Total Quality Management:
Savour your Business Improvement Opportunities

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Introduction

Certification to ISO 9001 is commonplace and, for laboratories, the adoption of ISO/IEC 17025 is increasing throughout the world. The Baldridge Award in the USA and the Deming Prize in Japan continue to attract a healthy number of applicants. These awards are designed to recognise excellence in quality management and success in related business performance criteria such as profitability and market share (Rao et.al, 1996, p 65). Why is there this interest in "quality" and quality frameworks? This paper seeks to discuss key elements of the total quality management philosophy and how organisations can apply the tenants of Total Quality Management (TQM) to achieve business excellence.

What is TQM?

TQM is more than statistics and quality control. Today, it is considered a framework for business excellence [1].

A number of writers have attempted to define TQM. Several approaches have been taken to define this framework for business improvement, which include: attempts to define "quality", defining TQM by the set of practices that enable an organisation to deliver quality products or services and a philosophical approach to defining TQM[2]. In trying to define the concept of TQM, it is perhaps most useful to discuss some of its basic principles.

W Edwards Deming was influential in the early stages of the quality movement. He condensed his philosophy into 14 points which became action items for top management to adopt. These 14 points are as follows.

1. *Create constancy of purpose toward improvement of product and service.*
2. *Learn the new philosophy.*
3. *Cease dependence on inspection of the product to achieve quality. But require statistical evidence of process control along with incoming critical parts.*
4. *Buy materials only if the supplier has a quality process. End the practice of awarding business on the basis of the price tag alone.*
5. *Use statistical methods to find trouble spots and constantly improve the system.*
6. *Institute modern aids to training on the job.*
7. *Institute modern methods of supervision.*
8. *Drive out fear.*
9. *Break down barriers between departments.*
10. *Eliminate numerical goals.*
11. *Review work standards to account for quality.*
12. *Remove barriers that rob people of their pride of workmanship.*
13. *Institute a vigorous program for training people in new skills.*
14. *Create a structure in top management that will push the above 13 points*[3].

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[1] Rao, A, Carr, L P, Dambolena, I, Kopp, R J, Martin, J, Rafii, F and Schlesinger, P F, 1996, *Total Quality Management: A Cross Functional Perspective*, John Wiley and Sons, New York, p v111.

[2] *ibid*, p26-58

[3] *ibid*, p 38

Philip Crosby, another respected writer on Quality, identified "Four Absolutes of Quality"[4]. These are:

1. Quality can be defined as conformance to requirements.
   In identifying the requirements, it is important to establish a partnership between customers and suppliers with a particular emphasis on:
   - mutual respect (open, supportive relationship);
   - mutual trust (teamwork); and
   - mutual benefit (technical, economic)[5].

2. Quality comes from prevention. Defects, errors and rework can all be prevented by thinking, planning, proofing and regulating what we do[6].

3. An attitude of Zero Defects. Non-conformances are determined by measurement[7].

4. Measurement is the price of non-conformance. Through making non-conformances visible, we are directed to take corrective action where necessary. In this way we can continually improve our processes[8].

Key aspects of TQM espoused by both Deming and Crosby are

- the demonstration of management commitment to quality improvement;
- the need to encourage participation in the TQM program;
- establishing measurements for quality in all activities; and
- a commitment to the development of employees through involving them in decision making, education and training[9].

In addition, Deming defined quality as not just meeting requirements, but surpassing customer needs and expectations throughout the life of the product[10]. It is thus essential that there is not only a focus on meeting customer expectations, but that there is also a desire to continuously improve, so as to delight the customer.

It is more than just the application of statistical tools and measurement through quality control activities that contributes to a successful TQM program. It is absolutely vital that the culture of the organisation reflects the Four Absolutes of Quality identified above and that the culture fosters an environment of continuous improvement. TQM is a *strategic* commitment to make quality and customer satisfaction a guiding factor in everything an organisation does.

The interrelatedness of customer satisfaction, continuous improvement, the culture of teamwork and the scientific approach and each aspect's importance in achieving a successful "quality" outcome is best shown through the Joiner Triangle.

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[4] Crosby, P, 1988, *Quality Work Group Education – Participant Workbook*, Philip Crosby Associates Inc. Winter Park, p 1.1

[5] *ibid*, p. 1.5

[6] *ibid*, p. 2.3

[7] *ibid*, p. 3.4

[8] *ibid*, p. 4.4

[9] Rao et. al, op. cit, p 44

[10] Gitlow, H S and Gitlow, S J, 1987, *The Deming guide to quality and competitive position*, Prentice Hall, Inc., Eaglewood Cliffs, p 35.

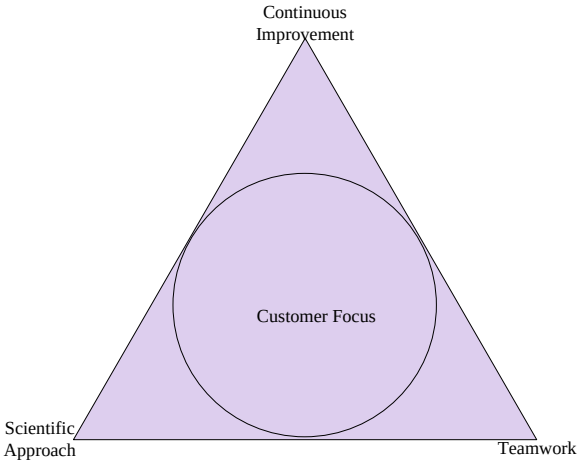

Figure 1: The Joiner Triangle
Source: Joiner, B L, 1994, *Fourth Generation Management: the new business consciousness*, p 12.

Customer focus is central to the TQM philosophy. Organisations must always bear in mind the needs and expectations of the customer. The three elements of organizations that contribute to the goals associated with a customer focus are shown by the three corners of the triangle- continuous improvement, teamwork and a scientific approach.

Why does TQM work in improving business performance?

Deming developed the Deming Cycle which illustrates how improvement in quality can lead to improvements in business performance.

