5 TOTAL QUALITY MANAGEMENT

5.1 INTRODUCTION

Total Quality Management is based on a collection of quality control principles first taught to the Japanese after the Second World War by Dr W Edwards Deming and other quality guru's like J.M. Juran. It has since grown to an all-encompassing business philosophy with scientifically founded principals and techniques.

This chapter explores the different aspects of Total Quality Management and will be used in a later chapter to evaluate it, together with the two other management philosophies, Just-in-Time and Theory of Constraints, against the defined functions. The chapter starts by discussing the overall management philosophy – a general description of what Total Quality Management is. The core principles are listed and discussed and the impact of Total Quality Management on a company is deliberated. The specific problem solving and measurement tools and techniques are described as well as the prerequisites for implementing Total Quality Management.

5.2 OVERALL MANAGEMENT PHILOSOPHY

It is difficult to define Total Quality Management in a few words. In the literature on Total Quality Management the absence of any uniform definition thereof is striking (Lau & Anderson, 1997: 86). This has led to the situation that many Total Quality Management initiatives are ill-defined which makes it difficult for companies to design and implement effective quality programs. Bellefeuille (1993: 47) tries to capture the essence of Total Quality Management in the following definition: "Total Quality Management is an interlocking arrangement of procedures and practices that ensures that all employees in every department are adequately trained and directed to continuously implement aligned improvements in quality, service and total cost such that customer expectations are met or exceeded." Hellsten & Klefsjö (2000: 242) echoes the customer focus when referring to Total Quality Management as an "...evolving system of practices, tools and training methods for managing companies to provide customer satisfaction in a rapidly changing world." Vuppalapati, Ahire & Gupta (1994:86) re-enforces the integrated approach of Total Quality Management and the focus on continuous improvement as a method to improve the quality of products and processes with the distinct aim of achieving customer satisfaction.

It is clear that there are certain underlying principles that stand out in all the different definitions. The first principal is that of an integrated, strategic approach that involves everyone in the company with the sole aim of satisfying the customer's expectations. But what are customer expectations? Determining the perceptions on quality from a large number of customers is very difficult (Lau & Anderson, 1997:94) yet a company needs to measure and act on all these perceptions. In general terms customers expect quality in the product as well as quality in service. Quality according to customers is that their need for a product or service must be met on time, every time and within an acceptable price range (Bloch, 1992:25). Therefore Total Quality Management integrates the philosophy, strategy, guiding principles, management and technical tools and quantitative methods of a company (Simmons, 1994:36) in order to meet the need of customers as and when it arises.

The second principle is that the impact of Total Quality Management is not only seen in the strategic processes of a company. The direct results of a Total Quality Management approach are seen on the shop floor. It improves the quality of products and services, placing a very specific technical focus on the processes that create the outputs, instead of just the outputs themselves (Trahant & Campbell, 1995:37). Deming emphasized that quality is the outcome of a method, not the method itself (Hellsten and Klefsjö, 2000:238) This implies that the focus is on the process of manufacturing the product according to quality standards, and not on applying quality assurance processes on finished products.

Thirdly, to turn the strategic plan into actions Total Quality Management uses the inherent capabilities of the workers to their fullest extent to control the processes to prevent defects and serve the customer best – to meet or exceed the expectations.

Therefore Total Quality Management can be described as an operational management philosophy that aims to deliver a product that equals or exceeds the customer's expectations. This is achieved by designing quality in from the product development stage right through to the after sales service processes utilizing and involving everyone in the company.

5.3 THE KEY VALUES OF THE PHILOSOPHY

Total Quality Management consists of core values, tools and techniques. The core values of Total Quality Management as expressed by various quality awards are summarised in table 4.

Table 4: Core values of awards (Hellsten & Klefsjö, 2000:240)

Malcolm Baldridge National Quality Award	European Quality Award	Swedish Quality Award
Customer driven quality	Results orientation	Customer orientation
Leadership	Customer focus	Committed leadership
Continuous improvement & learning	Leadership and consistency of purpose	Participation by everyone
Valuing employees	Management by processes and facts	Competence development
Fast response	People development and involvement	Long range perspective
Design quality and prevention	Partnership development	Public responsibility
Long range view of the future	Public responsibility	Process orientation
Management by fact		Prevention
Partnership development		Continuous improvement
Public responsibility and citizenship		Learning from others
Results focus		Faster response
		Management by facts
		Partnership

According to Hellsten & Klefsjö (2000:240) six core values can be identified when studying literature on Total Quality Management. These are "focus on customers", "management commitment", "everybody's commitment", "focus on processes", "continuous improvement" and "fact-based decisions". The following paragraphs discuss these values in more detail.

