5% and 73.3% of management at Toyota, Delta and Nissan respectively, agree that their department has drawn up its own more detailed quality policy based on the original organisation-wide policy. Testing against the critical 50% positive response rate, z scores are 7.42, 5.43 and 2.00 respectively. This means that these averages are significantly greater than 50% (see APPENDIX 18). These findings support sub-hypothesis six.

The responses of the other three manufacturers do not support this sub-hypothesis. At BMW, Samcor and VW, on average, only 20%, 22.2% and 25% of management respectively, agree that their department has drawn up its own more detailed quality policy based on the organisation-wide policy. Testing against the critical 50% positive response rate, z scores are -2.37, -2.86 and -2.00 respectively (see APPENDIX 18). This indicates that these averages are significantly less than 50%.

The above responses indicate that at Toyota, Delta and Nissan, quality appears to be treated as a line function, with each department drawing up its own more detailed quality policy, within the ambit of the original policy. Were quality is the responsibility of a centralised quality department, no purpose would be served, through each department, drawing up its own more detailed quality policy.

At BMW, Samcor and VW, individual departments have not draw up their own more detailed quality policies, based on the original quality policy. A possible explanation for this, is that at these manufacturers, quality is viewed as the responsibility of a centralised quality department, negating the need for each

functional department to draw up its own quality policy.

3.7 SUB-HYPOTHESIS 7.

An important element of the total quality improvement process is that all members of the workforce must have easy access to a quality manual. The importance of a quality manual is found in the contents of such a manual, which should provide, amongst others, expected quality responsibilities, quality procedures and quality expectations (see chapter four).

Sub-hypothesis seven contends that the majority of management and their subordinates have easy access to a quality manual. This manual should explain expected quality responsibilities, quality procedures and quality expectations. The question and responses relevant to this sub-hypothesis are summarised in table 7.1 (see APPENDIX 7).

At Toyota, Delta and Nissan, on average, 92.9%, 89.5% and 73.3% of management respectively, agree that they and their subordinates have easy access to a quality manual. Testing against the critical 50% positive response rate, z scores are 9.68, 5.43 and 2.00 respectively (see APPENDIX 18). These scores indicate that the average scores are significantly greater than fifty percent. At VW and BMW, on average, 30.8% and 27.3% of management respectively, claim that they and their subordinates have easy access to a quality manual. Testing against the critical 50% positive response rate, z scores are -1.57 and -1.71 respectively. These averages are significant. This means that it is not possible to disprove the alternate hypothesis that fifty percent or less of management at these plants believe that they and their subordinates have easy access to a quality manual. Based on the above findings, sub-hypothesis seven is accepted for Toyota, Delta, Nissan, BMW and VW.

The responses from Samcor do not support sub-hypothesis seven. On average, 30.8% of management at Samcor agree that they and their subordinates have easy access to a quality manual. Testing at the critical 50% level, the z score is -2.13. This means that this average is significantly less than fifty percent. For this reason, sub-hypothesis seven is rejected for Samcor.

The above responses show that all but one of the manufacturers have quality manuals which are readily available to their workforce. These positive responses suggest that at all of the plants except Samcor, there is a degree of acknowledgement that all employees do contribute to quality and, therefore, must have access to a quality manual.

The poor response from Samcor is rather surprising, since one would expect all employees to have access to a quality manual. What can be inferred from this response is that quality is treated as a centralised function and, therefore, there is no purpose to be served by making quality manuals available to line functions, who are not responsible for quality.

3.8 SUB-HYPOTHESIS 8.

The monitoring of employee attitudes to quality is an important element in the quality improvement process. The reason for this is that the constant monitoring of these attitudes will provide information which management require to assess the success of past projects aimed at quality improvement and to plot the cause for future action (see chapter four). The measurement and monitoring of employee attitudes to quality, therefore, forms an integral part of the measurement process, which is so important to total quality improvement (see chapter four).

Sub-hypothesis eight contends that the majority of management agree that their organisation does monitor management's and their subordinates' attitudes on quality. The questions and responses relevant to this sub-hypothesis are summarised in tables 8.1 and

8.2 (see APPENDIX 8).

At Toyota, Delta and Nissan, on average, 93.9%, 89.5% and 73.3% of management respectively, agree, that in their organisation, theirs and their subordinates' attitudes to quality are monitored. Testing against the critical 50% majority, z scores are 9.68, 5.43 and 2.00 respectively (see APPENDIX 18). This means that these averages are significantly greater than fifty percent.

Much discussion has taken place on the content of attitude surveys directed at the quality improvement process (see chapter four). Two recurring themes in this discussion are the monitoring of trends on employee attitudes to quality and levels of employee understanding of the quality improvement process. In this regard, at Toyota, Delta and Nissan, on average, 87.1%, 88.2% and 81.8% of management agree that trends regarding employee attitudes to quality are monitored. Similarly, on average, 93.5%, 94.1%, and 72.7% of management at Toyota, Delta and Nissan respectively, agree that levels of employee understanding of the quality improvement process are monitored. The z scores for these averages indicate that they are significantly greater than fifty percent (see APPENDIX 18). Regarding the frequency of such surveys, on average, 87.1%, 82.4% and 81.8% of management at Toyota, Delta and Nissan respectively, agree that such surveys are undertaken on an annual basis. Tested at the critical fifty percent level, z scores indicate that the averages are significantly greater than fifty percent. This means that at these plants, attitude surveys are undertaken on a annual basis. All of the above responses confirm that at Toyota, Delta and Nissan, the workforce's attitudes to quality improvement are monitored on a regular basis. In addition, the content of the attitude surveys comply with that recommended in the literature. Sub-hypothesis eight is accordingly accepted for these manufacturers.

The responses of the remaining three manufacturers are less

positive than the above. On average, 26.9% of managers at Samcor agree that the workforces attitudes to quality are monitored. At VW, the corresponding figure is 23.1%, while at BMW it is 18.2%. Testing against the critical 50% majority, z scores are -2.78, -2.31 and -2.76 respectively (see APPENDIX 18). This means that these averages are significantly less than 50%. It is, therefore, evident that these manufacturers do not conduct attitude surveys aimed at monitoring the quality improvement process. Sub-hypothesis eight is rejected for Samcor, VW and BMW.

An important indicator of the position held by management at Toyota, Delta and Nissan towards quality is given by the fact all these manufacturers conduct attitude surveys to monitor the attitudes of their workforce towards quality. The fact that the entire workforce is subject to these surveys, suggests that at these plants it is recognised that quality is an organisation-wide phenomenon, which is influenced by the entire workforce. In addition, the fact that attitude surveys have been carried out on the entire workforce indicates that in these companies an attempt is being made to move away from quality, as a centralised function, towards a more decentralised approach. Such an approach is consistent with the underlying principle of total quality management.

At the remaining three plants it appears that attitude surveys are not conducted. This suggests that the position of BMW, Samcor and VW towards quality, is that it is not as much the responsibility of the entire workforce as it is that of a centralised quality department.