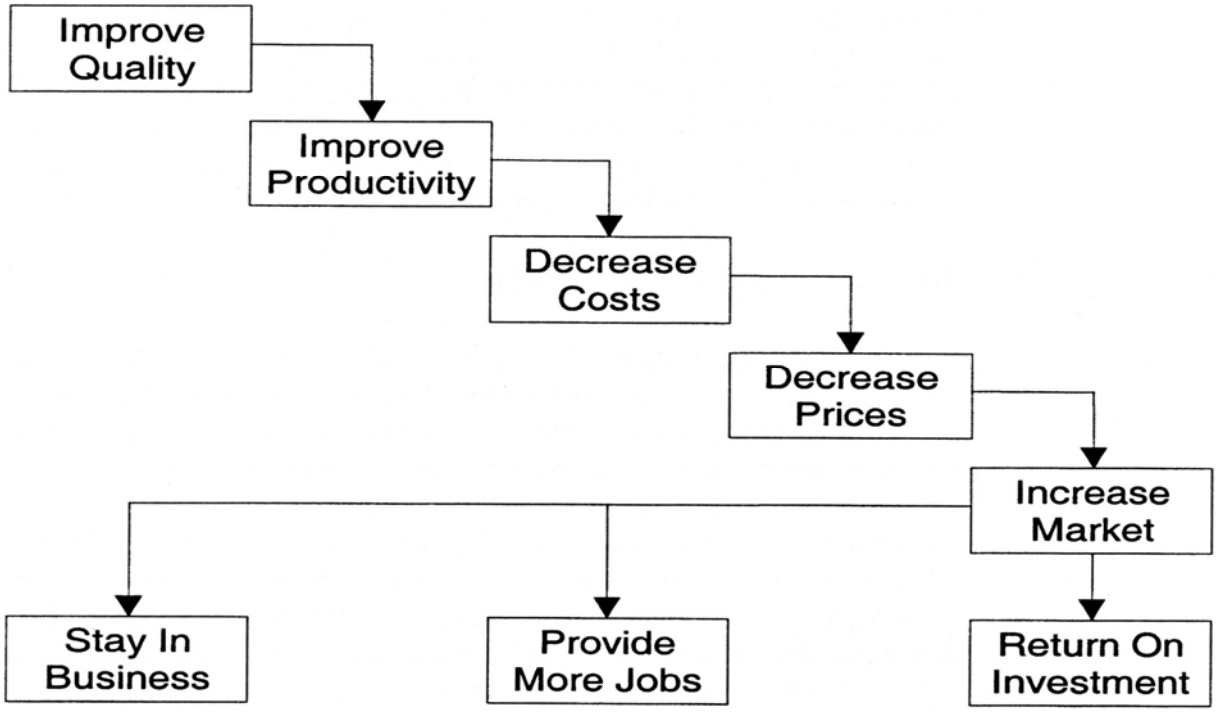

Figure 2: The Deming Cycle
Source: Howley, P, *The University of Newcastle, WEB C604 Course Notes*, 1999, p 1.16

An important aspect of TQM is its focus on implementation of quality improvement programs[11]. This supports an important phase in the strategic management process, that of implementation of strategy. Kiernan (1993) suggested several core elements of a model for executing strategy. Aspects of TQM that are included are described below.

- Empowerment/ diffused leadership:
  This recognises that all of an organisation's employees must work together to meet the challenges faced by the company.
- Organisational learning:
  This is the ability of an organisation to learn new concepts and adapt them effectively to their unique business environment. Encouragement of teamwork, communication across functions and willingness to communicate with business allies contributes to improving performance.
- Innovation/ experimentation:
  This is an attitude engendered through an inspiring vision and support of practices that foster experimentation and tolerates failures that result[12].

But TQM is different from other management approaches because of its use of scientific method and the use of continuous improvement tools. By using these tools, we gather objective data on how the business is performing and can thus make sound decisions to lead us towards achieving our business goals. TQM is about achieving a balance where we take *appropriate* actions to prevent non-conformances or defects from occurring.

Continuous Improvement Tools

Perhaps the most difficult task is starting the continuous improvement process. Fortunately, the seven-step method for continuous improvement has proven to be a successful model for systematic problem solving and quality improvement[13]. Strong problem solving skills are especially important in TQM. Adherence to the method fosters in-depth analysis of problems and development of effective solutions to these problems. The seven steps are as follows.

1. Select a problem and describe it clearly
   A *meaningful* and *relevant* problem is selected for investigation. It is defined in terms of the gap between the actual process and the target under ideal circumstances. A system for measuring progress is developed.
2. Study the present system
   The present system is flowcharted. This step involves the collection of data on how the current system operates and any relevant relationships are determined. Also at this stage, possible variables that could cause the problem to occur are identified.

3. Identify possible causes
   Potential causes for the problem are identified using brainstorming techniques. For difficult problems, experiments may need to be designed and performed to identify potential causes. This stage involves the development of cause-and-effect diagrams. The most probable causes are identified.

[11] Rao et. al, op. cit, p 16

[12] Keirnan (1993) in Rao, A, Carr, L P, Dambolena, I, Kopp, R J, Martin, J, Rafii, F and Schlesinger, P F, 1996, *Total Quality Management: A Cross Functional Perspective*, John Wiley and Sons, New York, p 16.

[13] Rao et. al, op. cit, p 199

4. Plan and implement a solution
   A list of possible solutions is developed, once again using brainstorming techniques. Following evaluation, one or more solutions are selected for implementation. It is important that the implementation phase is planned.

5. Evaluate effects
   Once again, data on the selected metrics are collected, as well as any other relevant data. The data are then analysed and the effectiveness of the solutions put in place is evaluated.

6. Standardise any effective solutions
   Effective solutions are permanently adopted through incorporation into standard operating procedures. Consideration is also given to the adoption of the solution in other operational areas.

7. Reflect on process and develop future plans
   At this stage the problem solving effort is reviewed and a summary of what has been learned is developed. Consideration is given to whether further improvement is needed to the problem area.[14]

The Plan-Do Check-Act (PDCA) cycle espoused by many writers[15] relates to the above process because it represents a concise version of the seven-step method.

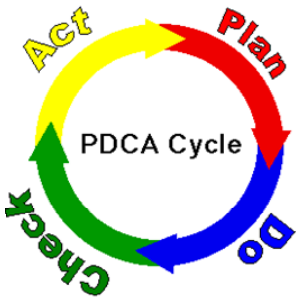

Figure 3: PDCA Cycle

The PDCA and seven-step method correspond as follows:

PDCA	Seven-step Method
Plan	1. Select a problem and describe it clearly 2. Study the present system 3. Identify possible causes
Do	4. Plan and implement a solution
Check	5. Evaluate effects
Act	6. Standardise any effective solutions 7. Reflect on process and develop future plans

[14] *ibid*, p 200
[15] *ibid*, p 199

The discussion above highlights the importance of the data collection: data are crucial in the steps relating to problem selection and evaluation of solutions. Because of the effort generally involved in improving processes, it is important that objective data are collected and used as the basis of developing an informed decision.

Types of data

Data can be quantitative or qualitative. Laboratory workers tend to be familiar with collecting and analysing the results of testing. In organisations which have adopted TQM principles, however, other useful data sources include qualitative TQM measurement tools such as auditing and surveys.

There are several statistical tools for collecting and analysing data. Not all of these tools involve "number crunching"; many provide an effective means of delving into processes and looking for weak points in these processes. Moreover, a number of these tools are in routine use. The key point in terms of the place of statistics in TQM is that all members of an organisation need to be able to apply statistical thinking and have a sound understanding of causality and random variation. This will ensure that firstly, efforts are directed to solving meaningful and relevant problems, and secondly, that the root cause(s) of these problems are identified and resolved.

Flowcharts

An excellent starting point in the collection of data is the use of the flowchart. Top-down flowcharts represent the main steps and sub-steps of a set of processes as they might occur if there were no errors. It is important to recognise that no one person can be expected to know *all* steps in a given set of processes. It is therefore vital that a number of perspectives are sought in developing flowcharts to ensure that these are truly representative of the processes which they depict. Once a top-down flowchart has been developed, a more detailed flowchart may be produced which shows the complexity of the process, including points at which errors can occur.

Using the example of standardisation of a sodium hydroxide solution, the diagram below shows the use of a top-down flowchart for this task.