5.3.1 Total customer satisfaction

Total Quality Management demands that all efforts must be directed towards fulfilling customer expectations. Customer expectations can be divided in two groups: order qualifiers and order winners. For a specific product/service to be accepted in the market it must have certain qualifiers. Qualifiers are attributes of the product that are perceived as being standard. Without them the product/service will not sell at all. For a product/service to be better than the competition it needs attributes that will excite the customer. The customer must feel that he/she wins when buying the specific product/service, as the attributes are more than in other similar products, and that it provides value for money. These attributes are the order winners – winning orders for the company! (Pretorius: 2001). Zultner (1993:81) also explored this concept and states that customers are satisfied on three levels:

Table 5: Customer satisfaction levels (Zultner, 1993:81)

TYPE OF REQUIREMENT IN PRODUCT / SERVICE	IMPACT ON CUSTOMER
Normal requirements (one dimensional quality)	Just asking what they want
Expected requirements (expected quality)	So basic the customer does not know about it until it is left out
Exciting requirements (attractive quality)	Unexpected and highly satisfying attributes

The company therefore needs to know what the customer wants in terms of quality attributes, and which attributes are order qualifiers or order winners. Tools used in the process of determining customer expectations are customer surveys, focus groups and complaints analysis (Bellefeuille, 1993:47). The expectation of customers must be met consistently in order to improve bottom-line performance of the company and not fall into the stagnation trap. As the market gets used to what are perceived as order winners, those specific attributes become order qualifiers! Thus for the company to continuously improve, emphasis must be placed on well-designed processes and procedures that are improved continuously.

But who is the customer? It is not just the final end user of the product or the client. The next process in the production flow is also a customer. Therefore each workstation throughout the value adding chain must know what its customer's needs are. By concentrating on meeting the requirements of the next workstation, it is ensured that the final product will meet the customer's demand. This concept of "the next process is the customer" was first coined by Kaoru Ishikawa, a Japanese business consultant and writer (Imai, 1986: 52). Lau & Anderson (1997:88) states "...management must also recognize that internal customers are as important in assuring quality as external customers who purchase and use the product."

Quality in a product is also defined by the quality of the after-sales service process. The modern day customer wants more than just a good final product. He/ she wants a package that includes good service during, as well as after, the transaction. World-class service is still in most cases an order winner. Cox & Wyndrum (1994:42) states that the customer's willingness to return to a supplier can be directly traced to the customer's perception of the quality of service of the supplier.

5.3.2 Continuous Improvement

The Total Quality Management philosophy requires that a company continuously improves its business processes. A very specific method of enabling continuous improvement in a Total Quality Management environment is found in the Japanese Kaizen system. According to Imai (1986: xx) Kaizen means "...continuing improvement involving everyone – managers and workers alike".

Kaizen is a process oriented way of thinking, in contrast with a results orientated way of thinking. Imai (1986:7) refers to the difference between maintenance, Kaizen and innovation. Maintenance is the activities that are directed toward maintaining the status quo, making sure the standards are followed. Kaizen aims to improve the standards, continuously seeking better ways of doing things. With these improvements one will not find drastic changes, or breakthrough technology. Small changes in layouts, operating processes, standards etc. are the driving force. Innovation refers to the major changes, the new technology, the breakthrough thinking. Zultner (1993: 79) also refers to these principles, but he calls it standardisation, improvement and innovation. He defines *standardisation* as the drawing up of a standard set of instructions, guidelines, templates, checklists, drawings etc. The goal is to reduce variability in processes and therefore achieve consistency. *Improvement* in processes is accomplished by using the plan-do-check-act cycle as discussed later in this paragraph. *Innovation* is accomplished by breaking bottlenecks and making quantum leap improvements.

Total Quality Management values a focus on processes rather than activities. Cox & Wyndrum (1994:44) presents a structured procedure that can be used when investigating processes for improvement (refer to table 6):

Table 6: Improvement process

STEP	ACTION	COMMENT
1	Define the process (map it out to understand it completely)	
2	Develop ownership of the process	Clear accountabilities – define who is currently responsible for what
3	Develop process management rules	○ Identify customer requirements ○ Establish measures / key performance indicators ○ Assess the as-is process to determine if it conforms to customer requirements
4	Improvement of the process	○ Quality improvement teams identify opportunities ○ Prioritise opportunities ○ Schedule tasks ○ Revise process
5	Start again at step 1	

A very specific method of achieving Kaizen (continuous improvement) can be found in the Deming cycle (Hall, 1987:61) that consists of four basic steps:

- Plan for the improvement
- Follow the plan
- Check the results
- Take the necessary action for addressing any deviations

It may be a very simple cycle but it ensures that a process does not stagnate. It is this continuous attention to detail that reduces the cost, effort and time used in the efficient running of operations. See figure 3 for a graphic representation of the cycle.

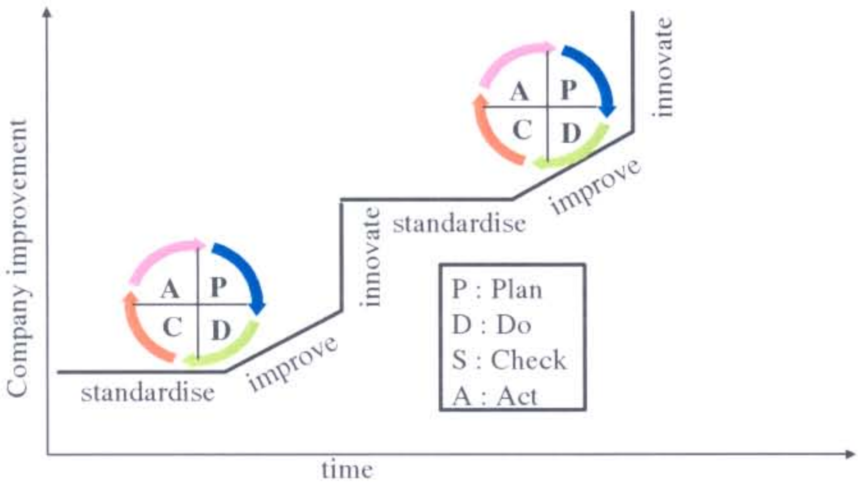

Figure 3: Continuous improvement cycle (Zultner, 1993: 81)

The PDCA cycle is usually used within quality circles. A Quality circle is defined as "..a small group that voluntarily performs quality-control activities…" (Imai, 1986:11).