3.9 SUB-HYPOTHESIS 9.

Many authors on the subject of total quality management agree that active management involvement in the quality improvement process is vital to its success. Where management are not seen to be actively participating in the quality improvement process there is a very real possibility that subordinates will interpret

this to reflect a lack of management commitment (see chapter four).

Sub-hypothesis nine holds that the majority of management agree that their superiors participate in at least one half of their quality team meetings. The questions and responses relevant to this sub-hypothesis are summarised in table 9.1 (see APPENDIX 9).

Consider the responses to question IV.A. At Toyota and Delta, superiors participate in, on average, 53.69% and 51.31% of the quality team meetings of their subordinates respectively. Testing against the critical 50% participation rate, z scores are -0.11 and -0.42 respectively (see APPENDIX 18). This means that these averages are not significant. It is, therefore, not possible to disprove the alternate hypothesis that the average level of superior involvement in quality team meetings in these organisations is fifty percent or less. This sub-hypothesis is accepted for these manufacturers.

For Nissan, VW, Samcor and BMW, the average degree of participation by superiors in their subordinates quality team meetings is 25.26%, 23.84%, 26.72%, and 7.27% respectively. Testing at the critical 50% participation level, z scores are 2.20, 2.21, 2.63 and 5.45 respectively. This means that the average rates of participation at each of these manufacturers is significantly less than 50%. Sub-hypothesis nine is rejected for Nissan, VW, Samcor and BMW.

Although not to much meaning can be attached to the above responses, they do provide an indication of the extent of management involvement and commitment to the quality improvement process. At Toyota, Delta and Nissan, the level of management participation in quality team meetings is far greater than that at either BMW, Samcor or VW. This suggests that at the former three plants, management assume an active role in the quality improvement process. That employees perceive this to be the case is important. Where they do not, they may interpret this to

reflect a lack of management commitment to the quality improvement process. Where subordinates perceive that management are not committed to the quality improvement process, there is little hope that they will either.

A number of reasons can be put forward explaining why management at BMW, Samcor and VW do not participate in their subordinates' quality team meetings. The more likely of these are:

- at these plants use is not made of quality improvement teams;
- at these plants quality improvement teams meet in the absence of their superior;
- at these plants quality is viewed as the responsibility of a centralised quality department, negating the need for the entire workforce to become involved in the quality improvement process.

3.10 SUB-HYPOTHESIS 10

An important element of the total quality improvement approach is that management and their subordinates be provided with an awareness of who their customers are. Many authors on the subject of total quality management refer to the importance of both internal and external customers in the production of a quality product (see chapter four). Accordingly, management should be aware of the fact that they have both internal and external customers (see chapter four).

Sub-hypothesis ten holds that the majority of management are aware that they have both internal and external customers. The questions and responses relevant to this sub-hypothesis are summarised in table 10.1 (APPENDIX 10).

On the question of external customers, there was 100% agreement by all management at the six manufacturing plants that their organisation has external customers (see question II.D(ii), APPENDIX 10). These averages are significantly greater than 50%.

On the existence of internal customers, there was, however, less agreement. On average, 90.9% of managers at Toyota are aware that they have internal customers. At Delta, the corresponding figure is 89.5%, while at Nissan it is 80%. Testing against the critical 50% majority, z scores are 7.65, 5.43 and 2.90 respectively (see APPENDIX 18). This means that these averages are significantly greater than 50%.

At the remaining three manufacturers, the level of awareness of internal customers is not the same as that identified at Toyota, Delta and Nissan. At Samcor, on average, there is only 30.8% agreement on the existence of internal customers. The corresponding figures at BMW and VW are 18.2% and 23.1% respectively. Tested at the critical 50% level, z scores are -2.22, -2.76 and -2.31 respectively (see APPENDIX 18). This indicates that these averages are significantly below fifty percent. An internal customer attitude is not held by these three manufacturers.

There is little doubt concerning the existence of an external client attitude at all six of the manufacturing plants. An internal customer attitude is, however, found only at Toyota, Delta and Nissan. There is little evidence to support the existence of an internal customer attitude at BMW, Samcor and VW. Based on the above findings, sub-hypothesis ten is accepted for Toyota, Delta and Nissan, while being rejected for BMW, Samcor and VW.

An awareness of the existence of external customers by management at all of the passenger vehicle manufacturers in the South African motor industry is hardly surprising. Less obvious though, is the existence of an internal client attitude. The adoption of such an attitude shows an awareness that each individual's output becomes the input at the next stage in the production process. This means that the quality of the output at each stage of the production process will have an effect on the quality of the product at a later stage of production. For this reason, where

the responsibility for quality is decentralised to the point of production, it is important for the workforce to be aware that they have internal, in addition to, external customers. The fact that management at Toyota, Delta and Nissan are aware that they have internal customers suggests that at these plants, quality responsibility may be decentralised to the point of production.

At the remaining three manufacturers, a possible explanation for the non existence of an internal client attitude is that quality responsibility is not decentralised.

3.11 SUB-HYPOTHESIS 11

An important element of the total quality improvement process, is that management and their subordinates should not only be aware of who their customers are, but should also be aware of the key quality requirements of these customers (see chapter four).

Sub-hypothesis eleven contends that the majority of management are aware of what the key quality requirements of their customers are. The question and responses relevant to this sub-hypothesis are summarised in table 11.1 (APPENDIX 11).

At Toyota, Delta and Nissan, on average, 93.9%, 89.5% and 73.3% of management respectively, are of the opinion that they are aware of the key quality requirements of their customers. Tested at the critical 50% level, z scores are 9.68, 5.43 and 2.00 respectively. This indicates that these averages are significantly greater than fifty percent. In support of this finding, at Toyota, Delta and Nissan, on average, 96.7%, 88.9% and 73.3% of management respectively, agree that their superiors regularly tell them what the key quality requirements of their customers are. Tested at the critical fifty percent level, these findings are significantly greater than fifty percent (see APPENDIX 18).

The responses received from the remaining three manufacturers are less convincing than the above. At VW, Samcor and BMW, on average, 61.5%, 53.8% and 45.5% of management respectively claim to be aware of the key quality requirements of their customers. Tested at the critical 50% positive response rate, z scores are 0.81, 0.30 and -0.33 respectively (see APPENDIX 18). This means that it is not possible to disprove the alternate sub-hypothesis, that fifty percent or less of management at these plants, are aware of the key quality requirements of their customers.

Based on all of the above responses, sub-hypothesis eleven is accepted for all six of the manufacturers.

Total quality management has as its point of departure an awareness of customer quality requirements. Such an awareness was found to be in existence at all six manufactures. This response suggests that throughout the industry there is a recognition that "the customer is king" and an effort is being made by all manufacturers to ensure that their entire workforce is aware of the quality requirements of their customers. Although encouraging, the above responses do not cast much light on the means used to ensure that customer requirements are met and serviced. These requirements may be met through extensive inspection or alternatively through building them into the product or service, as advocated under total quality management.