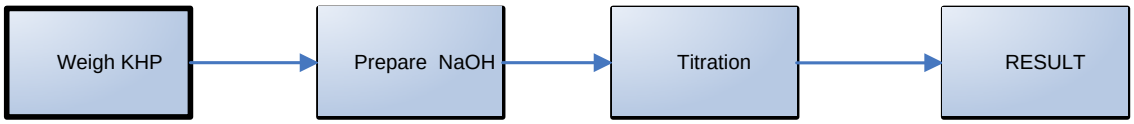

Figure 4: Top-down flowchart for standardisation of a sodium hydroxide solution
Source: Eurachem/CITAC Guide *Quantifying Uncertainty in Analytical Measurement*, 2000, p 40.

The detailed flowchart for this process might look something like the following:

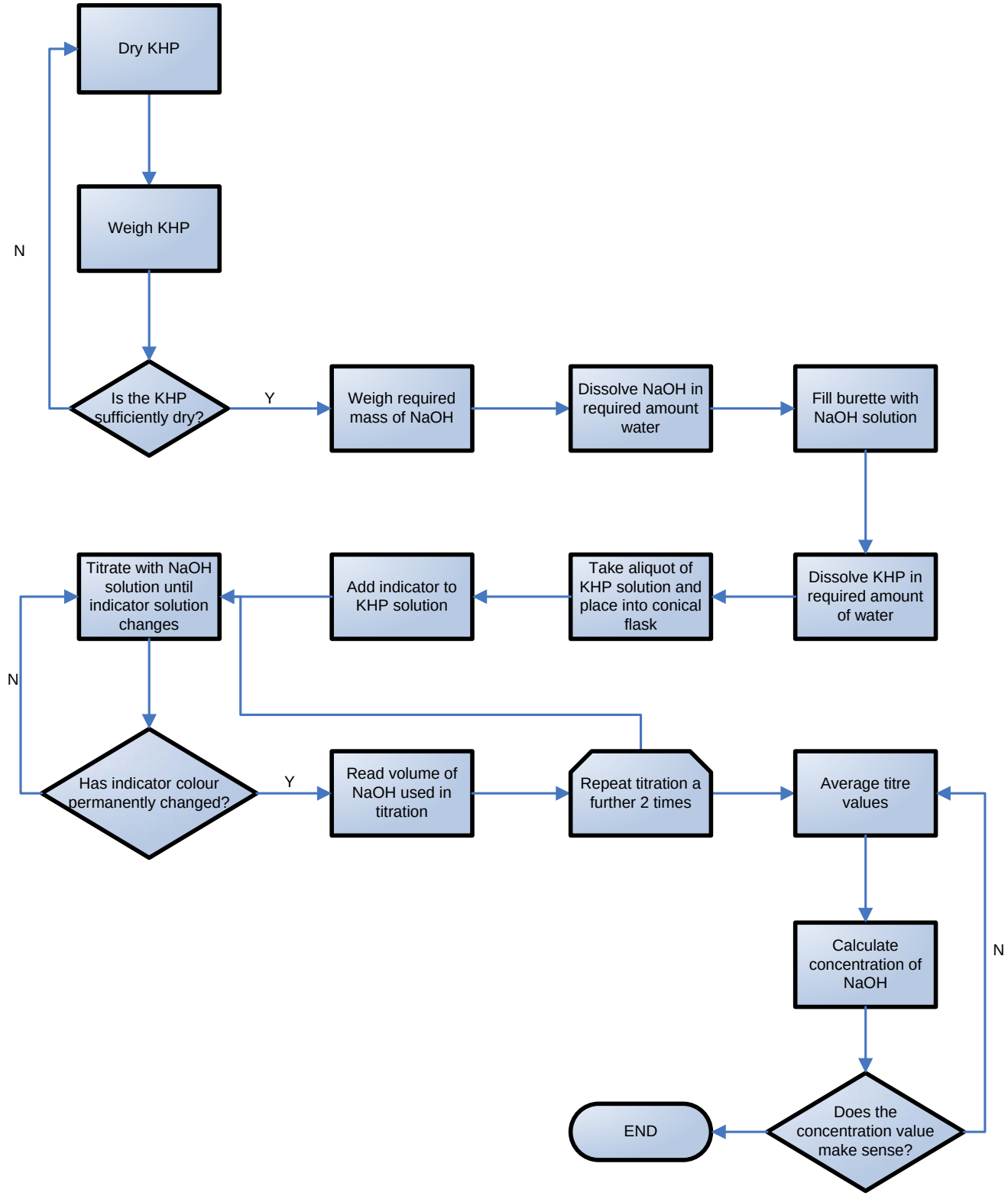

Figure 5: Detailed flowchart of standardisation of a sodium hydroxide solution

Important points to note in the detailed flowchart are the decision points, which represent points in the process in which errors could be introduced, and the additional complexity between the top-down flowchart and the

detailed flowchart. There may be other steps in the process that other analysts could identify and include in the detailed flowchart.

Cause and effect diagrams

These diagrams were developed by Dr Ishikawa in 1953. They show the relationship between a problem and its possible causes. Within laboratories, there has been resurgence in "popularity" of these diagrams because of the increased need to estimate measurement uncertainty. There are eight broad categories that problems could fall into:

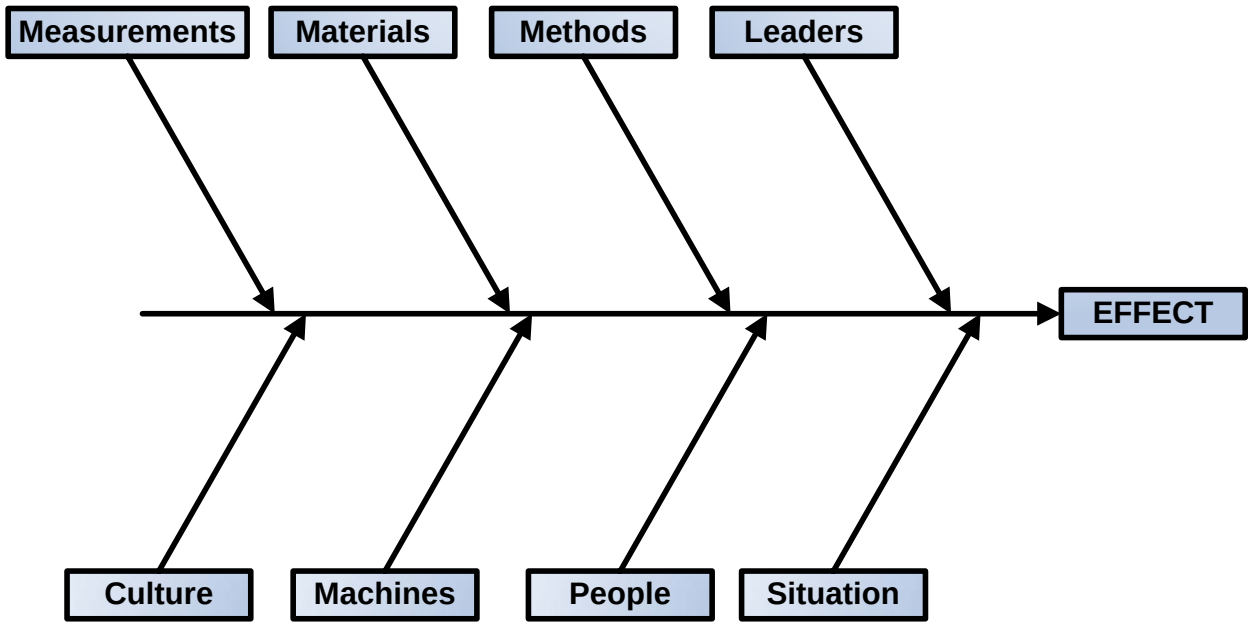

Figure 6: Categories of causes of problems
Source: Mahoney, F X and Thor, C G, 1994, *The TQM Trilogy: using ISO 9000, the Deming Prize, and the Baldridge Award to establish a system for total quality management*, p 156.