5.3.3 Fact based decision making

Relevant information on customers, suppliers, competitors, products and/or services and processes is critical to decision making regarding quality improvement (Lau & Anderson, 1997:91). Designing and implementing a valid measuring system for Total Quality Management is a central focus of an effective Total Quality Management program. The aim of the measurement system is to communicate meaningfully on what quality means, to allow specific quality goals to be established and results to be forecasted and thirdly to provide a basis for employee reward and motivational programs. Statistical process measurement is not only executed by a team of experts, but all workers are trained to understand and use these measurements. All the measurements are structured to focus the employees on what is needed to reach the goal of total customer satisfaction.

Total Quality Management concentrates strongly on the use of quantitative methods for detail measurement. Simmons (1994:36) goes so far as to state that "...numbers, measurement and statistics are at the heart of total quality management." Statistical process control was the first method used to measure if processes are under control. Not only production processes are measured, but also people, schedule, reliability and performance processes. Customer satisfaction and employee satisfaction are also measured.

5.3.4 Total employee involvement & commitment

Teamwork and partnerships are an essential part of a successful Total Quality Management program. These partnerships are not just internally focused, but must be extended to the suppliers. With divisional barriers existing within an organisation, and between an organisation and its suppliers, the sharing of ideas and knowledge creation cannot ensue. Therefore the involvement of the workers as well as the suppliers is essential in improving the processes within the company. Management needs to be totally committed towards involving all employees at all levels in the decision-making process, solving problems and sharing ideas.

Nadkarni (1995: 93) lists a few methods for advancing total employee involvement:

- Employees are empowered to make decisions.
- Quality policies are thoroughly explained.
- Success stories are celebrated.
- Diversity in ideas, attitudes and work habits are valued.
- Improvement suggestions are encouraged and followed up immediately.

Quality Circles is an excellent empowerment tool, as the groups need to present their ideas to the whole workforce (including management) and are rewarded not only for the impact on the bottom line, but also for the process followed – the effort put in to develop the proposals.

5.4 IMPACT ON FUNCTIONS

Total Quality Management has an impact far wider than just the production line. Quality becomes part of the culture of an organization. This section examines some of the other functional areas within an organisation that Total Quality Management has an impact on.

5.4.1 Safety

Safety in any industry is of cardinal importance. Trahant & Campbell (1995:36) refers to the use of Total Quality Management techniques in preventing shortcuts in operations by improving the process instead. Total Quality Management helps management to understand the production processes and therefore to be able to define risk areas. Using the plan-do-check-act cycle constant improvements can be made to the production processes to lower the safety risks identified.

5.4.2 Marketing

Marketing's function in a Total Quality Management environment is not just to generate sales, but also to determine the quality specifications from customers for the company's products and services. As customer satisfaction is the ultimate goal of Total Quality Management, paying inadequate attention to internal and external customers will be disastrous. Making assumptions about the customer's needs will result in misdirected efforts and investments (Masters, 1996:55). The marketing function needs to understand the customer in depth. Customer requirements are deployed to the design function, manufacturing and other services. A company needs to create and enhance long-term customer relationships that are not only based on advertising and promotions. Zineldin (1999:720) emphasizes that the company needs to "..understand the market structure and develop long-term relationships with suppliers, distributors, investors, end users and other companies and people in the market."

Another important role of the marketing function is to gain knowledge of the quality performance of the company's competitors. The difference between order qualifiers and order winners are to some extent determined by what competitors offer.

The functions listed above are pro-active actions that the marketing function needs to take. A more re-active role to be played is that of determining what went wrong with products and providing the information to the design function. Analysis of complaints, product returns, warranty claims etc. plays a major role in the re-shaping of processes and/or the redesigning of products. (Oakland, 1989: 32)

5.4.3 Product design

In a Total Quality Management environment quality is built–in from the design phase of a product. The original design of a product is influenced by its proposed use. A cafeteria chair will not have the same characteristics or quality specifications as a dining room chair. Quality of design therefore is "... a measure of how well the product or service is designed to achieve its stated purpose"(Oakland, 1989:6).

A design of high quality plays an important role in the prevention of defects in the product, but also in the logistics surrounding the manufacturing, maintenance and service of it. Utilising Total Quality Management principles the designers determine what will be the easiest, most economic method to manufacture the product, how to test the quality of the final product as well as how to maintain /service the final product afterwards. These operational specifications are then included into the design of the product. The detail specifications and standards for production and maintenance are developed using a technique called Quality Function Deployment (QFD) defined as "a system for translating consumer requirements into appropriate company requirements at each stage from research and product development to engineering and manufacturing to marketing/sales and distribution" (Hellsten & Klefsjö, 2000:241). Operating and maintenance manuals as well as quick and easy repair facilities are part of the total design package.

5.4.4 Procurement

The role of the procurement function needs to change to fit into the total quality focus of the company. When doing vendor ratings and supplier approvals, the critical factor must not only be price, but the ability of the supplier to meet the quality requirements set by the company.

