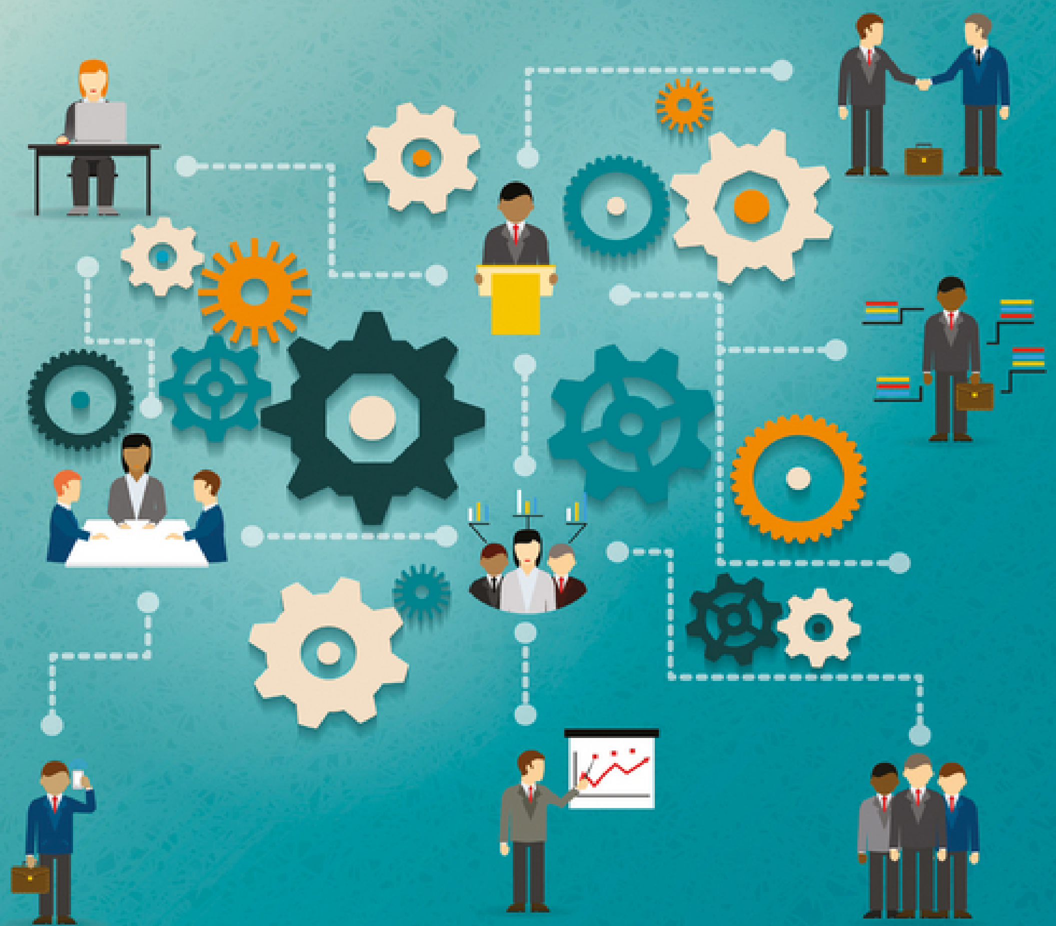
MANAGING QUALITY

AN ESSENTIAL GUIDE AND RESOURCE GATEWAY

6TH EDITION



EDITED BY BARRIE G.DALE, DAVID BAMFORD & TON VAN DER WIELE

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'Barrie and David are among the leading researchers and the best teachers in total quality management. Their teaching in quality management and performance improvement at Manchester Business School was very well liked by their students for many years. In this sixth edition of the book, they have chosen to cover a broad range of topics in TQM in great depth. While different companies may take different approaches to achieve their strategic goals, no company could afford not to commit itself to improving the quality of its products and services for ultimate customer satisfaction. This book introduces all important areas of TQM to students and provides a rich knowledgebase for both study and practice in quality management.'

Professor Jian-Bo Yang, Chair of Decision and System Sciences, Alliance Manchester Business School, The University of Manchester

'Previous editions of this excellent text have provided the basis for student reading and class reflection on current issues in quality management, but I am particularly pleased to see an excellent set of online resources to accompany the new book. The presentation material, exercise questions and video/web links provide an invaluable resource both for lecturers teaching the subject for the first time, but also for experienced teachers wishing to compare, contrast and update their material when adopting the book and planning future course delivery. I will certainly adopt and adapt the resources provided in my teaching of quality management from now on.'

Dr Paul Forrester, Senior Teaching Fellow, Keele Management School, Keele University

'A sustained focus on Quality Management is arguably the most important attribute of a competitive organization. An essential read for students, scholars and practitioners, the textbook provides an extensive examination of contemporary Quality Management that is timely, informed and accessible. The online resources are invaluable for educators and students alike, bringing a blended learning dimension to each chapter through multi-media videos, case studies and interactive teaching materials.'

Dr Claire Moxham, Senior Lecturer in Operations Management, Management School, University of Liverpool

Managing Quality

An Essential Guide and Resource Gateway

Sixth Edition

EDITED BY
Barrie G. Dale, David Bamford and
Ton van der Wiele

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Acknowledgements

In our role as editors we have attempted to ensure that each topic is adequately covered in breadth and depth and is presented simply and clearly. Subject to these constraints we have tried not to interfere with our contributors' styles because we believe an author's style is an integral part of getting his or her message across to the reader.

The brief given to the contributors was to keep the level of technical detail to a minimum and to write in a focused, non-specialist language. This is much easier in some subjects than others, but we believe that this objective has been achieved, and hope the reader will find that the structure of the book is logical and the content is clear and free from confusing jargon.

Finally, we wish to thank all the contributors for making this book possible. We have learned much from them. We hope the readers will too.

Preface

The subject of Quality Management is vast. There are many issues and interfaces to consider, and there are a considerable number of tools, techniques and systems which an organization can use to assist it in the introduction and development of the concept. The text covers the main aspects and functions of Quality Management, from identifying customer needs and requirements through to quality planning, supply and production/operations. This sixth edition of *Managing Quality* builds on the success of the previous publications. The book covers the main concepts and issues currently being debated and considered by business leaders throughout the world. It is a very comprehensive text and has developed a track record and following amongst students, academics and practitioners. Its purpose is to provide the reader with an appreciation of the concepts and principles of Quality Management. It has proved to be a wide-ranging source of reference for the many tools, techniques and systems which are associated with the concept.

In the book the term 'total quality management' (TQM) is used to describe the process of transformation by which all parts of the organization have a focus on quality with the ultimate objective of customer satisfaction and delight. Some people argue that the term TQM has fallen out of use, with directors and managers regarding it as a fallen star and a jaded concept. They moved on to what are perceived as newer concepts (e.g. Six Sigma, lean mapping, etc.). There is little doubt that in many companies and industries the issue of improvement in the quality of products and services remains urgent. Therefore in this book we are sticking to the term TQM and, when appropriate, coupling it to 'Strategic Process Improvement'.

The feedback on previous editions indicates that the book has been useful to industrialists, management consultants, academics, and undergraduate and postgraduate students from a variety of disciplines; TQM is not the special province of one group of people or one discipline. People studying for professional examinations that involve considerations of quality have also benefited from the use of the book. We hope readers will read the whole book to gain an understanding of the breadth and depth of Quality Management. However, most of the chapters do

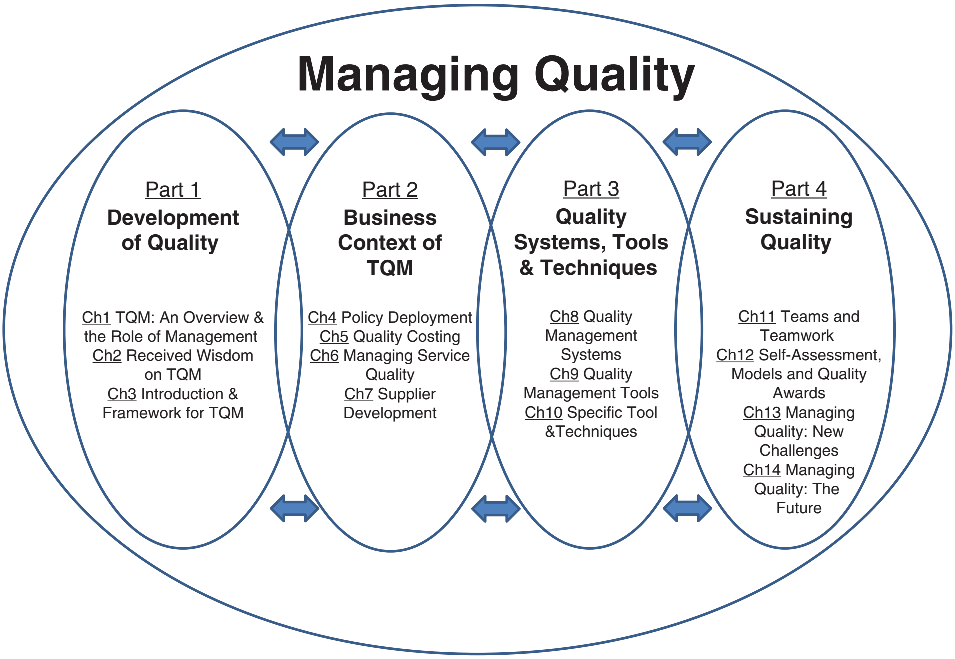

Figure 0.1 A conceptual model of management quality

stand alone and readers may choose to dip into the book in order to learn more about a particular subject.

In the spirit of continuous improvement, and a move into providing electronic support materials, a major revision of the book has been undertaken this time around. All chapters were fully reviewed and, to provide greater focus for the reader, some were extensively revised/combined, and some removed. In addition, appropriate support materials are now provided online (e.g. Instructor Resources, teaching slides, additional cases, key questions for each chapter, etc.). Please visit the book page on www.wiley.com for additional information/access.

The text is still arranged around four main areas; however, these have been refined and are presented as a conceptual model within Figure 0.1.

These interlinking parts serve to communicate the applied breadth and depth of aspects of relevant Quality Management application of tools, techniques and systems. Specifically the parts cover: Part One: Development Quality – overview and management, received wisdom, framework for TQM; Part Two: Business Context – policy deployment, quality costing, managing service quality, supplier development; Part Three: Quality systems, tools and techniques – quality systems, quality management tools, quality management techniques; Part Four: Sustaining Quality – teams, self-assessment and awards, New challenges, The future. We present the conceptual model of this.

The academic contributors have also outlined some of their recent research findings. We do hope that readers will find some new ideas and angles on subjects which have been brought to their attention. It is to be hoped that, through study of the text, readers will be encouraged to take up the challenge of strengthening their commitment and dedication to TQM and continuous improvement.

Barrie G. Dale
Professor Emeritus
Alliance Manchester Business School

David Bamford
Professor of Operations Management
The Business School, University of Huddersfield

Ton van der Wiele
Associate Professor Quality Management and Performance Improvement
Rotterdam School of Management, Erasmus University

About the Authors

The Editors

Barrie G. Dale is Professor Emeritus at Alliance Manchester Business School. Founder of the *International Journal of Quality and Reliability Management*, he was its co-editor for over 25 years. He has authored several other books including, *The Road to Quality* (1993), *Quality Improvement through Standards* (2nd edition, 1994), *Managing Quality and Human Resources* (2nd edition, 1997), *Working in Partnership* (1998), *Managing Business Improvement and Quality* (1998), *Total Quality Management Blueprint* (1999) and *Quality Costing* (3rd edition, 1999).

David Bamford is Professor of Operations Management at the Business School, University of Huddersfield. He is an experienced industrialist/academic with numerous publications to his name. Knowledge transfer projects, across many sectors, have been central to his academic career and his research interests are focused towards operations improvement strategies in the application of Operations Management theories, strategic organizational change, leadership and quality management, and sports operations management.

Ton van der Wiele was Associate Professor of Quality Management and Performance Improvement at RSM Erasmus University, Rotterdam. He has published many papers in various international journals on Quality Management, Performance Improvement, Management Consultancy and E-business. Quality-editor of the *International Journal of Quality and Reliability Management*, van der Wiele has worked in the Quality field for more than twenty-five years.

Contributors

Chapter Authors

Jim Bamford is Senior Lecturer in Operations Management at the Business School, University of Huddersfield, UK.

Bernard Burnes is Professor of Organizational Change at the Stirling Management School, University of Stirling, UK.

Benjamin Dehe is Senior Lecturer in Operations Management at the Business School, University of Huddersfield, UK.

Roy Lee was Squadron Leader, Support Management Group, Royal Air Force, Wyton, UK.

Barbara Lewis is Professor Emeritus of Marketing, Alliance Manchester Business School, University of Manchester, UK.

Marina Papalexi is the Research Assistant in Operations Management at the Business School, University of Huddersfield, UK.

Iain Reid is Senior Lecturer in Operations Management at the Business School, University of Huddersfield, UK.

Chapter Contributors

John Aldridge is Quality Manager at Survitec Survival Products, Shewsbury, UK.

Ian Ferguson is Managing Director of Ferguson Associates, Birmingham, UK.

Rory Love was Quality Engineer, Alexanders Ltd, Falkirk, UK.

John Macdonald was Managing Director of John Macdonald Associates, Surrey, UK.

Peter Shaw was TQM Project Officer, Manchester School of Management, UMIST, UK.

Jos van Iwaarden is a Senior Consultant at A.T. Kearney, Utrecht Area, The Netherlands.

Roger Williams is Professor Emeritus of Business and Management, Erasmus University, Rotterdam School of Management, Rotterdam, The Netherlands.

Part One

The Development and Introduction of Total Quality Management (TQM)

The purpose of Part One is to introduce the reader to some of the fundamentals of TQM. It deals with how to introduce TQM into an organization and its subsequent development. Sustaining TQM is far from easy, and the chapters examine issues to which attention needs to be given. It contains the following three chapters:

Chapter 1 – TQM: An Overview and the Role of Management
Chapter 2 – The Received Wisdom on TQM
Chapter 3 – The Introduction and a Framework for TQM

Chapter 1 examines the evolution of *quality management* ('coordinated activities to direct and control an organization with regard to quality') from *inspection* ('conformity evaluation by observation and adjustment accompanied as appropriate by measurement, testing or gauging') to *quality control* ('part of quality management focused on fulfilling quality requirements') to *quality assurance* ('part of quality management focused on providing confidence that quality requirements will be fulfilled' (ISO 9001: (2015)) and finally to *Total Quality Management* (TQM). This chapter outlines the main reasons why senior management should become personally involved in TQM. It examines what they need to know about TQM and what they need to do in terms of actions. The role of middle and first-line management is also key to putting in place the principles of TQM, and the activities that they need to get involved with are discussed.

Chapter 2 deals with the received wisdom on TQM. Quality management experts such as Crosby, Deming, Feigenbaum and Juran have had a considerable influence on the development of TQM throughout the world and their views and teachings are summarized in this chapter. The Japanese have had a profound influence on the understanding and development of TQM. Therefore, no book on TQM would be complete without some discussion of the way in which Japanese companies develop and manage the concept. The views of the four influential Japanese experts (Imai, Ishikawa, Shingo and Taguchi) are explored and summarized.

Chapter 3 deals with the introduction of TQM. It sets out by examining change and continuous improvement and deals with how the improvement process is triggered, which is usually in combination: the Chief Executive, competition, demanding customers and fresh-start situations. Following this, the chapter goes on to examine a range of approaches that can be followed in the introduction of TQM. A framework to assist with the introduction of TQM is presented. The structure of the framework consists of four main sections: organizing, using systems and techniques, measurement and feedback, and changing the culture. The framework has been used by a number of organizations in both the public and private sectors and in manufacturing and service industries to introduce the basic elements and practices of TQM and Strategic Process Improvement.

Chapter One

TQM: An Overview and the Role of Management

B. G. Dale, M. Papalexi, D. Bamford and A. van der Wiele

Introduction

In today's global competitive marketplace the demands of customers are gradually increasing as they require improved quality of services and products. Also, in some markets there is an increasing supply of competitively priced products and services from low labour cost countries such as those in the Far East, the former Eastern bloc, China, Vietnam and India. TQM and Strategic Process Improvement does not appear to have reached maturity in many BRIC (Brazil, Russia, India, China) economies (Moosa and Cardak 2006). This presents an opportunity, as well as a challenge, for TQM practitioners. Continuous improvement in total business activities with a focus on the customer throughout the entire organization and an emphasis on flexibility and quality is one of the main means by which companies face up to these competitive threats. For this reason, many organizations are looking for quality management and strategic process improvement in order to survive in increasingly aggressive markets and maintain a competitive edge over their rivals (Bamford et al. 2015). As a result of the efforts made by organizations to respond to these marketplace demands the quality of products, services and processes has increased considerably during the last two decades. Oakland (2014) states that:

> Total Quality has always been a key strategic factor for business success but it is now more than ever required to compete successfully in the global markets of the twenty-first century.

Having said this, it should be pointed out that in many markets today, quality is narrowly defined as the reliability of products and services. It is not considered as a competitive weapon any more but as a given requirement; and is considered an entry-level characteristic in the marketplace.

These days, many organizations have had experiences with working on the transformation towards total quality management (TQM) and/or strategic process improvement and this is coupled with its spread, from the manufacturing to the service sector and on to public services. In addition, new domains present themselves. For example, according to Bamford et al. (2016) achieving and maintaining a quality culture is complex across all industrial sectors but amplified in off-field sporting operations due to particular industry characteristics (Smith and Stewart 2010). For example, operating rules and regulations are often imposed on sporting venues by external parties, the outcome of a sporting tournament is uncertain, fans are both producers and consumers of the sporting experience and sporting rivals must collaborate to organize competitive events (Chadwick 2009, 2011; Stewart and Smith 1999). It is these industry characteristics that provide a backdrop of environmental uncertainty for off-field sporting operations and make quality management in this context a particularly interesting focus for further examination (Bamford et al. 2016).

But what is TQM? In simple terms, it is the mutual co-operation of everyone in an organization and associated business processes to produce value-for-money products and services which meet and, hopefully, exceed the needs and expectations of customers. TQM and strategic process improvement are ever-evolving practices of doing business in a bid to develop methods and processes that cannot be imitated by competitors. This chapter provides an overview of TQM and introduces the reader to the subject. It opens by examining the different interpretations that are placed on the term 'quality'. It then examines why quality has grown in importance during the last decades. The evolution of quality management ('Co-ordinated activities to direct and control an organization with regard to quality': ISO 9001 2015) is described through the stages of inspection, quality control, quality assurance and onwards to TQM. In presenting the details of this evolution, the drawbacks of a detection-based approach to quality are compared to the recommended approach of prevention. Having described these stages the chapter examines the key elements of TQM – commitment and leadership of the chief executive officer (CEO), planning and organization, using tools and techniques, education and training, employee involvement, teamwork, measurement and feedback, and cultural change.

The chapter concludes by presenting a summary of the points which organizations need to keep in mind when developing and advancing TQM. This is done under the broad groupings of organizing, systems and techniques, measurement and feedback, and changing the culture.

What is Quality?

'Quality' has a variety of definitions, interpretations and uses. Today, in a variety of situations, it is perhaps an over-used word. For example, when a case is being made for extra funding and resources, to prevent a reduction in funding, or to keep a unit in operation and in trying to emphasize excellence, just count the number of times the word ‘quality’ is used in the argument or presentation.

Quality as a concept is quite difficult for many people to understand, and much confusion and myth surround it.

In a linguistic sense, quality originates from the Latin word ‘qualis’ which means ‘such as the thing really is’. There is an international definition of quality: ‘the degree to which a set of inherent characteristics fulfils requirements’ (ISO 9001 2015). However, in today’s business world there is no single accepted definition of quality. Irrespective of the context in which it is used, it is usually meant to distinguish one organization, event, product, service, process, person, result, action, or communication from another.

Preventing confusion and ensuring that everyone in an organization is focused on the same objectives, there should be an agreed definition of quality. For example, BetzDearborn Inc. defines quality as: ‘That which gives complete customer satisfaction’, and Rank Xerox (UK) as ‘Providing our customers, internal and external, with products and services that fully satisfy their negotiated requirements’. North West Water Ltd use the term ‘business quality’ and define this as:

> Understanding and then satisfying customer requirements in order to improve our business results.
>
> Continuously improving our behaviour and attitudes as well as our processes, products and services.
>
> Ensuring that a customer focus is visible in all that we do.

There are a number of ways or senses in which quality may be defined, some being broader than others but they all can be boiled down to either meeting requirements and specifications or satisfying and delighting the customer.

Qualitative

When the word quality is used in a qualitative way, it is usually in a non-technical situation. ISO 9001(2015) says that ‘the term “quality” can be used with adjectives such as poor, good or excellent’. Some examples related to this are:

- In advertising slogans to assist in building an image and persuade buyers that its production and services are the best: Esso – Quality at Work; Hayfield Textiles – Committed to Quality; Kenco – Superior Quality; Philips Whirlpool – Brings Quality to Life; Thompson Tour Operations – Thompson Quality Makes the World of Difference.
- By television and radio commentators (a quality player, a quality goal, a quality try).

- By directors and managers (quality performance, quality of communications).
- By people, in general (quality product, top quality, high quality, original quality, quality time, quality of communications, quality person, loss of quality, German quality, 100 per cent quality).

It is frequently found that in such cases of 'quality speak' the context in which the word quality is used is highly subjective and in its strictest sense is being misused. For example, there is more than one high street shop which trades under the name of 'Quality Seconds', and some even advertise under the banner of 'Top Quality Seconds'. There is even a company with the advertising slogan 'Quality Part-Worn Tyres' on the side of its vans.

Quantitative

The traditional quantitative term which is still used in some situations is acceptable quality level (AQL). This is defined in ISO/NWIP 3951-2 (2010) as: 'the quality level that is the worst tolerable process fraction nonconforming when a continuing series of lots is submitted for acceptance sampling'. This is when quality is paradoxically defined in terms of non-conforming parts per hundred (i.e. some defined degree of imperfection).

An AQL is often imposed by a customer on its supplier in relation to a particular contract. In this type of situation the customer will inspect the incoming batch according to the appropriate sampling scheme. If more than the allowed number of defects is found in the sample the entire batch is returned to the supplier or the supplier can, at the request of the customer, sort out the conforming from non-conforming product on the customer's site. The employment of an AQL is also used by some companies under the mistaken belief that trying to eliminate all defects is too costly.

The setting of an AQL by a company can work against a 'right first time' mentality in its people as it appears to condone the production and delivery of nonconforming parts or services, suggesting that errors are acceptable to the organization. It is tantamount to planning for failure. For example, take a final product which is made up of 3,000 parts: if the standard set is a 1 per cent AQL, this would mean that the product is planned to contain 30 non-conforming parts. In reality there are likely to be many more because of the vagaries of the sampling used in the plan or scheme, whereby acceptance or rejection of the batch of product is decided.

Another example of a quantitative measure is to measure processes using sigmas (a sigma is a statistical indication of variation) and defects per million opportunities (DPMO). A sigma is essentially a measuring device that is an indication of how good a product or service is. The higher the sigma value the lower the number of defects. For example, 3 sigma equals 66,807 DPMO, while 6 sigma equals 3.4 DPMO (these values assume a normal distribution with a process shift of

1.5 sigma). The sigma level is a means of calibrating performance in relation to customer needs. Six Sigma (a quality improvement framework) has used sigmas to improve productivity and quality and reducing costs. Six Sigma is the pursuit of perfection and represents a complete way of tackling process improvement from a quantitative approach, involving many of the concepts, systems, tools and techniques described in this book. The Six Sigma concept is currently very popular as a business improvement approach. The key features include a significant training commitment in statistics and statistical tools; problem-solving methodology and framework; project management; a team-based project environment; people who can successfully carry out improvement projects (these are known as black belts and green belts, based on the martial arts hierarchy); leaders (master black belts); and project champions.

Uniformity of the product or service characteristics around a nominal or target value

Figure 1.1 presents the inside/outside specification dilemma; only the product or service dimensions that are within the design specification or tolerance limits can be considered acceptable. The difference between what is considered to be just inside or just outside the specification is marginal. It may also be questioned whether this step change between pass and fail has any scientific basis and validity.

Designers often establish specification limits without sufficient knowledge of the process by which the product and/or service is to be produced/delivered and its capability. It is often the case that designers cannot agree amongst themselves about the tolerances/specification to be allocated, and they tend to establish a tighter tolerance than is justified to provide safeguards and protect themselves. In many situations there is inadequate communication on this matter between the design and operation functions. Fortunately, this is changing with the increasing use of simultaneous or concurrent engineering.

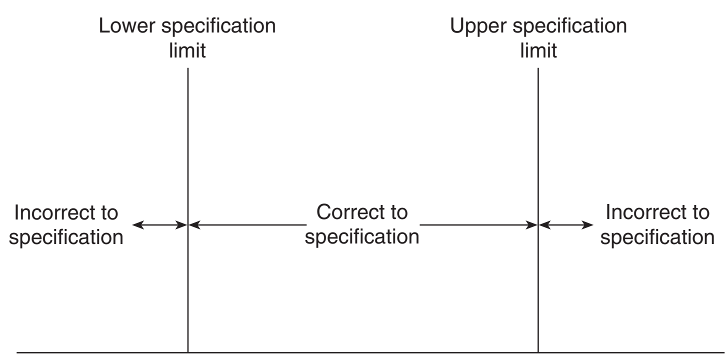

Figure 1.1 The inside/outside specification dilemma

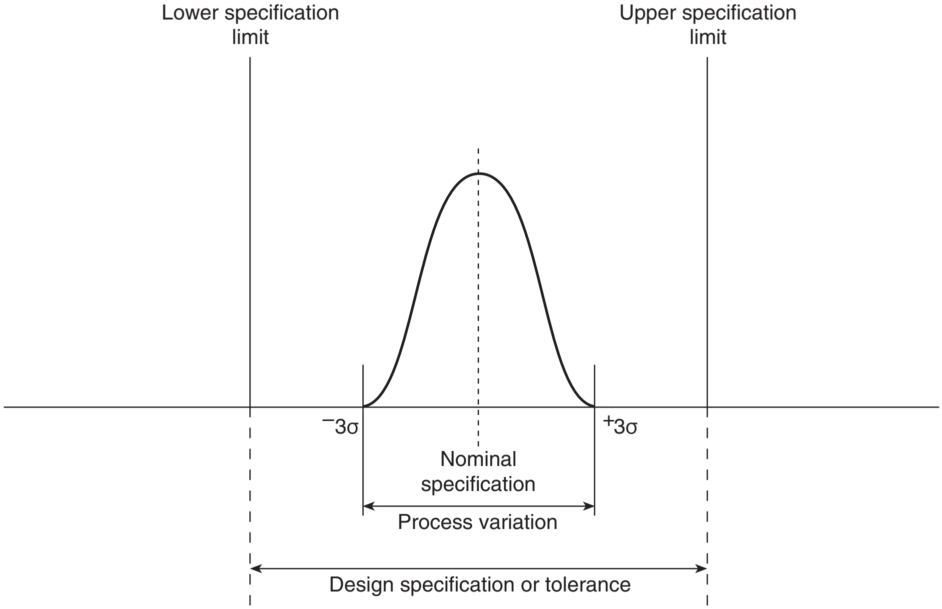

Figure 1.2 Design tolerance and process variation relationship

The main issue of working to the specification limits is that it frequently leads to tolerance stack-up; for example, in a manufacturing situation parts may not fit together correctly at the assembly stage. This is especially the case when one part that is just inside the lower specification limit is assembled to one that is just inside the upper specification. If the process is controlled such that a part is produced around the nominal or a target dimension with limited variation (see Figure 1.2), this problem does not occur and the correctness of fit and smooth operation of the final assembly and/or end product are enhanced.

The idea of reducing the variation of part characteristics and process parameters so that they are centred around a target value can be attributed to Taguchi (1986). He writes that the quality of a product is the (minimum) loss imparted by the product to the society from the time the product is shipped. Among the losses he includes time and money spent by customers; consumers' dissatisfaction; warranty costs; repair costs; wasted natural resources; loss of reputation; and, ultimately, loss of market share.

The relationship of design specification and variation of the process can be quantified by a capability index, for example, C*p*, which is a process potential capability index:

$$\mathrm{C}p = \frac{\text{Total specification width}}{\text{Process variation width}}$$

Conformance to agreed and fully understood requirements

This definition is attributed to Crosby (1979). He believed that quality is not comparative and that there is no such thing as high quality or low quality, or quality in terms of goodness, feel, excellence and luxury. In other words, quality is an attribute (a characteristic which by comparison to a standard or reference point, is judged to be correct or incorrect) not a variable (a characteristic which is measurable). Crosby made the point that the requirements are all the actions required to produce a product and/or deliver a service that meets the customer's expectations, and that it is management's responsibility to ensure that adequate requirements are created and specified within the organization.

Fitness for purpose/use

Juran (1988) was the first to use this definition of quality. He classifies 'fitness for purpose/use' into the categories of: quality of design, quality of conformance, abilities and field service. Focusing on fitness for use helps to prevent the over-specification of products and services. Overspecification can add greatly to costs and tends to militate against a right-first-time performance.

Satisfying customer expectations and understanding their needs and future requirements

Satisfying customers and creating customer enthusiasm through understanding their needs and future requirements is the crux of TQM and strategic process improvement. TQM is all about customer orientation and many company missions are based entirely on satisfying customer perceptions. Customer requirements for quality are increasing and becoming stricter. There are increasing levels of intolerance of poor quality goods and services and low levels of customer service and care. In most situations customers have a choice: they are not willing to jeopardize their own business interest out of loyalty to a supplier who does not perform as they expected; they will simply go to a competitor. In the public sector the customer may not have this choice; however, they can go to litigation, write letters of complaint, cause disruption, and use elections to vote officials out of office.

Superior-performing organizations go beyond satisfying their customers: they emphasize the need to delight them by giving them more than what is required in the contract. These organizations create a total experience for their customers, which is unique in relation to the offerings of competitors (which is called 'the experience economy', see Pine and Gilmore 2011). The wisdom of this can be clearly understood considering the situation where a supplier has given more than the customer expected (for example, an extra glass of wine on an aircraft; a sales assistant going out of their way to be courteous and helpful and providing very detailed information) and the warm feelings generated by this type of action.

A customer-focused organization also puts considerable effort into anticipating the future expectations of its customers (i.e. surprising quality), by working with them in long-term relationships, helping them to define their future needs and expectations. They aim to build quality into the product, service, system and/or process as upstream as is practicable. Excitement and loyalty are the words used to describe this situation.

A mechanism for facilitating a continuous two-way flow of information between themselves and their customers is considered necessary. There is also a variety of means available to companies for them to assess issues such as:

- How well the brand is respected
- How well they are meeting customer expectations
- What customers' chief causes of concern are
- What the main complaints are
- What suggestions for improvements customers might have
- How well they act on what the customer says
- How they might add value to the product and/or service
- What the best means of differentiating themselves in the marketplace are.

Organizations tend to focus on increasing the level of contact with the customer. These 'moments of truth' (Carlzon 1987; also see Fatma 2014) occur far more frequently in commerce, public organizations, the Civil Service and service-type situations than in manufacturing organizations. They use the following practices to increase the level of customer contact:

- Customer workshops
- Panels and clinics
- Using 'test' consumers and mystery shoppers
- Focus groups
- Customer interviews
- Market research
- Dealer information
- Questionnaire surveys
- Product reports
- Trailing the service and/or product
- Trade shows.