The benefits of using cause and effect diagrams include:

- The educational benefit from developing these diagrams, particularly with others;
- They provide a framework for discussion about a process;
- They force one to actively look for causes of problems and to collect data;
- They are a guide to concrete action[16].

The cause and effect diagram for our example of standardisation of sodium hydroxide is shown below.

[16] *ibid*, p 189

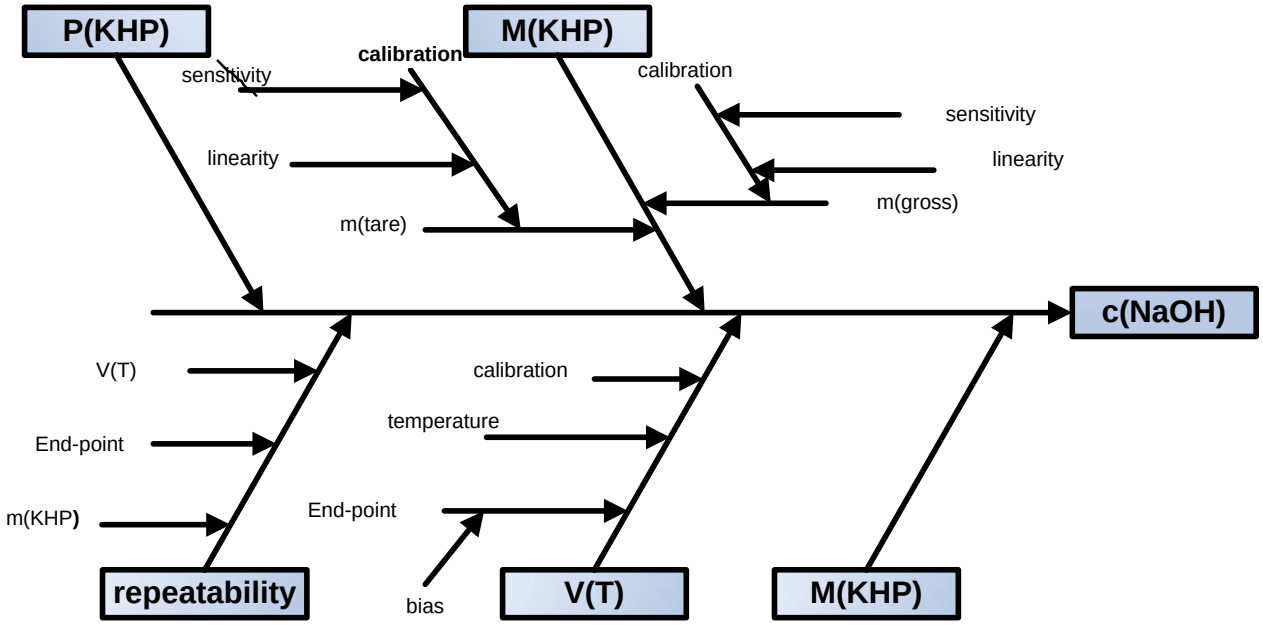

Figure 7: Cause and effect diagram for standardisation of a sodium hydroxide solution
Source: Eurachem/CITAC Guide *Quantifying Uncertainty in Analytical Measurement*, 2000, p 41.

Pareto Charts

The Pareto Principle states that, in many instances, a small proportion of items account for a large percentage of some variable linked to those items[17]. It is often referred to as "the 80-20 rule", although the proportions should not be fixed. Pareto charts are a useful tool for identifying the major cause(s) of a problem. These diagrams are also useful in assessing the effectiveness of quality improvement initiatives.

For example, in a laboratory setting, the Pareto charts could be used to drill down to identify which method, and then which part of a method is causing a problem in a laboratory's operations. For example, the Laboratory Manager of Vogon Wheat Millers has decided to look for improvement opportunities in the laboratory. At the same time, the laboratory has been receiving complaints regarding the quality of its results for acidity of the site's waste water. Using this information, the following Pareto chart can be developed which identifies broad categories of non-conformances for this test:

[17] *ibid*, p 181

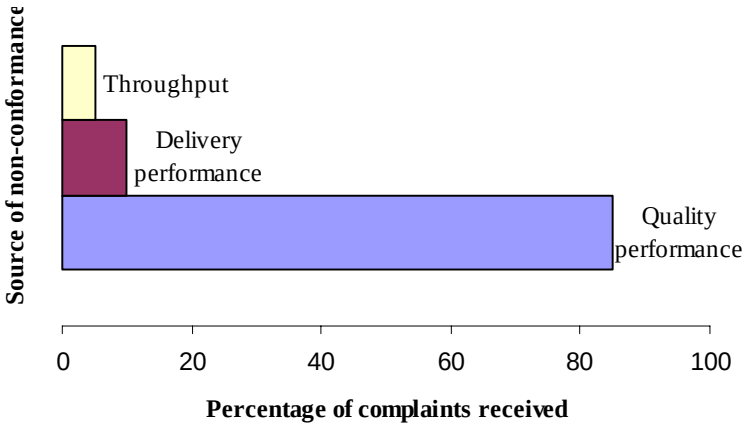

Figure 8: Pareto Chart of broad categories of causes of laboratory problems

The laboratory's quality performance used to be better. Because the complaints have related to acidity analysis, the Laboratory Manager decides to look at possible quality performance issues (as distinct from other performance categories) for this analysis. He discovers that a new production process came on line two months ago and he decides to examine the incidence of problems and the source of these problems for various aspects of the sample testing processes related to acidity analyses. His investigations reveal the following occurrences of problems.

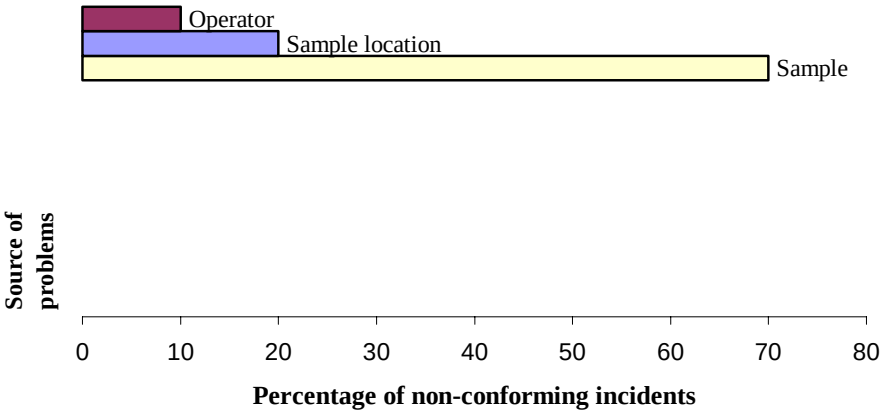

Figure 9: Pareto Chart of sources of problems for acidity samples

The above investigations identify problems with the nature of the samples. The Laboratory Manager finds that the matrix of the waste water has changed as a result of the new production process. It is having an effect on the titre values for the samples. The Laboratory Manager discovers that the new matrix for waste waters includes a significant quantity of environmental contaminants which impact on the quality of the acidity analysis. Further, a review of the titre values for the recent waste water samples reveals that these values are very small and could be a significant contributor to inaccurate results. He develops the following Pareto chart for the method from the work done to estimate measurement uncertainty.