Bloch (1992:25) mentions 3 different types of suppliers:

Quality suppliers - they meet basic requirements.
Preferred suppliers - they are better able to understand customers' needs.
Partner suppliers - they have quality and continuous improvement programs in place.

The procurement function needs to determine what type of supplier is needed for the different products produced by the company. The supplier strategy should be structured around that information – deciding which suppliers will be strategic partners, which will receive contracts, etc.

5.4.5 In-bound and out-bound logistics

It will not suffice if the manufacturing processes within a company are designed and operated according to Total Quality Management principles but the in-bound and out-bound logistical processes not. During the design phase of a new product in-bound and out-bound logistical processes are also looked at to ensure that the logistical process and facilities will sustain, if not enhance, the quality of the product. The receiving and issuing of raw materials can play a major role in the final quality of the product and needs close scrutiny to ensure everything is done in such a manner that product quality is not negatively affected. The whole inbound and out-bound logistical process must be statistically measured and controlled, and any deviations from target acted upon immediately. (Oakland, 1989:34)

5.4.6 Quality assurance (QA)

In a Total Quality Management company the focus of quality assurance shifts from detection of defects in the product to the prevention of product defects (Oakland, 1989:34). Inspections to remove defects are reduced and inspectors are used to improve processes and to determine errors beforehand. Quality assurance staff is responsible for advising on and providing of expertise on the quality management of manufacturing processes. They need to maintain the quality systems and train the workforce in the quality philosophy, management and techniques used in the company.

5.4.7 Organisational structure

Total Quality Management cannot succeed in an organisation with functional barriers, autocratic structures and restricting policies. Isolation of individuals and departments are detrimental to teamwork. Therefore a company that implements Total Quality Management will need to change its organisational structure to a more team driven structure. Masters (1996:54) lists some tools that can be used to identify the problems in the structure and policies of a company. These are brainstorming, fishbone diagrams and workflow diagrams. By using these tools companies can determine where in the organisational structure to focus the improvement effort.

The internal structure and functioning of teams will be affected. Teams in a Total Quality Management environment need to be empowered and efficient. To enable the transition from the traditional autocratic structure of teams to a more flexible, efficient set-up, Masters (1996:55) recommends the use of a trained facilitator. The facilitator will assist the new team to determine their purpose for existence. The team should have specific goals to achieve within a set time frame. The team must consist of cross-functional team members. It is very important is to ensure that the team accepts responsibility and accountability for reaching the set goals.

5.5 PROBLEM SOLVING & MEASUREMENT TOOLS AND TECHNIQUES

Measurement is the starting point for problem solving. Measurement focuses everyone on the important, critical issues that need to be addressed in a continuous improvement program.

Total Quality Management distinguishes between two types of measures (Perry & Wichert, 1995:52):

- measures of how the **process** is progressing
- measures of **results** from initiatives using the process.

The focus of the two types of measures is therefore on the process (operational, maintenance, design, etc) and the product (quality, quantity etc). The Total Quality Management measurement focus has a balanced viewpoint of what to measure and how to analyse the results. Bhote (1997:29) and Zultner (1993:85) summarise the problem solving and measurement tools into 3 distinct tool kits that are depicted in table 7.

Table 7: The 3 tool kits of TQM (Adapted from Bhote (1997: 29) & Zultner (1993:85))

QUALITY CONTROL TOOLS	QUALITY MANAGEMENT TOOLS	21st CENTURY QUALITY TOOLS
Pareto charts	Affinity diagrams	Design of experiments
Cause and effect diagrams	Inter-relationship diagrams	Multiple environment over stress test
Control charts (SPC)	Matrix data analysis charts	Quality function deployment
Frequency distributions	Tree diagram	Total productive maintenance
Brainstorming	Matrix diagram	Benchmarking
PDCA cycle	Process decision program chart	Poka yoke
Scatter plots	Precedence diagrams	Next operation as customer

The quality control and management tools presented in table 7 (columns 1 and 2) are well known, and will not be discussed, except for control charts (SPC). Figure 4 is a graphical representation of these 14 tools.