Customer complaints are one indication of customer satisfaction, and many organizations have a number of metrics measuring such complaints. BS ISO 10002 (2014) provides guidance on how to develop an effective complaints management system in order to analyse and use complaints effectively. The rationale is that managing complaints in a positive manner can enhance customer perceptions of an organization, increase lifetime sales and values and provide valuable market intelligence.

Why is Quality Important?

To answer this question, just consider the unsatisfactory examples of product and/or quality service that you, the reader, have experienced, the bad feelings it gave, the resulting actions taken and the people you told about the experience and the outcome. Sargeant et al. (2012), based on a range of studies carried out by TARP (Technical Assistance Research Programs), outline two arguments that are effective in selling quality to senior management.

First, quality and service improvements can be directly and logically linked to enhanced revenue within one's own company; and secondly, higher quality allows companies to obtain higher margins.

The following extracts some quantitative evidence in relation to these arguments:

- 'Problems decrease customer loyalty by 15 per cent to 30 per cent'
- '50 per cent of individual consumers and 25 per cent of business customers who have problems never complain to anyone at the company'
- 'If the call centre can resolve a customer's problem using quality service, thus changing a dissatisfied customer to a satisfied one, the company usually gets an increase in loyalty of 50 percentage points'
- 'One potential customer will be lost for every 50 who hear someone complain about a product or service'
- 'Market leaders can charge between 5 per cent and 10 per cent premiums for outstanding quality and service'.

In the 30-plus pages of 'Discoveries 2013', the American Society for Quality (ASQ) presented a report on the current use of core quality practices. The report included aspects of quality governance and management, outcomes and measures, competencies/training and culture. A selection of results, as highlighted by Hill (2014), is outlined below:

- 81% of all respondents indicate that quality goals exist for business/functional units
- 89% of all respondents indicate that standardized quality management processes are in place
- 86% communicate with customers to address their needs and complaints
- 68% share information on quality and performance with customers
- 81% of respondents seek to understand product performance through their customers' eyes.

It is difficult to determine the value of these results without having understood the customers' perception on quality.

Quality is not negotiable

An order, contract or customer which is lost on the grounds of non-conforming product and/or service quality is much harder to regain than one lost on price or delivery terms. In a number of cases the customer could be lost for ever; in simple terms the organization has been outsold by the competition.

If you have any doubt about the truth of this statement just consider the number of organizations that have gone out of business or lost a significant share of a market, and consider the reported reasons for them getting into that position. Quality is one of the factors that is not negotiable and in today's business world the penalties for unsatisfactory product quality and poor service are likely to be punitive.

Quality is all-pervasive

There are a number of single-focus business initiatives that an organization may deploy to increase profit. TQM and strategic process improvement encompass not only product, service and process improvements but also those relating to costs and productivity and to people involvement and development. A number of surveys show that customers are willing to pay more for improved quality of products and services. For example, in 2015, according to a survey by Hot Telecom, 56 per cent of respondents in Asia Pacific would pay extra for better coverage and faster downloads, 83 per cent of them seeking tailored offers based on their usage patterns (Waring 2015). In a similar vein, a study conducted by American Express on Australian consumers found that 73% of respondents were willing to pay more for good products and services (Philp 2011).

Managers sometimes say that they do not have the time and resources to ensure that product and/or service quality is done right the first time. They go on to argue that if their people concentrate on planning for quality then they will be losing valuable operational time, and as a consequence output will be lost and costs will rise. Despite this argument, management and their staff will make the time to rework the product and service a second or even a third time, and spend considerable time and organizational resources on corrective action and placating customers who have been affected by the non-conformances.

Remember 'Murphy's Law' – 'There is never time to do it right but always time to do it once more.'

Quality means improved business performance

Kano et al. (1983) carried out an examination of 26 companies which won the Deming Application Prize (this is a prize awarded to companies for their effective implementation of company-wide quality control; for details see Chapter 12). Between 1961 and 1980 they found that the financial performance of these companies in terms of earning rate, productivity, growth rate, liquidity, and net worth was above the average for their industries. According to Lee and Lee (2013), 223 companies have won the Deming Application Prize as of 2011.

There are 95 award winners of the Malcolm Baldrige National Quality Award (MBNQA) from 1988 to 2011 in different industry sectors, such as manufacturing, health care, service, education and small business. This programme was established to enhance the competitiveness of US businesses based on the seven criteria: leadership; strategic planning; customer focus; measurement, analysis and knowledge management; workforce focus; operations focus; and results (NIST 2011).

Similarly, the European Foundation Quality Management (EFQM) Excellence Model, which was developed based on MBNQA, has been used by over 20,000 organizations across Europe (Lee and Lee 2013). The Canada Awards for Excellence, which was developed based on the National Quality Institute's Framework for Organizational Excellence, has been designed to support continuous quality improvement for non-profit organizations, such as government, education, and health care (Evans and Lindsay 2009).

Lee and Lee (2013) concluded that there are many organizations award winners in the manufacturing and service sectors. In particular, they found that the most commonly used quality awards in the world, based on number of quality awards given, are as follows: EFQM (42.1%); MBNQA (25.2%); the Deming Award (7.5%); and other quality awards (25.2%).

The cost of non-quality is high

Based on a variety of companies, industries and situations, the cost of quality (or to be more precise the cost of not getting it right the first time) ranges from 5 to 25 per cent of an organization's annual sales turnover in manufacturing or annual operating costs in service-type situations; see Dale and Plunkett (1999) for details. An organization should compare its profit-to-sales turnover ratio to that of its quality costs-to-sales turnover ratio in order to gain an indication of the importance of product and service quality to corporate profitability.

Chiarini (2015) examined the impact of the ISO 9001 non-conformity process on the cost of poor quality in different sectors, including chemical, pharmaceutical, mechanical, food, ceramic and steel. He found that the ISO 9001 non-conformity process has the same impact on these six different sectors, highlighting that the reduction in cost of poor quality was no more than 27.14 per cent. He suggested that other important factors could reduce the total cost of poor quality, including the adoption of improvement techniques such as: Six Sigma and TQM.

Customer is king

In today's markets, customer requirements are becoming increasingly more rigorous and their expectations of the product and/or service in terms of conformance, reliability, dependability, durability, interchangeability, performance, features, appearance, serviceability, user-friendliness, safety, and environmental friendliness, is also increasing. These days many superior-performing companies talk in terms of being 'customer-obsessed'. At the same time, it is likely that the competition will also be improving and, in addition, new and low-cost competitors may emerge in the marketplace. Consequently there is a need for continuous improvement in all operations of a business, involving everyone in the company. The organization that claims that it has achieved TQM and strategic process improvement will be overtaken by the competition. Once the process of continuous improvement has been halted, under the mistaken belief that TQM has been achieved, it is much harder to restart and gain the initiative on the competition (see Figure 1.3). This is why TQM should always be referred to as a process and not a programme.

Quality is a way of life

Quality is a way of organizational and everyday life. It is a way of doing business, living and conducting one's personal affairs. Quality is driven by a person's own

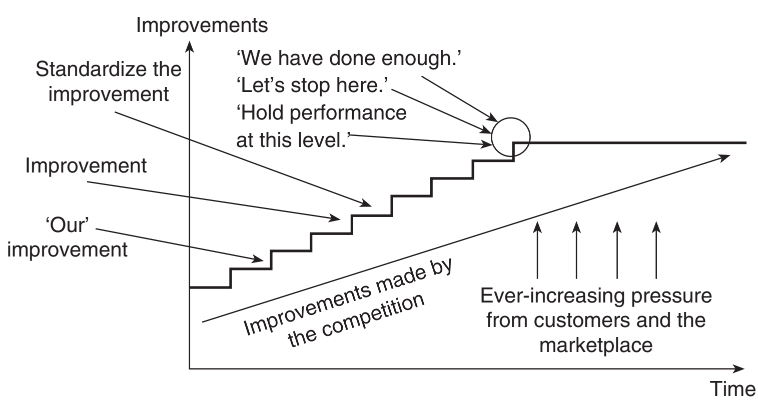

Figure 1.3 Quality improvement: a continuous process

internal mechanisms – ‘heart and soul’, ‘personal beliefs’. Belief in it can be likened to that of people who follow a religious faith. Companies like Toyota emphasize strongly the need for the commitment of all employees to managing and improving quality, which is an essential part of the famous Toyota Production System (Kull et al. 2014).

An organization committed to quality needs quality of working life of its people in terms of participation, involvement and development and quality of its systems, processes and products.

The Evolution of Quality Management

Systems for improving and managing quality have evolved rapidly in recent years. During the last two decades or so simple inspection activities have been replaced or supplemented by quality control, quality assurance has been developed and refined, and now many companies, using a process of continuous and company-wide improvement, are working towards TQM and strategic process improvement. In this progression, four fairly discrete stages can be identified: inspection, quality control, quality assurance and total quality management; it should be noted that the terms are used here to indicate levels in a hierarchical progression of quality management (Figure 1.4). British and International Standards definitions of these terms are given to provide the reader with some understanding, but the discussion and examination are not restricted by these definitions.

Inspection

> Conformity evaluation by observation and judgement accompanied as appropriate by measurement, testing or gauging. (ISO 9000 2015).

At one time inspection was thought to be the only way of ensuring quality, the ‘degree to which a set of inherent characteristics fulfils requirements’ (ISO 9000 2015). Under a simple inspection-based system, one or more characteristics of a product, service or activity are examined, measured, tested, or assessed and compared with specified requirements to assess conformity with a specification or performance standard. In a manufacturing environment the system is applied to incoming goods and materials, manufactured components and assemblies at appropriate points in the process and before finished goods are passed into the warehouse. In service, commercial and public service-type situations the system is also applied at key points, sometimes called appraisal points, in the production and delivery processes. The inspection activity is, in the main, carried out by dedicated

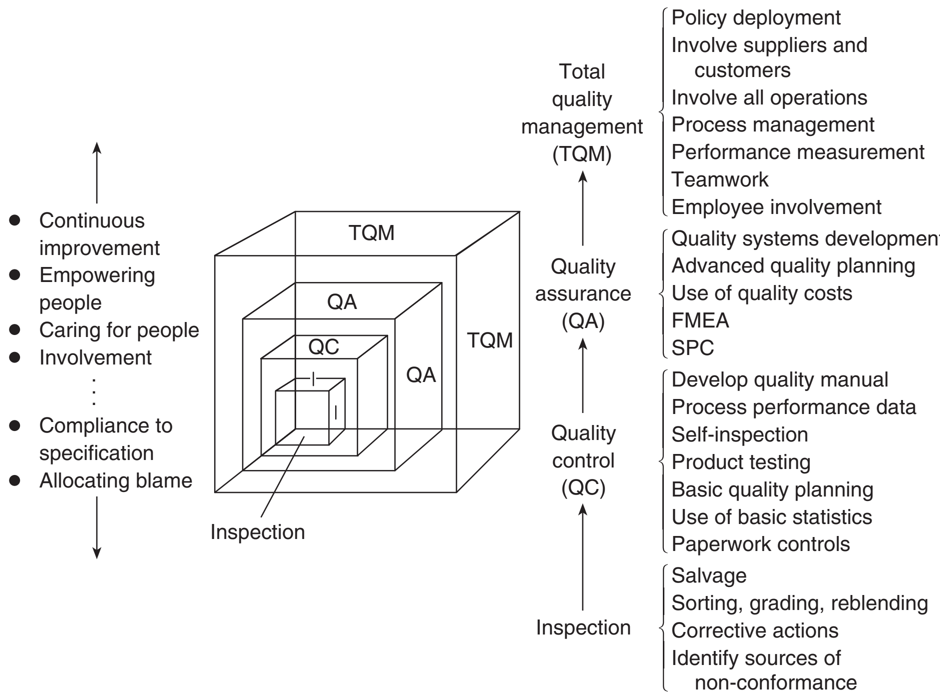

Figure 1.4 The four levels in the evolution of TQM

staff employed specifically for the purpose, or by self-inspection of those responsible for a process. Materials, components, paperwork, forms, products and goods which do not conform to specification may be scrapped, reworked, modified or passed on concession. In some cases inspection is used to grade the finished product as, for example, in the production of cultured pearls. The system is an after-the-event screening process with no prevention content other than, perhaps, identification of suppliers, operations, or workers, who are producing non-conforming products/services. There is an emphasis on reactive quick-fix corrective actions and the thinking is department-based. Simple inspection-based systems are usually wholly in-house and do not directly involve suppliers or customers in any integrated way.

Quality control

> Part of quality management focused on fulfilling quality requirements. (ISO 9000 2015)

Under a system of quality control one might expect, for example, to find in place detailed product and performance specifications, a paperwork and procedures control system, raw material and intermediate-stage product-testing and reporting activities, logging of elementary process performance data, and feedback of process information to appropriate personnel and suppliers. With quality control there will have been some development from the basic inspection activity in terms of sophistication of methods and systems, self-inspection by approved operators, use of information and the tools and techniques which are employed. While the main mechanism for preventing off-specification products and services from being delivered to customers is screening inspection, quality control measures lead to greater process control and a lower incidence of non-conformance.

Those organizations whose approach to the management of quality is based on inspection and quality control are operating in a detection-type mode (i.e. finding and fixing mistakes).

What is detection?

In a detection or 'firefighting' environment, the emphasis is on the product, procedures and/or service deliverables and the downstream producing and delivery processes; it is about getting rid of the bad things after they have taken place. Considerable effort is expended on after-the-event inspecting, troubleshooting, checking, and testing of the product and/or service and providing reactive 'quick fixes' in a bid to ensure that only conforming products and services are delivered to the customer. In this approach, there is a lack of creative and systematic work activity, with planning and improvements being neglected and defects being identified late in the process, with all the financial implications of this in terms of the working capital employed. Detection will not improve quality but only highlight when it is not present, and sometimes it does not even manage to do this. Problems in the process are not removed but contained, and are likely to come back. It also leads to the belief that non-conformances are due to the product/service not being inspected enough and also that operators, not the system, are the sole cause of the problem.

With a detection approach to quality, non-conforming 'products' (products are considered in their widest sense) are culled, sorted and graded, and decisions made on concessions, rework, reblending, repair, downgrading, scrap, and disposal. It is not unusual to find products going through this cycle more than once. While a detection-type system may prevent non-conforming product, services and paperwork from being delivered to the customer (internal or external), it does not prevent them being made. Indeed, it is questionable whether such a system does in fact find and remove all non-conforming products and services. Physical and mental fatigue decreases the efficiency of inspection and it is commonly claimed that, at best, 100 per cent inspection is only 80 per cent effective. It is often found that with a detection approach the customer also inspects the incoming

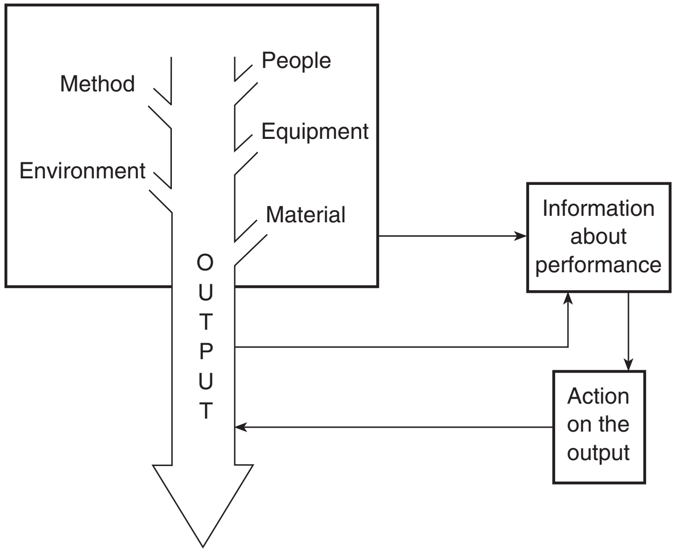

Figure 1.5 A detection-based quality system
Source: Ford Motor Company (1985)

product/service; thus the customer becomes a part of the organization's quality control system.

In this type of approach a non-conforming product must be made and a service delivered before the process can be adjusted; this is inherently inefficient in that it creates waste in all its various forms: all the action is 'after the event' and backward-looking. The emphasis is on 'today's events', with little attempt to learn from the lessons of the current problem or crisis. It should not be forgotten that the scrap, rework, retesting, reblending, and so on, are extra efforts, and represent costs over and above what has been budgeted and which ultimately will result in a reduction of bottom-line profit. Figure 1.5, taken from the Ford Motor Company (1985) three-day statistical process control course notes, is a schematic illustration of a detection-type system.

An environment in which the emphasis is on making good non-conformance rather than preventing it from arising in the first place is not ideal for engendering team spirit, co-operation and a good climate for work. The focus tends to be on switching the blame to others, people making themselves 'fireproof ', not being prepared to accept responsibility and ownership, and taking disciplinary action against people who make mistakes. In general, this behaviour and attitude emanate from middle management and quickly spread downwards through all levels of the organizational hierarchy.

Organizations operating in a detection manner are often preoccupied with the survival of their business and little concerned with making improvements.

Quality assurance

Finding and solving a problem after a non-conformance has been created is not an effective route towards eliminating the root cause of a problem. A lasting and continuous improvement in quality can only be achieved by directing organizational efforts towards planning and preventing problems from occurring at source. This concept leads to the third stage of quality management development, which is quality assurance:

> Part of quality management focused on providing confidence that quality requirements will be fulfilled. (ISO 9000 2015)

Examples of additional features acquired when progressing from quality control to quality assurance are, for example, a comprehensive quality management system to increase uniformity and conformity, use of the seven quality control tools (histogram, check sheet, Pareto analysis, cause-and-effect diagram, graphs, control chart and scatter diagram), statistical process control, failure mode and effects analysis (FMEA), and the gathering and use of quality costs. Above all one would expect to see a shift in emphasis from mere detection towards prevention of non-conformances. In short, more emphasis is placed on advanced quality planning, training, critical problem-solving tasks, improving the design of the product, process and services, improving control over the process and involving and motivating people.

What is prevention?

Quality assurance is a prevention-based system which improves product and service quality, and increases productivity by placing the emphasis on product, service and process design. By concentrating on source activities and integrating quality into the planning and design stage, it stops non-conforming product being produced or non-conforming services being delivered in the first place; even when defects occur they are identified early in the process. This is a proactive approach compared with detection, which is reactive. There is a clear change of emphasis from downstream to the upstream processes and from product to process (see Figure 1.6); 'product out' to 'customer in'. This change of emphasis can also be considered in terms of the plan, do, check, act (PDCA) cycle. In the detection approach the 'act' part of the cycle is limited, resulting in an incomplete cycle, whereas, with prevention, act is an essential part of individuals and teams striving for continuous improvement as part of their everyday work activities.

With prevention there is a clearly defined feedback loop with both negative and positive feedback into the process, product, and service development system.

Quality is created in the design stage and not at the later control stage; the majority of quality-related problems are caused by poor or unsuitable designs of

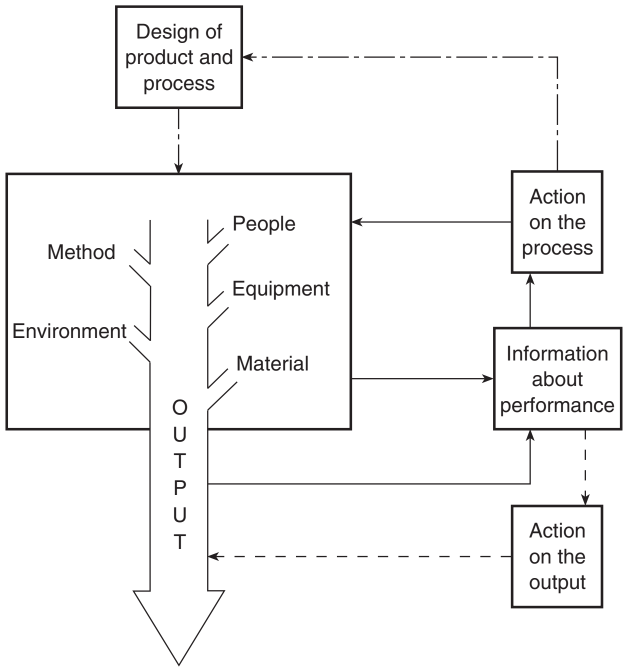

Figure 1.6 A prevention-based quality system
Source: Ford Motor Company (1985)

products and processes. In the prevention approach, there is a recognition of the process as defined by its input of people, machines, materials, method, management and environment. It also brings a clearer and deeper sense of responsibility for quality and eliminates the root cause of waste and non-value-adding activity to those actually producing and delivering the product and/or service.

Changing from detection to prevention requires not just the use of a set of tools and techniques, but the development of a new operating philosophy and approach that requires a change in management style and way of thinking. It requires the various departments and functions to work and act together in cross-functional teams to discover the root cause of problems and pursue their elimination. Quality planning and continuous improvement truly begin when top management includes prevention as opposed to detection in its organizational policy and objectives and starts to integrate the improvement efforts of various departments. This leads to the next level, that of total quality management.

Total quality management

The fourth level – TQM – involves the application of quality management principles to all aspects of the organization, including customers and suppliers, and their integration with the key business processes. It is a company-wide approach to quality, with improvements undertaken on a continuous basis by everyone in the organization. Individual systems, procedures and requirements may be no higher than for a quality assurance level of quality management, but they will pervade every person, activity and function of the organization. It will, however, require a broadening of outlook and skills and an increase in creative activities from those required at the quality assurance level. The spread of the TQM philosophy would also be expected to be accompanied by greater sophistication in the application of tools and techniques, increased emphasis on people (the so-called soft aspects of TQM), process management, improved training and personal development and greater efforts to eliminate wastage and non-value-adding activities. The process will extend beyond the organization to include partnerships with suppliers and customers and all stakeholders of the business. Activities will be reoriented to focus on the customer, internal and external, with the aim to build partnerships and go beyond satisfying the customer to delighting them. The need to self-assess progress towards business excellence is also a key issue.

There are many interpretations and definitions of TQM. Put simply, TQM is the mutual co-operation of everyone in an organization and associated business processes to produce value-for-money products and services, which meet and hopefully exceed the needs and expectations of customers. TQM is both a philosophy and a set of guiding principles for managing an organization to the benefit of all stakeholders. The seven quality management principles are defined in ISO 9001 (2015) as:

- *Customer focus.* The primary focus of quality management is to meet customer requirements and to strive to exceed customer expectations.
- *Leadership.* Leaders at all levels establish unity of purpose and direction and create conditions in which people are engaged in achieving the quality objectives of the organization.
- *Engagement of People.* Competent, empowered and engaged people throughout the organization enhance its capability to create value.
- *Process approach.* Consistent and predictable results are achieved more effectively and efficiently when activities are understood and managed as interrelated processes that function as a coherent system.
- *Improvement.* Successful organizations have an ongoing focus on improvement.
- *Evidence-Based Decision Making.* Decisions based on the analysis and evaluation of data and information are more likely to produce desired results.
- *Relationship Management.* For sustained success, organizations manage their relationships with interested parties, such as suppliers.

The Key Elements of TQM

Despite the divergence of views on what constitutes TQM, there are a number of key elements in the various definitions which are now summarized. Other chapters will provide more detail of these elements.

Commitment and leadership of the chief executive officer

Without the total demonstrated commitment of the chief executive officer and his or her immediate executives and other senior managers, nothing much will happen and anything that does will not be permanent. They have to take charge personally, lead the process, provide direction, and exercise forceful leadership, including dealing with those employees who block improvement and impetus. However, while some specific actions are required to give TQM and strategic process improvement a focus, as quickly as possible it must be seen as the style of management and the natural way of operating a business.

Planning and organization

Planning and organization feature in a number of facets of the improvement process, including:

- Developing a clear long-term strategy for TQM which is integrated with other strategies such as information technology, production/operations and human resources and also with the business plans of the organization.
- Deployment of the policies through all stages of the organizational hierarchy with objectives, targets, projects and resources agreed with those responsible for ensuring that the policies are turned from words into actions (see Chapter 8).
- Building product and service quality into designs and processes.
- Developing prevention-based activities (e.g. mistake-proofing devices).
- Putting quality assurance procedures into place which facilitate closed-loop corrective action.
- Planning the approach to be taken to the effective use of quality systems, procedures and tools and techniques, in the context of the overall strategy.
- Developing the organization and infrastructure to support the improvement activities.

Using tools and techniques

To support and develop a process of continuous improvement, an organization will need to use a selection of tools and techniques within a problem-solving approach (Papalexi et al. 2015). These should be used to facilitate improvement and be integrated into the routine operation of the business. The organization should develop a route map for the tools and techniques that it intends to apply. The use of tools and techniques as the means will help to get the process of improvement started: employees using them feel involved and that they are making a contribution, quality awareness is enhanced, behaviour and attitude change starts to happen, and projects are brought to a satisfactory conclusion.

Education and training

Employees, from the top to the bottom of an organization, should be provided with the right level and standard of education and training to ensure that their general awareness and understanding of quality management concepts, skills, competencies and attitudes are appropriate and suited to the continuous improvement philosophy; it also provides a common language throughout the business. A formal programme of education and training needs to be planned and provided on a timely and regular basis to enable people to cope with increasingly complex problems. It should suit the operational conditions of the business: is training done in a cascade mode (everyone is given the same basic training within a set time frame) or is an infusion mode (training provided as a gradual progression to functions and departments on a need-to-know basis) more suitable? This programme should be viewed as an investment in developing the ability and knowledge of people and helping them realize their potential. The training programme must also focus on helping managers think through what improvements are achievable in their areas of responsibility. It has to be recognized that not all employees will have received and acquired adequate levels of education. The structure of the training programme may incorporate some updating of basic educational skills in numeracy and literacy, but it must promote continuing education and self-development. In this way, the latent potential of many employees will be released and the best use of every person's ability achieved.

Involvement

There must be a commitment and structure to the development of employees, with recognition that they are an asset which appreciates over time. All available means, from suggestion schemes to various forms of teamwork, must be considered for achieving broad employee interest, participation and contribution in the improvement process; management must be prepared to share information and some of their powers and responsibilities, and to loosen the reins. Part of the approach to TQM and strategic process improvement is to ensure that everyone has a clear understanding of what is required of them, how their processes relate to the business as a whole and how their internal customers are dependent upon them. The more people who understand the business and what is going on around them, the greater the role they can play in the improvement process. People have got to be encouraged to control, manage and improve the processes which are within their sphere of responsibility.

Teamwork

Teamwork needs to be practised in a number of forms. Consideration needs to be given to the operating characteristics of the teams employed, how they fit into the organizational structure and the roles of member, team leader, sponsor and facilitator. Teamwork is one of the key features of involvement, and without it difficulty will be found in gaining the commitment and participation of people throughout the organization. It is also a means of maximizing the output and value of individuals.

There is also a need to recognize positive performance and achievement and celebrate and reward success. People must see the results of their activities and that the improvements they have made really do count. This needs to be constantly encouraged through active and open communication. If TQM is to be successful it is essential that communication must be effective and widespread. Sometimes managers are good talkers but poor communicators.

Measurement and feedback

Measurement, from a baseline, needs to be made continually against a series of key results indicators – internal and external – in order to provide encouragement that things are getting better (i.e. fact rather than opinion). External indicators are the most important as they relate to customer perceptions of product and/or service improvement. The indicators should be developed from existing business measures, external, competitive and functional generic and internal benchmarking, as well as customer surveys and other means of external input. This enables progress and feedback to be clearly assessed against a roadmap or checkpoints. From these measurements, action plans must be developed to meet objectives and bridge gaps.

Ensuring that the culture is conducive to continuous improvement activity

It is necessary to create an organizational culture that is conducive to continuous improvement and in which everyone can participate. Quality assurance also needs to be integrated into all of an organization's processes and functions. This requires changing people's behaviour, attitudes and working practices in a number of ways. For example:

- Everyone in the organization must be involved in 'improving' the processes under their control on a continuous basis and take personal responsibility for their own quality assurance.
- Employees must be encouraged to identify wastage in all its various forms to take out cost and get more value into a product or service.
- Employees can stop a process without reference to management if they consider it to be not functioning correctly.
- Employees must inspect their own work.
- Defects must not be passed, in whatever form, on to the next process.
- Each person must be committed to satisfying their customers, both internal and external.
- External suppliers and customers must be integrated into the improvement process.
- Mistakes must be viewed as an improvement opportunity.
- Honesty, sincerity and care must be an integral part of daily business life.

Changing people's behaviour and attitudes is one of the most difficult tasks facing management, requiring considerable powers and skills of motivation and persuasion; considerable thought needs to be given to facilitating and managing culture change.

The following section analyses the role of senior managers during the implementation of TQM and strategic process improvement. Developing and deploying organizational vision, mission, philosophy, values, strategies, objectives and plans, and communicating the reasons behind them together with the underlying logic is the province of senior management. This is why senior management have to become personally involved in the introduction and development of TQM and strategic process improvement, and demonstrate visible commitment to and confidence in it by leading this way of thinking and managing the business. Senior management must devote time to learning about the subject, including attending suitable training courses and conferences. If this is achieved it avoids false starts and helps to ensure longevity.

The Need for Senior Managers to Get Involved in TQM

The decision to start working on TQM and strategic process improvement can only be taken by the chief executive officer (CEO) in conjunction with the senior management team. They have to encourage a total corporate commitment to continually improve every aspect of the business. Quality is an integral part of the management of an organization and its business processes and is too important an issue to delegate to technical and quality specialists.

The ultimate aim is to have people taking ownership of the quality assurance of their processes and to have a mindset of continuous improvement. This state of affairs is not a natural phenomenon and does not happen overnight, and senior managers must be prepared to spend time coaching people along this path and providing the necessary influences.

Senior managers should be sensitive to the fact that some employees will resist the change to TQM. The usual reasons for this are that they are uncertain of the nature and impact of TQM and strategic process improvement, and their ability to cope: the change may lessen their authority over decisions and allocation of resources, and it threatens their prestige and reputation. If senior managers are personally involved in the change process it can help to breakdown these barriers.

Mohammad Mosadeghrad (2014) reported on his research that supportive leadership, consistent support of top management and employee involvement are critical to TQM success. One of the key roles of senior management is to develop effective strategies in order to support and enhance the chances of achieving business excellence (Sallis 2014).

The CEO must have faith in the long-term plans for TQM and strategic process improvement, and not expect immediate financial benefits. However, there will be achievable benefits in the short term, providing that the introduction of TQM is soundly based. Senior managers need to create and promote an environment in which, for example:

- People can work together as a team and teamwork becomes an integral part of business activities.
- Effective two-way communication is in place.
- People are involved in the business through decision-making.
- People improve on a continuous basis the processes under their control (i.e. the continuous improvement and passion for doing things better mindset).
- People direct their attention to identifying, satisfying, delighting and winning over customers, whether they be internal or external.
- Ideas are actively sought from everyone.
- Mistakes are freely admitted without recriminations and are perceived as an opportunity for improvement (i.e. a ‘blame-free’ culture).
- Recognition is given for improvement activities.

However, change is not something that any department or individual takes to easily, and administering changes in organizational practices has to be considered with care. It is only senior managers who can influence the indifference and persuade people that the organization is serious about TQM. It is they who have got to communicate in person to their people why the organization needs continuous improvement and demonstrate that they really care about quality. This can be done by getting involved in activities such as:

- Setting up and chairing a TQM steering committee or quality council.
- Identifying the major quality issues facing the organization and becoming personally involved in investigating them.
- Getting involved in quality planning, audit, improvement meetings and organizational housekeeping.
- Leading and/or attending quality training courses.
- Organizing and chairing defect review and customer return committees.
- Instigating and carrying out regular audits, self-assessment and diagnosis of the state of the art of TQM and continuous improvement.
- Dealing with customer complaints, and visiting customers and suppliers.
- Leading customer workshops, panels and focus groups.
- Visiting, on a regular basis, all areas and functions of the business, and discussing improvement issues.
- Developing, communicating and then following a personal improvement action plan.