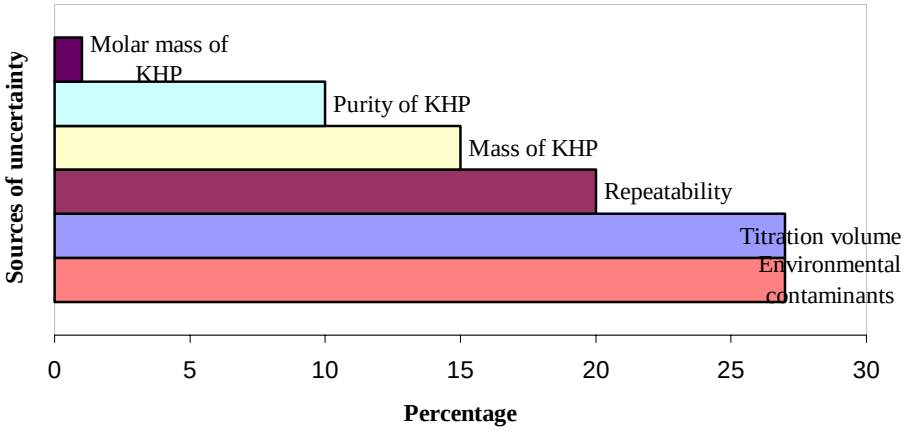

Figure 10: Pareto Chart of causes of problems for acidity measurements
Adapted from Eurachem/CITAC Guide *Quantifying Uncertainty in Analytical Measurement*, 2000, p 41.

The Laboratory Manager is now in a position to design an experiment which will overcome these problems and not expend energy on other aspects of the testing which do not contribute significantly to these problems.

Checksheets

These are useful tools for collecting data. They tend to make data collection efforts more accurate and will automatically produce a summary of data. The two main types of checksheets used are tally sheets and location plots. In a laboratory context, checksheets could be used to identify and record completion of various stages in processing samples or, where there is a choice available, to ensure that the correct equipment is used for analysis.

Histograms

These are powerful tools for understanding the variability of a process. Histograms are used for depicting numeric or continuous data and provide information on how processes are operating and the variability of the process through the measures of location or centrality and variation or spread. Evaluation of these aspects of histograms is not sufficient. It is equally important to consider the shape and any unusual features of the histogram to get an insight into the performance of a process.

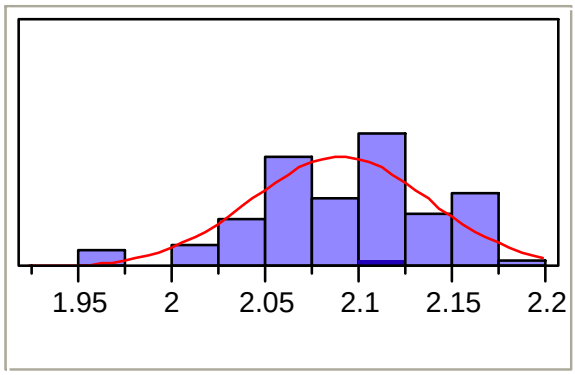

Figure 11: Histogram of protein results from wheat quality study

The above histogram shows a slightly skewed distribution, which indicates a bias in testing. Further, there are some aberrant (outlier) results which would need to be investigated.

Run charts and control charts

These charts are useful in showing the variability of a process. They are generally used to determine trends in data and other patterns that occur over time. Quality control data are usually plotted on these charts. Several types of charts are available for use, depending on the nature of the process under scrutiny.

An example might include plotting the results obtained by the Vogon Wheat Millers laboratory for VRM™ 001 for Dumas protein in wheat on a run chart or a control chart.

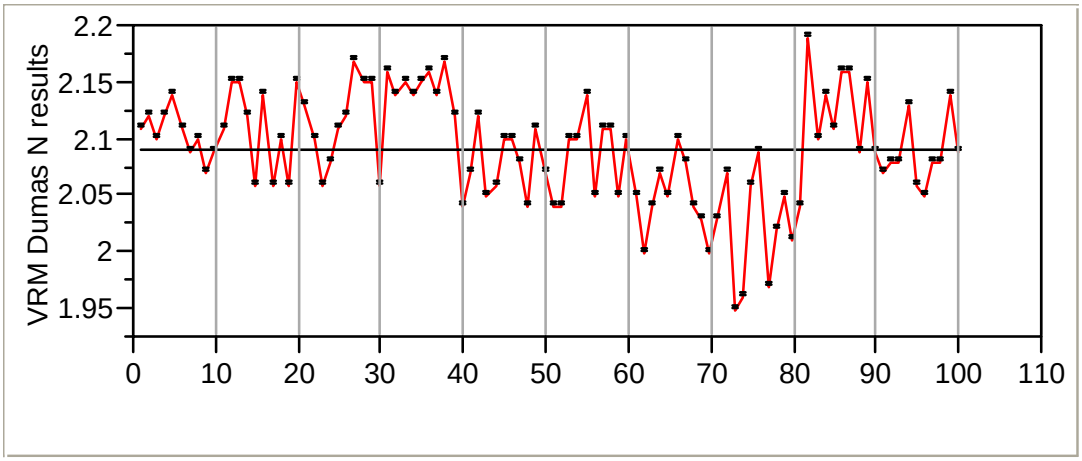

Figure 12: Run chart of VRM™ 001 for Dumas N in Wheat results

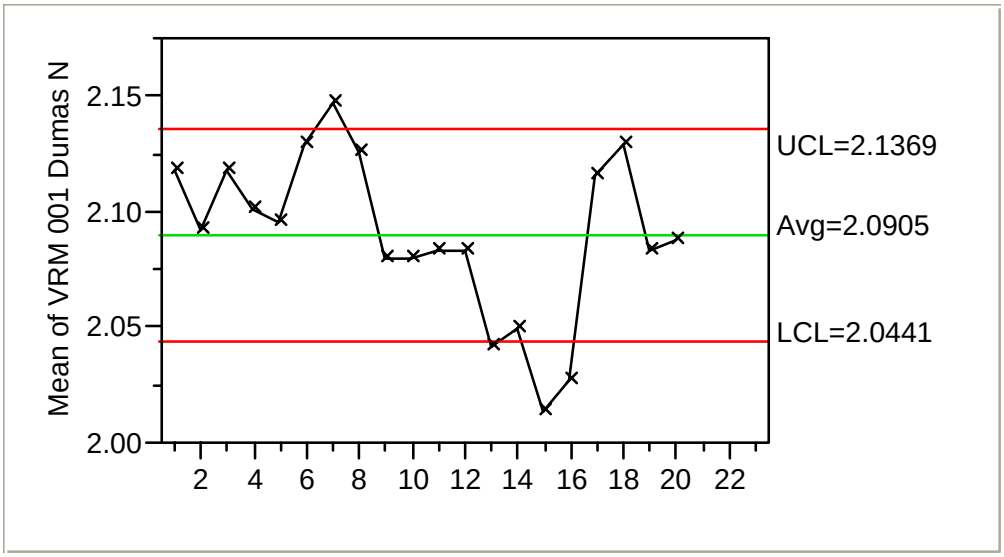

Figure 13: Variable Control Chart (XBar) of VRM™ 001 for Dumas N in Wheat results

Note that a run chart differs from a control chart by virtue of the fact that the run chart does not show the control limits for the process. The above charts show that the testing process is not in control at the beginning of the monitoring period. There are several places where the rules for the performance of data from a controlled process are disobeyed.