3.12 SUB-HYPOTHESIS 12.

Many authors on the subject of total quality management suggest that management have an important role to play in cascading quality knowledge down through the organisation (see chapter four). They suggest that one of the more successful means to achieve this is for management to be actively involved in the training of their subordinates.

Sub-hypothesis twelve holds that the majority of management personnel personally give their subordinates training aimed at

quality improvement. The questions and responses relevant to this sub-hypothesis are summarised in table 12.1 (APPENDIX 12).

At Toyota and Delta, on average, 87.9% and 78.9% of management respectively, agree that they personally involve themselves in giving their subordinates training directed at quality improvement. Testing at the critical 50% level, z scores are 6.32 and 2.94 respectively. This means that these averages are significantly greater than fifty percent. At Nissan, on average, 66.7% of management agree that they personally involve themselves in giving their subordinates training directed at quality improvement. Testing at the critical 50% level, the z score of this average is 1.3. This means that it is not possible to disprove the alternate hypothesis that at Nissan, 50% or less of management agree that they personally involve themselves in providing their subordinates with training on quality improvement (see APPENDIX 18). Based on the above responses, sub-hypothesis twelve is accepted for Toyota, Delta and Nissan.

A totally different picture emerges from the remaining three manufacturers. At BMW, Samcor and VW, on average, 18.1%, 23% and 15.4% of management respectively, agree that they personally involve themselves in providing their subordinates with training directed at quality improvement. Tested at the critical 50% level, z scores are -2.76, -3.27 and -3.53 respectively (see APPENDIX 18). This means that these averages are significantly below fifty percent. Sub-hypothesis twelve is accordingly rejected for these three manufacturers.

Although little significance can be attached to the above results, it is interesting to note in which organisations management personally give their subordinates education on quality improvement. The fact that management at Toyota, Delta and Nissan are personally involved in training their subordinates in quality improvement suggests that at these plants management adopt a hands on approach to quality improvement. That they are able to adopt such an approach suggests, that these management

have themselves been subject to training on quality improvement and are now being used to cascade this information throughout the organisation. That an attempt is made in these organisations to subject all employees to training on quality improvement, suggests that they consider quality responsibility to be a line function and not the responsibility of a central quality department. In addition, by management becoming personally involved in the provision of quality training to their subordinates, indicates that they are highly committed to the quality improvement process.

3.13 SUB-HYPOTHESIS 13.

Most authors on the subject of total quality management advocate the provision of specific training, directed at the tools and techniques of total quality management, to the entire workforce (see chapter four). This training should not be limited to general training on quality improvement, but should be directed specifically at providing the workforce with the tools and knowledge necessary to enable them to participate in the total quality improvement process. In addition, the effectiveness of this training will only be maximised if the training is ongoing, and not conducted on a once off basis (see chapter four).

Sub-hypothesis thirteen contends that the majority of management agree that specific training, directed at the tools and techniques of total quality management, is provided to them and their subordinates, on an ongoing basis. The questions and responses relevant to this hypothesis are summarised in tables 13.1, 13.2, 13.3, 13.4 and 13.5 (see APPENDIX 13).

Consider the responses to question VI.N. At Toyota, Delta and Nissan, on average, 90.9%, 89.5% and 73.3% of management respectively, agree that they and their subordinates receive training directed specifically at quality improvement. Testing at the critical 50% positive response rate, z scores are 7.65, 5.43 and 2.00 respectively (see APPENDIX 18). This means that

these averages are significantly greater than fifty percent. At VW, BMW and Samcor, on average, 69.2%, 54.5% and 50% of management respectively agree that they and their subordinates receive training directed specifically at quality improvement. Testing at the critical 50% level, z scores indicate that it is not possible to disprove the alternate hypothesis that for these three manufacturers, fifty percent or less of management hold that they and their subordinates receive training directed at quality improvement (see APPENDIX 18). Based on the above responses, one can only conclude that at all the manufacturing plants, training directed at quality improvement is provided.

The mere existence of training directed at quality improvement does not signify its competence in terms of providing management, and its workforce, with the tools and knowledge necessary to enable them to participate in the total quality improvement process. In order to assess the extent to which the training is directed at the tools and techniques of total quality management, its contents must be considered. Most authors on the subject of total quality management agree that training directed at the tools and techniques of total quality management, should focus primarily on job skills, problem solving tools, statistical process control, the importance of meeting specifications and interpersonal relations (see chapter four).

Consider question VI.O(i). At Toyota and Delta, on average, 93.1% and 100% of management respectively, agree that they and their subordinates are provided with training aimed at improving their job skills. Testing at the critical 50% level, these findings are significantly greater than fifty percent. At Nissan, on average, 72.7% of management, agree that they and their subordinates are provided with training aimed at improving their job skills. Testing at the critical 50% level, the z score of this average is 1.62. This means that it is not possible to disprove the alternate hypothesis that at Nissan fifty percent or less of management agree that they and their subordinates receive training aimed at improving their job skills (see APPENDIX 18).

Based on the above findings, it appears that the majority of management at Toyota, Delta and Nissan agree, that in their organisations, training aimed at improving job skills is provided. Similarly, the responses to questions VI.O (ii-v) indicate that at Toyota, Delta and Nissan, training is provided in the areas of problem solving, statistical process control, the importance of meeting specifications and interpersonal relations.

The responses from BMW, Samcor and VW proved less positive. Concerning training in the areas of job skills, problem solving tools, statistical process control and interpersonal relations, the positive responses, and resulting z scores, indicate that the averages received from all three of these manufacturers are significantly less than fifty percent. Regarding training directed at the importance of meeting specifications, on average, 61,6%, 55.6% and 50% of management at Samcor, VW and BMW respectively, agree that such training is provided. Testing against the critical 50% level, z scores indicate that it is not possible to disprove the alternate hypothesis that at BMW, Samcor and VW, fifty percent or less of management agree that training stressing the importance of meeting specifications is provided (see APPENDIX 18).

The only area of quality training recommended in the literature which is provided at BMW, Samcor and VW, is that stressing the importance of meeting quality specifications. The other areas of training advanced in the literature are not provided at these plants.

In an attempt to add validity to the above findings, a number of additional elements which reflect on the existence of training directed specifically at total quality improvement were investigated. These elements revolved around the level of understanding of quality in the context of total quality management. All four of the concepts on which respondents were questioned, in question I.G, are central to total quality, and form the basics of an understanding of total quality management

(see chapter four). Two additional elements central to an understanding of quality in the total quality context, are the importance of product specifications and the importance of a knowledge of the quality requirements of customers (see chapter four). These two issues are addressed by questions I.H and I.I.

Consider question I.G(i). At Toyota, Delta and Nissan, on average, 90.9%, 84.2% and 73.3% of management respectively, incorporate "conformance to requirements" in their definition of quality. Testing at the critical 50% level, z scores are 7.65, 4.04 and 2.00 respectively. This means that these averages are significantly greater than fifty percent. Similarly, the responses to questions I.G (ii-iv) indicate that at Toyota, Delta and Nissan, management define quality in a similar manner to that proposed in the literature (see APPENDIX 18).