The improvement process is a series of troughs and peaks (see Figure 1.7). At certain points in the process, the situation will arise that while a considerable amount of organizational resources are being devoted to improvement activities, little progress appears to be being made. In the first three or so years of launching a process of continuous improvement, and when the process is at one of these low

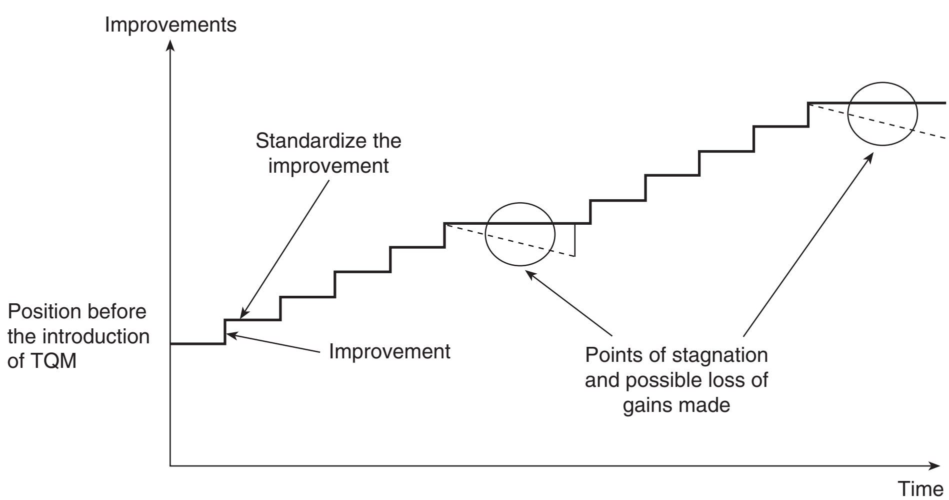

Figure 1.7 The quality improvement process

points, it is not uncommon for some middle and first-line managers and functional specialists to claim that TQM is not working and start to raise issues such as: 'Why are we doing this?'; 'Are we seeing real improvements?'; 'What are the benefits?'; 'Have we the time to spend on this?'. If the CEO is personally involved in TQM and perceived to be so, people are much less likely to express this type of view. The CEO and senior managers have a key role to play in helping to get people through this crisis of confidence in TQM. There are a number of mechanisms which can assist with this. For example, the managing director of a specialty chemicals company introduced the concept of 'Quality Action Days' to give all employees the opportunity to meet him and express their views and concerns on the company's progress with TQM and what could be done to speed up the process of employee involvement.

Organizations are not usually experienced in maintaining the gains made in TQM. In addition to leadership and organizational changes, factors such as takeovers, human resources and industrial relations problems, short-time working, redundancies, cost-cutting, streamlining, no salary increases, growth of the business, and pursuit of policies which conflict with TQM in terms of resources, etc. can all have an adverse effect on the gains made and damage the perception of TQM and strategic process improvement. People will be looking to senior managers to provide continuity and leadership in such circumstances.

What Senior Managers Need to Know about TQM

The first thing senior managers must realize from the outset is that TQM is a long-term and not a short-term intervention and that it is an arduous process. They must also realize that TQM is not the responsibility of the quality function. There are no:

- Quick fixes
- Easy solutions
- Universal panaceas
- Tools, techniques and/or systems which will provide all the answers
- Ready-made packages which can be plugged in and guarantee success.

The planning horizon to put the basic TQM principles into place is between eight and ten years. The Japanese manufacturing companies typically work on 16 years made up of four-year cycles – introduction, promotion into non-manufacturing areas, development/expansion, and fostering advancement and maintenance. Consequently, senior managers have got to practice and communicate the message of patience, tolerance and tenacity. It is highly likely that there will be some middle-management resistance to TQM, in particular from those managers with long service, who are concerned with the new style of managing, more than from staff and operatives.

In spite of the claims made by some writers, consultants and 'experts', senior managers must recognize there is no single or best way of introducing and developing TQM. Senior managers need to commit time in order to develop their own personal and group understanding of the subject; cohesion in the senior management team, which comes from understanding, is important in making the changes which are necessary with TQM. They need to read books, attend conferences and courses, visit the best practices in terms of TQM and talk to as many people as possible. The self-assessment criteria of the MBNQA and EFQM performance and excellence models (as outlined in Chapter 12) can assist in developing this overall understanding. This understanding of TQM will also assist the CEO in deciding, together with other senior managers and key staff, how the organization is going to introduce TQM. For example,

- What method and format of training are required?
- How many and what type of teams will be introduced?
- How many teams can be effectively supported?
- Which tools and techniques should be used?
- What is the role of a quality management system?
- How will TQM contribute to reducing warranty claims?

To start and then develop a process of continuous improvement, an infrastructure is required to support the associated tasks and departments and people need to be able to devote time to quality planning, and to prevention and improvement activities. Maletič et al. (2012) point out that continuous improvement is directly related to maintenance performance. Senior managers must diagnose the organization's strengths and opportunities for improvement in relation to the management of quality. This typically takes the form of an internal assessment of employees' views and perceptions (internal and group assessments, and questionnaire surveys), a systems audit, a cost of quality analysis, and obtaining the views of customers (including those accounts which have been lost) and suppliers about the organization's performance in terms of product, service, people, administration, innovation, strengths and weaknesses, etc. This type of internal and external assessment of perspectives should be carried out on a regular basis to gauge the progress being made towards TQM and help decide the next steps.

What Senior Managers Need to Do about TQM

This section is opened by reviewing the leadership criteria of the EFQM excellence model (EFQM 2012; see Chapter 12). The criteria detail the behaviour of all managers in driving the company towards business excellence. They concern how the executives and all other managers inspire and drive excellence as an organization's fundamental process for continuous improvement. The leadership criteria are divided into the following five parts:

- Leaders develop the mission, vision, values and ethics, and are role models of a culture of excellence.
- Leaders are personally involved in ensuring the organization's management system is developed, implemented and continuously improved.
- Leaders interact with customers, partners and representatives of society.
- Leaders reinforce a culture of excellence with the organization's people.
- Leaders identify and champion organizational change.

Senior managers need to decide the actions they are going to take to ensure that quality becomes the number one priority for the organization. They need to allocate time and commitment to:

- Decide how the company will approach the introduction and advancement of TQM.
- Communicate in an effective manner their views on TQM and strategic process improvement, recognizing the difference between the art and medium of communication.
- Lead education and training sessions, including the review of courses.
- Assess the improvements made.
- Get personally involved in improvement activities.
- Determine if the main principles of TQM are being absorbed into the day-to-day operations of the business.
- Understand how key competitors are using TQM.
- Lead and encourage the use of self-assessment methods and principles.

It is the responsibility of senior managers to ensure that everyone in the organization knows why the organization is adopting TQM and that people are aware of its potential in their area, department, function and/or process. Their commitment must filter down through all levels of the organization. It is important that all employees feel they can demonstrate initiative and have the responsibility to put into place changes in their own area of work.

A company-wide education and training programme needs to be planned and undertaken to facilitate the right type and degree of change. The aim of this programme should be to promote a common TQM language and awareness and understanding of concepts and principles, ensure that there are no knowledge gaps at any level in the organization, and provide the skills to assist people with improvement activities; this should include team leadership, counselling and coaching skills. A planned programme of training is required in order to provide employees with tools and techniques on a timely basis.

The CEO needs to delegate responsibility for continuous improvement to people within the organization. Some organizations appoint a facilitator/manager/co-ordinator to act as a catalyst or change agent. However, if this is to be effective the CEO must have a good understanding of TQM and the continuous improvement process. An infrastructure to support the improvement activities needs to be developed in terms of:

- Monitoring and reporting the results (there is nothing like success to convert cynics and counter indifference).
- Providing a focus and the people to make it happen.
- Developing and deploying improvement objectives and targets.
- Involving people from non-manufacturing areas.

It is helpful to establish a TQM steering committee or quality council type of activity to oversee and manage the improvement process. The typical role of such a group is to:

- Agree plans and goals and provide and manage resources.
- Monitor progress.
- Determine actions.
- Create an environment which is conducive to continuous improvement.
- Concur on issues of continuous improvement.
- Facilitate teamwork.
- Ensure that firm foundations are laid down.
- Identify impediments to progress.

From the vision and mission statements a long-term plan needs to be drawn up which sets out the direction of the company in terms of its development and management targets. This plan should be based on the corporate philosophy, sales forecast, current status, and previous achievements against plan and improvement objectives (Oakland 2011). It typically focuses on areas affecting quality, cost, delivery, safety and the environment. From this long-term plan an annual policy should be compiled, and plans, policies, actions, and improvement objectives established for each factory, division, department and section.

The process of policy deployment ensures that the quality policies, targets and improvement objectives are aligned with the organization's business goals. The ideal situation in policy deployment is for the senior person at each level of the organizational hierarchy to make a presentation to their staff on the plan, targets and improvements. One of the key aspects of policy deployment is its high visibility, with company and departmental policies, targets, themes and projects being displayed in each section of the organization. There must also be some form of audit at each level to check whether or not targets and improvement objectives are being achieved, and the progress being made with specific improvement projects. This commitment to quality and the targets and improvements made should be communicated to customers and suppliers. Some organizations use seminars to explain these policies and strategies. The respective reporting and control systems must be designed and operated in a manner which will ensure that all managers co-operate in continuous improvement activities.

The CEO must ensure that his or her organization really listens to what its customers are saying and is sensitive to what they truly need and to their concerns. This customer information is the starting point of the improvement-planning process. For example, a major blue-chip packaging manufacturer works with its customers to ensure that the packaging it produces is suited to the customers' packaging equipment. Senior managers must ensure that corrective action procedures and defect analysis are pursued vigorously and a closed-loop system operated to prevent repetition of mistakes. Positive quantifiable measures of quality as seen by its customers enable an outward focus to be kept on the market in terms of customer needs and future expectations. These typical performance measures include:

- Field failure statistics
- Reliability performance statistics
- Customer returns
- Customer complaints
- 'Things gone wrong' data
- Adverse customer quality communications
- Customer surveys
- Lost business
- Non-accepted tenders
- Prospect to customer conversion rate.

They also need to develop internal performance measures on metrics such as:

- Non-conformance levels
- Quality audit results
- Yield results
- Quality costs
- Employee satisfaction
- Employee involvement
- Service level agreements
- Score achieved against the EFQM or MBNQA models
- Percentage of employees satisfied that the organization is customer-focused and is a quality company.

It is usually necessary to evaluate the current internal and external performance measures to assess their value to the business. Without a measurement system to monitor the progress, continuous improvement will be more difficult (Kerzner 2013).

Senior managers should never overlook the fact that people will want to be informed on how the improvement process is progressing. They need to put into place a two-way process of communication for ongoing feedback and dialogue: this helps to close the loop. Regular feedback needs to be made about any concerns raised by employees; this will help to stimulate further involvement and improve communication. This also enables them to pinpoint any impediments to the process of continuous improvement.

Continuous improvement can be facilitated by the rapid diffusion of information to all parts of the organization. A visible management system and a storyboard-style presentation in which a variety of information is collected and displayed is a very useful means of aiding this diffusion. The CEO needs to consider seriously this form of transparent system.

Summary

This chapter defines quality and highlights its importance. It discusses the cost of lack of quality throughout the production of a product and/or the delivery of a service. It introduces the TQM, analysing the key element: commitment and leadership of the chief executive officer; planning and organization; using tools and techniques; education and training; involvement; teamwork; measurement and feedback. A list of points is offered which organizations should keep in mind when developing TQM and strategic process improvement. It also presents the role which senior managers need to take and the visionary leadership they need to display if TQM and strategic process improvement is to be successful. The chapter has outlined some of the things they need to get involved with, including chairing the TQM steering committee, organizing and chairing Defect Review Boards, leading self-assessment of progress against a model for business excellence, developing and then following a personal improvement action plan and sponsoring improvement teams. The chapter has summarized what senior management need to know about TQM and what they need to do to ensure TQM is successful and treated as part of normal business activities.

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Chapter Two

The Received Wisdom on TQM

B. G. Dale, M. Papalexi, D. Bamford and A. van der Wiele

Introduction

The purpose of this chapter is to introduce the reader to what the leading exponents of TQM have to say on the subject and explore, in brief, their teachings and advice.

In the Western world the four best-known quality management experts are all Americans – Crosby (1979), Deming (1982), Feigenbaum (1961/1983) and Juran (1988). These four men have had a considerable influence on the development of TQM in organizations throughout the world. In addition to the approaches and philosophies of these four experts the Japanese quality management culture is also widely publicized (Goetsch and Davis 2014; Sallis 2014). The work and ideas of a number of Japanese quality experts have been published in English. They include Imai (1986), Ishikawa (1985), Mizuno (1988), Nemoto (1987), Ozeki and Asaka (1990), Shingo (1986) and Taguchi (1986, and Taguchi et al. 2004). The ideas of these Japanese experts are all being applied in the West, but perhaps the work of Imai, Ishikawa, Shingo and Taguchi is the best known. It is for this reason that it is briefly reviewed here before considering some of the familiar concepts associated with how Japanese companies manage a process of continuous and company-wide improvement.

Given that the quality management discipline has come of age, some of the early contributors are already deceased. Their work is nevertheless discussed in this chapter because it helps to understand the developments that have taken place in the quality management discipline.

Crosby (1926–2001)

Philip B. Crosby's audience was primarily top management: he sold his approach to them and stressed increasing profitability through quality improvement. His argument was that higher quality reduces costs and raises profits. He defined quality as ‘conformance to requirements’, not as ‘goodness’. Crosby’s programme has 14 steps (Crosby 1979) that focus on how to change the organization and tend to be a specific action plan for implementation (see Box 2.1).

BOX 2.1 CROSBY’S 14-STEP QUALITY IMPROVEMENT PROGRAMME

1. Management commitment
2. Quality improvement team
3. Quality measurement
4. Cost of quality evaluation
5. Quality awareness
6. Corrective action
7. Establish an ad hoc committee for the zero defects programme
8. Supervisor training
9. Zero defects day
10. Goal-setting
11. Error cause removal
12. Recognition
13. Quality councils
14. Do it over again

Crosby’s approach is based on four absolutes of quality management, summarized as:

- Quality is defined as conformance to requirements.
- The system for achieving quality is prevention not appraisal.
- The only performance standard is zero defects.
- The measurement of quality is the cost of quality.

Crosby also produced a ‘quality vaccine’ comprising 21 areas divided into the five categories of integrity, systems, communications, operations and policies, which he treated as preventative medicine for poor quality. He argued that a business can be vaccinated against non-conformance to quality requirements.

He did not accept the optimal quality level concept because he believed that higher quality always reduces costs and raises profits. Cost of quality is used as a tool to help achieve that goal. With respect to the cost of quality he produced the first serious alternative to the prevention, appraisal, failure (PAF) categorization with the price of conformance (POC) – doing things right – and price of nonconformance (PONC) – doing things wrong – model. In terms of employee roles, Crosby allocated a moderate amount of responsibility to the quality professional. Top management has an important role, and the hourly workforce has a role, which is limited to reporting problems to management. One way that Crosby measured quality achievement was with a matrix, the quality management maturity grid, which charts the stages that management goes through from ignorance to enlightenment.

In summary, Crosby is acknowledged as a great motivator of senior management in helping them to understand how to get the improvement process started. His approach is generally regarded as simple and easy to follow. His critics often claim he lacked substance in giving detailed guidance on how to apply quality management principles, tools, techniques and systems. However, on the other hand, it can be argued that he simply wished to avoid being prescriptive.

Deming (1900–1993)

W. Edwards Deming's argument was that quality, through a reduction in statistical variation, improves productivity and competitive position. His early thinking was influenced by Shewhart, who is considered as the father of statistical quality control (Shewhart 1931). Shewhart became Deming's teacher and mentor and Deming subsequently became the evangelist for the statistical method. He defined quality in terms of quality of design, quality of conformance, and quality of the sales and service function. Deming's main argument was that by improving quality it is possible to increase productivity and this will improve organizational competitiveness. He did not accept the trade-off shown in the 'economic cost of quality' models and said there is no way to calculate the cost of delivering defective products to customers, which he believed is the major quality cost.

Deming advocated the measurement of quality by direct statistical measures of manufacturing performance against specification. While all production processes exhibit variation, the goal is to reduce variation. Deming's approach is highly statistical and he believed that every employee should be trained in statistical quality techniques. A 14-point approach (Deming 1986) summarizes his management philosophy for improving quality and changing the organization's culture (see Box 2.2).

Deming's view was that quality management and improvement are the responsibility of all the firm's employees: top management must adopt the 'new religion' of quality, lead the drive for improvement and be involved in all stages of the process. Hourly workers should be trained and encouraged to prevent defects and improve quality, and be given challenging and rewarding jobs. Quality professionals should educate other managers in statistical techniques and concentrate on improving the methods of defect prevention. Finally, statisticians should consult with all areas of the company.

BOX 2.2 DEMING'S 14 POINTS FOR MANAGEMENT

1 Create constancy of purpose towards improvement of product and service, with the aim to become competitive, stay in business, and to provide jobs.
2 Adopt the new philosophy – we are in a new economic age. Western management must awaken to the challenge, learn their responsibilities and take on leadership for future change.
3 Cease dependence on inspection to achieve quality. Eliminate the need for inspection on a mass basis by building quality into the product in the first place.
4 End the practice of awarding business on the basis of price tag. Instead, minimize total cost. Move towards a single supplier for any one item on a long-term relationship of loyalty and trust.
5 Improve constantly and for ever the system of production and service, to improve quality and productivity, and thus constantly decrease costs.
6 Institute training on the job.
7 Institute leadership (see point 12): the aim of supervision should be to help people, machines and gadgets to do a better job. Supervision of management, as well as supervision of production workers, is in need of overhaul.
8 Drive out fear, so that everyone may work effectively for the company.
9 Break down barriers between departments. People in research, design, sales and production must work as a team, to foresee problems of production and problems in use that may be encountered with the product or service.
10 Eliminate slogans, exhortations and targets for the workforce that ask for zero defects and new levels of productivity. Such exhortations only create adversarial relationships, as the bulk of the causes of low quality and low productivity belong to the system and thus lie beyond the power of the workforce.
11a Eliminate work standards (quotas) on the factory floor; substitute leadership instead.
11b Eliminate management by objectives, by numbers and by numerical goals; substitute leadership instead.
12a Remove barriers that rob the hourly worker of his or her right to pride of workmanship. The responsibility of supervisors must be changed from sheer numbers to quality.
12b Remove barriers that rob people in management and in engineering of their right to pride of workmanship. This means, inter alia, abolishment of the annual or merit rating, and of management by objectives.
13 Institute a vigorous programme of education and self-improvement.
14 Put everybody in the company to work to accomplish the transformation. The transformation is everybody's job.

Deming's other contributions include the PDCA (plan, do, check, act) or the PDSA (plan, do, study, act) cycle of continuous improvement, which Deming termed the Shewhart cycle, and the pinpointing of the seven 'deadly diseases' (lack of consistency of purpose; emphasis on short-term profits; evaluation of performance, merit rating, or annual review; mobility of management; running a company on visible figures alone; excessive medical costs; and excessive cost of liability), which he used to criticize Western management and organizational practices.

In summary, Deming expected managers to change – to develop a partnership with those at the operating level of the business and to manage quality with direct statistical measures without cost-of-quality measures. Deming's approach, particularly his insistence on the need for management to change the organizational culture, is closely aligned with Japanese practice. This is not surprising in view of the assistance he gave to the Japanese after the Second World War. Late in his life, Deming defined his approach to management as a system of profound knowledge.

A number of Deming user groups and associations have been formed, which are dedicated to facilitating awareness and understanding of his work and helping companies introduce his ideas. Also a number of authors (e.g. Madu 2012; Deming and Orsini 2013; Goetsch and Davis 2014; Sallis 2014) have produced books explaining Deming's approach and ideas.

Feigenbaum (1922–2014)

Armand V. Feigenbaum was General Electric's worldwide chief of manufacturing operations for a decade until the late 1960s. Later, he became president of an engineering consultancy firm, General Systems Co., which designs and installs operational systems in corporations around the world. Feigenbaum is the originator of the term 'total quality control', defined in 1961 in his first edition of *Total Quality Control* as:

> an effective system for integrating the quality-development, quality-maintenance, and quality-improvement efforts of the various groups in an organization so as to enable marketing, engineering, production, and service at the most economical levels which allow for full customer satisfaction.

Feigenbaum did not try so much to create managerial awareness of quality as to help a plant or company design its own system. To him, quality is a way of managing a business organization and is the responsibility of everyone (at the time this was a major contribution to the quality debate). Significant quality improvement can only be achieved in a company through the participation of everyone in the workforce, who must, therefore, have a good understanding of what management is trying to do.

Senior management's understanding of the issues surrounding quality improvement and commitment to incorporating quality into their management practice is crucial to the successful installation of Feigenbaum's total quality system. They must abandon short-term motivational programmes that yield no long-lasting improvement. Management must also realize that quality does not mean only that customer problems have to be fixed faster. Quality leadership is essential to a company's success in the marketplace.

Feigenbaum took a very serious financial approach to the management of quality. His major contribution to the subject of the cost of quality was the recognition that quality costs must be categorized if they are to be managed. He identified three major categories: appraisal costs, prevention costs and failure costs (Feigenbaum 1956). Total quality cost is the sum of these costs. He was also the first of the international experts to identify the folly of regarding quality professionals as being solely responsible for an organization's quality activities.

According to Feigenbaum the goal of quality improvement is to reduce the total cost of quality from the often quoted 25 to 30 per cent of annual sales or cost of operations to as low a percentage as possible. Therefore, developing cost-of-quality data and tracking it on an ongoing basis is an integral part of the process.

Feigenbaum said that management must commit themselves to:

- Strengthening the quality improvement process itself.
- Making sure that quality improvement becomes a habit.
- Managing quality and cost as complementary objectives.

In summary, though he did not espouse 14 points or steps like Deming or Crosby, it is obvious his approach is not significantly different: it simply boils down to managerial know-how. He did, however, identify 10 benchmarks for success with TQM (see Box 2.3).

BOX 2.3 FEIGENBAUM'S 10 BENCHMARKS FOR TOTAL QUALITY SUCCESS

1. Quality is a company-wide process.
2. Quality is what the customer says it is.
3. Quality and cost are a sum, not a difference.
4. Quality requires both individual and team zealotry.
5. Quality is a way of managing.
6. Quality and innovation are mutually dependent.
7. Quality is an ethic.
8. Quality requires continuous improvement.
9. Quality is the most cost-effective, least capital-intensive route to productivity.
10. Quality is implemented with a total system connected with customers and suppliers.

Juran (1904–2008)

Joseph M. Juran has made perhaps a greater contribution to the quality management literature than any other quality professional. Like Deming, he has had an influence in the development of quality management in Japanese companies and also worked with Shewhart at the Hawthorn plant, a Western Electric company in Illinois. While Deming provided advice on statistical methods to technical specialists from the late 1940s onwards, Juran in the mid-1950s focused on the role of senior people in quality management. Juran was the first to broaden the thinking in quality control by emphasizing the importance of management and the need for a supportive infrastructure. The focus of his series of lectures was that quality control must be an integral part of the management function and practised throughout the organization. It can be argued that the teachings of Juran provided the catalyst which resulted in the involvement of first-line supervisors and operators in the improvement process (Juran and Godfrey 1999; Pederson, Dresdow and Benson 2013; Kamonja et al. 2014).

Part of his argument is that companies must reduce the cost of quality. This is dramatically different from Deming. Deming ignored the cost of quality while Juran, like Crosby and Feigenbaum, claimed that reducing it is a key objective of any business. A 10-point plan summarizes his approach (see Box 2.4).

BOX 2.4 THE JURAN METHOD

1. Build awareness of the need and opportunity for improvement.
2. Set goals for improvement.
3. Organize to reach the goals.
4. Provide training.
5. Carry out projects to solve problems.
6. Report progress.
7. Give recognition.
8. Communicate results.
9. Keep the score.
10. Maintain momentum by making annual improvement part of the regular system and processes of the company

Juran defined quality as ‘fitness for use’, which he broke down into quality of design, quality of conformance, availability, and field service. The goals of Juran’s approach to quality improvement are increased conformance and decreased cost of quality, and yearly goals are set in the objective-setting phase of the programme. He developed a quality trilogy comprising quality planning, quality control and quality improvement. Juran defined two major kinds of quality management – breakthrough (encouraging the occurrence of good things), which attacks chronic problems, and control (preventing the occurrence of bad things), which attacks sporadic problems. He viewed the improvement process as taking two journeys – from symptom to cause (diagnosis) and from cause to remedy (diagnosis to solution).

Juran also allocated responsibility among the workforce differently from Deming. He put the primary responsibility onto quality professionals (who serve as consultants to top management and employees). The quality professionals design and develop the programme, and do most of the work. While granting the importance of top management support, Juran placed more of the quality leadership responsibility on middle management and quality professionals. The role of the workforce is mainly to be involved in quality improvement teams.

In summary, Juran emphasized the cost of quality, because the language of top management is money, and he recommended cost of quality for identifying quality improvement projects and opportunities and developing a quality cost scoreboard to measure quality costs. Juran's approach is more consistent with American management practices – he took the existing management culture as a starting point and built a quality improvement process from that baseline. In contrast to Deming he considered that if the energy generated by fear is harnessed and focused in a positive direction it can be a positive rather than a negative factor.

Are the Approaches of these Gurus Different?

Advocates of each guru are apt to claim that 'their man's' approach is the only one likely to work. This is an arrogant and myopic stance to adopt; each approach has its strengths and weaknesses and they are all proven packages. None of the experts has all the answers to the problems facing an organization, despite each guru and, in particular, their supporters stressing the exclusivity of their approaches and methods. It is also worth remembering that all four of these experts were consultants and it was in their own business interests and those of their supporters to distinguish their approach from those of their peers, and appear to have all the answers.

The ways of approaching quality management as suggested by Crosby, Deming, Feigenbaum and Juran are variations on a theme; the essential difference is the focus of their approach. A number of writers (e.g. Chiarini 2011; Reid et al. 2011; Oakland 2014; McCabe 2014; Ngee Goh 2014; Sallis 2014) have compared and contrasted the approaches of the four gurus and these commentaries are helpful in assessing the value of each approach. Broadly speaking, the teachings of these four gurus can be characterized by the main focus of their approach, as follows:

- Crosby: company-wide motivation.
- Deming: statistical process control.
- Feigenbaum: systems management.
- Juran: project management.

Imai (b. 1930)

Masaaki Imai (1986, 1997) is the person credited with bringing together the various management philosophies, theories, techniques and tools which have assisted Japanese companies over the last four or so decades to improve their efficiency. The published evidence indicates that the impact of Kaizen in Japanese companies has been considerable.

In simple terms, Kaizen is the process of incremental, systematic, gradual, orderly and continuous improvement that uses the best of all techniques, tools, systems and concepts (e.g. TPM, JIT, SMED, quality circles and the PDCA cycle). The aim of Kaizen is to ensure that everyone in an organization is of the frame of mind to pursue naturally continuous improvement in whatever they do. It also encourages people to accept continuing change at the place of action (the *gemba*, which means changing people's mindset about the organization and how they view their job). Running through the concept are a number of basic principles such as:

- Continuous focus on improvement
- Everyone in the company should be involved
- Delighting the customer
- Everything should be considered from a total system standpoint.

The key elements of Kaizen are:

- Adaptability of both people and equipment
- Use of existing technology to optimize capacity
- Creative involvement of all employees
- 'Make it a little better each day' attitude.

Ishikawa (1915–1989)

Kaoru Ishikawa's contribution is in three main areas: (1) the simplification and widespread use of the seven basic quality control tools; (2) the company-wide quality movement; and (3) quality circles. His thinking covers a number of aspects of modern-day TQM. An underlying theme throughout Ishikawa's work

(Ishikawa 1979, 1985, 1991) was that people at all levels of the organization should use simple methods and work together to solve problems, thereby removing barriers to improvement, co-operation and education and developing a culture that is conducive to continuous improvement.

Ishikawa developed the cause-and-effect diagram and was also responsible for bringing together the selection of tools which are now known as the seven basic quality control tools. His argument was that these seven tools, when used together, could help solve most problems.

He was an original member of the quality control research group of the Japanese Union of Scientists and Engineers (JUSE). In particular, he was on the editorial staff of the JUSE publication *Gemba to QC*, which, when it was launched in April 1962, called for the formation of quality circles (Sasaki and Hutchins 2014). This is the reason why Ishikawa is regarded as the 'father of quality control circles'. JUSE organized training programmes for shop-floor supervisors – workshop quality control study groups – and this led to the publication of the textbook. Subsequently, JUSE started to register the quality circles that then formed in manufacturing organizations. From this start Ishikawa played a great role in the development of quality circles in Japan and assisted with worldwide spread of the concept.

Shingo (1909–1990)

Shigeo Shingo has had a number of books translated into English (e.g. Shingo 1985, 1986, 1989). He is best known for his work on single minute exchange of die (SMED), the mistake-proofing (poka-yoke) defect prevention system and, in conjunction with Taiichi Ohno (1988), the development of the Toyota production system. He liked to be known as 'Dr Improvement' and is renowned for his work on improving manufacturing processes.

Shingo advocated the use of the poka-yoke system to reduce and eliminate defects. He classified poka-yoke systems into two types: regulatory functions and setting functions. Two main functions are performed by the regulatory devices: (1) control methods which, when abnormalities are detected, shut down the machine thus preventing the occurrence of further non-conformities, and (2) warning methods which signal, by means of noise and/or light devices, the occurrence of an abnormality. There are three main types of poka-yoke setting functions: (1) contact methods in which sensing devices detect abnormalities; (2) fixed-value methods in which abnormalities are detected by counting devices; and (3) motion-step methods where abnormalities are detected by failure to follow a predetermined motion or routine.

The term SMED refers to the theory and technique for performing set-up operations in less than 10 minutes. It is a fundamental approach to continuous improvement, bringing benefits in terms of stock reduction, productivity improvements, flexibility, reduction in set-up errors and defects, and improved tool management. The concept of SMED and quick changeover advanced by Shingo challenges traditional wisdom (e.g. economic batch sizes, that set-up always takes a long time, and that the skills required for set-up changes can only be acquired through long-term practice and experience). Shingo identified three main stages of improvement through SMED:

1 Differentiate and separate internal set-up (which can only be performed when a machine is shut down) from external set-up (which can be done while the machine is running).
2 Shift internal set-up elements to external set-up.
3 Improve the methods involved in both internal and external set-ups.

The contribution he made to the development of the Toyota Production System is legendary and his written work outlines a number of methods (e.g. JIT, scheduling, workplace layout, stock control SMED, mistake-proofing) for improving quality and productivity.

Taguchi (1924–2012)

Genichi Taguchi is a statistician and electrical engineer who was involved in rebuilding the Japanese telephone system. He was contracted to provide statistical assistance and design of experiment support. Taguchi rejected the classical approach to the design of experiments as being too impractical for industrial situations and revised these methods to develop his own approach. He has been applying Taguchi design of experiments in the Japanese electronics industry for over 30 years.

His ideas fall into two principal and related areas known as 'the loss function' and 'off-line quality control'. In his ideas about the loss function, Taguchi (1986) defined quality as follows: 'The quality of a product is the loss imparted to society from the time the product is shipped.' Among the losses he included consumers' dissatisfaction, warranty costs, loss of reputation and, ultimately, loss of market share. Taguchi maintained that a product does not start causing losses only when it is out of specification, but when there is any deviation from the target value. Further, in most cases the loss to society can be represented by a quadratic function (i.e. the loss increases as the square of the deviation from the target value). This leads to the important conclusion that quality (as defined by Taguchi) is most economically achieved by minimizing variance, rather than by strict conformance to specification.