Scatter plots and correlation

These tools are useful in depicting the relationship between two quantitative variables.

To demonstrate, Vogon Wheat Millers has found problems with its on-line NIR determinations, especially on colder days. The Laboratory Manager suspects it is a problem with the signal intensity and decides to monitor the temperature and signal intensity when the reference material in analysed every eight hours. This will establish if there is any relationship between these two variables. The following graph shows the outcome of these investigations.

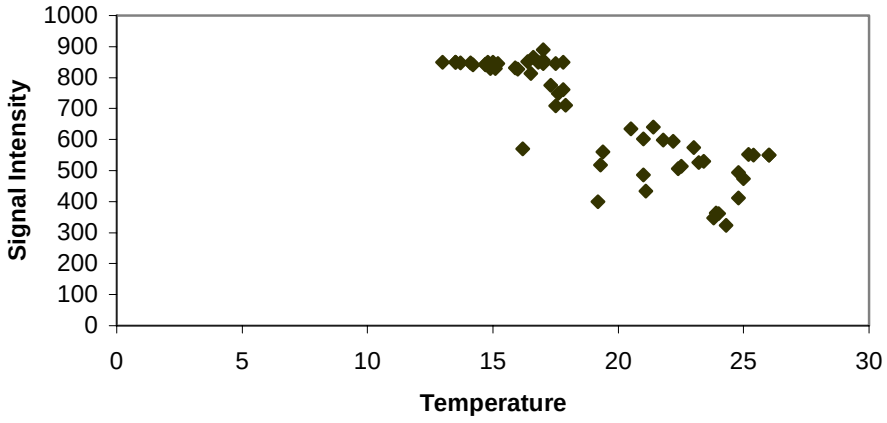

Figure 10: Scatter plot of temperature versus signal intensity

From inspection of the figure above, a fairly strong negative relationship can be observed between temperature and signal intensity. As temperature decreases, signal intensity increases. Hence, the Laboratory Manager can

look at better ways of achieving environmental control to ensure that problems with variation in signal intensity do not persist.

Building on the basics of continuous improvement

There are some useful techniques to enhance the continuous improvement process. Organisations can easily fall into the routine of taking a reactive approach to problem solving. The following techniques help to promote the proactive nature of continuous improvement:

Brainstorming

Brainstorming is a very useful technique for generating ideas, whether these are for identifying problems or developing solutions to problems. In brainstorming, team members assemble and generate ideas with the assistance of a facilitator. During the first phase, the facilitator's role is to specifically discourage the evaluation of the ideas until all ideas have been recorded. The use of affinity diagrams and electronic brainstorming tools can be especially effective in overcoming issues relating to "Groupthink".

Process capability and six- sigma quality

One of the key elements of TQM is the notion of conformance to specifications. Process capability provides a quantitative measure of this aspect. It relies on the principle that every process has some variation in its quality parameters. This is called the *natural spread*. However, often specification limits are set for these quality parameters, which may or may not be aligned with the natural spread. The range of these specifications is called the *tolerance spread*. The relationship between the tolerance spread and the natural spread can be quantified by calculating the process potential index, C_p:

C_p = Tolerance spread/Natural spread = (USL-LSL)/6 S

A C_p value of less than 1.00 indicates a tolerance spread wider than the natural spread and hence suggests a capable process is occurring. It is important to note that this index is applicable to processes centred between specifications. The process performance index, C_{pk} should be calculated for processes which are not centred between specifications:

C_{pk} = Distance from the mean to the nearest specification limit/ 3 S

It should be noted that a process must be in statistical control in order for its process capability to be effectively measured.

In 1997, Motorola took this concept one step further as a part of its continuous improvement efforts. The concept of six-sigma quality is based on the fact that if a process output is normally distributed, then 3.4 parts per million would be out of specification in the long run. This quantitative approach to continuous improvement can lead to dramatic reductions in defect rates. This gave rise to a new approach, the Six Sigma approach, to continuous improvement. Two processes may be used to undertake Six Sigma projects, depending upon the nature of the process: DMAIC (define, measure, analyse, improve, control); or DMADV (define, measure, analyse, design and verify)[18].

[18] iSixSigma, Six Sigma- What is Six Sigma, cited from www.isixsigma.com/sixsigma, accessed 27 August 2004.

Taguchi Loss Function

Dr Taguchi developed the Taguchi Loss Function which is based on variability reduction. The approach teaches that minimal variability in everything is inherently good, however, rather than trying to stay within specification limits, one should instead determine where, within those specification limits, the best value lies. Then, devote the necessary efforts to minimise variability around that point[19]. This is distinct from the "goalpost" philosophy of quality management where any values within the allowed tolerance band are acceptable. Further, he postulated that there was only an insignificant difference in cost between a dimension that lies just within the allowed tolerance band and one that lies outside this band[20].

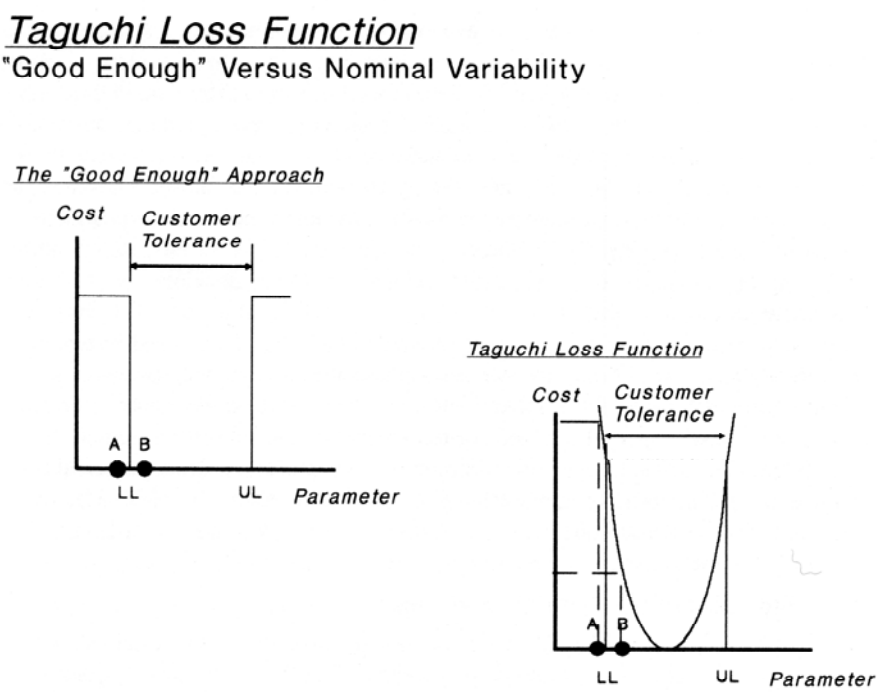

Figure 11: Taguchi Loss Function and Goalpost Quality Management Philosophy
Source: Berk, J and Berk, S, 1993, Total quality management: implementing continuous improvement, p. 165.