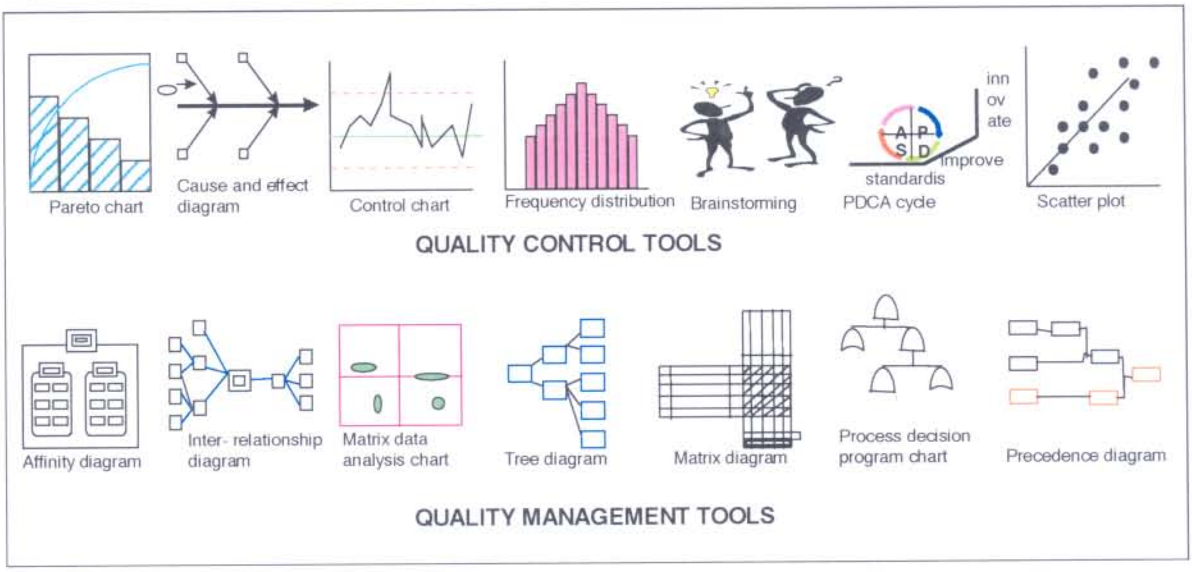

Figure 4: The 14 quality control and management tools

5.5.1 Control charts

Gitlow et.al. (1989:162) define control charts as "..statistical tools used to analyse and understand process variables, to determine a process's capability to perform with respect to those variables and to monitor the effect of those variables on the difference between customer (either internal and /or external) needs and process performance". By implication the role of control charts are firstly to determine if a process is statistically under control, stable and predictable. Secondly they are used to enable management to improve the process by manipulating the variable factors.

A control chart has a basic structure consisting of a centerline and control limits. Control charts are constructed by drawing samples, and these samples are grouped together. The centerline is the average of the sampling distribution, and the control limits are based on the mean plus/minus three times the standard error (upper and lower control limits). The standard error is based on the variation that occurs within the sampled subgroups. An example of a typical control chart is shown in figure 5.

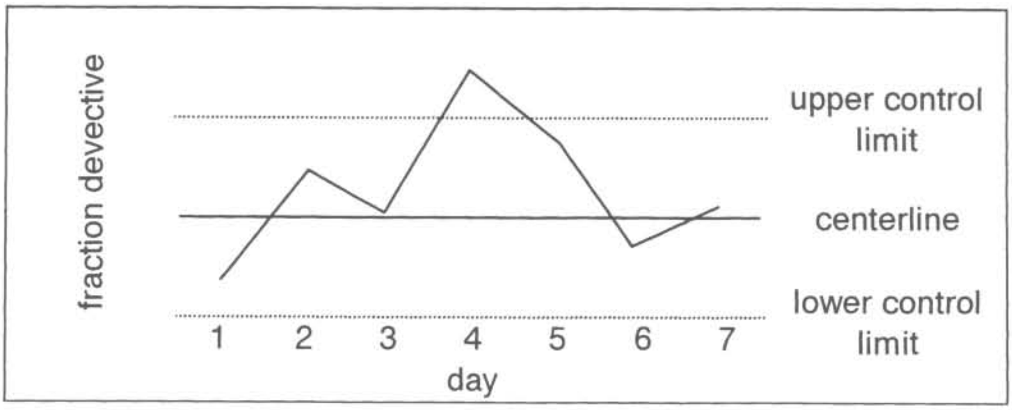

Figure 5: Structure of a control chart (Gitlow et.al., 1989:p167)

A stable process is one from which all special causes of variation have been removed. The process only exhibits variation as a result of inherent system limitations. Once a process is stable, it has a known capability. Only when the process capability is known can the process be compared to similar, or benchmark processes, to determine improvement opportunities. Management can also only manage the deviations that do occur on a daily basis if they have a baseline to work from, as derived from the centerline and upper and lower control limits of a capable process that is statistically in control.

Different types of control charts exist, based on the type of data used as well as the purpose of the chart. Gitlow et.al (1998:p175-176) describe the different types.

Attribute control charts

Attribute data arise from the classification of items into categories, the counts of the number of items in a given category or from counts of the number of occurrences per unit. For example, a result may be good/bad, right/wrong, black/white (categories), or the number of parts per hour that are defected are counted. The following attribute control charts are used:

- p chart : control the fraction of units
- np chart: control the number of units with some characteristic
- c chart : control the number of events in some fixed area of opportunity
- u chart : control the number of events in a changeable are of opportunity
- individual charts : control the count when the assumptions for the other attribute control charts cannot be met

Variable control charts

Variable data arise from the measurement of a characteristic or from the computation of a numerical value from two or more measurements of variable data. Specific attributes of the process, product or service are measured, e.g. length, time or temperature. The values of a variable are measured, in contrast with attribute data where the count of the variable is measured. The following variable control charts are used:

- x-bar chart: control the process average
- R chart: control the process range
- s chart: control the process standard deviation
- median chart: combination of an x-bar and R chart
- individuals chart : control subgroups of size one

To determine if a process is statistically in control a set of simple rules are used, or specific patterns are identified. Gitlow et.al (1989:190) discusses 5 simple rules that indicate a lack of statistical control in a process. To utilise these rules the area between the centerline and a control limit is divided in three zones, each a standard error wide. The zone closest to the centerline is Zone C, and the farthest Zone A.

A process lacks control if:

- Any single value falls outside of the control limits.
- Any two out of three consecutive points fall in one of the A zones or beyond on the same side of the centerline.
- Four out of five consecutive points fall in one of the B zones or beyond on the same side of the centerline.
- Eight or more consecutive points lie on one side of the centerline.
- Eight or more consecutive points move upward in value or downward in value.