This conclusion provides the basis for Taguchi's ideas for off-line quality control. Off-line quality control means optimizing production process and product parameters in such a way as to minimize item-to-item variations in the product and its performance. Clearly this focuses attention on the design process. Taguchi promoted three distinct stages of designing in quality:

- *System design*. This involves the selection of parts and materials and the use of feasibility studies and prototyping. In system design technical knowledge and scientific skills are paramount.
- *Parameter design*. The numerical values for the system variables (product and process parameters which are called factors) are chosen so that the system performs well, no matter what disturbances or noises (i.e. uncontrollable variables) are encountered by it (i.e. it is robust).
- *Tolerance design*. If the system is not satisfactory, tolerance design is then used to improve performance by tightening the tolerances.

Japanese-Style Total Quality

The Japanese define their goal as continual improvement towards perfection. They allocate responsibility for quality and its improvement among all employees. At the highest levels, the emphasis is on breakthrough and on teamwork throughout the organization. There are a number of now familiar concepts associated with Japanese-style TQM, or total quality control (TQC) or company-wide quality control (CWQC) as they term it (see Mizuno 1988; Nemoto 1987).

Earlier work tried to make a distinction between TQC and CWQC, but in Japanese companies today they appear to be one and the same. These concepts include:

- Total commitment to improvement
- Perfection and defect analysis
- Continuous change
- Taking personal responsibility for the quality assurance of one's own processes
- Insistence on compliance
- Correcting one's own errors
- Adherence to disciplines
- Orderliness and cleanliness.

The following simple facts outline what can be learnt from the Japanese experience of TQM:

- TQM depends on a systematic approach which is applied consistently throughout the entire organization.

- There are no quick fixes for the TQM success of Japanese companies. Western executives are always on the lookout for the universal panacea; unfortunately there are none. This search for the quick fix is often an irritation to the Japanese. Their success is the result of the application of a combination of procedures, continuous discussion, systems, tools, improvement actions and considerable hard work and dedication from all employees.
- Senior and middle managers must believe in TQM as a key business strategy and be prepared to stick with it over the long term and ensure that it is integrated with other strategies.
- There must be a permanent managed process which examines all products, service processes and procedures on a continuous basis and develops the mindset in all employees that there is no ideal state. Self-assessment against the criteria of the recognized quality management excellence models are an invaluable means of assessing progress in order to ensure that an organization continues to win customers.
- Each person should take personal responsibility for the quality assurance activities within their area of control and quality assurance must be integrated into every process and every function of an organization.
- Planning for improvement must be thorough.
- Improvement is a slow, incremental process. Companies should not expect quick and major benefits from the application of any single method, system, procedure and/or tool or technique. To be effective the quality management tools and techniques must be used together, in particular the seven original quality control tools.
- There must be a fanatical obsession with pursuing perfection, challenging targets, reacting quickly to problems to find out what went wrong and putting in place corrective action.
- The concept of TQM is simple; however, defining, introducing and fostering the process is a considerable task and requires total commitment from all employees.
- TQM is all about common sense. The Japanese put common sense into practice. They manage and apply common sense in a disciplined manner. In European companies a typical saying is ‘You cannot teach common sense’; the Japanese have done just that.

Summary

The published writings and philosophies of the eminent people mentioned in this chapter can provide the necessary inspiration and guidance to organizations in introducing and developing a process of continuous improvement. While the slavish following of a guru’s teachings or points is no guarantee of success, despite the propaganda, it would be a brave manager who can afford not to learn from their collective wisdom. They should, however, be prepared to adapt and develop these teachings to suit their operating conditions and available resources.

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Chapter Three

The Introduction and a Framework for TQM

B. G. Dale, M. Papalexi, D. Bamford and A. van der Wiele

Introduction

There are a number of approaches which can be followed in the introduction of TQM and strategic process improvement. These include:

1 A listing of TQM principles and practices in the form of a generic plan along with a set of guidelines.
2 Prescriptive step-by-step approaches.
3 Methods outlining the wisdom, philosophies and recommendations of internationally respected experts on the subject (i.e. Crosby, Deming, Feigenbaum and Juran).
4 Self-assessment methods such as the MBNQA model for performance excellence and the EFQM excellence model (see Chapter 12).
5 Non-prescriptive methods in the form of a framework or model.

With all this available advice and prescription it is not surprising that there is sometimes inertia on the part of senior management teams who are faced with the task of introducing TQM in their organizations.

It is up to the management team of each organization to identify the approach that best suits their needs and business operation. Indeed, it is not unusual for an organization to find that its TQM approach is not working out as planned and to switch to another approach. Some of the main ways of starting TQM are examined in this chapter. It begins by examining why organizations decide to embark on TQM.

The contribution of Dr David Lascelles contained in the section 'Change and Continuous Improvement' is acknowledged.

Change and Continuous Improvement

Changing the life-long behaviour, customs, practices and prejudices of an organization is not easy. Organizations committed to quality will strive continually to improve the quality of their goods or services, and are committed to change, but in many cases they were intended to be stable and unchanging. Good reasons must exist either inside or outside the organization to precipitate the process of change and get managers to recognize that they need to improve their business.

In Japanese companies, the major motivations for introducing TQM and strategic process improvement include:

- Environmental, national and business factors and changing circumstances such as: the second oil crisis, exchange rate of the yen, slow economic growth and severe competition.
- A lack of effective long-range planning.
- An organizational emphasis on defensive mechanisms.
- A need to develop new products which are attractive to the marketplace.
- Slow growth in sales and market, leading to stagnation of the business.
- Concerns about how to achieve the long-term plan of the organization and the president's plan on quality, cost and delivery.
- Complacency about current profits and a failure to recognize the seriousness of the situation.
- The written and verbal experiences of companies who were already practising TQM.
- Organizational, conceptual and business weaknesses such as:
  - Lack of advance planning for quality
  - Lack of liaison between development, design and manufacturing departments
  - Emphasis on manufacturing for quantity without sufficient regard for quality
  - Management policies were not universally understood throughout the organization
  - A poor approach to the solution of problems
  - The morale of workers was poor
  - Only stop-gap measures were employed to cope with customer claims
  - Chronic defects in the manufacturing process
  - Problems at production start-up due to insufficient pre-production planning.

Lascelles and Dale (1989) report that the improvement process is often triggered by one or more of the following:

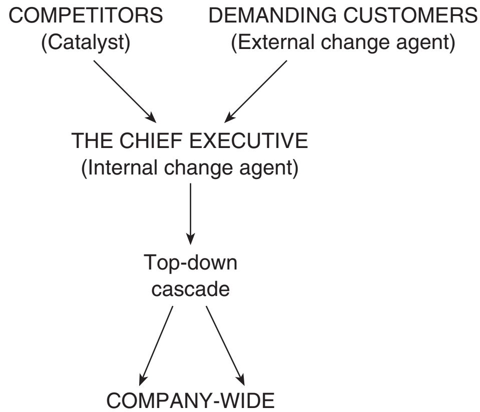

Figure 3.1 Market-led paradigm of TQI
Source: Lascelles and Dale (1993)

- The chief executive
- Competition
- Demanding customers
- Fresh-start or greenfield situations.

Later, Lascelles and Dale (1993) and Langer and Yorks (2013) argued that competition acts as a catalyst setting off a chain reaction which enhances quality awareness in the market, resulting in demanding customers and chief executives behaving as external and internal change agents respectively (see Figure 3.1).

Forces for Change

The chief executive officer

Many writers on the subject of quality management are agreed that unless the CEO plays an active role and takes the lead to improve quality within an organization, attempts and gains made by individuals and departments will be short-lived. The limited success usually surfaces in a lack of empowerment at lower levels of the organizational hierarchy. However, most chief executives want tangible proof of the need for continuous improvement and for their own involvement, because they usually have a number of urgent matters which need their attention. Thus other factors must also be present, of which market pressure (e.g. intense competition, demanding customers) has by far the greatest impact.

Competition

Competition is fierce in today's business environment and quality is recognized as a key consideration in many purchasing decisions. There is little doubt that quality is an essential part of the marketing mix as companies seek ways to differentiate effectively their products and/or services from those of their competitors. Many successful companies now advertise their products and/or services on the basis of quality and reliability rather than price. For example, consider the number of advertisements in which the word 'quality' is featured. The motivation for improvement is provided here by the need to stay competitive, and the change agent is the customer whose awareness of quality has been enhanced. As a result of such pressures, suppliers of goods and services have themselves become demanding customers and seek improved levels of quality conformance from their own suppliers.

Demanding customers

Demanding customers with high product and service quality expectations and an established reputation for quality can be very effective change agents. In addition to providing tangible evidence of the value of reputation and standing, they have the potential for bringing about radical and permanent changes in attitudes towards continuous improvement among their suppliers through the requirements they place on them. Many major purchasers have policies which outline what is required of suppliers in terms of their approach to quality management (e.g. the QS 9000 quality system standard). Documents such as these describe fundamentals that must be incorporated into a supplier's quality planning methods and quality system to control and improve quality. Each supplier is responsible for building on these fundamentals to develop an effective quality system, and products and services which are defect-free. Many quality-conscious purchasers assess and evaluate supplier performance. Some also provide resources to help suppliers implement tools, techniques and systems, improve workplace layout, and give guidance on problem-solving.

'Fresh-start' situations

The degree of entrenchment of attitudes, and hence the difficulty of changing them, is related to the length of time an organization has been established, its size, staff turnover rate, managerial mobility, markets, competitors, and many other factors which influence the 'performance' of an organization. A fresh-start situation therefore provides excellent opportunities to make rapid, fundamental, changes to attitudes and relationships.

A 'greenfield' venture may be the setting up of a new company, a new operational direction for an existing company (e.g. creation of a new strategic business unit as part of a diversification programme), an established company relocating to a new factory, or a company establishing a new operation in existing premises after rationalizing plant, product lines, manpower, etc. A greenfield venture provides an opportunity for the introduction of a process of continuous improvement in a situation where there is no prior history of lame excuses, acceptance of non-conformance, shipping non-conforming products in order to meet production targets, providing and accepting a poor level of service and poor delivery performance. In a greenfield venture there is an opportunity to start from scratch without any vested interest or inhibiting procedures to overcome. It is an opportunity for senior management to try to do all the things that should be done to engender a culture of continuous improvement.

How Do Companies Get Started?

Once change has been triggered, organizations need to translate enhanced quality awareness and organizational need for improvement into effective action. At this stage an organization's senior management team ask questions such as:

- What should we do?
- What are the priorities?
- What advice do we need?
- Should the approach be top-down or bottom-up?
- Do we need an umbrella term? Do we have to use the term TQM? What are the alternatives: quality improvement, continuous improvement, business improvement, customer care, customer focus, customer first, excellence?
- How do we apply these tools and techniques?
- How quickly should we proceed?
- What courses and conferences should we attend?
- Which network of companies should we attempt to join?
- What training do we need?
- What packages and programmes should we buy?

Their dilemma is often compounded not just by a lack of knowledge of TQM and the process of continuous improvement but also by a lack of experience in managing organizational change. The overwhelming quantity and variety of available advice, which is often conflicting, sometimes biased and sometimes incorrect and misdirected, simply adds to the confusion and chaos. It is not surprising then that there is sometimes inertia on the part of senior management teams who are faced with the task of introducing a formal process of continuous improvement in their organizations.

Approaches to TQM

Each writer on the subject of TQM and strategic process improvement develops and outlines an approach which reflects their own background, values and experience. These approaches include:

1 Methods outlining the wisdom, philosophies and recommendations of the internationally respected experts on the subject.
2 Prescriptive step-by-step approaches.
3 A listing of TQM principles which are presented in the form of a TQM implementation plan and a set of guidelines.
4 Non-prescriptive methods in the form of a framework or model.
5 Self-assessment methods based on the excellence models on which the Malcolm Baldrige National Quality Award (MBNQA) and the European Quality Award (EQA) are based.

Thus it can be seen that there are a number of ways to get started and it is up to each organization to identify the approach which best suits its needs and business operation.

Applying the wisdom of the quality management experts

The writings and teachings of Crosby, Deming, Feigenbaum and Juran, discussed in Chapter 2, are a sensible starting point for any organization introducing TQM and strategic process improvement. The usual approach is for an organization to adopt the teachings of one of these quality management experts and attempt to follow their programme. The argument for this approach is that each expert has a package which works, the package gives some form of security, it provides a coherent framework, gives a discipline to the process and provides a common language, understanding and method of communication. To facilitate this some companies have purposely opted for the simplest package. The approach of Crosby is generally recognized as being the easiest to follow. Muralidharan (2015) stated that Crosby, followed by Juran and then Deming, were the most frequently used experts. Observations of organizations setting out on this road show that sooner or later they will start to pull into their improvement process the ideas of other quality management experts. This is understandable because none of these experts has all the answers to the problems facing an organization, despite the claims made about the exclusivity of approach.

Applying a consultancy package

Some companies (usually large concerns) decide to adopt the programme of one of the major management consultancies on the grounds that it is a self-contained package which can be suitably customized for application throughout their organization. Most of the 'gurus' have their own consultancy activities to help organizations implement the ideas and principles of the expert in question. Also a number of the consultancy packages are based on the teachings and wisdom of the quality management gurus.

It is important for a company to understand that the use of a consultant organization does not relieve the senior management team of their own responsibilities for TQM and strategic process improvement; it is their responsibility to own the improvement process and to exercise leadership. A key part of consultancy is the transfer of skills and knowledge, and when the project is complete the training and guidance provided by the consultant must remain within the organization in order that the process of improvement can progress and develop. They also help to change the way managers think and behave. The consultant should be perceived by the organization as an 'implementation' tool and not as an initiator of TQM and the improvement process. Management consultancies bring their expertise and skills to the company and provide the resources, experience, disciplines, objectivity and the catalyst for getting the process started. An organization can benefit from the use of this expertise providing it is willing to accept the recommendations of the consultants.

The company needs to understand clearly what it is buying from a consultancy. It is often difficult to define in precise detail what is required in a TQM assignment, with the consequence that the terms of reference are vague. A booklet, *Choosing and Using a Consultant*, produced by the Employment Department (1991) and aimed at directors and managers, contains a number of useful pointers to identify, select and work with consultants. In a similar vein, numerous reported examples present and analyse this relationship (Lépée et al. 2012; Pozzebon and Pinsonneault 2012 and Hsu et al. 2014).

Frameworks and models

A framework or model is usually introduced to present a picture of what is required in introducing TQM and strategic process improvement. They are the means of presenting ideas, concepts, pointers and plans in a non-prescriptive manner and are usually not considered to be a 'how-to' guide to TQM introduction and subsequent development. They are more concerned with the destination than the route to it. A framework allows the user to choose their own starting point and course of action and build gradually on the individual features and parts at a pace which suit their business situation and available resources. Aalbregtse et al. (1991) provide an excellent description of what a framework should consist of and its objectives. A number of writers (e.g. Mohammad et al. 2011; Yu et al. 2012; Bon and Mustafa 2013; Ahmad et al. 2014; Mishra and Kumar Sharma 2014) have proposed a range of TQM improvement frameworks. A typical framework for managing continuous improvement is the improvement framework described in the following section.

A Framework for the Introduction of TQM[1]

This section presents a framework for the introduction of TQM. It is divided into four main sections, all of which need to be addressed once the motivation for TQM has been identified. The motivation will set the overall strategic direction of TQM and influence the relevant importance of each part of the framework. The foundation of the framework is 'organizing' and the two pillars which form its structure are the use of 'systems and techniques' and 'measurement and feedback'. 'Changing the culture' is something which must be considered at all stages, including the initial organizing activities, but primarily results from the other initiatives described, interact with them throughout the process, and will evolve with the organization's operating experience of TQM. People, both as individuals and working in teams, are central to TQM and without their skills and endeavours continuous improvement will simply not occur. The framework integrates the various aspects of TQM, from 'soft' approaches such as teamwork, employee development and human relations, to the use of 'hard' techniques such as SPC and FMEA. A diagrammatic representation of the framework is given in Figure 3.2 and a summary of its features in Table 3.1.

The framework provides an indication of how the various aspects of TQM fit together and is particularly useful for those organizations who:

- Are taking their first steps on the TQM journey.
- Have got ISO 9000 series registration and require some guidance and advice on what to do next.

[1] Barrie Dale acknowledges the contribution of Professor Ruth Boaden to the development of the framework described in this chapter. He also wishes to thank the directors and managers who have commented on earlier versions of this chapter, in particular, the past and current associates of the TQM Multi-Company Teaching Company Programme for their invaluable suggestions in the development of the framework.

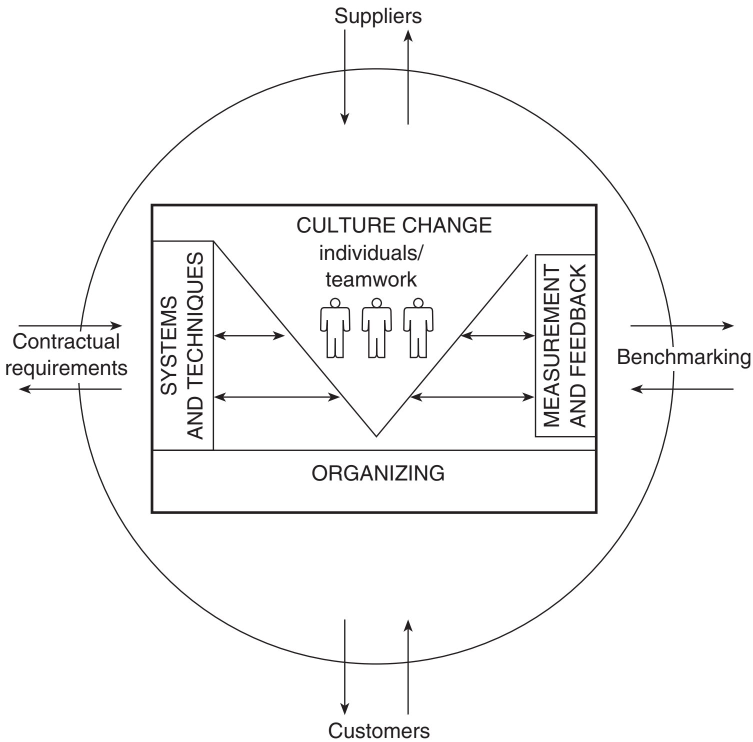

Figure 3.2 The TQM framework
Source: Dale and Boaden (1993)

- Are attempting to develop improvement plans and controls across a number of sites.
- Have less than three years' operating experience of TQM and continuous improvement.

The framework is not a 'how-to' guide for TQM; there are a considerable number of such guides outlining a step-by-step approach to TQM. These guides usually have a set starting point and follow a single route. The framework is a means of developing and presenting plans in a non-prescriptive manner; it is a guide to action and not to be followed slavishly. If used in the correct manner the framework ensures that there are adequate mechanisms in place to enable continuous improvements to occur. At this stage the organization can turn to the use of self-assessment methods against a recognized excellence model to identify strengths and weaknesses in its approach.

The framework was initially developed as a theoretical tool, from the authors' research experience. The details of the framework as presented here have been

Table 3.1 TQM framework: a summary

Organizing	*Systems and techniques*	*Measurement and feedback*	*Changing the culture*
Long-term strategy for TQM formulated and integrated with other strategies; improvement plans developed	Identification of applicable tools and techniques at each stage of continuous improvement	Key internal and external performance measures identified, defined and developed	Assess the current status of organizational culture before developing plans for change
Definition of quality, TQM and continuous improvement developed and agreed	Training in the use of tools and techniques, for the right people at the right time	Ongoing discussion with customers about expected performance	Recognize the ongoing nature of culture change, and the need to outline specific changes
Choice of approach to TQM	Identification of other systems and standards that may be required by customers or legislation	Means for celebration and communication of success and teamwork developed	Recognize the role of people as an asset
Identification of sources of advice	Use of a formal quality system	Benchmarking, once improvement is under way	Plan change consistently and incrementally
Stages of improvement activity identified, taking the starting point into account	Identification of key business processes and improvement based on these processes	Consideration of the link between results from improvement and rewards	To minimize conflict, consider the inter-relationships of all activities within the organization
Executive leadership and commitment to TQM		Means of assessing the progress towards world-class performance considered, e.g. EFQM or MBNQA models	Identify factors which indicate that culture is changing
Vision and mission statements and values developed and communicated to all members of the organization			Consider the national and local culture
Decide the means by which TQM will be communicated			
Formal program of education and training for all members of the organization			
Organizational infrastructure established to facilitate local ownership of TQM			
Teamwork established as a way of working and part of the infrastructure			

based on its use by the senior management teams of a number of major manufacturing companies and a number of service organizations, in both private and public environments. In addition, the framework has also been used in syndicate exercises by some 300 people from a wide variety of manufacturing and service organizations, in America, Hong Kong, South Africa and the UK. With its solid research base and practical testing and application, it is a very robust framework.

Organizing

This foundation stage is concerned with the motivation for starting TQM and a process of continuous improvement and the resultant strategies, plans, and means necessary to introduce and develop the process. The appropriate time to introduce TQM must also be considered, as should communication down and across the organization of what TQM is, why it is being adopted and what will be involved, including the cost and required resources.

In planning this stage full use should be made of pilot schemes, whether they are in relation to the use of a technique such as Statistical Process Control (SPC) or the operation of improvement teams. In this way, problems can be resolved on a small scale and experiences fed back and reacted to before development and advancement of the issue under study.

The key actions in this stage can be described as follows:

1 *A clear long-term strategy for TQM should be formulated and integrated with other key business strategies, departmental policies and objectives. This also includes the development of a quality policy and quality strategy. The aim should be to integrate them with the long-term plans of the business.* Any short-term strategy that the organization needs to pursue (e.g. to cater for rapid turnover of staff, market downturns, exchange fluctuations and supply difficulties) should be consistent and integrated with the long-term strategy. The strategy must then be developed into a series of improvement plans and objectives for each department and function and also for those areas and aspects of the business which have been identified as requiring improvement, and methods of monitoring and assessment developed.

2 *A common organizational definition for quality, TQM, and other terms used as part of the continuous improvement process, should be developed, agreed and communicated in simple and non-technical language, after discussion.* Consideration should also be given to the term used to describe the improvement initiative, or indeed to whether a term is required. The development of a glossary of quality-related terms should be considered; useful guidance is provided in BS EN ISO 9000 (2015). A lack of such definitions can hamper the progress of TQM; a glossary will also help to prevent misunderstandings, and competing views and different interpretations being expressed by

the various functions and levels within the business and also with customers and suppliers, improving communication both inside and outside the business.

3 *The approach to TQM should be decided.* This will depend on the existing culture of the organization as well as the preferences of senior management but is an important element in its success. Whichever TQM approach is adopted, it should be flexible and capable of fine-tuning to suit the business needs and objectives of the organization. Some of the available options were explored in Chapter 1.

4 *The organizations and people (internal and external) who can be sources of advice on the approach to TQM, and its introduction and development, should be identified.* Such advice may also be required to develop the quality management system to meet the requirements of ISO 9001 and/or QS 9000 and the application of particular tools and techniques. Useful expertise is often available within the organization. Such people know the internal workings of the organization, its processes and the unique problems which exist. This expertise should not be overlooked. It is always beneficial to combine internal expertise with external consultants' knowledge and skills.

5 *Stages of improvement activity should be identified at the outset, taking into account the starting point of the organization, the motivation for TQM and the tools and techniques that may be applicable.* For example, Newall and Dale (1991) identified six stages of an improvement process – awareness, education and training, consolidation, problem identification and improvement planning, implementation of quality plans and assessment. A formal project-planning methodology, which requires the identification of milestones and their ongoing monitoring, is also a vital tool at this stage.

6 *Executive leadership, tangible commitment and support should be recognized as being crucial at all stages (see Chapter 1).* Such commitment should be demonstrated in actions such as allocating time to understanding and involvement in TQM, being visible and accessible ('management by wandering about'), holding discussions with people at the operating level of the business, providing words of encouragement and advice, 'quality' placed at the top of every business meeting agenda, identification of key performance measurements, use of tools and techniques in their everyday work activities, developing personal action plans, seeking feedback on their style of management, acting as a mentor to improvement teams, attending training sessions, writing articles on TQM in the company newsletter, ensuring that any decisions made are consistent with the agreed plans and objectives, and exhibiting a passion for TQM.

7 *Vision and mission statements, which are concise and understandable to all employees, should be developed, displayed and communicated in company-unique language.* It is also important to outline what needs to be done to make these statements and the associated company values become a reality,

Person and function	Type of course and duration		
	General awareness	Specific (e.g. FMEA)	Degree of difficulty
Senior management			
Clerical			
Operator			

Figure 3.3 TQM training matrix

including the benefits that will accrue from TQM and how it will affect the way employees go about their jobs.

8 *It is important that everyone in the organization can identify with the vision and mission statements* since this will help to unite and focus employees on where the organization is heading. Employees must feel that the vision statement is achievable.

9 *Communication is a key component of TQM and management cannot communicate too much on issues relating to TQM and the improvements made.* The communication should be based on common sense, be two-way, use jargon-free language and be consistent in the approach adopted. The means of communication should include both written and verbal mediums in both group and individual mode (e.g. notice boards, whiteboards, news-sheets, booklets, team-meeting minutes, team briefings, senior management 'state-of-the-nation' briefing breakfast and birthday meetings and electronic mail).

10 *A formal programme of education and training should be established.* This is important in order to build the skills of employees, and should involve basic job skills and process training, including induction, TQM awareness, customer care, and training in the use of tools, techniques and systems.

11 *The development of a training matrix* (see Figure 3.3) helps to ensure that needs and capabilities are identified, along with the current level of awareness of TQM, quality systems, tools and techniques, etc. Training records also need to be maintained.

12 *An organizational infrastructure should be established which will ultimately facilitate local ownership of TQM.* Direction should be provided by the TQM steering committee, but the time it sometimes takes for people to accept such ownership for TQM and continuous improvement should not be underestimated. Actions include deciding the membership of the committee, role and meeting frequency; setting up, as appropriate, local steering groups; identification of improvement co-ordinator (full-time or part-time), facilitators and team leaders, along with clear definitions of their roles; ensuring

the means by which the actions developed by improvement teams can be carried through; and agreeing budgets.

13 *Teamwork should be established and become part of the organization's method of working.* In the first place it is suggested that a review is undertaken of any teams which are already established, in conjunction with their previous and current projects. Following this, task forces/project teams and cross-functional improvement teams should be established to address the major problems facing the organization, followed by the setting up of departmental improvement teams.

Systems and Techniques

This pillar of the framework involves the development of a quality management system to provide the necessary controls and discipline, and the standardization of improvements. It also involves the use of quality management tools and techniques to, for example, aid quality planning, listen to the 'voices' of customers, capture data, control processes, make improvements, solve problems and involve people. Key actions at this stage include:

1 *The tools and techniques applicable at different stages of the improvement process should be identified.* In the first place consideration should be given to identifying which tools and techniques employees are familiar with and those which are in regular use. Tools and techniques should be classified as core and optional, depending on their nature and impact and the environment (e.g. manufacturing or service) in which they are being applied.

2 *The right type of training targeted at the right people should be developed; it should emphasize the why and how of the tools and techniques and the benefits of their use.* Many studies (e.g. Wandersman et al. 2012; Goetsch and Davis 2014; Jeston and Nelis 2014) have demonstrated that the right type of training helps to stop the misuse of tools and techniques (e.g. SPC being applied in the wrong areas; only part characteristics being measured, used only for control purposes; lack of reactive disciplines, etc.). When tools and techniques have been used incorrectly, an additional set of problems in the introduction of TQM is created. Suitable training packages on tools and techniques should be developed and customized for the organization – this is perceived to be very important in some situations (e.g. public services).

3 *The use of a formal quality management system should be considered, if one is not in place.* If such a system is already in use, then some evaluation of its contribution to TQM is vital; the objective should be to continually improve and strengthen the quality system and ensure that any improvements are built into the system.

4 *Any other systems and standards which may be required as part of future contractual or legislative requirements, or simply in order to compete in certain markets, should be identified and implemented.* If relevant systems and standards are integrated with the improvement initiative it is less likely that the organization will have conflicting priorities and policies, and confusion will be reduced.
5 *Process analysis and improvement should be a continual part of the organization's improvement process.* There should be a focus on processes (e.g. business planning and control and order generation) rather than functions within the organization. Process analysis and innovation gives emphasis to the centrality of quality throughout the business process and also focuses attention on customer and supplier relationships.

Measurement and Feedback

This pillar of the framework enables the 'voice of the customer' to be translated into measures of performance with which the organization can identify, and on which it can improve. It also deals with internal measures of performance, supplier assessment and development and rewards and recognition. Key actions at this stage include:

1 Key internal and external performance measures should be identified and defined across the organization.
2 Discussion with customers (internal as well as external) about the performance expected and their needs and expectations should be undertaken, using a variety of techniques. This must be an ongoing exercise to ensure that gaps between actual performance and customer needs and expectations are identified and analysed, and actions put in place for closing the gap. In going about this exercise it is also important to assess the relationship between the sales and marketing functions and the strengths of each. The main objective of all this is to build a partnership with customers and to develop customer loyalty in order to build competitive advantage.

   Issues that have to be considered in this marketplace research include:
   - How well the organization is meeting customer expectations
   - How customers perceive they are treated
   - The main complaints from customers
   - Suggestions the customer might have for improvements and what else may be required in terms of products, services and features
   - How the organization rates against the competition
   - Whether the data which have been collected are actually used to generate improvements which benefit the customer.

In some organizations it may be necessary to initiate suitable systems for identifying customer needs. Customers must also be encouraged and invited to challenge the organization that is delivering the product or service. The trend is for increasing the level of contact with customers (internal and external), and such 'moments of truth' occur far more frequently in commerce, public organizations and service-type situations than in manufacturing organizations (see Chapter 6). Systems to identify customer needs include:

- Customer workshops
- Client service and call centres
- Panels and clinics
- Focus groups
- Customer interviews
- Market research
- Surveys: mail (including electronic), telephone, comment cards, point of purchase (survey designs should vary in length, contact and format)
- Trailing the service and/or product
- Field trials of new products
- Using 'test' consumers and mystery shoppers
- Feedback from professional and trade associations
- Product launches
- Field contacts.

Often potential sources of information are customers lost and customers gained, the data that the finance and accounts department hold on customers, and field failure and warranty claims.

There must be a methodology and system for analysing and feeding back the data gathered from customers by such means (i.e. customer service measurement); the same applies to data on competitors. A considerable amount of researchers have focused on using the receiving feedback to understand customer needs (i.e. Dienst et al. 2014; Celuch et al. 2015; de Haan, Verhoef and Wiesel 2015).

3 *Benchmarking should be considered once the organization has taken some steps to improve quality.* The benchmarking of a small number of strategic processes helps employees to see the need for change and thereby give impetus to the improvement process. The concept of benchmarking is a proven technique for assisting companies with a process of continuous improvement. It is a process whereby internal performance and practices are compared to those of other companies, including the superior-performing ones, in a bid to develop, improve and achieve the best practice that leads to superior performance (see Parast and Adams 2012; Sallis 2014 and Chapter 10 below for details).