The responses from management at BMW, Samcor and VW paint a very different picture. The average responses of management at these three plants, about the inclusion of certain concepts central to total quality management, into their definition of quality, are all significantly below fifty percent (see APPENDIX 18). This means that management at BMW, Samcor and VW do no include, in their definition of quality, concepts such as conformance to requirements, quality is tangible and quality involves both quality of design and quality of conformance.

On average, 45.5%, 57.7% and 61.5% of management at BMW, Samcor and VW respectively, agree that quality is an organisation-wide concept. Tested against the critical 50% level, z scores are -0.33, 0.72 and 0.81 respectively (see APPENDIX 18). This means that it is not possible to disprove the alternate hypothesis that at these manufacturers, fifty percent or less of management agree that quality is an organisation-wide concept. The responses to question I.G, received from management at BMW, VW and Samcor, indicate that of the four elements central to any definition of quality, as advocated in the literature, only one is included in their definition.

The responses to questions I.H and I.I received from the various manufacturers lend support to the above findings. The responses to these questions, on average, from management at Toyota, Delta and Nissan, are significantly greater than fifty percent, while those at the remaining three manufacturers are significantly less than fifty percent. This means that at Toyota, Delta and Nissan, management are aware of the importance of customer requirements and product specifications in deciding what constitutes a quality product. The same however cannot be claimed for the remaining three manufacturers.

The responses to questions I.G, I.H and I.I support the findings of questions VI.N and VI.O. From the responses to questions I.G, I.H and I.I, it is evident that the majority of management at Toyota, Delta and Nissan have a good understanding of total quality management. The same cannot be claimed for management at the remaining three manufacturers. The responses to the same questions received from management at BMW, Samcor and VW, place doubt on the extent to which they understand, and are aware of, the essentials of total quality management. The sum of the responses to all of the above questions lend support to the workforces at Toyota, Delta and Nissan having been exposed to specific training aimed at total quality improvement, while casting doubt on similar training at BMW, Samcor and VW.

Most authors agree that for the effect of organisational training to be maximised, it should be ongoing, and not conducted on a once off basis (see chapter four). Regarding the frequency of training directed at quality improvement provided at Toyota and Delta, on average, 86.7%, and 88.2% of management respectively agree that it is provided on an ongoing basis. Tested against the critical 50% level, these averages are significantly greater than fifty percent (see APPENDIX 18). This means that training directed at quality improvement undertaken at Toyota and Delta is provided on an ongoing basis. At Nissan, on average, 72.7% of management agree that training aimed at quality improvement is provided on an ongoing basis. Testing at the critical 50% level,

the z score is 1.62. This means that it is not possible to disprove the alternate hypothesis that fifty percent or less of management at Nissan agree that training aimed at quality improvement is conducted on a continuous basis (see APPENDIX 18). Based on the above responses, training directed at quality improvement undertaken at Toyota, Delta and Nissan, is conducted on an ongoing basis.

At BMW, Samcor and VW, on average, 16.6%, 23.1% and 22.3% of management respectively, agree that training directed at quality improvement is conducted on an ongoing basis. Testing at the critical 50% level, these averages are significantly below fifty percent (see APPENDIX 18). This means that at BMW, Samcor and VW, training, directed at quality improvement, is not conducted on an ongoing basis.

The majority of management at Toyota, Delta and Nissan agree that specific training in the quality field is provided to them and their subordinates on an ongoing basis. In addition, this training appears to address the major areas underlying the process of total quality management. This contention is confirmed by the level of understanding of the underlying principles of total quality management shown by the respondents. The above responses, when viewed as a whole, suggest that at these three plants, specific training directed at the fundamentals of total quality management is provided, on an ongoing basis. This situation provides a strong indication that these plants have adopted, and are investing in, a total quality management approach to quality improvement.

The same cannot be claimed for BMW, Samcor and VW. At these plants, while quality training is provided, all evidence suggests that it is not directed specifically at the principles of total quality improvement, nor is it conducted on an ongoing basis.

Based on the above findings, sub-hypothesis thirteen is accepted for Toyota, Delta and Nissan, while being rejected for BMW,

Samcor and VW.

3.14 SUB-HYPOTHESIS 14.

The literature abounds with information on the importance of management commitment to the quality improvement process (see chapter four). Without management commitment, there is little chance that the total quality improvement process will succeed. The importance of management commitment stems from the fact that total quality management is a participative process, whose success is, to a large degree, dependant on a participative style of management (see chapter four). Many authors on the subject of total quality management are of the opinion that one of the most successful ways to enhance management commitment to the participative quality improvement process, is to link their success in the process to their upward mobility in the organisation. This means that management should in some manner be evaluated on their performance in the participative quality improvement field (see chapter four).

Sub-hypothesis fourteen contends that the majority of management perceive that they are evaluated on their performance in the quality improvement field, with particular emphasis being placed on participative quality improvement. The questions and responses relevant to this sub-hypothesis are summarised in tables 14.1 and 14.2 (see APPENDIX 14).

Consider question IV.I. On average, 81.9%, 94.8%, 81%, 73.1%, 97% and 92.3% of management at BMW, Delta, Nissan, Samcor, Toyota and VW respectively, agree that they are appraised on their success in improving quality in their departments. Testing at the critical 50% level, all of these averages are significantly greater than fifty percent (see APPENDIX 18). This means that management at all of the manufacturing plants are appraised on their ability to improve quality. Although encouraging, these responses fail to provide any information on the content of the evaluation. The importance of identifying the contents of the

evaluation, is that of particular concern in this study is the use of the principles of total quality management to promote quality improvement. Total quality management is a participative process and the success of such a process is to a large degree dependant on a participative style of management (see chapter four).

At Toyota, Delta and Nissan, on average, 97%, 94.8% and 73.3% of management respectively, agree that they are appraised on their willingness and ability to involve subordinates in the decision-making process, in the area of quality improvement. Testing at the critical 50% level, z scores are 15.82, 8.07 and 2.00 respectively (see APPENDIX 18). This means that these averages are significantly greater than fifty percent. Management at the above plants are appraised on their willingness and ability to involve subordinates in the decision-making process, in the area of quality improvement.

At BMW, Samcor and VW, on average, only 18.2%, 23.1% and 23% of management respectively, agree that they are appraised on their willingness and ability to involve subordinates in the decision-making process, in the area of quality improvement. Testing at the critical 50% level, these averages are significantly below fifty percent (see APPENDIX 18). Management at these plants, although being appraised on their ability to improve and maintain quality standards, are not appraised on their willingness and ability to achieve improved quality through involving their subordinates in the decision-making process.