Taguchi taught that, by adopting his philosophy, business can realise significant improvements to operational costs.

Cost of Quality

The above discussion on Taguchi's Loss Function leads to an important question: what is the cost of "quality"? In any business it is important to recognise that everything we do that is beneficial to our company comes at some cost. For quality, these costs can be divided into two broad categories, each with two sub-categories:

- Conformance costs
  - Prevention costs- including training and education, developing documentation, audits, calibration, method validation and supplier capability surveys.

19 Berk, J and Berk, S, 1993, *Total quality management: implementing continuous improvement*, Sterling Publishing Company, Inc., New York, p 164.
20 *ibid*, p 165.

- Appraisal costs – these include quality control, reference material purchases, proficiency testing participation and accreditation costs.

- Non-conformance costs
  - Internal failure costs – for laboratories, these costs include retesting, downtime due to equipment failures and opportunity costs.
  - External failure costs – costs resulting from customer complaints, product recalls, the costs of losing a customer and equipment repair costs.

The various costs can be determined through accounting reports which have been developed to capture this information. Often these figures are only estimates, but it is important that both accounting departments and other organisational departments cooperate to develop the best estimate of the costs of quality because there is an optimal total quality cost which organisations should aim for. We do not want to expend a disproportionate amount of our resources to achieve "perfection".

People and teamwork- the clincher in the philosophy of total quality management

Key elements of successful implementation of TQM programs are the people and the use of teams[21]. It is people who identify problems and potential solutions, it is people who monitor processes and it is people who perform the tasks which allow an organisation to reach its strategic goals. Properly utilised, people are the most valuable investment and resource of any organisation. To facilitate successful outcomes, it is important that people work in teams both within and across departments, wherever appropriate, as this approach gives rise to the best ideas for improving the organisation. Having said this, however, it is important that the right people come together to form teams, so that informed decisions can be reached. The starting point in selecting the right team members is therefore the competence of those individuals. Other interpersonal attributes of team members also play an important role in ensuring the success of a team's efforts.

Relationship of ISO 9000, ISO 17025 and quality awards to TQM

How do common quality management approaches fit into the TQM model? We will examine this in relation to ISO/IEC 17025, ISO 9000 (2000) series, the Deming Prize, the Baldridge Award and the Australian Business Excellence Framework. Mahoney and Thor (1994) developed a system for evaluating various quality management models. This will be used as the framework for comparison between the approaches being studied.

ISO/IEC 17025 General requirements for the competence of testing and calibration laboratories

The standard currently makes use of the requirements outlined in ISO 9000 (1994) and as such is a good starting point on the pathway to TQM. There is a strong emphasis on the need for documentation and traceability (in both the paper-trail and scientific senses). There is a focus on taking corrective and preventive action, but no discussion on continuous improvement. There is no discussion on statistical quality or process control as stand-alone topics. However, these topics are briefly covered in the technical clauses of the standard, for example, in the clauses relating to assuring the quality of test and calibration results. The standard's real strength is in its focus on technical competence in addition to the presence of a quality management system.

ISO 9000 series Quality Management Systems

The ISO 9000 series is also a good starting point on the road to TQM. ISO 9001(2000) focuses organisations on the need to document their systems and to have traceable systems in place. The standard emphasises the requirement to take corrective action when things go wrong and moves management systems towards the philosophy of continuous improvement. However, it does not deal with the issues of statistical quality or process control in a great deal of depth.

[21] Rao et. al, op. cit, p 51.

The Deming Prize

This prize was established in 1951 by the Union of Japanese Scientists and Engineers (JUSE) in recognition of Dr W Edwards Deming's work in the area of industrial quality control. Applicants must define progress towards implementing the following conditions.

1. *How are policies determined and transmitted? What results have been achieved?*
2. *How are scopes of responsibility and authority defined? How are cooperation promoted and quality control managed?*
3. *How is quality control taught, and how is training delivered to employees? To what extent are QC and statistical techniques understood? How are QC circle activities utilized?*
4. *How is information collected and disseminated at various locations inside and outside the company? How well is it used? How quickly?*
5. *Are critical problems grasped and analysed against overall quality and the production process? Are they interpreted appropriately, using the correct statistical methods?*
6. *How are standards used, controlled and systematized? What is their role in the enhancement of company technology?*
7. *Are quality procedures reviewed for maintenance and improvement? Are responsibility and authority scrutinized, control charts and statistical techniques checked?*
8. *Are all elements of the production operation that are essential for quality and reliability (from product development to service) examined, along with the quality assurance management system?*
9. *Are products of sufficiently good quality being sold? Have there been improvements in quality, quantity and cost? Has the whole company been improved in quality, profit, scientific way of thinking, and will to work?*
10. *Are strong and weak points in the present situation recognised? Is promotion of quality control planned and likely to continue?*[22]

In addition, the judges can also consider:

- Profits
- Cost controls
- Research
- Product development and design
- Equipment maintenance
- Instrumentation and inspection
- Manufacturing processes
- Inventories
- Safety
- Personnel and labour relations
- Delivery performance
- Education and training
- Quality assurance coordination
- Complaint handling
- Customer opinion utilisation
- After-sale service
- Relationships (associates, subcontractors, suppliers, customer companies)[23]

The Deming prize therefore covers most aspects of a TQM program. It does not formally deal with issues such as procurement and subcontracting relationships, handling, storage, labelling and safety, inventory procedures, marketing, delivery and customer service and satisfaction. Its strengths are its focus on quality control and assurance, production process and statistical quality control.

The Baldridge Award

The Baldridge Award is managed by National Institute of Science and Technology (NIST). Applicants are judged against a series of criteria across seven categories, as follows:

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[22] Mahoney, F X and Thor, C G, 1994, *The TQM Trilogy: using ISO 9000, the Deming Prize, and the Baldridge Award to establish a system for total quality management*, AMACOM, New York, p 58-60.
[23] *ibid*, p 61.

- Leadership- the success of senior leaders in addressing values, directions, and performance expectations, as well as a focus on customers and other stakeholders, empowerment, innovation, and learning. The organisation's governance and how it addresses its public and community responsibilities are also examined.
- Strategic Planning – how the organisation develops deploys and measures progress towards its strategic objectives and action plans.
- Customer and Market Focus –how an organisation determines requirements, expectations, and preferences of customers and markets, how it builds relationships with customers and determines the key factors that lead to customer acquisition, satisfaction, loyalty and retention, and to business expansion.
- Measurement, Analysis and Knowledge Management – how the organisation selects, gathers, analyzes, manages, and improves its data, information, and knowledge assets.
- Human Resource Focus- how an organisation's work systems and employee learning and motivation enable employees to develop and utilize their full potential in alignment with the organisation's overall objectives and action plans. This category also examines an organisation's efforts to build and maintain a work environment and employee support climate conducive to performance excellence and to personal and organisational growth.
- Process Management- examines the key aspects of your organisation's process management, including key product, service, and business processes for creating customer and organisational value and key support processes. This category encompasses all key processes and all work units.
- Business Results – the organisation's performance and improvement in key business areas—customer satisfaction, product and service performance, financial and marketplace performance, human resource results, operational performance, and governance and social responsibility. The organisation's performance levels relative to those of its competitors are also examined.[24]

Clearly, the Baldridge Award criteria place emphasis on some areas which are treated summarily in other frameworks, such as human resources development and management and customer satisfaction. It is not as strong with respect to requirements for documentation.