4 *Means of celebrating and communicating success with TQM should be considered, and methods developed for recognizing the efforts of teams and individuals.* The issue of ownership of TQM is linked to providing adequate recognition,

rewards and incentives for quality efforts, and in this way the message that quality is a strategic concern is reinforced. Two quotes worthy of mention are 'What gets measured gets done' (Anders Scharp, former CEO, Electrolux) and 'What gets rewarded gets repeated' (Anne Van't Haaff, former corporate quality manager, KLM).

Publishing successes is an effective means of communicating how people have tackled improvements. Recognition and communication of success can be facilitated in a number of ways such as quality news-sheets, team briefs, quality action days, team competition/celebration days, quality conferences, presentations by the president and/or CEO, supplier award days, 'thank you' notes, small tokens of appreciation such as mugs, pens, meals, certificates and trophies, publicity in the company newsletter and so on. Personal 'thank you' and 'praise' notes from senior management are often seen as a more genuine recognition than buying people through money.

5 *Linking rewards to improvement activities and results must be considered, although it is controversial.* Financial payment for participation in improvement activities, in particular those schemes relating to individuals, should be discouraged but perhaps not overlooked. Continuous improvement should be a natural part of every person's job, but people at different levels of an organization have widely differing expectations of what improvement means to them personally and to the company. There is a view, however, that 'links to pay and promotion may still be the most tangible proof that top executives take total quality seriously' (see Brinsfield 2012; Ford et al. 2014).
6 *Means of assessing the progress of the business towards world-class performance should be used.* For example, the MBNQA criteria for performance and the EFQM excellence model should be considered (see Chapter 12).

Changing the Culture

Organizations attempt to change culture for different reasons. Changing the culture is a key element in TQM and has wide-ranging implications for the whole organization; it requires the introduction and acceptance of individual, group, and organizational change. TQM provides the opportunity to make and influence behaviours and attitudes which have real effects on internal and external relationships and the way the organization conducts its business.

Culture change is not just relevant to TQM, although the increased emphasis on customers and their needs makes some form of culture change a must for most organizations. The change of culture must be planned to avoid ambiguity and facilitate improvement; a significant number of academic articles have focused on this element (Brown 2011; Green 2012; Maroofi 2012; Gimenez-Espin et al. 2013; Valmohammadi and Roshanzamir 2015).

It is not possible to identify key actions for this stage, but there are a number of features which should be considered:

1 *An assessment, from both management and employee perspectives, of the current status of the organizational culture should be undertaken before firm plans for change are developed.* Senior management must be prepared to resolve conflicts, and resistance to change which is identified in the assessment; the personal values of staff and their expectations sometimes present a problem.
2 *Culture change must be recognized as ongoing, rather than as a prerequisite to the introduction of TQM and strategic process improvement.* Some degree of culture change in terms of senior management commitment and leadership and provision of adequate resources must, however, take place prior to and as part of the organizing stage. For example, the effective use of tools and techniques, developing the quality management system to meet the requirements of the ISO 9000 series, teamwork, the impact of successful improvement projects, presentations, recognition, effective channels of communication, etc. are all activities which can contribute to culture change. There are of course other activities which will contribute to the culture change process (e.g. improving the environment in terms of provision of uniforms and safety shoes, team meeting rooms and lockers) which may not connect directly with TQM and the improvement process.
3 *Change should be planned and take place in a consistent and incremental manner.* Experience indicates that if the change is too great and unplanned the organization will revert back to the status quo. The planned changes must be outlined in specific terms and, where possible, qualified against a time-scale. Employee attitude surveys, customer surveys and internal customer–supplier workshops are also useful for identifying culture change indicators. Examples of possible changes include:
   - Delegate decision-making and the responsibility for taking actions down to the lowest possible level and spread the power base.
   - Teach managers to adopt a listening, consulting and learning style of leadership.
   - Train managers to act as trainers.
   - Provide opportunities for management to listen to the views of staff and customers and develop a listening and learning style of leadership.
   - Enable every employee to visit a customer and other parts of the business.
   - Introduce the concept of associates rather than employees.
   - Introduce cross-functional team activity.
   - Recognize and respect people's contribution to the business.
   - Operator exchange programmes.
   - Change to a cellular type of organization.
   - Change the payment system to one which recognizes issues such as the team, acquisition of skills, flexibility, etc.

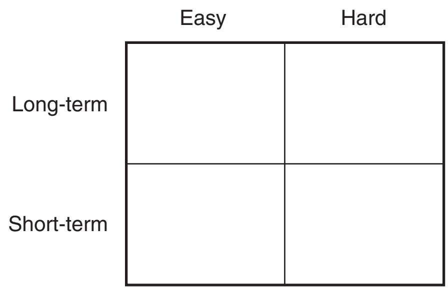

Figure 3.4 Culture change grid

The grid shown in Figure 3.4 can be used to classify the degree of difficulty of each change and its effects.

4 *The role of people within the organization should be recognized*. The way that they are treated is vital, since they are an intellectual asset whose value to the organization can be increased by careful nurturing or decreased by poor management. It should also be recognized that most organizations are made up of people of differing ages, backgrounds, skills, abilities, levels of enthusiasm, levels of flexibility and ability to accept change. If culture change is to be successful these people-based factors must be taken into account.

5 *Teamwork is an important facilitator in culture change, but organizations must ensure that the organizational infrastructure can adapt to the changes which teamwork will bring*. The operating characteristics of the teams to be employed in TQM should be defined and communicated (see Chapter 11). It is also essential that participants in teams and other improvement activities are volunteers, not 'conscripts'.

6 *The interrelationship of all activities in the organization, and the way in which they contribute to the overall quality of service and product provided, should be identified, so that conflict is minimized and TQM becomes part of the way in which the business is run*. Such conflict typically arises at middle management level, where the impact of strategic initiatives meets the problems of the day-to-day running of the organization. In any large organization there will be a variety of initiatives going on at one time, many of which will affect staff directly (e.g. installation of new computer systems, development of information technology, introduction of manufacturing resource planning (MRP II), cost-cutting exercises, marketing promotions), and these may indirectly contribute to the quality of product and service provided.

7 *Factors which indicate that TQM has started to change culture should be identified*. Without such factors it is difficult to know whether culture change is taking place, and the concept may be undermined by 'lack of results'. Factors that indicate that culture is changing include:

- Changes to procedures and systems are easier to make.
- Motivators and champions start to emerge from various parts of the organization.

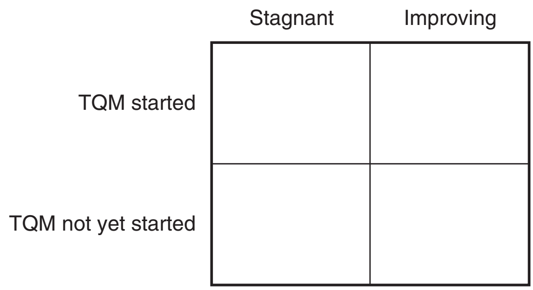

Figure 3.5 TQM grid

- People talk processes and not functions.
- People are not afraid of expressing their views.
- People show a positive response to recognition.
- Employees are viewed by senior management as an asset and not a cost.
- People volunteer to take on tasks which would previously have involved considerable negotiation between management and unions.
- Ideas and suggestions start to flow from the shop floor.
- Team meetings scheduled outside of team shift, without pay.
- Continuous improvement goes on in the face of organizational instability.

Use of the Framework

The framework should be used as part of an eight-stage process:

1 *Review the organization's adoption of TQM to date.* This should include a presentation by senior management on the progress to date and future plans. The grid shown in Figure 3.5 can be used for pinpointing the current position and the features of the first four levels of the TQM adoption model – 'uncommitted', 'drifters', 'tool-pushers' and 'improvers' – are also of help in positioning an organization.
2 *Customize the framework to suit the individual organization.* In the first place, a full presentation of the framework is made to the participants. The features of each section of the framework have to be considered and customized to suit the individual organization and its business.
3 *Present and debate the customized framework.* The consolidated framework developed is presented, giving the opportunity to the management team to add or delete features as appropriate.
4 *Assess which features of the framework are already in place.* Self-audit surveys and internal and external indicators can be employed. A number of methods of measurement can be used; for example, ranking each feature on a 1 to 6 scale

Culture Change Section	*Yes*	*In part*	*No*
Commitment			
– Senior management	•		
– Visibility		•	
Current status			
– Questionnaire			•
Employee involvement	•		
Training and people Development			
– Customer appreciation	•		
– Appraisals/objectives	•		
– Skills audit		•	
Conditions of employment			•
People environment		•	

Figure 3.6 TQM framework: feature assessment

or the use of a yes/no/in part classification (Figure 3.6 shows an example of this).

5 *Prioritize the features which are not already in place.* This should be done in accordance with the overall strategy and business plans of the organization.

6 *Develop plans to introduce the prioritized features of the framework identified in the previous stage.* The plans should have a start and finish date, with detailed actions, milestones, resources and responsibilities.

7 *Communicate the details of the framework and the plans derived from it down through the organization.* This helps to gain acceptance. The framework should also be communicated to suppliers and customers.

8 *Identify any potential problems in putting the plans developed at stage 6 into place.* Some typical problems encountered are: lack of structure and how to formalize the existing organization in relation to current management roles and responsibilities, lack of trained personnel, definition of terms (e.g. customer response time), conflict of barriers, traditional attitudes, time conflicts/constraints and constructing a real and meaningful mission statement which can be owned.

The format shown in Figure 3.7 can be used as part of this process.

Features	*Vision*	*Plans*					
	What will it look like?	What does it involve?	What is the current situation?	What needs to be done?	Who is going to do it?	What is going to be done?	What are the obstacles/issues?
1							
2							

Figure 3.7 TQM framework: organizing section

Outcomes

The following are the outcomes derived by those organizations that have used the framework:

- Developing the framework provides a mechanism for debating TQM and continuous improvement strategies, plans, actions and initiatives and helps to generate a common level of understanding and reconcile views and opinions. It also assists management in identifying the factors which can slow down the process of improvement (e.g. inconsistent objectives, insufficient involvement and ownership, lack of data, lack of operator involvement, failure to complete projects, break-up of improvement teams, etc.) and helps to pinpoint and eradicate weaknesses in the current TQM approach of the organization.
- The framework, once developed and customized, becomes a reference point for current and future improvement initiatives.
- Use of the framework requires all members of senior and middle management to be involved in the planning process, thereby developing ownership of the resultant plans.
- The framework provides a means of communicating, in the organization's own language, what is involved in TQM and provides the essential logic of why the organization is adopting and progressing TQM.
- In a multi-site operation the framework provides a common approach and language for all businesses, and those likely to be acquired in the future. In this way it avoids confusion with common suppliers and customers and presents a consistent approach and TQM image to both employees and the marketplace.
- It can be used not only to assess the maturity of TQM but also to audit whether or not certain features of the framework are firmly in place. In this way the next set of priorities can be identified.
- The correct use of the framework ensures that an organization puts in place the key features of TQM and a process of continuous improvement.

Summary

This chapter has argued that a formal approach to TQM is triggered by one or more of four factors, namely the CEO, competition, demanding customers and fresh-start situations.

The point has been made that there is no 'right' way of introducing and developing TQM. There are a number of approaches, and these have been examined in the chapter. It is senior management's responsibility to select the approach which best suits its business and operating environment and any constraints which may exist. Employees have to be involved and understand the new process. The approach should always be tailored to the organization and 'off-the-shelf' packages avoided. Senior management have much to gain by networking with their counterparts in different businesses and this exchange of ideas and concerns and discussion of common issues can help to fine-tune the approach which is being used and to advance the development of TQM.

Finally, a framework for the introduction of TQM has been presented and analysed based on its four main sections, all of which need to be addressed once the motivation for TQM has been identified.

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Part Two
The Business Context of TQM

The purpose of Part 2 of the book is to introduce the reader to some activities which have an influence on TQM from a business context. It contains four chapters:

Chapter 4 – Policy Deployment
Chapter 5 – Quality Costing
Chapter 6 – Managing Service Quality
Chapter 7 – Supplier Development

Chapter 4 looks at Policy Deployment, as the Western translation of 'hoshin kanri', the Japanese strategic planning and management process involving setting direction and deploying the means of achieving that direction, with appropriate involvement at all levels of the organizational hierarchy. The chapter reviews the history and concept of policy deployment and proposes a policy deployment model. It is argued that this model will enable an organization to deploy, in an effective manner, its vision, mission, goals, objectives, targets and means.

Chapter 5 explains why quality costs are important to management, the chapter also defines quality costs and outlines how to identify, collect, analyse, report and use them to best advantage. Quality-related costs commonly range from 5 to 25 per cent of an organization's annual sales turnover, depending on the 'industry' and the way in which it manages quality. The reduction of costs is an important part of any business plan.

Chapter 6 examines the implications for service quality in a changing business environment. It explores definitions and characteristics of services, the service quality GAP model, dimensions and determinants of service quality, measurement of service quality, customer service and service encounters and service delivery processes and the role of personnel.

Finally in this section, Chapter 7 acknowledges that organizations cannot consider TQM or strategic process improvement in isolation; they need to involve their customers and suppliers in the improvement process. The chapter outlines the importance and role of supplier development in TQM and the need to develop long-term collaborative business partnerships between customer and supplier. It identifies the typical barriers in supplier development and draws on best practice to outline how organizations should start and advance the partnership concept.

Chapter Four

Policy Deployment

R. G. Lee, B. G. Dale, I. Reid and D. Bamford

Introduction

An increasing number of organizations, as part of a strategic planning approach to continuous improvement, are starting to use policy deployment. The methodology is aimed at being consistent in target-setting and achievement, not just in magnitude but in overall organizational effectiveness.

In the late 1980s the concept of policy deployment was little known outside Japan. Dale (1990) recalls leading study missions of European executives and management consultants to leading exponents of TQM in Japanese manufacturing industry in 1988 and 1989, and it was clear that, when the concept of policy deployment was introduced by the Japanese host organization, this was something new to the study mission participants. This prompted Dale to write an introductory piece on the concept. Policy deployment is the Western translation of 'hoshin kanri', the Japanese strategic planning and management process involving setting direction and deploying the means of achieving that direction; the PDCA cycle is used extensively in the process.

By the early 1980s hoshin kanri had begun its journey across the Pacific Ocean on a wave of Deming Application Prize-winning Japanese subsidiaries such as Hewlett-Packard's YHP Division and Fuji-Xerox. MBNQA- and EQA-winning companies started to use policy deployment successfully in the early and mid-1990s respectively in order to link medium- to long-term policy to annual plans to achieve significant improvements in business results. Figure 4.1 is an illustration of the policy deployment system from a manufacturer of ceramic products. According to Jolayemi (2008) policy deployment is the process of engaging the entire organization in the strategic direction of the business through vertical and horizontal shared ownership.

This chapter reviews the definition, concept, and characteristics of policy deployment and proposes a policy deployment model based on the catch-reflect-improve-pass process (Kesterson 2014). The model, based on research described in Lee and Dale (1999), demonstrates how policy deployment, business results and self-assessment are inextricably linked into the PDCA cycle of

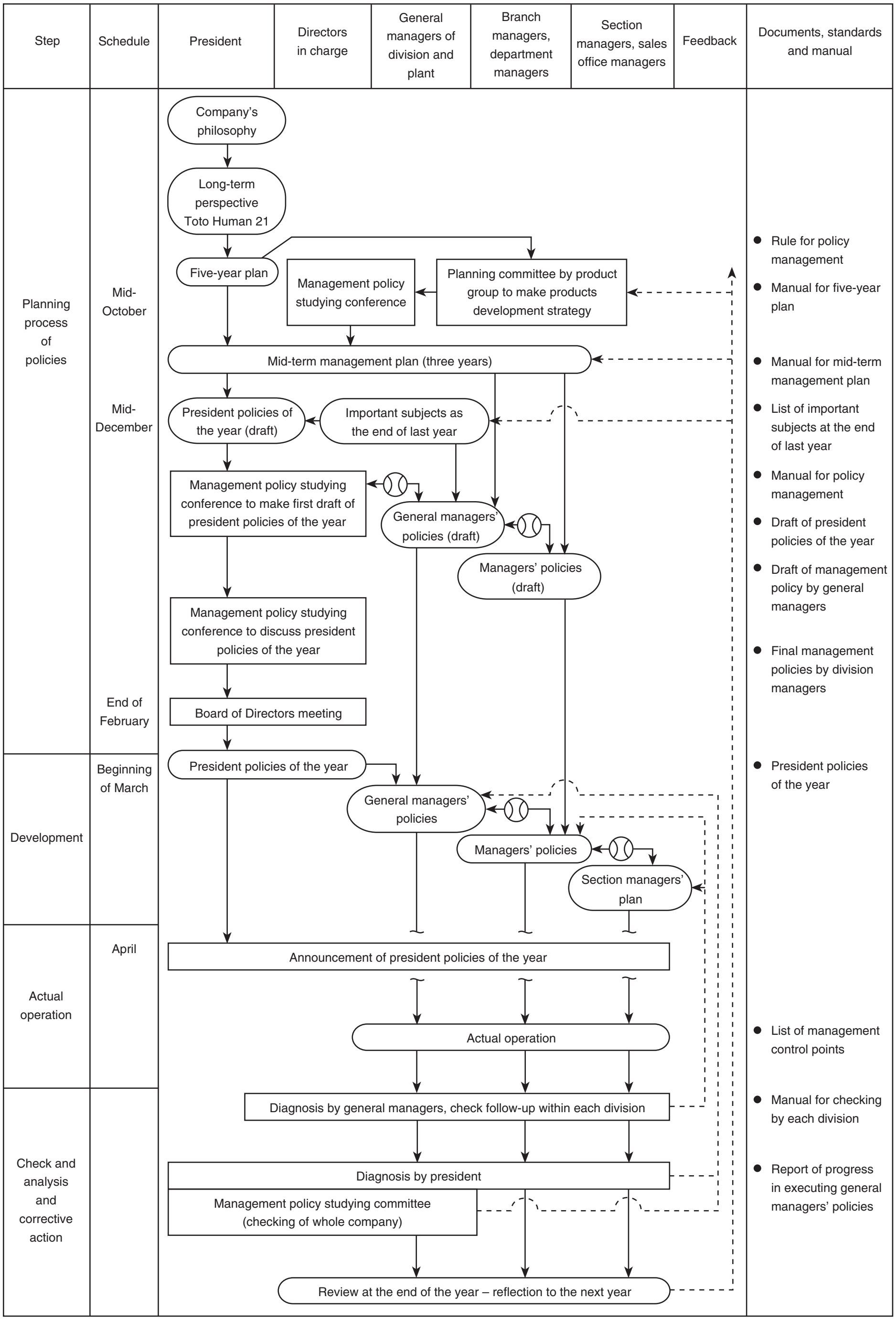

Figure 4.1 An example of the policy management system
Source: Toto Ltd, Chigasaki Works, Chigasaki City, Japan

business operations, and it is argued that this will enable an organization to deploy its vision, mission, goals, objectives, targets and means more effectively.

Definitions: Policy Deployment

Hoshin kanri was developed in Japan to communicate a company's policy, goals and objectives throughout its hierarchy; its main benefit is to focus attention on key activities for success. A literal translation of hoshin kanri provides an insight into its concept (Total Quality Engineering 1997):

> Hoshin = a compass, a course, a policy, a plan, an aim; Kanri = management control, care for;
>
> Together = 'management control of the company's focus'.

The popular term 'policy deployment' is often used interchangeably with hoshin kanri. While the translation is useful as an insight, and in particular attention should be drawn to the 'management', 'control' and 'focus' as elements, there are a number of widely varying definitions of hoshin, hoshin kanri, management by policy and policy deployment which expand the concept. Watson (1991) simply states that 'Perhaps the most accurate term for hoshin kanri would be target-means deployment.' Total Quality Engineering (1997) say hoshin kanri is:

> A system of forms and rules that encourage employees to analyse situations, create plans for improvement, conduct performance checks, and take appropriate action.

Integrated Quality Dynamics (1997) define hoshin as:

> A one-year plan for achieving objectives developed in conjunction with management's choice of specific targets and means in quality, cost, delivery, and morale.

or, in 'catch-phrase' form,

> Hoshin = Target + Means

While these definitions offer variations on the themes of plans, targets and means, the most comprehensive and 'encompassing' definition, and one that emphasizes the importance of the PDCA cycle and feedback, is that of Mizunode quoted in Eureka and Ryan (1990):

Deploy and share the direction, goals, and approaches of corporate management from top management to employees, and for each unit of the organization to conduct work according to the plan. Then, evaluate, investigate and feedback the results, or go through the cycle of PDCA continuously and attempt to continuously improve the performance of the organization.

The following are the main characteristics which emerge from this discussion of policy deployment definitions:

- Clear organizational goals understood by employees from each level of the organization.
- Involvement of employees in the development of action plans.
- All employees and functions are working in the same direction to achieve the organization's objectives.
- Regular review mechanism using the PDCA cycle thereby promoting an environment of continuous improvement.
- Visible display of information.

Another significant point to draw from the preceding definitions is that they 'interpret' hoshin kanri and often fail to mention feedback. Interpretation of hoshin kanri as policy deployment by Western writers often leads to a watering down of the concept, and although 'catch-phrase' versions may make Western managers' jobs easier, it can lead to inadequate application of the method and unsatisfactory results (Oakland 2011).

What is Policy Deployment?

'Policy Deployment within a process of long-term planning is one of the features of "the approach" to Total Quality Control (TQC) by Japanese companies', Dale (1990). He described the deployment of the president's annual management policy plan through the levels of the organizational hierarchy. The process involves developing plans, targets, controls and areas for improvement based on the previous level's policy and an assessment of the previous year's performance. The plans and targets are discussed and debated at each level until a consensus on plans and targets is reached, along with the methods for meeting the goal.

The control of the deployment process and subsequent implementation of the policies is conducted through quarterly, monthly, weekly and daily reviews depending on the level of the individual involved. Dale (1990) says the PDCA cycle 'is extensively used in these diagnoses' and that 'the discipline of policy deployment and agreement at each level' ensures everyone is working in the same direction. More recently, Kondo (1997) described hoshin kanri as 'a system of management in which the annual policy set by a company is passed down through the organization and implemented across all departments and functions'. There are a number of elements in Kondo's article which are key to the Japanese approach, support the foregoing summary of Dale's (1990) description of the process, and which are often overlooked or underplayed by those describing Western systems of policy deployment. The key points made by Kondo (1997) are:

- Policy deployment is effective in motivating employees.
- The aim of the process is 'give and take'.
- For a top-down approach to work senior managers have to be highly respected.
- Results are checked by means of individual managers' control items.
- The process is an important strategy for allowing top managers to exercise leadership.
- Policy is not determined only by short-term considerations.
- Top management must 'lead the way in whipping up everyone's energy and enthusiasm'.
- The purpose of the top management audit is to find and solve problems, discover and build on strengths, and standardize and institutionalize improvements.
- If management audits are carried out in the wrong way, there is a danger they will become superficial and ritualistic.
- It is important for top managers to talk directly to ordinary workers.

Kondo (1998) notes that 'Hoshin Kanri proved extremely effective in furthering company wide improvement plans by uniting the efforts of all employees.'

The most important policy deployment concepts to be drawn from the writings of Dale (1990) and Kondo (1997) are:

- Leadership
- Communication
- Control
- Review
- And that there are four stages:
- Policy-setting
- Policy deployment
- Policy implementation
- Evaluation and feedback

However, despite the defined process and benefits to be gained from effective policy deployment, even in Japanese companies there are some fundamental problems with its application. Kogure (1995) defines them as:

1 Ambiguity of relations between goal and policy.
2 Unfitness of content of management policy between superiors and subordinates in terms of a policy's abstractness and concreteness.

Kogure (1995) describes the first problem as one of distinguishing between policies and goals, the order in which they are issued and how they relate to each other. With respect to the second problem, Kogure discusses how there is an imbalance between content of policy and level of issuer – the higher the

Table 4.1 Main similarities and differences between policy deployment and management by objectives (MBO)

Similarities	*Differences*
self-determination of goals	policy deployment focuses on a general improvement plan for the organization and not on an individual's performance
attainment of goals	policy deployment ensures an individual's goals are congruent with company objectives
setting continuously higher goals	policy deployment encourages employee participation in objective-setting rather than acquiescence to a superior's bidding and direction
improvement in performance	policy deployment focuses on timely and relevant feedback, not an annual or bi-annual review of progress
self-evaluation of results	policy deployment focuses on the process of getting there, how the objectives will be met and what actions an individual must take
co-ordination, discussion, and exchange of ideas	policy deployment emphasizes process and quality tools and techniques to solve problems
inducement of creativity and morale improvement	policy deployment encourages the formulation of management teams
	policy deployment encourages the establishment and implementation of TQM
	policy deployment emphasizes customer focus and quality of products and services

policy-issuer the more abstract the policy should be; it is the role of the subordinate to develop plans and not policy.

What Policy Deployment is Not

Policy deployment is not a solution to all planning problems but a process which enables managers to plan effectively and translate those plans into actions. Furthermore, although Integrated Quality Dynamics (1997) consider the description of hoshin kanri as policy deployment as 'not the best translation' (they describe hoshin as a one-year plan with targets and means and state that hoshin management is not only 'deployment'), their 'myths' are worth repeating:

- Hoshin is part of QFD.

Hoshin myths

- Hoshin is only for the top management of an organization.
- Hoshin is the corporate policy.
- Hoshin is following the direction of the shining needle.

Hoshin management myths

- Hoshin management is part of QFD.
- Hoshin management works successfully only in Japanese organizations.
- Hoshin management is strategic planning.
- Hoshin management can be implemented without any other TQM methods and systems.
- The key to successful hoshin management is deployment of targets.
- When implementing hoshin management the starting point is to determine the corporate vision.

These 'myths', offered by Integrated Quality Dynamics, give valid insights into misconceptions perpetuated by some writers on the subject. Policy deployment is not just about corporate philosophy and management jargon, it provides a positive process which engages all employees in the cycle of planning, implementing, and reviewing policy. The authors believe that policy deployment is not:

- An excuse to pay lip-service to employee feedback during the catch ball process.
- An opportunity for 'empowered' employees to take decisions without adequate direction, support, checks and balances.
- A permit for managers to abdicate their responsibility for the plan and the results.

The Policy Deployment Process

Policy deployment works on two levels to manage continuous improvement and achieve business results: strategic objectives and daily control of the business. The key features of the process are now examined.

Five- to ten-year vision

A challenging, customer-focused vision, pertinent to people at all levels and appropriate for the next five to 10 years, is required. According to Goal/QPC Research (1996) a draft of the vision should be given to the organization for a reality check and then communicated to everyone at all levels. Unfortunately, this is easier said than done, as visions are generally created at top management level and any reality check is likely to receive middle management filtering of employee comments to prevent unfavourable views reaching top management (i.e. the 'sponge' effect). The most effective way of overcoming this problem is to gather accurate information on the company, its customers, competitors and market, and then hold workshops between top management strategists and employees without middle management interference. However, this method needs to be treated with caution because it is not usually a good approach to ignore middle managers.

Mid-term three to five-year objectives

Translating the vision into mid-term objectives, together with the broad means to achieve them, is the next step. Wood and Munshi (1991) suggest that the objectives should be prioritized, and from this the critical ones are selected with a focus on a small number of breakthrough objectives (a maximum of three). Then, determine the means by which the objectives will be achieved and cascade the objective and means through a catch ball discussion. The process of catch ball provides the opportunity to ensure commitment to objectives at each hierarchical level and produces an organization which is focused and committed to the same goals. However, these medium-term goals, as extensions of past performances, are of little value without analysis of critical problems, current practices and changes inside and outside the company.

Annual plan and objectives

Annual, short-term objectives are determined from the mid-term goals and the annual plans should be actionable and specific. This one-year plan includes the targets, means and measures that each manager will work on during that year. The managers will develop their annual policies, improvement targets and plans for every section and department which are within their remit of responsibility. Goal/QPC Research (1996) say it is necessary to choose a small number of target areas on which to focus (six to eight maximum) and half of these should be related to the manager's participation in the strategic plan and the other half to the critical process of the person's regular job. However, Mulligan et al. (1996) suggest that departments should have only three or four goals so line management can have the appropriate level of focus and resources assigned. Regardless of the number of objectives, all must be measurable, with monthly numerical targets, and the reasons for selection must be compelling and obvious (Watson 1991). Furthermore, they should be owned by the organization through the process of catch ball, and the plan, objectives, and targets should not be constrained at management level, but cascaded down to each individual team or employee.

Deployment/roll down to departments

Clear, disciplined action plans with direction for improvement, what is to be measured, and the processes to be improved are generated through a continuous catch ball between all organizational levels and around chosen targets. Corporate and division/department planning cycles should be synchronized and annual plans should present a prioritized set of actionable tasks, designed to achieve breakthrough in critical areas (Wood and Munshi 1991). A significant aspect of policy deployment is the extent to which the targets and means initiated at the top level are extensively modified through negotiation by the creativity of the lower levels of employees through bottom-up feedback. This involvement of everyone results in full ownership and understanding of the plan at all levels of the organization. The goal of catch ball is to prevent sub-optimization, and local optimization may have to be forsaken in the interests of the company as a whole, even if this appears to rebuff the concept of 'empowerment' which pervades modern companies. Ideally, policy deployment should be a shop-floor process, with no off-site management retreats and/or staff-level planning. Once the goals, objectives and plans have been agreed, along with the methods and means to reach the goal, they should be openly displayed in the work area adjacent to the progress charts that are tracking achievement and targets.

Execution

The actionable tasks, following the deployment phase, should be taken up by teams and individuals, departmentally and cross-functionally, depending on the task. When using the cross-functional approach it is essential to determine the lead department to determine responsibility for and supervision of the task. The team/individual should have a clear statement of target and means and follow a PDCA cycle, with periodic checks from senior management (Wood and Munshi 1991). It is usual for a department to keep a register of the improvement action agreed with staff.

In this way the improvement activities of an organization are focused on carrying out projects to meet these policies. This ensures integration and the internalization of objectives. Every employee understands their manager's policy and therefore knows what to do and that everyone is working in a common and unified direction to achieve the goals of the business. In addition, employees understand the issues which are important to the company, helping to facilitate relations between the different sections of the business.

Progress review (monthly and quarterly)

The control and review of policies are necessary to compare actual to planned performance of each activity that is supporting the organization's goals and

blackburn challenge 98

Our aim is to defy inflationary pressures in all areas of our business. Our measure of success will be – achieving profitability at an output level of 7000 housings a day.

NSK-RHP *blackburn – Hoshin Kanri* 1998

We will all take ownership for achieving Profitability Without Volume

blackburn mission

Our aim is to give unrivalled stakeholder satisfaction – by ensuring product conformance, on time delivery, minimal environmental impact and competitive costing. Always developing our people to their full potential and involving them to ensure their safety and well being.

Strategies

* Through the application of Teamworking, involving everyone in Kaizen and CANDO activities, we intend to develop Total Productive Maintenance (TPM) in all areas of the site.
* The achievement of Target 160 actions will ensure we achieve profitability in 1998.
* Through achievement and maintenance of standards – ISO9002, ISO14001, BS8800 & IIP we will ensure Customer/Neighbour/Employee satisfaction.