The responses to question IV.G provide further confirmation that at Toyota, Nissan and Delta, the decentralisation of decision-making responsibility in the area of quality improvement is pursued. This question is based on the assumption that subordinate management will pursue that which they feel senior management place a premium on. At Toyota and Delta, on average, 93.4%, and 89.5% of management respectively, agree that senior management in their organisations are in favour of the

decentralisation of decision-making responsibility in the area of quality improvement. Tested at the critical fifty percent level, these averages are significantly greater than fifty percent (see APPENDIX 18). At Nissan, the corresponding response is 78.5%. Testing at the critical 50% level, it is not possible to disprove the alternate hypothesis that at Nissan, fifty percent or less of management agree that senior management in their organisation are in favour of the decentralisation of decision-making responsibility, in the area of quality improvement. The above responses mean that at Toyota, Delta and Nissan, senior management are seen by subordinate management to be in favour of the decentralisation of decision-making responsibility, in the area of quality improvement.

The responses of the remaining three manufacturers paint a totally different picture. At BMW, Samcor and VW on average, 10%, 25% and 16.7% of management respectively, agree that senior management in their organisations are in favour of the decentralisation of decision-making responsibility, in the area of quality improvement. Tested at the critical fifty percent level, these averages are significantly less than fifty percent (see APPENDIX 18). These responses mean that at BMW, Samcor and VW, senior management are seen by subordinate management as being in favour of the decentralisation of decision-making responsibility, in the area of quality improvement.

The responses to questions IV.H and IV.G provide a strong indication that at Toyota, Delta and Nissan, management are appraised on their willingness and ability to involve subordinates in the decision-making process, in the area of quality improvement, while those at BMW, Samcor and VW are not. Where management are appraised on their ability to involve subordinates in decision-making, it is fair to expect that subordinates would be encouraged to participate in decision-ma ing. Confirmation that management at Toyota, Delta and Nissan actually do involve their subordinates in the decision-making process, while those at BMW, Samcor and VW do not, is provided

by the responses to questions IV.E, and IV.F. At Toyota and Delta, on average, 96.9% and 89.5% of management respectively, involve their subordinates in decision-making, in the quality field, wherever possible. Testing at the critical z level, these averages are significantly greater than 50%. At Nissan, 60% of management claim that they involve their subordinates in decision-making, in the quality field, wherever possible. Testing at the critical z level, this average is significant. This means that it is not possible to disprove the alternate hypothesis that fifty percent or less of management at Nissan involve their subordinates in decision-making (see APPENDIX 18). The above responses indicate that management at Toyota, Delta and Nissan do involve their subordinates in decision-making, in the field of quality improvement. The same however does not hold for the remaining three manufacturers. At BMW, Samcor and VW, on average, 18.2%, 30.8% and 23.1% of management respectively, involve their subordinates in decision-making, in the quality field. Testing at the critical z level, these averages are significantly less than 50%. This means that at these plants management do not involve their subordinates in decision-making, in the field of quality improvement.

Not surprisingly, on average, 100%, 94.5% and 78.5% of management at Toyota, Delta and Nissan respectively, are involved by their superiors in decision-making in the quality improvement field. Tested at the critical 50% level, these averages are significantly greater than 50%. This means that at these plants, senior management involve subordinate managers in decision-making where possible. At the remaining three manufacturers, the responses were less positive. At BMW, Samcor and VW, on average, 25%, 25% and 16.7% of management respectively, are involved by their superiors in decision-making in the quality improvement field. Tested at the critical 50% level. these averages are significantly less than 50% (see APPENDIX 18). This means that at these plants, senior management do not involve subordinate managers in decision-making in the area of quality improvement.

The sum of the responses to the above questions leave little doubt as to the fact that at Toyota, Delta and Nissan, management are evaluated on their willingness and ability to involve their subordinates in decision-making in the quality improvement field. At the remaining three plants, it appears that management are not evaluated on their willingness and ability to involve their subordinates in decision-making in the quality improvement field. Sub-hypothesis fourteen is accordingly accepted for Toyota, Delta and Nissan, while being rejected for BMW, Samcor and VW.

The above responses provide an indication that at Toyota, Delta and Nissan management are actively encouraged to participate and involve their subordinates in the quality improvement process. This is indicated by the fact that at these plants, rewards have been structured so as to reward and encourage participative management styles. This sends out a strong message that executive management at these plants recognise the importance of gaining the participation of the entire workforce in the quality improvement process. The fact that the reward structures at Toyota, Delta and Nissan have been structured so as to reward behaviour consistent with participative quality improvement, suggests that these organisations are committed to total quality management and its underlying principles.

At the remaining three manufacturers, there appears to be little or no reward for management who involve their subordinates in the quality improvement process. This would seem to suggest that at these organisations a premium is not placed on participative quality improvement. The reason for this could be that at BMW, Samcor and VW, more attention is paid to ensuring quality through inspection by a central quality department, than through the decentralisation of quality responsibility.

3.15 SUB-HYPOTHESIS 15.

Many authors on the subject of total quality management agree that in order to ensure the continuity and prosperity of the participative quality improvement process, participants should be provided with incentives to participate in the process (see chapter four).

Sub-hypothesis fifteen contends that the majority of management agree that they and their subordinates are provided with incentives to participate in the quality improvement process. The questions and responses relevant to this hypothesis are summarised in tables 15.1 and 15.2 (see APPENDIX 15).

Consider the responses to question VI.S. At Toyota, Delta and Nissan, on average, 90.9%, 84.2% and 73.3% of management respectively, agree that they and their subordinates are provided with incentives to participate in the quality improvement process. Testing at the critical 50% level, z scores are 7.65, 4.04 and 2.00 respectively (see APPENDIX 18). This means that these averages are significantly greater than fifty percent. Management and subordinates at these plants are provided with incentives to participate in the quality improvement process. Confirmation of this finding is provided by the responses to question VI.Q. At Toyota, Delta and Nissan, on average, 93.9%, 89.5% and 80% of management respectively, agree that they and their subordinates are recognised for contributions which they make towards quality improvement. Testing at the critical 50% level, z scores are 9.68, 5.43 and 2.90 respectively. These averages are significantly greater than fifty percent (see APPENDIX 18). At Toyota, Delta and Nissan, management and their subordinates are provided with incentives to participate in the quality improvement process. Regarding the nature of these incentives, the responses to questions VI.R and VI.T provide a strong indication that at the above plants, only non-financial incentives are provided. There is little evidence to support the existence of financial incentives.

The same cannot be claimed for the remaining three manufacturers. At VW, BMW and Samcor, on average, 23.1%, 18.2% and 19.3% of management respectively, agree that they and their subordinates are provided with incentives to participate in the quality improvement process. Testing at the critical 50% level, z scores are -2.31, -2.76 and -4.02 respectively (see APPENDIX 18). This means that these averages are significantly less than fifty percent. These responses indicate that at VW, BMW and Samcor, management and their subordinates are not provided with incentives to participate in the quality improvement process. In support of this finding, the responses to question VI.Q indicate that at BMW, Samcor and VW, management and their subordinates are not recognised for contributions to the quality improvement process. On average, 18.2%, 30.8% and 23.1% of management and their subordinates at BMW, Samcor and VW respectively, are recognised for contributions which they make to quality improvement. Tested at the critical 50% level, z scores are -2.76, -2.22 and -2.31 respectively (see APPENDIX 18). This means that these averages are significantly less than fifty percent. The workforce at BMW, Samcor and VW are not provided with incentives to participate in the quality improvement process.