Certain control chart patterns exist that is utilized to identify a variation in the process. Table 8 is a summary of these patterns.

Table 8: Summary of control chart patterns (Gitlow et.al, 1989:347)

Pattern	Description	Possible cause
Natural	Does not exhibit any points beyond the control limits, runs, or other non-random patterns. Have most of the points near the centerline.	Stable process
Shift in level	Involves a sudden, or gradual rise or fall in the level of data on a control chart. Also involves trends – gradual shifts in level that do not settle down.	Dramatic change in the process
Cycles	Repeating waves of periodic low and high points	Special disturbances that appear and disappear with some degree of regularity
Wild	Freaks or grouping / bunching – one or more subgroups that are very different from the main body of subgroups	Freaks: Calculation errors, external disturbances Grouping: introduction of a new system of disturbances
Multi-universe	Absence of points near the centerline of too many points near the centerline	Two or more distributions for a quality characteristic changing over time or not changing over time
Instability	Erratic points on a chart exhibiting large swings up and down	Special disturbances that sporadically affect the process
Relationship	Interaction between variables or the tendency of one chart to follow the other	The behaviour of one variable is affecting the other

Management is not only concerned with whether a process is statistical in control or not, but also need to if a process is able to meet specifications (i.e. the specified outer diameter of a shaft). To determine this process capability indices are used (table 9).

Table 9: Process capability indices (Gitlow et.al. 1989:452)

Index	Purpose
C_p	Summarise process potential to meet two-sided specification limits where the process average equals nominal
CPU	Summarise process potential to meet only a one-sided upper specification limit
CPL	Summarise process potential to meet only a one-sided lower specification limit
C_{pk}	Summarise process potential to meet two-sided specification limits where the process is off nominal.

Control charts are a valuable tool in the manager's toolkit for process control and improvement. There is however other techniques that can be used, and these are described in paragraph 5.5.2.

5.5.2 The 7 tools of the 21st century

The 7 tools of the 21st century (third column in table 7) are summarized as follows by Bhote (1997:31-38).

Design of experiments (DOE)

DOE is used to solve those chronic problems that are constantly picked up by statistical process control. It can be used in the design phase of products / processes or in the optimisation of products/ processes. DOE is used to improve quality and therefore to reduce defects in processes and products. DOE separates the important product variables from the unimportant ones. The parameters of these variables are determined and then optimised to establish realistic specifications and tolerances.

The benefits of these simple clue-generating experiments are that it does not interfere with ongoing production, and workers can solve the majority of chronic problems with nothing more than common sense.

Multiple environment over stress tests (MEOST)

MEOST is a reliability improvement tool. MEOST goes further than FMEA (failure mode effect analysis), FTA (fault tree analysis) and ALE (accelerated life tests) to design reliability in the product beyond the needed stress levels. MEOST works because it implies testing the product with combined stresses / environments to simulate actual customer use. It also tests "beyond normal design stress to a maximum practical overstress" situation (Bhote, 1997: 31).

The method of operation of these tests is:

- A profile of all the possible stress levels and environments that the product will be subjected to in the field is obtained. Test chambers are then designed and built to simulate these combined stresses.
- The product is then tested in these chambers, by starting with only a fraction of the stresses that can occur. Gradually the combined stress and time factors are increased until the guaranteed lifetime in the field is reached. If any failures occur failure analysis is done and corrective actions taken.
- The next step is to continue the time-stress increase up to maximum over-design stress levels. Where more than two failures of the same failure mode occur, failure analysis is done and corrective actions taken.
- Steps 2 and 3 are now repeated but for double the time. If the test is successful the product is ready for distribution. If not failure analysis is done and corrective actions taken.
- After six months in the field samples of the product is retrieved for repeat testing as described in steps 2 and 3. With statistical analysis the company can determine if the guaranteed lifetime is / will be met.

The benefit of MEOST is that it virtually eliminates field failures and therefore removes one of the major customer complaints.

Quality function deployment (QFD)

This tool is used to "capture the voice of the customer.... for new products and services" Bhote (1997: 33). The "House of quality" matrix is used to change the "what" (requirements) of the customer into the "how" of design specifications. Similar houses are developed to progress "...from parts to process, process to production, production to test and from test to quality requirements" Bhote (1997: 33). Figure 6 represents a sample House of Quality.