Enablers

* Improve our productivity performance through,
  - key machine productivity status displayed throughout the factory – on line OEE's
  - all key machines taken to TPM stage 3 by Q2 and to stage 5 by Q3
  - key machine breakdown history (6 months) input to MAINPAC by Q4
  - 80% of our people involved in TPM activities by Q4
* Improve our cost performance by,
  - breaking down the factory into natural work groups, identifying all cost elements and setting targets for reduction
  - displaying sample housing costs at each stage of the production process to increase the cost awareness of our people
  - involving the Kaizen TPM Teams in the implementation of all ***Target 160*** activities
* Improve our customer/neighbour/employee satisfaction by,
  - maintenance of ISO9002 and ISO14001 working to improve our audit compliance
  - promoting a positive effect on the environment both inside and outside of our business
  - improving our employees' health standard and well being through achievement of BS8800
  - raising the skills level of our people in line with the business needs through IIP and application of our training plans, working always towards accreditation of the training to NVQ standards

	Objectives	***Targets***
Quality	Reduce Incident Of Audit Non Compliance	–50%
	Reduce Customer Complaints	–50%
	Conformance To Specification	Fdry 97.6% M/c 99.2%
	Reduce Ferrybridge Returns	0.05%
Cost	Reduce Casting Cost	£2.07
	Reduce Expenditure Cost	–10%
	Reduce Labour Cost	–10%
Delivery	Improve Schedule Adherence	TBA
	Foundry & Machine Shop	TBA
People	Validation Of Skills Levels	40%
	Personal Development Reviews	1/year
Health **&** **S**afety	Achieve BS8800	Q4
	Reduce Lost Time Accidents	–50%
	Reduce Accident Incidents	–50%
	Introduce Smoking Policy	Q3
Environment	Reduce Waste	–10%
	Reduce Energy Usage	–10%
	Hold An 'E' Day	June 98

Danny McGuire
(Plant Manager)
Issue Level 1:1

Figure 4.2 NSK–RHP top-level policy deployment annual plan
Source: NSK–RHP Blackburn foundry

NSK-RHP *blackburn* Environmental Policy 1998

'Breaking the Mould' to ensure our ENVIRONMENTAL future.

Strategies

- Through the Continuous improvement cycle, we will develop strategies to reduce our energy usage.
- Through our philosophy of '***Cost Down***' we will identify all waste and set out a programme to eliminate, minimise, recycle or make good use of all waste within the site.
- Through improved communications, we will involve our people, customers, suppliers, neighbours, regulatory bodies and other interested parties in minimising our impact on the environment.

Enablers

- Establish Programmes and systems for pollution prevention – specifically carry out trials to establish viable alternative products for solvent based paints and rust preventatives.
- Ensure compliance with all relevant environmental laws and legislation to which our organisation subscribes.
- Work with our local authority to ensure compliance with the Environmental Protection Act.
- Use the TMC process for setting and reviewing environmental targets and objectives.
- Inform, instruct and train our people in environmental issues, thereby ensuring continuous environmental awareness with the use of competency based training plans.
- Build on our 'best practice' recognition for incorporating environmental issues into existing management systems.
- Through communications and teamwork, involve our people to minimise our impact on both local and global environment.
- Contribute to the reduction of global warming through the reduction of, reuse of or recycling of all waste.

Objectives

Quality	Set up review meetings with local Environmental Officer to agree compliance with all legislative regulations, e.g. EPA.
Cost	Install bulk storage of paint, amine and resins by Q4 98 Target 10% energy & waste disposal reduction CAPEX proposal for site sub-metering Q4 98
Delivery	Audit waste disposal suppliers annually Deploy environmental TMC to work groups
People	Introduce formal start-up and shutdown procedures across site, complete Q2 98 Specific environmental issues to be posted on notice boards and briefed as necessary. Site to have an Environmental open day for employees' children during 1998.
Safety	Test and refine all Emergency Procedures. Complete ALL environmental aspects assessments Q1 98 Reduce Pollard noise levels to below 85 dec.
Environment	Investigate re-use of waste coolant, proposal by Q3 98. Carry out trials on alternative Rust Inhibitors, proposal by Q2 98 Install abatement equipment – amine

Danny McGuire
(Plant Manager)
Issue Level 1:1

Figure 4.3 NSK–RHP environmental policy
Source: NSK–RHP Blackburn foundry

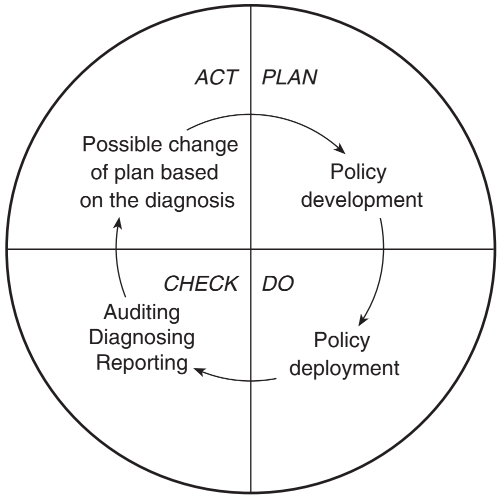

Figure 4.4 The plan-do-check-act cycle
Source: Dale and Cooper (1992)

objectives; identify gaps, problems and root causes; determine counter-measures; and recognize and reward achievement.

The progress reviews stress the importance of self-diagnosis of targets and process to ensure that there is an alignment of activities in the cascading of organizational objectives and operating methods. Problems should be identified and corrective action implemented. PDCA is built into the policy deployment process and regular checking will assure continuous improvement and reduce costs (see Figure 4.4). The results of these activities are reflected in the following year's policy and assist in improving the process of deployment. In some organizations, the process of policy deployment is also subject to diagnosis by outside experts.

Annual review

Wood and Munshi (1991) suggest the review process should focus upon the following:

- Achievements of the past year
- Lessons learned in the past year
- The gap between goals and achievements in the past year
- Root cause analysis of the problems
- Environmental factors
- Future plans for the organization

This forms the basis of policy deployment for the succeeding year, the check being undertaken at the start of the cycle. However, one important review should not be forgotten, the review of the policy deployment process itself, to learn from mistakes made and improve it for the following year; the process can also constitute a useful theme for a benchmarking project.

Mulligan et al. (1996) say that the most tangible aspect of policy deployment is the four sets of reports that support the organization's planning process:

- Articulated objectives
- Objective owners

Hoshin plan summary
- Long- and short-term goals
- Implementation strategy
- Specific improvement focus

Hoshin action plan
- Detailed links between core objectives and implementation initiatives

Hoshin implementation plan
- Records progress as the plan is implemented
- One plan for each objective
- Incorporates: task ownership; milestones and due dates

Hoshin implementation review
- Charts post-implementation results relative to company goals
- Competitive benchmarks
- Accepted world-class benchmarks

Visible display

It is good practice for a department or section to have a visible display of the outcomes from the policy deployment process as part of their visible management system; Figure 4.5 illustrates the key points of the typical format of such a display. The left-hand side of the chart shows the tree of policy deployment from the plant manager down to the level of each section. The overall rate of imperfection for each section is related to the different processes, with information being provided on individual problems. A proportion defective (p) control chart is used to monitor the rate of imperfection against the set target. The right-hand side of the chart indicates the annual improvement targets for quality, cost, delivery, safety and morale. A slogan relating to the improvement is displayed at the head

- President policy and annual theme
- Plant manager's policy, annual theme for the plant and improvement targets
- Section manager's policy and improvement targets
- Statement of major projects
- Current rate of non-conformance and targets for improvement
- Data collected using the seven QC tools
- Improvement monitored using a proportion non-conforming units chart (*p* chart)

Quality Delivery Cost Safety Morale

Annual improvement targets
Slogans
Project themes
Factors being monitored
(e.g. morale – number of suggestions made by employees, the project themes being resolved by QCs, and the willingness to educate new employees in the principles of TQC)

Figure 4.5 Key points of the visual display of policy deployment for a section
Source: Dale and Cooper (1992)

of the problem to be solved. The names of the workers who are responsible for the various activities relating to the policy deployment are also displayed. It is usual to position at right angles to the board and completing the policy deployment 'corner' examples and pictures of typical imperfections in the section together with an improvement book. This book logs each improvement which has been made and helps to promote standardization; it also serves as a point of reference as to what type of improvements have been made in the past. Some organizations keep the specific details of the deployment within the relevant offices, posting only the specific key actions, responsibilities and measures on the shop-floor policy deployment display. It is argued that in this way employees' attention is focused on the specifics rather than elaborate details.

A Check-Reflect-Improve-Scrutinize-Pass (CRISP) Approach to Policy Deployment

From an analysis of the research carried out into the policy deployment process of a 'world-class' organization and observations of the use of policy deployment by a variety of organizations, including Japanese manufacturing companies based

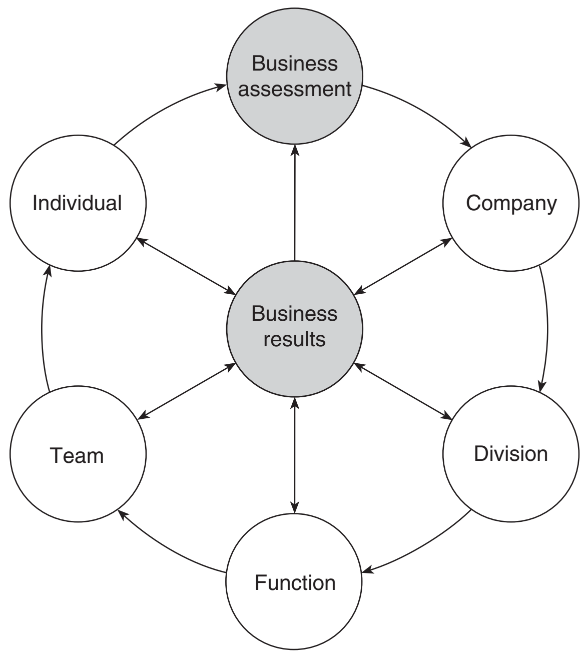

Figure 4.6 The policy deployment wheel

in the UK, it is clear that the key to ensuring the effectiveness of the process is leadership and communication (see Lee and Dale 1999).

In the literature on policy deployment there is consistent reference to cascade and catch ball as essential elements. However, based on research and practical experience, deployment is the area where management can have the most impact but often fail to deliver what is necessary. The cascade process often does not work because line managers fail to communicate with their teams in an effective manner due to lack of time, skills or management style. Catch ball fails to work because employees do not see the results of the process and it becomes over-reliant on individual management style. Policy deployment can be viewed in the form of a wheel (see Figure 4.6), with business results at the hub, targets and means as the spokes, and catch ball as the rim. What is required is an effective application of the PDCA cycle, as described by Akao (1991) and Kondo (1997), throughout this policy deployment wheel.

Mulligan et al. (1996) make a valid and astute observation: 'The image of catch-ball involves a group of children passing a ball (idea) amongst themselves while standing in a circle.' They go on to say that an alternative mnemonic – 'CRIP' – embodies the catch ball concept more clearly. CRIP stands for catch, reflect, improve and then pass the idea. Preferably, no one should pass on the idea immediately on receipt without first improving it. In this way they believe a consensus is achieved with maximum participation and minimal conflict. However, more importantly, it prevents 'passing the buck' and, combined with PDCA, it can be used throughout the policy deployment process to monitor progress and the continued relevance of objectives. Indeed, this whole cycle can become CAPD (check, act, plan, do), when policy deployment begins with annual self-assessment and the monitoring cycle begins with the 'check' step to ensure goals remain viable and appropriate (see Akao 1991).

One solution to the 'management' problem encountered with policy deployment is for organizations to adopt the CRISP approach. This is a development of the mnemonic CRIP, as briefly described by Kesterson (2014) in relation to their discussion of hoshin kanri as a strategic planning method. CRISP stands for catch, reflect, improve, scrutinize and then pass. The addition of 'scrutinize' is an innovation which would solve the problems of unsatisfactory, incomplete policy deployment and lack of management commitment and attention to the process, which, from our research, are believed to be the main issues. Furthermore, as well as being a memorable mnemonic, the word CRISP has the added advantage of suggesting the brisk, decisive manner in which the process is conducted.

Essentially, CRISP entails each individual and team catching the policy, reflecting and improving upon it, but, before passing the policy up and down the hierarchical chain, having their work scrutinized by the previous level to ensure the reflection and improvement are in line with the original policy (see Figure 4.7). This is the all-important 'check' aspect in the PDCA cycle which often does not occur in an organization's deployment process. Although, at first sight, this approach may appear to add unnecessary bureaucracy to policy deployment and extend the process time-frame, the addition of scrutiny does not have to be viewed as a burden, because the CRISP approach has the following advantages:

- Senior managers are required to demonstrate and use their leadership and communication skills.
- Senior managers can ensure that the right policy is being cascaded down the chain by checking their subordinates' planning activities.
- Senior managers can ensure that there is commonality of policy deployment throughout the organization, that policy deployment is pervasive and that the whole organization is pulling together as one team in the same direction.
- Cross-functionality of plans and purpose will be facilitated.
- Managers can 'check employees' understanding' of the policy through scrutiny of their planning output and terms of reference.
- Middle and first-line managers are required to perform catch ball-cascade because their teams' plans and terms of reference will be checked by senior managers and middle managers respectively.
- Managers are required to communicate effectively in a team forum to ensure they meet senior management's scrutiny requirements.
- Managers would not be able to 'pass the policy deployment buck' without tailoring it, in conjunction with their team, because of senior management scrutiny.

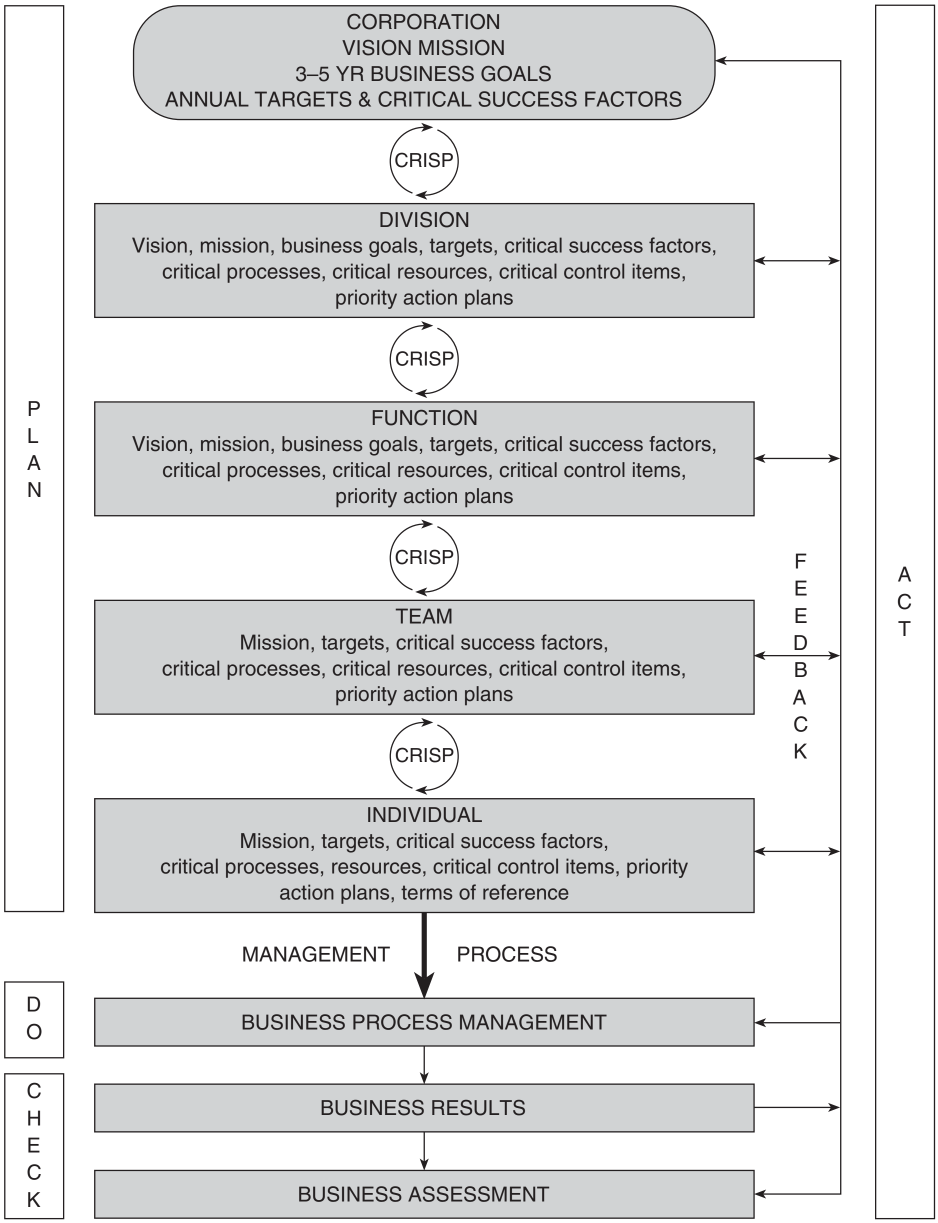

Figure 4.7 A CRISP approach to policy deployment

- Managers would have an opportunity to demonstrate their leadership skills to senior managers throughout the process.
- Leadership and communication skill gaps can be identified and personal development programmes organized during the process.
- Teams and individuals will see the catch ball process in action when they are involved in scrutiny of the next level's improvement of their objectives.

- Teams and individuals will 'buy in' to policy deployment when they see management using their feedback, become involved in its scrutiny, and have plans and objectives linked to company goals.
- It provides a 'closed loop' for policy deployment.

The CRISP approach does not necessarily elongate the policy deployment process if it is done efficiently. Much of the work should be done pre-policy deployment, with individuals and teams working cross-functionally to draft their VFO, plans and roles, responsibilities and objectives, after carrying out a self-assessment against a recognized excellence model, such as EFQM or MBNQA. In this manner the pre-policy deployment work will be the basis of the catch ball feedback up the chain and form the framework for the final policy deployment activities. If CRISP is executed correctly, after undertaking a self-assessment, the workload during the policy deployment phase should be reduced. If the self-assessment and pre-policy deployment CRISP process has been successful there should be no surprises or major reworks following the actual policy deployment.

An example of the application of a CRISP approach to policy deployment in a typical business unit (BU) would follow the process outlined below:

1 Prior to receiving the policy from the corporate organization, following self-assessment, each team/individual in the BU would go through a cross-functional process of defining their prioritized VFO, drafting plans and their terms of reference (TOR) for the following year. This would be fed up the chain through the BU using CRISP. Each higher level would catch the input from the subordinate teams/individuals, reflect upon it, improve upon it by co-ordinating all cross-functional inputs, give the results of the improvement back to the originating teams/individuals for scrutiny to ensure that the original sense has not been subverted and then pass it on to the next level. Finally, the general manager (GM) of the BU would pass on the BU prioritized VFO to the corporate organization for incorporation into their planning process.
2 On 'catching' the corporate organization's VFO, the senior management team, led by the GM, would reflect upon it in relation to the BU VFO they had already determined, noting complementary and conflicting points. The senior management team would then improve the corporate organization's VFO using the previously determined BU VFO to produce the final version. The senior management team would pass their improved and BU-specific VFO back to the corporate organization for scrutiny to ensure that the original sense of the deployed policy had not been distorted. On confirmation from the corporate organization that the BU VFO are acceptable, the senior management team would pass on the BU prioritized, cross-functionally co-ordinated policy – via the appropriate communication channels – to subordinate teams.
3 At the next function level, the team of line managers, led by a senior manager, would 'catch' the BU policy. The function team would reflect upon this policy, led by a senior manager, who would show where their original input to

the BU policy has been used to determine the BU VFO (highlighting catch ball) and how the BU VFO are linked to the corporate organizations VFO. The team would then improve upon the BU VFO by linking their original and draft VFO to the BU VFO and determining a revised set of function-specific VFO. Again, before the line managers deployed this policy to their teams, the function-specific VFO would be passed back to the senior management team for scrutiny to ensure the interpretation and improvements were valid, there were no cross-functional conflicts and that the senior management's direction had been followed at the function level. As part of this scrutiny the senior management team would check function, vision, mission, goals, objectives, targets, critical processes, resources, priority action plans, critical control items, and TORs. On passing scrutiny, the function line managers would communicate the deployed policy to their teams.

4 At team level, a similar process to that at the function level would occur and this would be finally deployed down to an individual level as necessary.

Following the successful use of the CRISP approach to policy deployment, each individual and team should see how their original input to the planning process, following self-assessment, has been used to generate the VFO and how their role is linked to the company policy. In this way, each employee will possess TORs that they have developed with their manager and are specifically tailored to support the VFO. They will also have a vision, mission, goals, objectives, targets and means that they have contributed to and can understand in terms of their work and the company policy. Most of all they will have played their part in policy deployment, been involved in catch ball and bought in to the process.

The CRISP approach is a generic management technique and can be applied to any organization involved in a communication and feedback process. A model which shows the CRISP approach applied specifically to policy deployment is provided at Figure 4.7. The model highlights how the PDCA cycle overlays the business process; that using a CRISP approach policy is deployed throughout the company; and, following the policy deployment process, how business process management results and self-assessment are linked to this cycle.

Summary

Policy deployment is a structured planning process that uses fact-based and participative methods to deliver achievement of objectives through continuous improvement. There are three common phases:

- Definition of the vision, mission, goals and objectives of the company.
- Deployment of the objectives throughout the organization.
- Management of the achievement of objectives.

The following are the key concepts which underpin policy deployment:

- Clear organizational goals understood by all employees.
- Involvement of employees in the development of action plans.
- All employees and functions are working in the same direction to achieve the organization's objectives.
- Regular review mechanism using the PDCA cycle, thereby promoting an environment of continuous improvement.
- Visible display of information to all concerned.

To ensure that the policy deployment process is effective everyone in an organization needs to have proactive involvement in the cascade and catch ball process, and this should be led by the senior management team. BUs, departments and sections need to prioritize and co-ordinate their VFOs in an effective manner and then use these to identify and prioritize the processes which need to undergo improvements.

During the PDCA cycle of policy deployment, managers should focus on the 'check' rather than the 'act', which employees should be empowered to do. However, this check should not be used as an excuse for management to neglect their responsibility to inspect their subordinates' work. One method of ensuring that the cascade and catch ball of policy deployment is effective and closed loop is to adopt the CRISP approach as described here and encourage managers to demonstrate effective leadership and communication.

Throughout the policy deployment literature (e.g. Akao 1991; Dale 1990; Hill 1994; Kondo 1997) there is a constant emphasis on the PDCA cycle in strategic planning and daily control. CRISP strengthens the catch ball process which represents the PDCA cycle between organizational levels, and facilitates Kogure's (1995) 'pattern 4' of policy content and level of issuer, by forcing managers to conduct policy deployment and to have their activities scrutinized before passing the improved targets and means up or down the hierarchy. At each management level they are having their work checked by superiors and checking that of their subordinates (and vice versa) and, in this way, allowing everyone to exercise and demonstrate leadership and commitment.

Hoshin kanri, or policy deployment, is simply PDCA applied to the planning and execution of a few critical strategic organizational objectives. It is an essential element of TQM and strategic process improvement is acknowledged by authors such as Oakland (2011), Lascelles and Peacock (1996) and van der Wiele et al. (1996a, 1996b) as an essential link with self-assessment against an excellence model. Although policy deployment is best used by sophisticated organizations that are a long way down the TQM road, the authors believe that fundamental elements such as catch ball can be used by less advanced companies to develop leadership and employee involvement and lay the foundation for future use of the full policy deployment approach.

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Chapter Five

Quality Costing

B. G. Dale, I. Reid and D. Bamford

Introduction

This chapter defines quality costs and explains why they are important to management. It also outlines how to determine, report and use quality-related costs. Quality costs arise from a range of activities; for example, the functions of sales and marketing, design, research and development, purchasing, storage, handling, production planning and control, production/operations, delivery, installation and service make, in some way, a contribution to these costs. Suppliers, subcontractors, stockists, distributors, agents, dealers, and especially customers can all influence the incidence and level of these costs.

Quality-related costs commonly range from 5 to 25 per cent of a company's annual sales turnover or operating costs in public sector-type operations, depending on the 'industry' and the way in which the company manages quality and the improvement process. Ninety-five per cent of this cost is expended on appraisal and failure. Reducing failure costs by eliminating causes of failure can also lead to substantial reductions in appraisal costs. Quality costs may be reduced to one-third of their current level by the use of a cost-effective quality management system (Dale and Plunkett 1990), and information-based technologies, see Kim and Kim (2011).

Definition and Categorization of Quality Costs

The importance of definitions to the collection, analysis and use of quality costs cannot be overstressed (Bamford and Land 2005). Without clear definitions there can be no common understanding or meaningful communication on the topic. The definition of what constitutes quality costs is by no means straightforward, and there are many grey areas where production and operation procedures and practices overlap with quality-related activities. Quality costs may be regarded as a criterion of quality performance – but only if valid comparisons can be made between different sets of cost data. Clearly the comparability of sets of data is dependent on the definitions of the categories and elements used in compiling them. If definitions are not established and accepted, the only alternative would be to qualify every item of data so that at least it might be understood, even though it may not be comparable with other data. The value of much of the published data on quality-related costs is questionable because of the absence of precise definition and lack of qualification (see also a recent review of the quality costing literature by Schiffauerova and Thomson (2006) and Luther and Sartawi (2011).

Many definitions of quality-related costs are in fairly specious terms. Admittedly there are definitions in preparing unambiguous, acceptable definitions and in finding generic terms to describe tasks that have the same broad objectives in different cases, such as service quality (see, Johnston and Ozment 2015).

It should also be appreciated that problems of rigorous definition arise only because of the desire to carry out costing exercises. Consideration of quality in other contexts (e.g. training, supplier development, design and engineering changes, and statistical process control) does not require such a sharp distinction to be made between what is quality-related and what is not. But there is ample practical and research evidence in the literature to show that, even when collecting costs, collectors do not feel constrained to stick to rigorously defined elements. By and large collectors devise their own elements to suit their own industry and/or particular situation. The result is a proliferation of uniquely defined cost elements which preclude comparisons between data from different sources.

Accounting systems do not readily yield the information needed, as it is presently defined, and rigorous definitions of quality activity elements are necessary only for costing purposes. Thus there is an apparently absurd situation of defining elements in a way which makes them difficult to cost. Given that accounting systems are unlikely to change radically to accommodate quality costing difficulties, there should be greater consideration of the accounting aspects when defining quality cost elements. However, the use of activity-based costing (ABC) systems should make it easier to gather quality-related costs. In simple terms ABC breaks down products and services into elements, called 'cost drivers' (e.g. machine set-up) and for each cost driver an overhead rate is determined. The cost drivers are then added together for a particular product or service. This results in more accurate product costs, since costs are not just related to volume of production but to the environment (e.g. variety, change, complexity) in which they are produced. Details of ABC are provided by Innes and Mitchell (1990) and Cooper and Kaplan (1991). These systems are used to enable more accurate calculations of product costs, and tend to focus on values at an activity level. This enables the quality cost associated with an activity to be more easily obtained. It also aids the inspection of the detailed activity analysis and consideration of the cost drivers affecting these activities. ABC is of particular benefit in identifying costs in non-manufacturing areas, such as conceptual process planning (see Hassan et al. 2010). A process management structure in which a manager is responsible for a complete process regardless of functional structures is also an aid to the identification, collection and reporting of quality cost data.

Over-ambition or over-zealousness may prompt people, including management consultancies, to try to maximize the impact of quality costs on the CEO and members of the senior management team. Consequently they tend to stretch their definitions to include those costs which have only the most tenuous relationship with quality. This attempt to amplify quality costs can backfire. Once costs have been accepted as being quality-related there may be some difficulty in exerting an influence over the reduction of costs which are independent of quality management considerations. In relation to this point of over-ambition the following questions are posed:

- Is the typically quoted figure of quality costs as 25 per cent or so of annual sales turnover or operating costs realistic?
- What is the basis for figures which are frequently quoted in excess of this 25 per cent?
- What are the likely reactions of senior management when the calculated quality costs are less than this figure? For example, figures of this order of magnitude tend to be remembered by senior management. If the calculated quality costs for their organization turn out to be less than this figure, there is sometimes a tendency for them to believe they have nothing to worry about in terms of continuous improvement; this is clearly a dangerous assumption.
- What can be said to executives whose response to this claim of 25 per cent is along the lines, 'If the organization is incurring costs of this magnitude how are we managing to survive?'

Definitions of the categories and their constituent elements are to be found in most standard quality management texts. Detailed guidance is given in specialized publications on the topic: BS 6143 (1990), Campanella (1999), Campanella and Corcoran (1983), Dale and Plunkett (1999) and Grimm (1987).

The widespread use and deep entrenchment of the prevention-appraisal-failure (PAF) categorization of quality costs (Feigenbaum 1956) invites analysis of the reasons for it. After all, arrangement of data into these categories is usually done for reporting purposes, after the collection exercise. It adds nothing to the data's potential for provoking action, except perhaps by facilitating comparison with earlier data from the same source (and even this may not be valid because of their relationship to current warranty costs, where these are included, and to other current costs). However, there are some general and specific advantages to be gained from the PAF categorization. Among the general advantages are that it may prompt a rational approach to collecting costs, and it can add orderliness and uniformity to the ensuing reports. The specific advantages of this particular categorization include:

- Its universal acceptance.
- Its conferral of relative desirability of different kinds of expenditure.
- Most importantly, its provision of keyword criteria to help to decide whether costs are, in fact, quality-related or basic work (e.g. essential activities in producing and supplying a company's products and/or services); in this way it helps educate staff on the concept of quality costing and assists with the identification of costs.

Matters are judged to be quality-related if they satisfy the criteria set by their definitions of prevention, appraisal and failure. However, whilst strategic process improvement and TQM has developed, the need to identify and measure quality costs across a wider spectrum of company activities has arisen, and the traditional prevention-appraisal-failure approach is, in some respects, unsuited to the new requirement. Among its limitations are:

1 The quality activity elements as defined do not match well with the cost information most commonly available from accounting systems.
2 There are many quality-related activities in grey areas where it is unclear which category they belong in (this is not detrimental to the process of cost collection, provided the decision-making is consistent).
3 It is not broad enough to account for many of the activities of non-manufacturing areas.
4 In practice the categorization is often a post-collection exercise done in deference to the received wisdom on the topic.
5 The categorization seems to be of interest only to quality assurance personnel.
6 It is not an appropriate categorization for the most common uses of quality-related cost information.
7 To the unwary, because of the distribution of cost elements, it can lead to more focus on the prevention and appraisal components rather than on failure costs.

In these circumstances a broader categorization which measures only the cost of conformance and the cost of non-conformances, as in Crosby's (1979) philosophy, is gaining recognition. The principal arguments in its favour are that it can be applied company-wide and it focuses attention on the costs of doing things right as well as the costs of getting them wrong. This is considered to be a more positive all-round approach which will yield improvements in efficiency. In theory all costs to the company should be accounted for under such a system. In practice, departments identify key result areas and processes against which to measure their performance and costs.

Clearly the prospects for success of a costing system will depend on how well the system matches and integrates with other systems in the company and the way that the company operates. Categorization of costs so that they relate to other business costs, and are easy for people to identify with, must have distinct operating advantages. From observations of quality departments at work, it is suggested that a supplier-in-house-customer categorization would have such advantages. Another such practical alternative, based on investigations carried out into one company's total cost of ownership of supplied parts, is attaining, possessing and sustaining costs: for details see Nix et al. (1993). However, whatever categorization is preferred there is no escaping the need to decide what is quality-related and what is not. In attempting to do so there are no better passwords than prevention, appraisal, and failure (despite their limitations as cost categories). Clearly it is quality-related, it is part of the business agreement between a company and its customers, and the company must make financial provisions to meet its possible liabilities under the agreement.

If, say, 'fitness for purpose' is the quality objective, it must be met through suitable specifications and detailed requirements, and the cost collectors must not be left in the difficult situation of trying to decide what parameters affect the product's or service's suitability for its purpose.