The responses to questions VI.Q and VI.S leave little doubt as to the existence of incentives to participate in the quality improvement process at Toyota, Delta and Nissan. The same questions highlight the lack of such incentives at BMW, Samcor and VW. Sub-hypothesis fifteen is accepted for Toyota, Delta and Nissan, and rejected for BMW, Samcor and VW.

The above responses suggest that at Toyota, Delta and Nissan, management are actively encouraged to participate and involve their subordinates in the quality improvement process. This is indicated by the fact that at these plants incentives directed at rewarding and encouraging participative management styles are given. It is apparent that at these plants the importance of gaining the participation of the entire workforce in the quality improvement process is recognised. The fact that the reward

structures at Toyota, Delta and Nissan have been structured so as to reward behaviour consistent with participative quality improvement, suggests that these organisations are committed to the decentralisation of quality responsibility. This is one of the underlying principles of total quality management.

At the remaining three manufacturers, there appears to be little or no incentive for management to involve their subordinates in the quality improvement process. At these plants a premium is not placed on participative quality improvement. The reason for this could be that at BMW, Samcor and VW, more attention is payed to ensuring quality through inspection by a central quality department, than through the decentralisation of quality responsibility.

3.16 SUB-HYPOTHESIS 16.

Almost without exception, the literature on total quality management recommends the establishment of some form of quality improvement team in the organisation. These teams may be specific to one department or have cross-functional representation. They are seen as the vehicle whereby subordinates are able to meet and address quality problems (see chapter four).

Sub-hypothesis sixteen contends that the majority of management and their subordinates belong to some form of quality improvement team. The questions and responses relevant to this hypothesis are summarised in table 16.1 (see APPENDIX 16).

In response to question VI.A, on average, 93.9%, 89.5% and 73.3% of employees at Toyota, Delta and Nissan respectively, belong to some form of quality improvement team. Tested at the critical 50% level, z scores of the averages to both questions indicate that the averages are significantly greater than fifty percent (see APPENDIX 18). This means that at Toyota, Delta and Nissan, both management and their subordinates belong to a quality improvement

team. At VW, on average, 69% of management and their subordinates belong to a quality improvement team. Tested at the critical 50% level, the z score is 1.48. This score is significant, which means that it is not possible to disprove the alternate hypothesis that fifty percent or less of management and their subordinates belong to a quality improvement team (see APPENDIX 18). Based on the above responses, management and their subordinates at Toyota, Delta, Nissan and VW belong to a quality improvement team. This supports sub-hypothesis sixteen.

At BMW and Samcor, on average, 18.2% and 30.8% of management belong to a quality improvement team. Similarly, 18.2% and 30.8% of employees at these plants belong to a quality improvement team. Tested at the critical 50% level, the z scores for all of the above averages indicate that they are significantly less than fifty percent (see APPENDIX 18). This means that at BMW and Samcor, management and their subordinates do not belong to a quality improvement team. This does not support sub-hypothesis sixteen.

Where applicable, a series of questions were asked to obtain information on the nature of the quality improvement teams at the various manufacturers (see APPENDIX 16, figures 16.1, 16.3, 16.4, 16.5 and 16.6). This information serves to confirm that not only do employees at Toyota, Delta, Nissan and VW belong to some form of quality improvement team, but that the nature of these teams corresponds fairly closely with that recommended in the literature.

YOTA

Size: The average size of the quality improvement teams is 9.2. people per team

Area: 93.5% of management agree that the members of their quality improvement team are from the same work area (see question VI.D).

Leader: 93.1% of respondents agree that the leader of their team is there regular work supervisor (see question VI.E).

Appointed: 87.9% of respondents agree that the leader of their team is appointed by management (see question VI.F).

Meeting: 87.1% of respondents agree that their team meets on a daily basis (see question VI.G).

Authority: 92% of respondents agree that their quality improvement team has the authority to implement solutions to identified problems within certain limits (see question VI.I).

DELTA

Size: The average size of the quality improvement teams is 10.1 people per team.

Area: 88.2% of management agree that the members of their quality improvement team are from the same work area (see question VI.D).

Leader: 88.2% of respondents agree that the leader of their team is their regular work supervisor (see question VI.E).

Appointed: 88.2% of respondents agree that the leader of their team is appointed by management (see question VI.F).

Meeting: 88.2% of respondents agree that their team meets on a daily basis (see question VI.G).

Authority: All the respondents agree that their quality improvement team has the authority to implement solutions to identified problems within certain limits (see question VI.I).

NISSAN

Size: The average size of the quality improvement teams is 8.7 people per team.

Area: 81.8% of management agree that the members of their quality improvement team are from the same work area (see question VI.D).

Leader: 90.9% of respondents agree that the leader of their team is their regular work supervisor (see question VI.E).

Appointed: 90.9% of respondents agree that the leader of their team is appointed by management (see question VI.F).

Meeting: 81.8% of respondents agree that their team meets on a daily basis (see question VI.G).

Authority: All the respondents agree that their quality improvement team has the authority to implement solutions to identified problems within certain limits (see question VI.I).

VW

Size: The average size of the quality improvement teams is 8.8 people per team.

Area: 88.9% of management agree that the members of their quality improvement team are from the same work area (see question VI.D).

Leader: 77.8% of respondents agree that the leader of their team is there regular work supervisor (see question VI.E).

Appointed: 88.9% of respondents agree that the leaders of their team is appointed by management (see question VI.F).

Meeting: 88.9% of respondents agree that there team meets on a weekly basis (see question VI.G).

Authority: 83.3% of respondents agree that their quality improvement team has the authority to implement solutions to identified problems within certain limits (see question VI.I).

Quality improvement teams are one of the prime vehicles for facilitating the participation of the workforce in the quality improvement process. From this can be inferred that where an organisation has established such teams, it is pursuing a policy aimed at the decentralisation of quality responsibility.

The above responses indicate the existence of some form of quality improvement teams at Toyota, Delta, Nissan and VW. This suggests that these organisations are intent on involving all their employees in the quality improvement process. Such an approach is consistent with the standpoint that quality is a line function and not the responsibility of a centralised quality department.

At BMW and Samcor, there is little evidence to support the existence of some form of quality improvement team. The absence of some form of team to facilitate the involvement of all employees in the quality improvement process suggests that such involvement is not a priority at these plants. Such a stance would be consistent with the standpoint that quality is the prime responsibility of a centralised quality department, rather than that of the entire workforce.