Australian Business Excellence Framework

The Australian Business Excellence Awards are administered by Business Excellence Australia. Award winners are judged against the categories in the Australian Business Excellence Framework, an integrated leadership and management system that describes the essential features, characteristics and approaches of organisational systems that promote sustainable, excellent performance.

The Framework defines seven Performance Categories that are interrelated. Organisations cannot achieve sustained success without sound systems and processes in place for all seven. The performance categories and evaluation items are as follows.[25]

[24] NIST, 2004, *Baldridge National Quality Award, Criteria for Performance Excellence*, cited from http://baldrige.nist.gov, accessed 27 August 2004.

[25] Business Excellence Australia cited from http://www.businessexcellenceaustralia.com.au/GROUPS/ABEF/#7, accessed 27 August 2004.

Category	Item
1.0 Leadership	1.1 Strategic direction 1.2 Organisational culture 1.3 Leadership throughout the organisation 1.4 Environmental and community consultation
2.0 Strategy and Planning	2.1 Understanding the business environment 2.2 The planning process 2.3 Development and application of resources
3.0 Knowledge and information	3.1 Collection and interpretation of data and information 3.2 Integration and use of knowledge in decision making 3.3 Creation and management of knowledge
4.0 People	4.1 Involvement and commitment 4.2 Effectiveness and development 4.3 Health, safety and well-being
5.0 Customer and Market Focus	5.1 Knowledge of customers and markets 5.2 Customer relationship management 5.3 Customer perception of value
6.0 Innovation, Quality and Improvement	6.1 Innovation process 6.2 Supplier and partner processes 6.3 Management and improvement of processes 6.4 Quality of products and services
7.0 Success and sustainability	7.1 Indicators of success 7.2 Indicators of sustainability

Comparative Analysis of the various TQM frameworks

Mahoney and Thor[26] evaluated ISO 9001 (1994), the Deming Prize and the Baldridge Award against a set of twelve sub-systems which they developed to encompass all aspects of the TQM philosophy. In this paper, the author has made use of the evaluation model and extended the analysis to include ISO/IEC 17025, ISO 9000 (2000), the current Baldridge Award criteria and the Australian Business Excellence Awards, to allow comparison across a range of frameworks that Australian laboratories could make use of in implementing TQM. The original results of Mahoney and Thor for the Deming Prize have also been reviewed by the author and some changes suggested. The results of this analysis are provided below.

[26] Mahoney and Thor, op. cit, p 36-37.

Subsystem	ISO/IEC 17025 (1999)	ISO 9001 (2000)	Deming Prize	Baldridge Award	Australian Business Excellence Framework
1. Management leadership/ operational performance/ continuous program elements/ wall-to-wall deployment	2	2	3	4	4
2. Market research/ planning design procedures/ product-service development	2	3	1	4	3
3. Purchasing-procurement proficiency/ contracting methods/ supplier performance	4	3	1	2	3
4. Handling/labelling/ storage/ safety	2	1	1	1	1
5. Documentation/ records/ control procedures/ policies/ traceability	4	4	3	1	1
6. Human resources management/ training/ development/ education	3	2	2	4	2
7. Transformation and added value (production/service process activities)	3	3	3	4	1
8. Process quality control/ standards/ quality results/ benchmarking/ auditing	4	4	3	4	2

Subsystem	ISO/IEC 17025 (1999)	ISO 9001 (2000)	Deming Prize	Baldridge Award	Australian Business Excellence Framework
9. Inspection/testing/ test equipment/ tagging/ corrective action/ control of non-conforming output	3	3	5	3	2
10. Packaging/ handling/ inventory procedures	2	2	1	1	2
11. Marketing/ distribution/ delivery/ installation/ operation	0	0	1	2	1
12. Customer service/ customer satisfaction/ guarantees-warranties	2	1	1	3	3

Codes:

0 No attention
1 Slight attention
2 Moderate attention
3 Heavy attention
4 Great attention

This analysis shows that all approaches have strengths and weaknesses in terms of adoption and emphasis of TQM principles. No single framework is perfect or delivers exceptional opportunities for business excellence. But, knowledge of the various frameworks available can assist organisations to fully implement these principles and hence realise business improvements.

Issues in Implementing TQM

No paper on implementation of any management approach would be complete without some discussion on issues relating to implementation. We can all learn from history; if we don't, we are destined to repeat the same mistakes.

Deming developed the "Seven Deadly Diseases" as the obstacles facing organisations in successfully implementing total quality management. These are as follows.

1. Lack of constancy of purpose
2. Emphasis on short-term profits and short-term thinking
3. Annual performance reviews

4. Mobility of management and job hopping
5. Management use of visible figures only
6. Excessive medical costs
7. Excessive costs of liability[27]

One of the most important phases in implementing TQM is the development of a "quality culture". Often this requires some organisational change, which can lead to cultural resistance. Kanter, Stein and Jick[28] identified the "Ten Commandments for Change":

1. *Analyse the organisation and its need for change*
2. *Create a shared vision and common direction*
3. *Separate from the past*
4. *Create a sense of urgency*
5. *Support a strong leader role*
6. *Line up political sponsorship*
7. *Craft an implementation plan*
8. *Develop enabling structures*
9. *Communicate, involve people and be honest*
10. *Reinforce and institutionalise change.*

But what can organisations practically do to achieve change and the adoption of a "quality culture"? The proliferation of this philosophy within an organisation starts at "the top". Leaders must build shard visions, challenge existing processes and models and foster systematic ways of thinking. However, what if you are working at a bench level- can you hope to achieve much by way of implementation of TQM principles? Yes you can!

The above "Ten Commandments" can be adopted in even the smallest unit of an organisation. It can be tough, but change can be fostered through the actions of just one worker when their efforts demonstrate business improvement.

Other issues in implementing TQM relate to the development of statistical thinking within an organisation. It is imperative that organisation members are provided with the opportunity to learn about and understand these techniques, so that they are used appropriately and effectively within the organisation.

Conclusion

Total Quality Management is a holistic approach to business excellence. It encompasses all aspects of an organisation to its full extent, including its suppliers and customers. These aspects include traceability, competence, validation of processes, knowledge of the quality attributes of products and measurement of these attributes and monitoring of quality attributes through quality control activities. It makes use of tools such as basic quantitative statistical techniques and other data collection and analysis tools, such as auditing and management review. But it is essential that, in making use of these tools, organisations look fairly and squarely at the data collected and foster both real and potential business improvement opportunities. It is only through this proactive approach to management that real progress towards business excellence can be achieved.

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[27] Howley, P, *The University of Newcastle, WEB C604 Course Notes*, 1999, The University of Newcastle, Newcastle, p 1.43.

[28] Kanter, Stein and Jick (1992) in Rao, A, Carr, L P, Dambolena, I, Kopp, R J, Martin, J, Rafii, F and Schlesinger, P F, 1996, *Total Quality Management: A Cross Functional Perspective*, John Wiley and Sons, New York, p 435.

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