Collecting Quality Costs

Purpose

Among the main purposes of collecting quality-related costs are:

1. To display the importance of quality-related activities to company management in meaningful terms (i.e. costs).
2. To show the impact of quality-related activities on key business criteria (e.g. prime cost, and profit and loss accounts).
3. To assist in identifying projects and opportunities for improvement.
4. To enable comparisons of performance with other divisions or companies to be made.
5. To establish bases for budgets with a view to exercising budgetary control over the whole quality operation.
6. To provide cost information for motivational purposes at all levels in the company.

There is little point in collecting quality-related costs just to see what they may reveal. It must not be seen as just another cost-monitoring exercise. Getting the purposes of the exercise clear at the outset can go a long way towards avoiding pitfalls and unnecessary work.

Strategies

Clearly the strategy to be adopted will be influenced by the purpose of the exercise. If, for example, the main objective is to identify high-cost problem areas then approximate cost data will suffice. If the intention is only to get a snapshot from time to time as a reminder of their magnitude, the strategy will be to identify and measure large ongoing costs. Another aspect which needs to be considered is whether to collect and allocate costs on a departmental or business unit basis or across the whole company. In some cases analysis at company level is inadequate. Whatever the purpose of the exercise, key elements in any strategy are to involve the finance and accounting department right from the outset and to start with a pilot exercise on an important operation, process or department.

Scope

As mentioned earlier, deciding the scope of the exercise in the sense of agreeing what should be included under the quality-cost umbrella may be far from straightforward. There are many ‘grey areas’. For example, there are those factors which serve to ensure the basic utility of the product, guard against errors, and protect and preserve quality, e.g. the use of design codes, preparation of engineering, operations, technical and administrative systems and procedures, capital premiums on machinery and equipment, document and drawing controls, and handling and storage practices. Whether such factors give rise to costs which may be regarded as being quality-related is a matter for judgment in individual cases.

Problems of categorization may arise for costs generated by functions other than quality and production/operations. Examples are the contributions of purchasing and supplier development to supplier quality assessment, assurance, and development and the activities of engineering design departments involved with concessions and design modifications prompted by quality considerations. Quantifying, classifying and costing such inputs is difficult, but they can amount to significant expenditures. These are the kinds of problems which will need to be addressed when deciding the scope of the exercise. Because each case is different it is not possible to offer general solutions, other than to suggest that, if there is serious doubt, the cost should not be defined as being quality-related where it is unlikely to be amenable to change by quality management influences. Other suggested criteria are that an item or activity is quality-related when (1) if less is spent on it, failure costs will possibly increase and (2) if more is spent on it failure costs will possibly decrease. It is always better to underestimate rather than overestimate the costs of quality.

Cost collection

When establishing a cost-collection procedure for the first time, four important points to be noted are:

1 There is no substitute for a detailed, thorough examination of the operating processes at the beginning. Modifications to the procedure may be made later, if necessary, with hindsight and as experience of applying the procedure grows.
2 People will readily adopt ready-made procedures for purposes for which they were not intended if they appear to fit their situation. Hence it is very important that the 'first off' should be soundly based.
3 Procedures should be 'user-friendly' (i.e. the information needed should be readily obtainable from a relatively small number of sources). Nothing inhibits information-gathering so much as having to gather it from a large number of sources. It is strongly recommended that the system used to collect quality costs should be made as automatic as possible with minimum intervention of the cost owners.
4 The accounts department must be involved right from the start.

It is most important that quality cost-collection guidelines are developed. For example, apportioning staff time to a particular quality cost category, how to allocate an activity into different cost categories, what to include in a particular element, losses caused by substandard products/services, etc.

Quality cost information needs to be produced from a company's existing systems. It is easier to develop a quality costing system in a 'greenfield' situation as opposed to attempting to break into an established system. A common fallacy is that larger companies have accounting systems from which it is relatively easy to extract quality-related costs. Often such companies have large, immutable accounting systems and practices imposed by a head office and have little flexibility to provide quality costs.

When seeking to measure costs under quality-related headings it is sometimes easy to overlook the factor that the task is primarily a cost-collection exercise and that these exercises have other, different, criteria to be considered which are sensibly independent of the cost topic. It is suggested by Plunkett and Dale (1985) that an appropriate set of criteria for any cost-collection exercise is:

- Purpose
- Relevance
- Size of costs

- Ease of collection
- Accuracy of data
- Potential for change
- Completeness.

A set of back-up criteria like these can often provide a useful way out of the dilemma about whether or not particular activities and costs should be included in a costing exercise.

Some Cost Aspects in Business

There are a number of cost aspects – hidden in-house quality costs, scrap and rework, appraisal costs and warranty costs – which occur in businesses and which warrant discussion. Commercial organizations and those providing a service will have their equivalents of these types of costs.

Hidden in-house quality costs

Hidden quality costs occur in two forms:

1. Those owing to inbuilt inefficiencies in processes and systems.
2. Activities which are clearly quality-related but do not carry a quality tag.

There are many inbuilt inefficiencies such as excess materials allowances, excess paper and forms, excess production/operation starts, poor material utilization, deliberate overmakes and production overruns. These, though, are sometimes not regarded as costs; they may in fact have their origins in engineering, technical, management operations and operating inefficiency. The same may also be true of the provision of standby machines, equipment and personnel, additional supervision, some safety stocks and items, and other contingency items. Similarly excess and selective fitting owing to variability of machined parts is often an accepted practice. This can be considerably reduced or even eliminated by the use of SPC and design of experiments.

The principal problem arising from built-in inefficiencies within a product, process and system apart from their direct costs, is that they distort the base values against which important judgments are made; ironically, the more the base values are used the more firmly entrenched and accepted the built-in inefficiencies become. For example, major activities in the second category are concessions, modifications and engineering changes. It is suspected that in many companies concessions are an expedient way of maintaining production schedules and that little account is taken of the disadvantages incurred in deciding to overlook non-conformances. Not least among these are proliferation of paperwork and lax attitudes towards quality and its improvement among managers, supervisors and operatives. In fact, frequent concessions on non-conforming goods are a positive disincentive to operators and first-line supervisors to get it right first time. There is a need for a new set of specific definitions and elements to help determine the costs associated with these types of activities.

Scrap and rework

These costs are collected and reported in most companies. They are frequently regarded as important costs which feature in companies' business decisions. Yet the economics of scrapping or rectification are by no means clear in many companies.

The first difficulty is the valuation to be placed on scrapped goods. Some popular views encountered are that the value should be the factory selling price, the market price, the raw materials price or the materials cost plus the cost of processing to the point of scrapping, or the materials cost plus 50 per cent of the cost of processing, irrespective of the point of scrapping. These different bases will obviously give rise to very different valuations. The second difficulty is that the decision about whether to scrap or rework is often taken by personnel who do not have access to the financial information necessary to make an economic choice. And in any case the economics will vary depending on workload, urgency of delivery, etc. It will often be found that scrap vs. rework decisions are based primarily on ease of rework and output and delivery targets rather than on cost.

The practice, found in some organizations, of deducting from quality costs the income from sales of scrap is to be discouraged because it makes the overall quality cost appear to be better than it really is. Also, the type and quantity of scrap sold at a particular time may bear no relation to current production.

Appraisal costs

Though appraisal costs cover a wider range of activities, the majority of the expenditure is on in-house inspection and test activities. Opinions differ about whether testing is an appraisal cost. Carson (1986) is positive that testing is about detecting defects, that it is an appraisal cost, and that there is an onus on the businesses to 'get it right first time'. This is all part of the change of philosophy from detection to prevention, as discussed in Chapter 1.

Warranty costs

Warranty costs are usually met from a provision set aside for the purpose. Care needs to be taken when determining costs from changes in provisions because the provision may be used to meet some other charge or may be topped up from time to time with arbitrary amounts of money. Hence it is necessary to know about all the transactions affecting the provision.

Reporting Quality Costs

Quality cost reporting is not yet widely accepted as one of the normal activities in the reporting of quality performance. An important consideration in the presentation of quality-related costs is the needs of the recipients, and it may be worth presenting information in several different formats. For example, weekly reports of the cost of scrap and rework may be of greatest value to shop floor supervisors, monthly reports of total costs highlighting current problems and progress with quality improvement projects would be suitable for middle management, while total costs and costs on which to act are needed by senior managers. While selective reporting of this kind has its merits, it should always be done against a background of the total quality-related cost. Ideally quality cost reports should show opportunities for cost savings leading to increased profits or price reductions.

For maximum impact, quality costs should be included in a company's cost reporting system. Unfortunately, the lack of sophistication of quality cost collection and measurement is such that it does not allow quality cost reporting to be carried out in the same detail and to the same standard as, for example, reporting on the production/operations and marketing functions. Reporting of quality costs is, in the main, a subsection of the general reporting of quality department activities, and as such loses its impact. Often quality reports do not separate out costs as an aspect of quality which is worthy of presentation and comment in its own right. This usually results in cost information not being used to its full potential. Separating costs from other aspects of quality and discussing them in the context of other costs would improve the clarity of reports and help to provide better continuity from one report to the next.

Good standards of reporting are essential if the costs are to make an impact and provoke action. Managers are like everyone else in wanting easy decisions to make. Having costs, which are the basis of business decisions, tangled up with technical information makes the data less clear than they could be and may provide a reason to defer action. The manager's problem should not be to disentangle and analyse data in order to decide what to do; it should be to decide whether to act, choose which course of action to pursue and ensure provision of the necessary resources. Problems, possible solutions and their resource requirements should be presented in the context of accountability centres which have the necessary authority to execute the decisions of the senior management team.

Many manufacturing companies make goods for stock, and it may be many months or possibly years after manufacture that a product goes into service. This raises the issue of the comparability (or even relevance) of categories of cost one to another. Much has been written about definition, categorization, and reporting of quality costs, and the implication is always that the reported costs are concurrent and relevant to each other. Clearly, prevention costs should have a bearing on appraisal and failure costs, and expenditure on appraisal may influence the magnitude and distribution (between internal and external) of failure costs, but not necessarily concurrently. In some industries the time lags arising between action and effect are such that concurrent expenditures on, say, prevention and warranty bear no relation whatever to each other. Reporting only concurrent costs in isolation can be misleading, and in some cases it is perhaps worth considering contemporary costs as well as concurrent costs.

The long intervals which may occur between manufacture and receipt of warranty claims can have some special implications for cost reporting. Warranty costs in any period may bear no relation to other quality costs incurred in the same period, and should not be reported in the same context. To include them can distort considerably the quality performance of the company or department as depicted by the levels and ratios of quality-related costs. The delays may also mean that the causes underlying the failures leading to the claims may no longer be a problem.

One of the maxims of cost-collecting seems to be that, in general, costs need to be large to attract attention. This creates something of a dilemma for the cost collector because large costs are often insensitive to change. But the collector cannot omit large costs and concentrate only on smaller costs which may readily be seen to change. Hence cost groupings need to be chosen carefully so that cost reductions achieved are displayed in such a way that both the relative achievement and the absolute position are clearly shown. Another dilemma arises from the fact that one-off estimates do not change and that there is no point in collecting costs which do not change.

The creation of a quality-related cost file, integrated with existing costing systems but perhaps with some additional expense codes, should not present many problems. As stressed earlier, it is important to make provision in the file for collecting data which are not readily quantifiable even though it may take a long time to obtain satisfactory returns on a routine basis.

When reporting costs at regular intervals it is important to ensure that sets of data remain comparable. If additional cost elements are introduced as an organization becomes more experienced in quality costing, these must be reported separately until an appropriate opportunity arises to include them among related costs. It is also worth coding each cost element to indicate its source and status (e.g. accounting records, calculation from standard data, calculation through surrogates, average rates, estimates, etc.).

Presentation of costs under prevention, appraisal, and internal and external failure, as advocated by BS 6143 (1990) and Campanella (1999), is the most popular approach, albeit with different cost elements appropriate to different industries, whether manufacturing, commercial or service-related. This format is favoured by quality managers perhaps because, on the face of it, it forms a quality balance sheet for the quality management function with prevention equivalent to investment, appraisal to operating cost, and failure to losses. This categorization of costs is of interest and some value to quality managers, but less so to other functional managers on the grounds that they do not relate directly to the activities of the business.

The influence of senior management is vital in the reporting of quality costs. If there is no pressure to reduce costs against mutually agreed targets then the reporting will become routine and people, quite naturally, will devote their efforts to what they believe are the most important activities. It is important that senior management develop a quality cost reduction strategy.

Uses of Quality Costs

According to Morse (1983): 'The potential uses of the information contained in such a [quality cost] report are limited only by imagination of management.' Many of the uses can, however, be grouped into four broad categories:

- First, quality costs may be used to promote product and service quality as a business parameter.
- Secondly, they give rise to performance measures.
- Thirdly, they provide the means for planning and controlling quality costs.
- Fourthly, they act as motivators.

The *first* use – promoting quality as a business parameter – is usually interpreted as gaining the attention of higher management by using their language – i.e. money. But costs can also be used to show that it is not only the quality department that is involved in quality, that everyone's work can impinge on quality and that it is indeed an important business parameter – especially if the influences of suppliers and customers are made clear. Clearly knowledge of quality-related costs will enable decisions about quality to be made in an objective manner.

The *second* use – giving rise to performance measures – includes a wide variety of activities. Among them are:

1 *Trend analyses* to show changes in costs or cost ratios with time. Diagnosis of the cause of change can often prompt pilot exercises in the use of specific tools and techniques.
2 *Pareto analyses* to identify quality improvement projects. This is the quickest route to the exploitation of quality cost data.

3 *Identification of investment opportunities.* Progressive companies are always looking for profitable ways to invest in quality improvement projects and initiatives, but their task is made very difficult by the lack of data and understanding of the economics of investment in quality. While it may be axiomatic that prevention is better than cure, it is often difficult to justify investment in prevention activities. To some extent such investments are regarded as acts of faith. Little is known and nothing has been published on the appropriate levels and timing of investments, payoffs or payback periods. However, there are many opportunities for investment in prevention, with consequential real cost savings. Employing qualified, experienced staff, encouraging continuing education and providing training are examples of investment in personnel. Investment in supplier quality development activities is claimed by many companies to pay handsome dividends (Galt and Dale 1990). Of more direct interest to engineers and technical personnel are the possibilities of effective savings through investment in tooling, equipment and machinery and mistake-proofing devices (for details of mistake-proofing see Shingo 1986). A poor standard of tools is frequently responsible for non-conforming product, and the extra costs of providing a higher standard of tooling is often a worthwhile investment. Quality considerations also enter into the selection of machinery and equipment inasmuch as a premium is paid for machine tools with the potential to achieve a capable process, thus avoiding failure costs, and maybe some appraisal costs. Kaplan (1983) takes this line of argument further when he suggests that if manufacturing costs decrease as quality increases (and there is evidence of this), then the financial justification for new capital equipment, including robots, should include the savings in manufacturing costs from achieving a lower incidence of defects.
4 *Performance indicators and quality efficiency indexes.* Business efficiencies are commonly analysed and expressed using a variety of criteria (mostly financial). Maintenance and improvement of quality are not among the criteria used. Quality managers' efforts to persuade fellow managers and directors of the value of continuous improvement to a company are often frustrated by a lack of well-known and accepted indices or standards. Some companies have developed measures for the purpose of internally monitoring improvement, but no general guidelines or methods of calculation exist which would readily allow a company to assess its standards against a norm or other companies' performances. The most popular comparative measure against which quality costs are measured is gross sales, followed by manufacturing or operating costs and value added. Other useful bases are hours of direct production labour, units of product, and processing costs. It is widely held that single ratios do not tell the whole story and may always need to be considered alongside other ratios. BS 6143 (1992) recommends that at least three comparison bases should be used, and urges care and caution in the selection of bases. Other useful guidance is contained in Campanella (1999) and Feigenbaum (1991).

Quality cost data may also be used to assist with vendor rating. Winchell (1987) lists 'visible' and 'hidden' quality costs. Included in the visible quality costs category are the following:

- Receiving or incoming inspection
- Measuring equipment calibration
- Qualification of supplier product
- Source inspection and control programme
- Purchased material reject disposition (material review)
- Purchased material replacement
- Rework of supplier-caused rejects
- Scrap of supplier-caused rejects.

The visible costs, if tracked, are perhaps most significant because they can be good indicators of problem areas.

Hidden quality costs include:

- Those that are incurred by the supplier at his plant.
- Those incurred by the buyer in solving problems at the supplier's plant.
- Those costs which usually are not allocated to suppliers, but are incurred by the buyer as a result of potential or actual supplier problems – including loss of business from customers who don't come back.

In much of the foregoing it is implicit that placing costs on activities and quality management data somehow enhances the underlying data and shows something which might otherwise not be revealed. While enhancement of data in this way may be useful, it may not always be necessary. Sometimes only translating numbers into costs is sufficient to provoke action (e.g. Richardson 1983). Similarly, the mere collection of data may provoke investigative action.

The *third* use of quality costs – as a means of planning and controlling quality costs – is widely mooted in the literature. Costs are the bases for budgeting and eventual cost control. Contributions from the quality fraternity tend to see establishment of quality cost budgets for the purpose of controlling costs as the ultimate goal which may be achieved after accumulating data over a long time in pursuit of quality improvements of specific cost reductions.

Despite the popularity of the topic with contributors to the quality literature, there are relatively few examples of its application to quality costing. The state of development of quality costing in most companies is not advanced enough to establish budgetary control over quality costs other than within the quality department.

Fourthly, quality costs can be used for motivational purposes at all levels in a company. Costs have traditionally been used to motivate senior managers to become interested and take part in the promotion of quality. As companies move towards TQM and strategic process improvement the use of costs as a motivator becomes more widespread. Thus, for example, costs of scrapped goods are displayed to line supervision, operatives and clerical staff because they can see the relevance of them to their work. It is found that this group of people responds positively in terms of increased quality awareness, improved handling of the product, housekeeping disciplines, etc. Although the costs may be relatively small in company terms, they are usually large in relation to operatives' salaries. Thus a strong impact is made, in particular when poor trading conditions result in restrictions being placed on salary increases and even in freezes or reductions being imposed, without disclosing sensitive cost information.

Finally, while it is clearly important to make good use of quality-related costs, it is equally important to avoid misuse of them. For example:

- It must be remembered that in some industries quality costs are not susceptible to conventional cost-reduction techniques and quality may not be compromised to save money, e.g. where there is a possibility of severe loss of life or ecological disaster. Only in those situations where the consequence of failure is merely loss of profit is a manufacturer in a position to trade off quality expenditure against potential loss of profit resulting from product failures (Cox 1982).
- Costs alone must not be used to determine an optimum level of quality as suggested by 'economic cost of quality' models which appear everywhere in the literature. Such models have been heavily and widely criticized in recent years. For example, Plunkett and Dale (1988) have observed that, though well-intentioned in warning against extravagance in pursuing quality, the models are only notional and do not reflect actual experience. Many of the published models are ambiguous, inaccurate and misleading. While there is no objection to trying to optimize quality costs, quality should not be compromised. Quality should be determined by customer requirements, not optimum quality costs. The real dangers are that taking cognizance of the model will inhibit the development of TQM and strategic process improvement in the company and that the company will perhaps settle for a standard of quality which is less than what the customer requires. The form of the model, shown in Figure 5.1 from BS 6143 (1990), resembles real situations much more closely than the classical optimum-quality cost models that are usually portrayed in quality management and production and operations management textbooks.
- Comparisons with other cost data should be avoided. Comparisons should only be made after it has been shown that the data are genuinely comparable (i.e. sources, computation, accounting treatment, and reporting methods are identical).

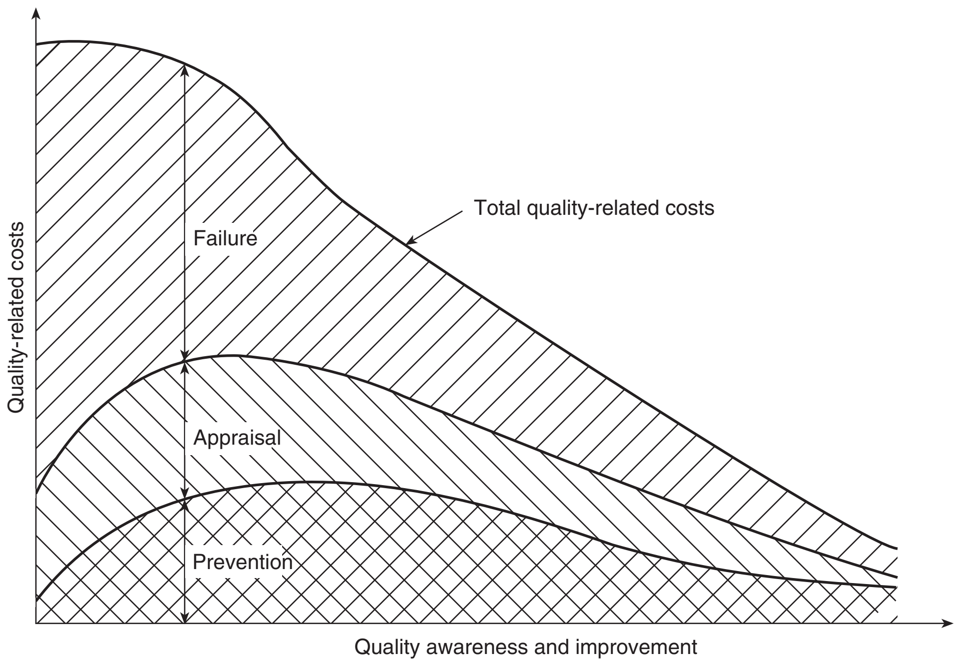

Figure 5.1 Increasing quality awareness and improvement activities
Source: BS 6143-2 (1990)

Summary

The value of cost data should not be underestimated. Costs are a most effective way of drawing attention to and illuminating situations in ways that other data cannot. It has been found that even the most rudimentary attempts at quality costing have been beneficial in identifying areas of waste and trends in quality improvement performance. It should also not be forgotten that quality costs are already being incurred by an organization; the whole purpose of the quality costing exercise is to identify these 'hidden costs' from various budgets and overheads, the objective being to allocate these indirect costs to a specific cost activity.

Unfortunately, the whole process of definition, collection, reporting, and use of quality-related costs is not yet well enough developed to be used in the same way as many other costs. A major influence in this is undoubtedly the solid entrenchment of the prevention-appraisal-failure categorization of quality-related costs. The potential uses of cost data derived from elements defined via this categorization are restricted and do not fit well with companies' day-to-day operating modes and experience (Bamford and Land 2005). Nor do they lend themselves to sophisticated business uses. However, even with restricted potential, there is still much to be gained, as shown in this chapter. Sizes and proportions of costs can be used successfully as criteria for deciding whether to act, what resources should be committed, priorities to be allocated, etc.

As things stand now, the most widely accepted and used categorizations and definitions of quality cost elements cause the definition-collection-reporting-use process sequence to be definition-driven, with companies making the best use they can of the outcome. But companies should be looking for more effective ways of using quality cost data. Perhaps taking a different approach to the categorization and definition of costs will assist with this.

However, what is more important is to make the process sequence dynamic. Use is the most important part of the sequence, but at present there is little or no feedback from uses to definitions. There is a need for use-driven definitions which will in turn affect the collection and reporting stages. The system can then become dynamic, changing as business requirements change. It is a task which needs to be tackled jointly by accountants and the manager responsible for quality in the company. The question to be answered is: 'How can cost information be used to improve the company's quality status, keeping in mind that quality status is determined by customers, supplier performance and in-house quality management?'

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Chapter Six

Managing Service Quality

B. R. Lewis, I. Reid and D. Bamford

Introduction

Managing service quality is concerned with understanding what is meant by service quality, what its determinants are and how they may be measured, and identifying the potential shortfalls in service quality and how they can be recovered. Responsibility for quality service lies with operations, marketing, human resources and other management – working together within an organization.

For more than two decades, service quality issues have been of academic and practitioner interest, and to marketers in particular, as organizations are increasingly sourcing services that become part of their value proposition to their (business) customers from external providers (van Iwaarden and van der Valk 2013). This results from the increasing importance of the services sector in both developed and developing economies – to embrace both public and private, profit and not-for-profit organizations. It includes industries such as financial services, health care, tourism, professional services, government, transport and communications and sports – where the focus of business activity is on 'services' rather than 'products' (Bamford et al. 2015). Services are characterized as being different from products along a number of dimensions that have implications for the quality of service provided to customers.

- They are typically intangible: there is usually little or no tangible evidence to show once a service (e.g. investment advice, consultation with a doctor) has been performed.
- The production and consumption of many services are simultaneous; the service may not be separable from the person of the seller, and the customer may be involved in the service performance (e.g. legal advice, hairdressing). Thus, the service process, including staff at the customer interface, becomes integral to service quality.
- Related to this is heterogeneity: variability often exists in services as a function of labour inputs and non-standardization of delivery, and so the use of quality standards in the conventional sense is more difficult.

- Many services cannot be stored to meet fluctuations in demand (e.g. a doctor's time, hotel rooms, purchase of shares in a privatization issue), so companies need to develop systems to manage supply and demand.

In this chapter some comments will be made on the changing business environment, which has implications for service quality. The focus will then turn to defining service quality, measurement of service quality and the role of personnel in service delivery. The final sections are concerned with the service delivery process, the need to monitor service quality, and the development of service recovery strategies.

The Service Environment

Environmental trends that impact on service and quality issues relate to consumers' awareness and expectations, technological developments, and competitive elements.

Consumers, be they individuals, households or businesses, are more aware of the alternatives on offer (in relation to both services/products and provider organizations) and rising standards of service. Their expectations of service and quality are therefore elevated, and they are increasingly critical of the quality of service they experience. Expectations are what people feel a service/product should offer and how they relate to the company and its marketing mix, both the traditional elements (product, price, place and promotion), and the extended elements of physical evidence, process and people (see Booms and Bitner 1981). The physical environment includes tangible clues which might be essential (computers in a travel agency) or peripheral (decor, uniforms) to a service being bought. The service process is also critical: if systems are poor (e.g. breakdown of computer access to customer accounts in a bank) employees get blamed and consumers perceive poor quality service. Personnel are also integral to the production of a service and, although their degree of contact with the customer varies, all have a contribution to make. Furthermore, advances in technology include management information systems, marketing information systems to include customer databases, online bankings' automated clearing systems, tourism reservation/booking systems, and e-commerce and e-procurement systems.

These advances provide a major contribution to facilitate customer–company exchanges and increase levels of service. Mechanization and computerization, including the use of the Internet, can depersonalize services, but also results in increases in speed, efficiency, accuracy and improved services. The other side of the coin is that depersonalized service could lead to reduced customer loyalty. But, generally, high-tech and high 'touch' go hand in hand, better personal service with enhanced technological efficiency. Technology can free employees' time and allow them to concentrate on the customer and enhance customer–staff interaction. Technology will not replace people in the provision of services.

In addition, the business environment is increasingly complex and competitive as a result of economic conditions, legislative activity (e.g. deregulation in financial services and air travel; the Citizens' Charter in the public sector in the UK) and increased customer choice and sophistication. Corporate reaction has been to emphasize operations and financial efficiency, and/or more focused product and market strategies. In addition, companies may also have an appreciation of the importance of customer service and quality, and the possible opportunities for attaining differentiation and achieving a competitive edge by providing superior service. Consequently, service quality is seen as a mechanism to achieve pre-eminence in the marketplace and the battle for market share, and so becomes a factor in strategic planning.

The benefits of good service

Without a focus on service quality, organizations will face problems and complaints from both employees and customers, and associated financial and other costs. Further, a proportion of dissatisfied customers will complain and tell others, generating adverse word-of-mouth publicity and possibly accusations of blame between personnel in the organization, and some will switch to competitors. With a service quality programme, an organization can expect a number of benefits relating to customers, employees and corporate image.

- The most frequently mentioned benefit is enhancing customer loyalty through satisfaction. Looking after present customers can generate repeat *and* increased business and may lead to the attraction of new customers from positive word-of-mouth communication. This is significantly more cost-effective than trying to attract new customers (see e.g. Rosenberg and Czepiel 1984).
- A number of organizations highlight the additional benefit of increased opportunities for cross-selling (see Lewis 1990). Comprehensive and up-to-date product knowledge and sales techniques among employees, combined with developing relationships and rapport with customers, enable staff to identify customer needs and suggest relevant products.
- In relation to employees, benefits may be seen in terms of increased job satisfaction and morale and commitment to the company, good employer–employee relationships, and increased staff loyalty, all of which contribute to reducing the rate of staff turnover and the associated costs of recruitment, selection and training activities. Further to this, Heskett et al. (1994) in their service–profit chain, model the impact of employee satisfaction and performance and employee loyalty and retention on customer satisfaction and retention and organizational success.

- In addition, good service quality enhances corporate image and may provide insulation from price competition; some customers will pay a premium for reliable service quality. Overall, successful service quality leads to reduced costs (of mistakes, operating, advertising and promotion) and increased productivity and sales, market share, profitability and business performance.

Defining Service Quality

At this point it is useful to introduce the concept of 'service encounters', which may also be referred to as 'moments of truth' or 'critical incidents' (see Albrecht and Zemke 1985; Czepiel et al. 1985). A service encounter is any direct interaction between a service provider and customers and may take varying forms. For example, a bank customer wishing to make an account inquiry may choose between an interaction with an automated teller machine, or to access via the Internet, or to interact with a bank employee by phone, letter, or face-to-face in a branch. Every time a customer comes into contact with any aspect of the bank and its employees, he or she has an opportunity to form an impression of the bank and its service. Service encounters have a high 'impact' on consumers, and the quality of the encounter is an essential element in the overall impression and evaluation of the quality of service experienced by the customer.

Service encounters also have an impact on employees in relation to their motivation, performance and job satisfaction, and their rewards. Consequently, all organizations need to manage their service encounters effectively for the benefit of customers and employees and for the achievement of corporate goals. This concept is developed further by Lewis and Entwistle (1990), who illustrate the variety of encounters which may prevail and which together impact on customer service and quality.

Further, one can witness the extent to which technology is impacting on and improving service encounters. Bitner et al. (2000) have examined the ability of technology to effectively customize service offerings, recover from service failure and spontaneously delight customers. They examine the infusion of technology as an enabler of both employees and customers in efforts to achieve these three goals. Service quality is variously defined, but essentially is to do with meeting customer needs and requirements and with how well the service level delivered matches customers' expectations. Expectations are desires/wants, i.e. what we feel a service provider should offer, and are formed on the basis of previous experience of a company and its marketing mix, awareness of competitors and word-of-mouth communication. Consequently, service quality becomes a consumer judgment and results from comparisons by consumers of expectations of service with their perceptions of actual service delivered (see Berry et al. 1985, 1988; Grönroos 1984; Liu et al. 2015). If there is a shortfall, then a service quality gap exists which providers would wish to close. However, one needs to bear in mind that:

- Higher levels of performance lead to higher expectations.
- To find expectations greater than performance implies that perceived quality is less than satisfactory. This is not to say that service is of low quality: quality is relative to initial expectations – one of the issues to take into account when measuring service quality.

The concept of service quality gaps was developed from the extensive research of Berry and his colleagues (Parasuraman et al. 1985; Zeithaml et al. 1988). They defined service quality to be a function of the gap between consumers' expectations of a service and their perceptions of actual service delivery by an organization, and suggested that this gap is influenced by several other gaps that may occur in an organization.

Gap 1. Consumer expectations – management perceptions of consumer expectations

Managers' perceptions of customers' expectations may be different from actual customer needs and desires, i.e. managers do not necessarily know what customers (both internal and external) want and expect from a company. This may be remedied by market research activities (e.g. interviews, surveys, focus groups, complaint monitoring), and better communication between management and personnel throughout the organization.