3.17 SUB-HYPOTHESIS 17.

Much has been written on the importance of cross-functional quality improvement teams in the quality improvement process (see chapter four). One of the central themes of total quality management is that the production of a quality product is achieved through paying attention to quality throughout the organisation. Every process or activity within the organisation influences the quality of the final product or service being produced, and should be included in the total quality improvement process (see chapter four). Quality is influenced by activities within and between organisational functions. Most authors on the subject of total quality management advocate the establishment of cross-functional quality improvement teams to assist with the

co-ordination of the quality improvement process between different functions of the organisation. The existence of cross-functional quality improvement teams provides a strong indicator that quality is viewed as being an organisation-wide concept.

Sub-hypothesis seventeen holds that the majority of management agree that their organisation has cross-functional quality improvement teams. The question and responses relevant to this sub-hypothesis are presented in figure 17.1 (APPENDIX 17).

At Toyota, Delta and Nissan, on average, 81.8%, 84.2% and 73.3% of management respectively, agree that their organisations have cross-functional quality improvement teams. Tested at the critical 50% level, z scores are 4.53, 4.04 and 2.00 respectively. This means that these averages are significantly greater than fifty percent (see APPENDIX 18). At VW, on average, 40% of management hold that cross-functional quality improvement teams are utilised. Tested at the critical 50% level, the z score is -0.64 (see APPENDIX 18). This means that it is not possible to disprove the alternate hypothesis that at VW, fifty percent or less of management hold that cross-functional quality improvement teams are used. The above responses provide a strong indication that cross-functional quality improvement teams are used at Toyota, Delta, Nissan and VW. Sub-hypothesis seventeen is accepted for these manufacturers.

At BMW and Samcor, on average, 18.2% and 30.8% of management respectively, agree that cross-functional quality improvement teams are used. Tested at the critical 50% level, z scores are -2.76 and -4.99 respectively. This means that these averages are significantly below fifty percent (see APPENDIX 18). At BMW and Samcor, cross-functional quality improvement teams are not utilised. Sub-hypothesis seventeen is rejected for these manufacturers.

One of the prime functions of quality improvement teams is to assist with and facilitate the co-ordination of the quality

improvement process between different functions of the organisation. In accordance with this, the existence of cross-functional quality improvement teams at Toyota, Delta, Nissan and VW suggests that at these plants quality is viewed as being an organisation-wide concept. Based on these findings it appears as if these manufacturers consider quality to be a line function requiring the participation of the entire workforce, rather than the responsibility of a centralised quality function.

At BMW and Samcor there is little evidence to support the existence of cross-functional quality improvement teams. The absence of these teams at the above plants could be ascribed to either of the following reasons:

- some means other than cross-functional quality improvement teams are used to assist with and facilitate the co-ordination of the quality improvement process between different functions;
- quality is not considered to be a line function spanning all functions and employees within the workplace, but rather the responsibility of a centralised quality department.

4 CONCLUSION

Table 10 presents a summary of the sub-hypotheses which are accepted or rejected, for each of the six manufacturers.

As is evident from the analysis of the research results, there are indications of a large discrepancy between the manner in which total quality management is practised by the various manufacturers in the South African motor industry. There appears to be a reliance on inspection as the prime means of ensuring quality at BMW, Samcor and VW. At Toyota, Delta and Nissan, the responsibility for quality appears to a large degree to have been

decentralised to the point of production.

Table 10. Summary of Sub-Hypotheses Accepted and Rejected

A = ACCEPT. B = REJECT

MANUFACTURER SUB-HYPOTHESIS	BMW	DELTA	NISSAN	SAMCOR	TOYOTA	VW
1. INSPECTION	R	A	A	R	A	R
2. RESPONSIBILITY	R	A	A	R	A	R
3. COST OF QUALITY	R	A	A	R	A	A
4. QUALITY POLICY	R	A	A	R	A	R
5. SIGNING	R	A	A	R	A	R
6. DEP POLICY	R	A	A	R	A	R
7. MANUAL	A	A	A	R	A	A
8. ATTITUDES	R	A	A	R	A	R
9. TEAM MEETINGS	R	A	R	R	A	R
10. CUSTOMERS	R	A	A	R	A	R
11. REQUIREMENTS	A	A	A	A	A	A
12. TRAINING	R	A	A	R	A	R
13. TRAINING	R	A	A	R	A	R
14. EVALUATION	R	A	A	R	A	R
15. INCENTIVES	R	A	A	R	A	R
16. TEAMS	R	A	A	R	A	A
17. TEAMS	R	A	A	R	A	A

CHAPTER SEVEN

CONCLUSIONS AND DIRECTIONS FOR FUTURE RESEARCH

1 SUMMARY OF THE RESEARCH

This research was undertaken with specific characteristics and clearly identifiable objectives.

1.1 RESEARCH CHARACTERISTICS

This research was classified as a hypothesis generating field of study, which shared characteristics in common with conceptual studies which do not involve either a dependent or an independent variable. Care was taken to ensure that this research, which investigated total quality management in the South African motor industry, was based both on a valid empirical study and a thorough literature survey.

1.2 SUMMARY OF THE RESEARCH OBJECTIVES

The first objective of this research was to cover, in detail, total quality management and its underlying principles. This objective was met by an indepth literature survey, which focused on various theories of total quality management. A capitulation of these theories identified certain common threads which run through most of the theories of total quality management and which should play a role in total quality management in any organisation, irrespective of its size or nature.

The second objective of the research was to investigate the approaches to total quality management adopted by the various manufacturers in the South African motor industry. This objective was met through a valid and extensive empirical study.

On completion of the first two objectives of this dissertation, it was possible to address the third objective. This involved a

comparative analysis of the approaches to total quality management, as employed by the various manufacturers in the South African motor industry, with that recommended in the literature. This analysis illustrated that the approaches to total management employed in the South African motor industry vary from manufacturer to manufacturer, as to the extent to which they adhere to the principles recommended in the literature.

1.3 SUMMARY OF EMPIRICAL FINDINGS

The hypothesis on which this research was based, is that total quality management, as advocated in the literature, is being practised by all six of the passenger vehicle manufacturers in the South African motor industry, which were researched. As was stated in chapter five, a number of sub-hypotheses were set up in an attempt to prove or disprove the main hypothesis. Each sub-hypothesis addresses an issue which, in accordance with most literature on the subject of total quality management, should be a core element of any program of total quality management. The elements identified in the sub-hypotheses will all be present in an organisation which practices total quality management, as advocated in the literature. Therefore, with reference to this dissertation, the extent to which an organisation is or is not practising total quality management is determined by the number of sub-hypotheses which are accepted or rejected for that organisation The greater the number of sub-hypotheses accepted for a particular manufacturer, the more closely it is following the principles of total quality management, as advocated in the literature.

At both Toyota and Delta, all seventeen of the sub-hypotheses are accepted. This overwhelming response leaves little doubt as to the extent to which these two manufacturers are adhering to the principles of total quality management. All of the elements identified in the literature as being central to total quality management are present at these two manufacturers. It is therefore concluded that the principles of total quality

management are being followed to a high degree at these plants. It appears that the quality of output at these plants is ensured, not through complete reliance on detailed inspection, but through the adoption of a preventative approach to quality improvement. It appears as if quality assurance and improvement are ensured through the adoption of a preventative approach, rather than being treated as a post-production inspection function. This is achieved through not leaving quality responsibility with a central quality department, but decentralising it to the point of production. Much of the driving force at these two plants is provided by attempting to satisfy customer needs and expectations.