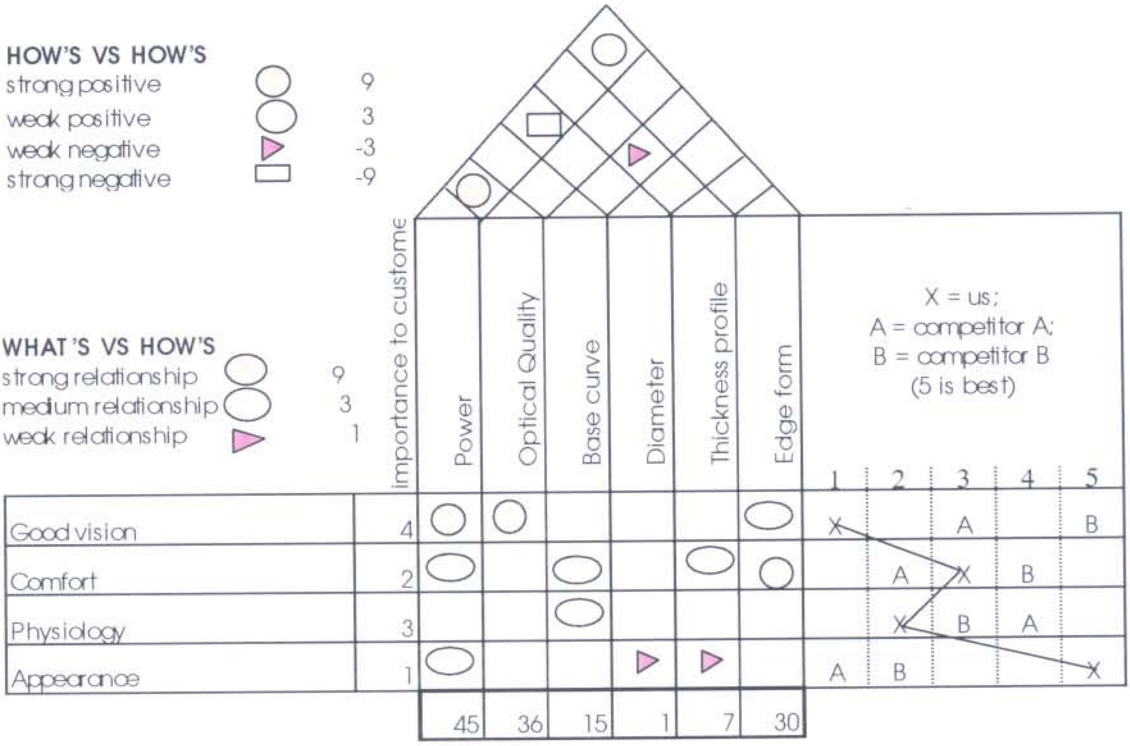

Figure 6: Sample House of Quality (adapted from Bhote (1997: 34))

The customer's most relevant requirements are listed on the far left (the "what"), which are prioritised in terms of importance. On the far right is the rating of the company's performance versus the competition for each requirement. In the middle is a relationship matrix, comparing the link (strong, medium or weak) between each customer requirement (the "what") and each design specification (the "how"). A simple calculation pinpoints the engineering specifications that must be concentrated on to meet customer requirements and therefore ensure competitive strength. On the roof is a correlation matrix to see if each pair of engineering specifications has a reinforcing correlation or a conflicting correlation. In the example above it is clear that the company should focus on the power factor of the contact lenses, as that influences the total quality rating of the product.

Total Productive Maintenance (TPM)

This tool improves equipment productivity and quality in manufacturing processes. It aims to reduce maintenance costs, increase the factory overall efficiency and start preventing errors instead of finding them. It makes use of tools such as DOE (as discussed above), RCM (reliability centered maintenance) and life cycle costing to determine which maintenance strategy to follow for a specific piece of equipment. The maintenance strategy consists of a combination of predictive, preventive, scheduled and repair maintenance. The operators are closely involved in determining the maintenance strategy.

Benchmarking

Benchmarking is the practice of organisations learning and adapting from the best in order to improve their own manufacturing and services processes. The objective is to close the gap with competitors in key function areas within the company. The first step in a benchmarking process is to determine what to benchmark – which key functional areas need improvement. Then it is important to create a baseline of these key areas for comparison with external companies. After the company has decided which external companies are the best in the key areas, they need to visit the companies and gather (as well as share) information that will enable them to compare themselves with the external company. The gap can then be determined and improvement plans put into place to close the gap. A danger of benchmarking is that it is difficult to ensure that apples are compared with apples; therefore the results may be skewed if enough effort was not put into specifying the scope and details of the benchmarking exercise.

Poka-yoke

According to Bhote (1997:36) "This tool eliminates operator – controllable errors…" It is not always possible for the operators to prevent defects if they are working in a labour intensive environment. "The objectives of poka-yoke are to provide sensors (electrical, mechanical or visual) that warn an operator that a mistake has been made or, preferably, is about to be made and can be avoided." Examples of such sensors are thickness guides that deflect items that are either too thick or too thin. Quality teams can then determine the origin of the problem and fix it without letting the faulty parts go through to the next workstation.

Next operations as customer (NOAC)

"NOAC helps improve the quality, cost and cycle time of white-collar jobs" Bhote (1997: 37). It can be applied to service organizations and support services in manufacturing companies. The objectives of NOAC are to break down departmental walls, revolutionise business processes and replace supervisor evaluations with internal customer evaluations. The first step in using the NOAC tool is to establish a steering committee and improvement teams that will oversee the business process re-design. Thereafter the specific problems in the business process are determined and the impact on quality, cost, cycle time and morale is quantified. Next the internal customers are involved to determine what their priority requirements are and then to determine if the internal suppliers can meet those requirements. To be able to develop improvements on the system the total process need to be mapped out in detail, i.e. determine the cycle time for each step in the process. Now the process can be streamlined by removing the non-value adding steps, or the process can be totally re-designed. After implementation of the new process it is important to conduct reviews and to track progress against the targets set.

5.6 IMPLEMENTATION

It is important for organisations to understand what is necessary for a successful implementation of Total Quality Management. If the underlying assumptions and critical success factors are not known and not taken into account it may lead to an unsuccessful Total Quality Management implementation.