At Nissan South Africa, sixteen of the seventeen sub-hypotheses are accepted. This response provides a very strong indication that, although to a slightly lesser degree than at Toyota and Delta, the principles of total quality management are being followed to a high degree at this plant. As at Toyota and Delta, it appears that, quality improvement and assurance is tackled in a preventative manner, through the decentralisation of quality responsibility.

At VW South Africa, twelve of the seventeen sub-hypotheses are rejected. This indicates that the principles of total quality management are not closely adhered to at this plant. Although there is an indication that certain of the principles are followed, for the greater part, it seems that quality is ensured through some means other than adherence to the principles of total quality management.

At BMW South Africa, fifteen of the seventeen sub-hypotheses are rejected. This outcome sends a strong signal that at BMW, little attention is given to the principles of total quality management. It appears that quality is ensured through some means other than adherence to the principles of total quality management, the most likely means being a heavy reliance on detailed inspection.

The least positive response to the extent of reliance on the principles of total quality management to ensure quality, was received from Samcor, where sixteen of the seventeen sub-hypotheses are rejected. This response indicates that scant attention is paid to the principles of total quality management, as the means to ensure quality at this plant. This suggests that quality assurance and improvement are ensured through detailed inspection. Quality responsibility does not appear to be decentralised to the point of production, but is treated as the responsibility of a centralised quality department.

The above findings illustrate that there is a large discrepancy between the manner in which total quality management is practised by the various manufacturers in the South African motor industry. Certain of the manufacturers appear to rely on inspection as the primary means to ensure the quality of their product while others emphasise prevention.

Based on the above observations, conclusive evidence to support adherence to the principles of total quality management can only be found at Toyota, Delta and to a lesser degree at Nissan. At the remaining three manufacturers, BMW, Samcor and VW, little evidence to support adherence to the principles of total quality management can be found. These findings make it possible to reject the hypothesis that total quality management, as advocated in the literature, is being practised by all six of the passenger vehicle manufacturers in the South African motor industry.

2 IMPLICATIONS OF RESEARCH FINDINGS

A possible explanation for the reliance at BMW, Samcor and VW on inspection as the prime means to ensure quality are first, the education and skill levels of both management and workers and second, the lack of adequate management.

The black education level in South Africa has resulted in operators with an average education level that is much lower than

workers in equivalent positions in other parts of the world. This has resulted in difficulties in implementing advanced quality programmes, which involve statistical techniques, in a manner similar to countries such as Japan or the U.S.A. To overcome this problem, extensive education programmes are going to have to be undertaken in the workplace, but ultimately changes must take place in the formal education system.

Another major problem in the South African environment is the lack of adequate management. The shortage of skilled managers has resulted in many managers being in positions that require greater skills or experience than they have. This is especially so in the quality area, where there are managers of the "old school" who still believe in "quality by inspection" approaches, rather than modern quality techniques. This problem can be addressed in a number of ways:

- extensive management training programs are going to have to be undertaken;
- managers already trained and committed to the principles of total quality management could be attracted from other industries and even other countries.

As has been discussed in chapter two, a total reliance on quality by inspection has its downfalls. These include, first, the price at which quality is ensured. Inspection is a costly process, and where it is relied on as the primary means to assure quality, profits could come under pressure. Furthermore, the high cost associated with extensive inspection could seriously weaken the organisation's competitive position against organisations which rely on more efficient means of quality assurance. Second, inspection is not the most effective means of quality improvement. This is primarily due to the fact that under this approach, quality is treated as a post-production function, with defects only being addressed on completion of production. Inspection is also not effective as the means to ensure quality, as the responsibility for quality is removed from production responsibility. This results in those involved in production

being less particular about the quality of their output, as they are aware that at a later stage, their work will be inspected for quality faults. This means that organisations which hope to improve, or at least maintain, their competitive position, are going to have to take note of more cost effective, efficient means of quality assurance. Organisations which do not adhere to the principles of total quality management are going to be pressurised into adopting a more preventative approach to quality assurance. This will involve revision of existing management styles and the adoption of extensive training programs. Although the initial costs of this may be high, experience has shown that the benefits to flow from such a policy usually outweigh the associated costs.

3 FURTHER RESEARCH

This research drew significantly on the literature and was based on the findings of prior research in the area. As a result of its findings, therefore, it was inevitable that further areas of research could be identified. Where appropriate, hypotheses relating to the further research have been identified.

3.1 REPEAT SURVEY BASED ON EMPLOYEES AS WELL AS MANAGERS

It is suggested that since the research component of this dissertation concentrated purely on management personnel, a repeat survey, based on employee respondents as well as management, should be undertaken. This research would:

- help to confirm the results of the present study;
- provide more information on total quality management as practised in the South African motor industry. The opinions of employees on the subject would be particularly valuable, as they are one of the main players in any program of total quality management;

- identify the extent to which there is agreement between managers' views', on the extent to which they adopt the principles of total quality management, and those of the workforce, who are actually the targets of many of the techniques of total quality management.

3.1.1 *HYPOTHESIS*

- The principles of total quality management, as advocated in the literature, are being practised by employees in the South African motor industry.

3.2 IDENTIFY THE BENEFITS TO FLOW FROM TOTAL QUALITY MANAGEMENT

In order not only to survive, but to make a profit, organisations have to search for more efficient, effective means of producing products and services. Total quality management has been suggested by a number of authors as a means to increase profitability, through reductions in costs, improved job satisfaction and commitment etc. Actual research in this area is, however, minimal. By investigating possible benefits to flow from a program of total quality management, it would be possible to determine the value of such programs to organisations.

3.2.1 *HYPOTHESES:*

- Total quality management results in cost savings to the organisation.
- Total quality management results in increased levels of employee commitment to quality improvement.
- Total quality management results in increased levels of job satisfaction.

3.3 TOTAL QUALITY MANAGEMENT IN SOUTH AFRICA

Most of the literature on total quality management is based on total quality management as practised in the U.S.A or Europe. Very little research has, however, been conducted into total quality management in South Africa. Such a study would provide information on:

- the applicability of total quality management as practised in the U.S.A and Europe to the South African situation;

- whether total quality management, as practised in the U.S.A and Europe, can be imported as a package to be implemented without having to adapt it to suit South African conditions.

3.4 COMPARATIVE COMPANIES

This research could be carried out by comparing "successful" companies with "less successful" companies. This would, however, require some objective measure of quality to determine the successful from the less successful. Such a study could facilitate the identification of those factors which are present in the successful companies, but not in the unsuccessful ones. These factors could then be considered as contributing to the relatively better quality performance of the more successful companies.

3.5 OTHER INDUSTRIES

A study on total quality management in other industries could be carried out. Examples would be retailers, financial institutions or other service industries.

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