5.6.1 Management and employees commitment

Without total support from top management employees will show low participation and enthusiasm for Total Quality Management (Masters, 1996:53). The management team needs to clearly communicate their reason for adopting Total Quality Management by developing a valid case for change and selling it to all employees. The vision and strategic direction of the company that stems from the case for change will not amount to anything if it is not transformed into actions that the total workforce can relate to and support. Total Quality Management uses a technique called policy deployment to transform strategy into action plans.

Management's role has to change from being directive to being coaches for their workforce. (Cox & Wyndrum, 1994:44) This will enable workers to be empowered and supported with proper education, training and decision making responsibilities. In this transformation from followers to partners in the company the workforce will need guidance and coaching from management.

The values and operating mechanisms of the leadership group of a Total Quality Management company is summarized as follows by Nadkarni (1995:92):

- Sharing information on quality problems, future changes, etc. with customers.
- Having respect for people throughout the company, regardless of their position.
- Not compromising integrity at all.
- Making use of quality councils that review quality management
- Developing long range strategic quality plans.
- Personal involvement in the total workforce.
- Sustained commitment with the road taken.

A successful Total Quality Management implementation does not only depend on the commitment and involvement of the managers. The employee also plays an integral role in the process. Employees will need to understand that there is a difference between empowerment and management displacement. (Dresner, 1994:17) Managers will not stop making decisions but will actively involve the employees in the decision making process. Therefore employees must recognise their own value and actively participate in all aspects of Total Quality Management. They must insist on, and engage in, cross training, that will increase the value they can add to the company. Within the Total Quality Management organization a major emphasis is placed on teamwork and employees will need to adapt to this environment and be willing to exchange ideas freely.

5.6.2 Organisational culture

Total Quality Management needs a special company culture in order to survive. Organisations are often impatient and start implementing Total Quality Management without a concentrated effort and strategy for changing the culture (Masters, 1996:53). According to Perry & Wichert (1995:51) the hardest part of changing the culture is getting people to accept the new values and ways of doing things. To institutionalize the new values a culture of sustained communication is needed that will continue before and during the implementation. It is essential that everybody have access to all the information on the new way of doing things, the changes coming their way and any other relevant information they need, when they need it (Woods, 1997:53). This can be a major paradigm shift for companies who believe in only communicating at month-end! Employees in a Total Quality Management environment will constantly be busy searching for better ways of doing their jobs and will therefore require information to assist them in this search. They must be able to specify which information they need, and not just receive monthly reports according to their position in the hierarchy. Employees must at all times be informed of the progress of the quality initiative. It is important that the truth be told, whether good or bad. The new values will only start to become living values when everyone in the organization can relate to the Total Quality Management program, with up-to-date information that can be trusted and is readily available.

There are various ways to communicate the progress made in the implementation of Total Quality Management. Oakland (1989:242) suggests a few:

- Implementing suggestions schemes.
- Having regular departmental workshops.
- Induction and vocational training that addresses aspects of Total Quality Management
- Poster campaigns.
- Specific references to projects and work reminders.
- Quality competitions with prizes and formal presentations.
- Demonstrations and exhibitions to illustrate the workings of Total Quality Management and the progress made with implementation.
- Informative newsletters.
- Opinion surveys.

These are over and above the continuous reporting of statistical analysis on processes where Statistical Process Control has been implemented.

5.6.3 Proper planning

A proper implementation plan for Total Quality Management is of the utmost importance to prevent failure. Masters (1996:53) lists three components of a successful plan:

- Management must obtain company wide commitment for the implementation of the Total Quality Management program.
- The communication must be very precise, clear and frequent. It is of great importance to communicate the vision, mission and goals of the company.
- The last component is to ensure that the plan makes provision for open communication channels to discuss the new focus of the company.

The plan must remain flexible, but a time frame for implementation should be developed and communicated to the whole company.

An implementation plan for Total Quality Management is one aspect of the planning needed, but another important step is to incorporate the Total Quality Management principles into the business planning process. The quality focus must be integrated with the strategic initiatives of a company (Thayer, 1995:16).

5.6.4 Training and education

As Total Quality Management places such a high value on the involvement of the workforce they need to be highly skilled in not only their functional areas but also in all aspects of quality management. This includes knowledge of and ability to use all the tools and techniques described in paragraph 5.5. The emphasis on training will necessitate an increase in expenditure on training. Training can take place via formal training sessions or informal on-the-job training sessions. Masters (1996:54) mentions newsletters and bulletin boards as methods of informal training where 5-minute discussion can be held on current important quality issues and/or topics.

5.6.5 Change management

An ineffective change effort can result in a stalled Total Quality Management program. Trahant & Campbell (1995:38) mentions three setbacks that can occur:

- When change takes too long, the need for change diminishes, leading to a much more difficult implementation.
- Higher costs can occur because of the additional time and attention needed to implement Total Quality Management.
- A sense of failure can paralyse and scare managers and workers alike.

It is therefore of utmost importance that change management is included in the planning stage of a Total Quality Management implementation.

5.7 CONCLUSION

In this chapter Total Quality Management as an operational management philosophy was discussed. Total Quality Management is an operational management philosophy that focuses on processes to improve quality with the intent to obtain total customer satisfaction. This chapter presented the key values of Total Quality Management and explained the impact these values have on the functions within a company. The unique measurement tools and techniques used in a Total Quality Management company were discussed. Finally the pre-requisites for successful implementation of Total Quality Management in a company were determined.