Gap 2. Management perceptions of consumer expectations – service quality specifications actually set

Even if customer needs are known, they may not be translated into appropriate service specifications, due to a lack of resources, organizational constraints or absence of management commitment to a service culture and service quality. The need for management commitment to and resources for service quality cannot be overstated.

Gap 3. Service quality specifications – actual service delivery

This is referred to as the service performance gap and occurs when the service that is delivered is different from management's specifications, owing to variations in the performance of personnel – employees not being able or willing to perform at a desired level. Solutions are central to human resources management and will be returned to.

Gap 4. Actual service delivery – external communications about the service

What is said about the service in external communications is different from the service that is delivered, i.e. advertising and promotion can influence consumers' expectations and perceptions of service. Therefore, it is important not to promise more than can be delivered (or expectations increase and perceptions decrease), and not to fail to present relevant information. Success in this area requires appropriate and timely information/communication both internally and to external customers. Gaps 1 to 4 together contribute to consumers' expectations and perceptions of actual service (Gap 5). Organizations need to identify the gaps prevalent in their organization, determine the factors responsible for them, and develop appropriate solutions.

Dimensions of service

Dimensions of service (quality) have been researched and discussed for 20 years. Grönroos (1984) referred to the technical [outcome] quality of service encounters, i.e. what is received by the customer, and the functional quality of the process, i.e. the way in which [the] service is delivered – typically, this includes the attitudes and behaviour, appearance and personality, service-mindedness, accessibility and approachability of customer-contact personnel. In addition, there exists the corporate image dimension of quality, which is the result of how customers perceive a company, and is built up by the technical and functional quality of its services. This model was later synthesized with one from manufacturing which incorporated design, production, delivery and relational dimensions of quality. For example, Edvardsson et al. (1989) present four aspects of quality which affect customers' perceptions:

- *Technical quality*: to include skills of service personnel and the design of the service system.
- *Integrative quality*: the ease with which different portions of the service delivery system work together.
- *Functional quality*: to embrace all aspects of the manner in which the service is delivered to the customer, including style, environment and availability.
- *Outcome quality*: whether or not the actual service product meets both service standards or specifications and customer needs/expectations.

An investigation in the manufacturing sector (Lewis and Craven 1995), that focused on the relationship between a major supplier and its business customers (also manufacturers), found three dimensions of service quality. These related to products (e.g. quality of products, record of technological innovation, range of products, technical specifications, product availability); the organization and its personnel (e.g. reputation, previous experience, helpful personnel, technical support, after-sales services, location of supplier, communication/response times); and operations/systems (e.g. delivery reliability and speed, ease of contact, administrative efficiency, and electronic aspects of ordering).

However, the most widely reported set of service quality determinants is that proposed by Parasuraman et al. (1985, 1988). They suggested that the criteria used by consumers that are important in moulding their expectations and perceptions of service fit 10 dimensions:

- *Tangibles*: physical evidence
- *Reliability*: getting it right first time, honouring promises
- *Responsiveness*: willingness, readiness to provide service
- *Communication*: keeping customers informed in a language they can understand
- *Credibility*: honesty, trustworthiness
- *Security*: physical and financial; confidentiality
- *Competence*: possession of required skills and knowledge of *all* employees
- *Courtesy*: politeness, respect, friendliness
- *Understanding*: knowing the customer, his needs and requirements
- *Access*: ease of approach and contact.

These 10 dimensions vary with respect to how easy or difficult it is to evaluate them. Some, such as tangibles or credibility, are known in advance, but most are experience criteria and can only be evaluated during or after consumption. Some, such as competence and security, may be difficult or impossible to evaluate, even after purchase. In general, customers rely on experience properties when evaluating services. Subsequent factor analysis and testing by Parasuraman et al. (1988) condensed these determinants into five categories (tangibles, reliability, responsiveness, assurance and empathy) to which Grönroos (1988) added a sixth dimension, recovery.

Service providers should also consider the contribution of Johnston et al. (1990) and Silvestro and Johnston (1990), who investigated service quality in UK organizations and identified 15 determinants which they categorized as hygiene, enhancing, or dual threshold factors.

- *Hygiene* factors are those that are expected by the customer; failure to deliver will cause dissatisfaction (e.g. cleanliness in a restaurant, train arrival time, confidentiality of financial affairs, lack of queues, return of phone calls).
- *Enhancing* factors lead to customer satisfaction; failure to deliver will not necessarily cause dissatisfaction (e.g. bank clerk addressing you by name, welcome of a waiter in a restaurant).
- *Dual threshold* factors are those for which failure to deliver will cause dissatisfaction, and delivery above a certain level will enhance customers' perceptions of service and lead to satisfaction (e.g. explanation of a mortgage service repayment level, interest charges, payback period and other relevant conditions).

More recently, Zeithaml et al. (2000) researched the delivery of service quality over the web. They studied focus groups of consumers with varying experience of Internet buying, assessing their expectations and perceptions of buying on the web, and found eleven dimensions of e-service quality: access, ease of navigation, efficiency, flexibility, reliability, personalization, security/privacy, responsiveness, assurance/trust, site aesthetics, and price/knowledge. Personal service was not considered critical in e-service quality except when problems occurred or when consumers had to make complex decisions. They also discussed service quality gaps or shortfalls that may occur when companies interact with their customers through the Internet. These are:

- *An information gap*, owing to insufficient or incorrect information about website features desired by customers.
- *A design gap* to include aspects of site design and functioning of the website.
- *A communications gap*, to include inaccurate or inflated promises.

The combined effect of these gaps leads to a fourth, fulfilment, gap which relates to stock availability, the reordering process and delivery: this may occur as a result of deficiencies in the design and operation of the website, see Upadhyaya et al. (2015), a user's perception about web services.

Zones of tolerance

Consumers' expectations with respect to dimensions of service are generally reasonable; for example, they expect luggage to arrive with them on an aircraft, and planes to arrive on time most of the time. They also expect basics; for example, from a hotel in terms of security, cleanliness, and being treated with respect. However, expectations vary depending on a host of circumstances and experiences and they also rise over time.

Consumers have what Parasuraman et al. (1991) refer to as 'zones of tolerance', the difference between what is desired and what is considered adequate. The desired level of service is what the consumer hopes to receive, a blend of what 'can' and 'should' be, which is a function of past experience. The adequate level is what they find acceptable; it is based in part on their assessment of what the service will be, the 'predicted' service, and it depends on the alternatives that are available. Tolerance zones vary between individuals, between service aspects and with experience, and tend to be smaller for outcome features than for process dimensions. In addition, if options are limited or non-existent (for example, the choice of general practitioner services, or of rail and plane routes or hotels) desires may not decrease but tolerance levels may be higher. Conversely, if many alternatives are available (for example, the choice of restaurants in a city), it is easy to switch and tolerance zones are more limited. Further, expectations are higher in emergency situations (for example the theft of a chequebook or loss of a credit card) and when something was not right the first time.

Table 6.1 Measuring service expectations and perceptions

		strongly agree				strongly disagree		
		1	2	3	4	5	6	7
service expectations:	e.g.	'customers should be able to trust bank employees'						
(*E*)		'banks should have up-to-date equipment'						
and perceptions:	e.g.	'I can trust the employees of my bank'						
(*P*)		'my bank has up-to-date equipment'						

Measurement of service quality

The measurement of service quality has also been the focus of research interest and debate over the last 20 years. Parasuraman's dimensions of service provided the basis of the SERVQUAL questionnaire (Parasuraman et al. 1988), which was designed to measure service quality, i.e. the comparison between consumers' expectations of service (*E*) and their perceptions of actual service delivered (*P*). This is a 22-item scale with reported good reliability and validity which can be used to better understand service expectations and perceptions of consumers. The original scale items were of the form shown in Table 6.1.

During the last 15 years, a host of research studies have used SERVQUAL or similar instruments to assess the dimensions of service quality. Of particular interest are those researchers who have debated SERVQUAL and related methodologies (see e.g. Buttle (1996a) and Smith (1995) for a review of some of the evidence). Areas of concern have focused on conceptual/theoretical, operational and interpretative issues, to include for example:

- The disconfirmation paradigm. Should service quality measurement be based on an assessment of performance minus expectations, or is attitude a better description of service quality?
- The relative focus on the process and outcome of service delivery.
- The measurement of expectations: what is being measured? Ideal, desired or adequate expectations, etc.
- The dimensionality of service quality and its applicability to all service industries and situations.
- The scaling techniques incorporated and associated importance weightings of service quality dimensions.
- Changes in attributes and importance, expectations, and perceptions over time.
- The timing of measurement: before, during or after a particular service encounter.

Some of the most recent research also incorporates the potential impact of cultural setting on the dimensionality of service quality, for example in financial services where Lewis et al. (2002) found eight dimensions of service quality in retail banking in Cyprus: tangibles, reliability, responsiveness, customer contact personnel, commitment to customers, services portfolio, access and image. This followed from earlier evidence (Lewis 1991), in an international comparison of retail bank customers in the US and UK, of cultural differences in attitudes and behaviour which impact on expectations and perceptions of service quality.

Finally, researchers such as Cottam and Lewis (2001) have considered the extent to which consumer expectations, perceptions and satisfaction may change during the course of extended service delivery and consumption. In particular, they found, from repeated measures of expectations throughout a yearlong service experience, that levels of expectation, both ideal and predicted, changed during the process of service consumption, and that expectations were not a key variable in predicting satisfaction with the service.

There thus remains a considerable challenge for both academics and practitioners to refine the methods used to identify and measure appropriate dimensions of service quality and the gaps that exist for organizations.

The Role of Personnel in Service Delivery

Having assessed customer needs, organizations must set standards/specifications and systems for service delivery to include the relevant dimensions of customer service, i.e. to avoid Gap 2. This implies a requirement for management commitment to a service culture and service quality, and the allocation of appropriate resources – in relation to products, systems, environment and people.

The subsequent challenge is to ensure that the service delivered meets the specifications set. This depends on the performance of *all* employees, who must be able and willing to deliver the desired levels of service. Employees' contributions in meeting customer needs and, thus, influencing customer perceptions of service cannot be overstated. Success depends on the development of enlightened personnel policies for recruitment and selection, training, motivation and rewards for all employees – both customer-contact and backroom staff.

Internal marketing

An understanding of the concept of internal marketing is central to personnel policies. Internal marketing views employees as internal customers and jobs as internal products (see Berry 1980), and a company needs to sell its jobs to employees before selling its service to customers: satisfying the wants of internal customers upgrades the capability to satisfy the needs of external customers. Grönroos (1981) refers to three objectives of internal marketing:

- *Overall*: to achieve motivated, customer-conscious and care-orientated personnel.
- *Strategic*: to create an internal environment which supports customer-consciousness and sales-mindedness among personnel.
- *Tactical*: to sell service campaigns and marketing efforts to employees – the first marketplace of the company – via staff training programmes and seminars.

The concept of internal marketing has been researched by Varey (1996), who studied the origins, nature, scope and application of the concept and considered how it might be developed to take greater account of the social and non-economic needs and interests of people working in an organized enterprise. From extensive review of the literature in various disciplines, organizational case studies, expert academic opinion and in-depth interviews with managers, some limitations of the popular concept of internal marketing were addressed and consideration given to the structural impact of internal marketing which leads into a presentation of a broader conception of internal marketing. A number of themes that offer a contribution to this broader conception were identified. They include: marketing-oriented service employee management; organization as an internal market; internal marketing as a social process; the individual person in an internal market; a relational perspective on communication; and empowerment.

Further, Ahmed and Rafiq (2002: 4–24) discuss the development and evolution of the internal marketing concept, models of internal marketing, and links with service quality, customer satisfaction, customer loyalty and profitability.

Personnel policies

Personnel issues are addressed by Lewis and Entwistle (1990), who develop the concept of service encounters to include encounters or *relationships* within the organization – at all levels and between levels – which contribute to the quality of service delivered to the final customer. This includes relationships between: customer contact and backroom employees; operations and non-operations staff; and staff and management at all levels and locations.

Successful personnel policies include recruitment and selection of the 'right' people. Key characteristics for employees to perform effectively may relate to: process and technical skills; interpersonal and communication skills; flexibility and adaptability; and empathy with the customer. It is also vital to identify the training needs of new *and* present employees with respect to technical and interpersonal dimensions, and to consider employment conditions, i.e. employees' wants and attitudes with regard to working conditions, benefits and welfare. This is undertaken, typically, via a training audit. Subsequently, training programmes may be developed to provide product, company and systems knowledge and also interpersonal and communication skills. Zeithaml et al. (1988), in relation to Gap 3, indicate that success will depend on:

- *Teamwork*: evidenced by a caring management and involved and committed employees.
- *Employee–job fit*: the ability of employees to perform a job.
- *Technology–job fit*: are the 'tools' appropriate for the employee and the job?
- *Perceived control*: e.g. do employees have flexibility in dealing with customers? If not stress levels may rise and performance decrease.
- *Supervisory control systems*: based on behaviours rather than 'output quality'.
- *Avoidance of role conflict*: for employees in satisfying their expectations of the company *and* the expectations of customers.
- *Avoidance of role ambiguity*: i.e. employees should know what is expected of them and how performance will be evaluated and rewarded.

Customer service training programmes are typically designed to move a company to a service-oriented culture by breaking down barriers and improving internal communications. Advantages are seen to be: creating an atmosphere of all working towards a common goal; understanding the work of others; and encouraging all staff to have responsibility and authority for achieving corporate objectives – which includes empowering employees to exercise judgment and creativity in responding to customers' needs.

Employees also need to be supervised and systems set to monitor and evaluate their performance (e.g. product knowledge tests, mystery shoppers) *and* satisfaction. In addition, organizations have a variety of recognition and reward schemes for excellent employees: customer-service awards may be financial or not, and may involve career development.

Service Delivery

In relation to service delivery, organizations need to avoid Gap 4, i.e. a failure to deliver the service as promised. Once a company has successfully assessed customer needs, translated them into service systems and standards, and recruited and trained employees, it must then manage its 'promises'. Quality systems are of benefit in helping to ensure this. Further, a company needs appropriate advertising and promotion so that the service that is offered in external communications matches the service that the organization is able to deliver. Advertising and promotion affect customers' expectations and perceptions of the delivered service, so it is important not to promise more than can be delivered. Realistic communications are needed so as not to increase expectations unnecessarily and decrease perceptions of quality: the hotel that advertised 'there are no surprises' was deemed to be over-promising.

Monitoring service quality

A critical element in any service strategy is for a company to have in place systems to measure and monitor success. These include research and evaluation among employees and customers, using focus groups, discussions, surveys and interviews, and sometimes mystery shoppers and 'control' branches. Collection and analysis of customer complaints and complimentary letters is also valuable, and for some organizations key indicators are provided by service guarantees and recovery activities.

Many, if not most, service providers now make promises and/or offer guarantees with respect to products/services, delivery and aspects of performance. In the private sector, these may be an element in a company's competitive armoury, for example: hotels which offer cash compensation or free accommodation if difficulties are not resolved in 30 minutes; a pizza delivery which becomes free after a certain time delay; UK organizations providing financial services publicizing their codes of practice including, for example, their 'promises to students' and 'commitments to you'; and a shopping centre which publishes promises to customers, including information on consumer rights with respect to faulty goods and the return of goods.

Utility companies in the UK have been actively developing and promoting, for competitive and consumer-oriented reasons, their service guarantees. For example, 'TXU Energi aims to deliver faultless customer service . . . if our service doesn't match our promise we want you to *tell* us. If we have slipped up, you'll see a credit on your bill'. United Utilities publish standards for all their services and make various promises. For example, with respect to planned mains repairs, they make promises relating to provision of information, timing and restoration of water supply, and cash compensation is available and levels clearly specified if these promises are not met.

In addition, Virgin Trains have a detailed Passengers' Charter which sets out their commitment to passengers with respect to customer care, service improvement, quantified standards (i.e. reliability and punctuality of trains), keeping passengers informed, and what happens when things go wrong. They also include quantified compensation and refund levels.

Hart (1988) summarizes key considerations relating to service guarantees. Some aspects of service and customer satisfaction cannot be guaranteed, for example unconditional on-time arrival of planes, and so guarantees must be realistic. A good service guarantee is unconditional, easy to understand and communicate, easy to invoke and easy to collect on. It should also be meaningful, in particular with respect to payout, which should be a function of the cost of the service, seriousness of the failure and perception of what is fair; for example 15-minute lunch service in a restaurant or a free meal. Ideally, a service guarantee should get everyone in the company to focus on good service, and to examine service delivery systems for possible failure points.

Service failure

To turn to service failures and customer complaints, service providers now appreciate that only a small proportion of dissatisfied customers complain, so that complaint data are not a true reflection of the extent of customer dissatisfaction. The reasons why dissatisfied people keep quiet are discussed by Goodman et al. (1986) and Horovitz (1990) and include:

- Fear of hassle or too much trouble to complain.
- No one is available to complain to or there is no easy channel by which to communicate disquiet.
- No one cares and it won't do any good.
- Do not know where to complain.
- Customers seeing themselves as a source of service problems by their failure to perform in the creation of the service.

Organizations should strive for zero defects in their service delivery – to get things right the first time (see Reichheld and Sasser 1990). Consequently, many companies develop service quality systems that tend to be rigid, with sophisticated techniques and structured personnel policies – to try to provide consistent high-quality service. However, all service organizations will find themselves in situations where failures occur in their encounters with customers with respect to one or more dimensions of service quality, and where they need to deal with customer dissatisfaction and complaints. Problems do occur (e.g. bad weather may delay an airline flight, or employees may be sick and absent) and mistakes will happen (e.g. a hotel room not ready on time, a dirty rental car, a lost cheque book or suitcase).

One should note, however, that a service failure may not only relate to a flawed outcome. A service failure can still occur if the service fails to live up to the customer's own expectations (Michel 2001). In fact, Lewis and Spyrakopoulos (2001) define a service failure as 'any dissatisfaction or problem that a customer perceives in relation to a service or a service provider'. A number of researchers have investigated service failures and several have attempted to classify them (e.g. Bamford and Xystouri 2006; Armistead et al. 1995; Bitner et al. 1990, 1994; Hoffman et al. 1995; Johnston 1994; Kelley et al. 1993) in relation to: problems in the service organization (e.g. with regard to employees, equipment and systems); those which may be customer-induced; and those that are a result of the actions of other organizations. In addition, there is evidence that service failure can lead to decline in employee morale and service performance (Bamford and Xystouri 2006; Bitner et al. 1994).

Service recovery

The actions that a service provider takes to respond to service failures are referred to as service recovery. Service recovery is defined by Armistead et al. (1995) as 'specific actions taken to ensure that the customer receives a reasonable level of service after problems have occurred to disrupt normal service', and by Zemke and Bell (1990) as 'a thought-out, planned, process for returning aggrieved customers to a state of satisfaction with the organization after a service or product has failed to live up to expectations'. The response from an organization to service failures needs to be the result of a conscious, co-ordinated, effort of the firm to anticipate that service flaws will occur, and to develop procedures, policies and human competencies to deal with them.

When something does go wrong, what do customers expect from the service firm? Zemke and Bell (1990) and Zemke (1994) concluded that customer expectations for service recovery are: to receive an apology for the fact that the customer is inconvenienced; to be offered a 'fair fix' for the problem; to be treated in a way that suggests the company cares about the problem, about fixing the problem, and about the customer's inconvenience; and to be offered value-added atonement (i.e. compensation) for the inconvenience. Service recovery is 'emotional and physical repair': organizations need to fix the customer first and then fix the customer's problem.

Critical to the service recovery process is the empowerment of front-line employees. It is essential to give personnel the authority, responsibility and incentives to identify, care about and solve customer problems and complaints; to allow them to use their initiative and judgment to respond flexibly, and to act with respect to the best solutions to satisfy customers. The personnel implications are highlighted by Schlesinger and Heskett (1991): empowerment is seen to lead to better job performance and improved morale – it is a form of job enrichment, evidenced by increased commitment to jobs and reflected in attitudes towards customers. Knowing that management has confidence in employees helps to create positive attitudes in the workplace and good relationships between employees and between employees and customers.

A recent study by Lewis and Spyrakopoulos (2001) investigated service failures and service recovery strategies used by banks to respond to them. A survey questionnaire was developed to measure customers' perceptions of the magnitude of service failures and the effectiveness of service recovery strategies. Service failures related to banking procedures, mistakes, employee behaviour and training, technical failures and omissions of the banks: they were found to vary in importance and some were more difficult to deal with satisfactorily than others. Different service recovery strategies (e.g. corrections, compensation, apologies and explanations) were more effective for particular failures. Further, customers with long relationships and higher deposits with their banks were more demanding with respect to service recovery.

A recent interesting stream of research has emerged in response to the question 'How do customers evaluate companies' service recovery strategies?', and focuses on consumers' evaluation of satisfaction with complaint handling in terms of perceived justice (see Blodgett et al. 1997; Mattila 2001; Michel 2001; Smith and Bolton 1999; Smith et al. 1999; Tax and Brown 2000; Tax et al. 1998). In addition, Smith and Bolton (2002) consider the manager's perspective on recovery efforts in relation to customer perceptions of justice. Perceived justice comprises three elements:

- *Distributive justice*: the perceived fairness of the outcome. What did the offending firm offer the customer to recover from the service failure (e.g. refund or replacement)?
- *Interactive justice*: this refers to the perceived fairness of the manner in which the customer is treated during the complaint-handling process and includes courtesy and politeness of personnel, empathy, effort in resolving the situation and the firm's willingness to apologize and provide an explanation for the service failure.
- *Procedural justice*: the perceived fairness of the process used to rectify a service failure, e.g. the speed (or delay) in processing and correcting complaints, the accessibility and flexibility of the procedures.

The main conclusion to be drawn from the available evidence is that, in order to recover effectively from service failure, an organization must provide a fair outcome, with a sincere apology, while taking the blame and acting swiftly to recover from the failure. Further, interactions between the justice dimensions mean that failure to deliver on one of them can impact negatively on the total success of the recovery. The effectiveness of service recovery strategies has also been shown to depend on factors such as the service type, the magnitude of the failure, the type of failure (i.e. process or outcome), prior experience, service recovery expectations, purpose of purchase and attitudes towards complaining.

Overall, from a review, of the available research evidence, it is possible to suggest a number of requirements for companies to create an effective service recovery programme:

- Seek out possible failure points. Focus on critical service encounters and try to anticipate problems, in particular as few people complain.
- Educate customers and encourage complaints. Make it easy to complain (e.g. 24-hour customer service hotlines) and offer service guarantees.
- Monitor service process, detect and track service failures, and analyse complaint data. Measure performance against company standards. Use the findings to improve service quality and prevent failures and dissatisfaction from happening again.
- Engage in customer research, focused on both the process and outcome of service delivery, to: identify when things go wrong; track how service recovery is implemented; and measure again to see if the recovery has satisfied the customer (i.e. follow up feedback).
- Develop proactive service recovery, to include, in addition to reinstatement, elements such as: initiation of the recovery process, which can

enhance customers' evaluation of the service provider; apologies, to show that the customer's problem is being taken seriously and is important to the organization; speedy response; and recompense as appropriate.
- Train, empower and facilitate employees to recover. Service recovery typically involves interpersonal interaction and communication skills, and knowledge skills, with implications for human resources management.
- Show management commitment. Employees need to be supported by senior management who have a commitment to absolute customer satisfaction.

Summary

Today the business environment is characterized by changing customer expectations, technological and product advances, legislative and political developments, and economic and competitive conditions which contribute to an increasing emphasis on service quality for all organizations – in both the services and manufacturing sectors. Managing service quality necessitates an integrated approach from operations, marketing, human resources and other key managers/areas of a business.

Organizations need clearly defined service strategies with top management commitment and leadership. They need to understand their service encounters (both internal and external to the company) and potential failure points, and to avoid service quality shortfalls or gaps. This can be achieved by researching both service personnel and customers, identifying key dimensions of service quality, and developing appropriate service quality initiatives. Successful service strategies will include emphasis on products/services, delivery systems and procedures, technology, and personnel – their skills and commitment to the organization and its customers.

The outcome of a successful service strategy will be satisfied and retained employees and customers, with consequent benefits to the organization. The links between customer retention and profitability have been evident for a number of years (see e.g. Buttle 1996b; Heskett et al. 1994). There is a growing awareness of the 'lifetime value' of retained customers in terms of the revenues and contributions earned from a long-term relationship, i.e. the longer the association between company and customer, the more profitable the relationship for the company.

In conclusion, one can refer to the work of Zeithaml (2000), who has recently reviewed the evidence on the profit consequences of service quality. She offers a substantive and valuable review of research projects and findings on the effect of service quality on profits; the link between perceived service quality and purchase intentions; customer and segment profitability; and the key drivers of service quality, customer retention and profitability. She also develops an inventory of questions for ongoing research.

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Chapter Seven

Supplier Development

B. G. Dale, B. Burnes, I. Reid and D. Bamford

Introduction

The quality of purchased supplies is crucial to an organization's products and services and consequently to its success in the marketplace. In many cases, as outsourcing has become the norm, bought-in components and services can account for some 70 to 80 per cent of the final cost of a product. It is therefore clear that suppliers are critical to the competitiveness and performance of the purchaser's products and services. Many major European companies, following the example of Japan, have during the last 20 years or so started to encourage their suppliers to develop their quality management systems, adopt a continuous improvement philosophy, eliminate non-value-added activity, improve their manufacturing systems, use lean manufacturing techniques, become more flexible and responsive, pursue cost-down activities, and concentrate on their core competencies and product lines. If the major companies wish to become and stay competitive they have to take their suppliers with them; electronic commerce and the internet are also facilitating and encouraging closer links with suppliers.

This process of customers working together with their suppliers to effect these changes is given a variety of names: supplier development, supply-chain management, supplier relationships management, co-makership, partnership sourcing, customer–supplier alliances, proactive purchasing and even Guanxi (Wiegel and Bamford 2015). This variety of names, and the way different organizations interpret them and the process, has led to much confusion about both the meaning and practicality of the partnership approach to purchasing. As well as the initiatives by customers and suppliers there are also currently a number of industry-wide initiatives to facilitate closer relationships between suppliers and customers and reduce costs in the whole value chain.

This chapter, examines the key issues in sustainable partnerships under the main headings of long-term issues of partnership, barriers to developing partnerships, conditions of partnerships, the issues to be considered in partnership, the process of partnership and the potential difficulties. The chapter concludes with a list of dos and don'ts when developing partnerships.

Long-Term Issues of Partnership

The traditional, open-market bargaining approach to customer–supplier dealings has been based on the assumption that the parties involved are adversaries who have conflicting objectives and are engaged in a win-lose and 'dog eat dog' contest, based upon tough negotiations, price orientation and cost undercutting with no love lost between businesses. This approach, which in reality no one can benefit from, focuses on negative issues, involves power abuse, and is characterized by uncertainty, all of which can seriously undermine, rather than reinforce, the competitiveness of both customers and suppliers.

Partnership demands a new form of relationship. It means working together towards common aims and aspirations. It is based on the principle that both parties can gain more through co-operation than conflict. Partnerships are characterized by mutual trust and commitment, integrity, integration, co-operation, honesty, a willingness to openly declare problems and work together to find answers, the sharing of data and ideas, improvements and best practices, clearly understood responsibilities, collaborative R&D, and a desire to continuously improve products and services. As an example, many first-tier suppliers are no longer being handed a prescriptive design by the original equipment manufacturer (OEM). Instead they are provided with a specification which the component, when assembled, must conform to. Other examples include suppliers setting up a manufacturing facility alongside their customers and a supplier's staff working on the customer's assembly line. In many respects, this form of relationship has similarities with a vertically integrated firm but without the difficulties of managing a complex business across different types of technologies and processes. One of the drivers for closer relationships with suppliers has been the move by OEMs to concentrate on their core competencies and to shift other activities and responsibilities to their suppliers. It must not be forgotten that a partnership does not come about by accident, and it cannot be sustained by inattentiveness. It is a management process which needs to be managed.

To develop a viable long-term business relationship, considerable changes in behaviour and attitude are required and need to be promoted in both customer and supplier organizations. Customers need to be prepared to develop plans and procedures for working with suppliers and commit resources to this. For their part, suppliers have to accept full responsibility for the quality of their shipped product and not rely on the customer's receiving inspection to assess if it meets their requirements. As a prerequisite of partnership, both parties have to reach an agreement on how they will work together, what they want from the relationship and how to resolve any problems which may arise. To ensure that the relationship is sustainable it is important that the objectives of the agreement should be examined and discussed on a regular basis.

The typical benefits of developing a long-term business partnership include:

- Reduction and elimination of the inspection of supplied parts and materials.
- Improved product and service quality, and delivery performance and responsiveness.
- Improved productivity, increased stock turns and lower inventory carrying cost and reduced costs per piece.
- Value-for-money purchases.
- Security and stability of supplies.
- Transfer of ideas, expertise and technology between customer and supplier and dissemination and implementation of best practice.
- Joint problem-solving activities, with the customer providing assistance to the supplier to help improve processes, leading to easier and faster resolution of problems.
- Integration of business practices and procedures between customer and supplier.
- A comprehensive customer–supplier communications network to ensure the supplier is provided with early access to the customer's future designs and business plans and is kept informed of changing customer requirements. This assists with the planning of workloads and typically opens up wider channels than those in the traditional relationship where the buyer and sales representatives would be the main point of contact.
- Customer and supplier being more willing and open to examine their processes to look for improvements.
- The supplier contributing to the customer's design process, undertaking development work and monitoring technological trends; this can lead to innovative products and services, and other business opportunities.
- Helping to develop sustainable growth of the supplier in terms of investment in equipment and manufacturing/business resources. Related to this is the reputation and credibility in the marketplace of both partners which arises from the relationship.
- Exposure of the supplier to new tools, techniques, systems and business practices.
- Provision by the customer of an advisory service to suppliers in terms of training, equipment and operating methods.

Barriers to Developing Partnerships

Developing partnerships is not without difficulties. Lascelles and Dale (1990) have carried out research which reveals that certain aspects of the customer–supplier relationship can act as a barrier to supplier development. These include:

- Poor communication and feedback
- Supplier complacency
- Misguided supplier improvement objectives
- Lack of customer credibility as viewed by their suppliers
- Misconceptions regarding purchasing power

Poor communication and feedback

In general, communication and feedback between customer and supplier is not good. Sometimes it is even so bad that the parties do not even realize how poor they are at communicating with each other. The main dissatisfactions expressed by suppliers relate to technical specifications and requirements, the lack of consultation on design and product engineering issues and changes to the delivery schedule. There are some strong indications that not all dissatisfied suppliers actually communicate their dissatisfaction to the customer.

Supplier complacency

This covers issues such as being insular, not being prepared to take a global view of supply and being unconcerned about customer satisfaction. There are two types of measurement relating to a customer's satisfaction with the quality of supplies, reactive and proactive.

Examples of reactive measures include:

- Failure data (e.g. non-conformity analysis, customer rejections, warranty claims)
- Customer assessment rating and audit reports
- Verbal feedback from meetings with customers
- Contractual requirements outlined in the customers' vendor improvement plans

Examples of proactive measures are:

- Customer workshops and forum meetings
- Market research
- Benchmarking key processes
- Competitor evaluation
- Reliability analysis
- Advanced quality planning

Misguided supplier improvement objectives

Customers are often not sure what they want from supplier improvement initiatives and can underestimate the time and resources required to introduce and develop partnerships. There also appears to be a dilution and distortion of the quality message as requirements are passed down the supply chain. For example, when faced with demands to improve quality from customers, first-tier suppliers usually react by implementing specific tools and techniques required by the customer. In turn, the supplier then insists that their own suppliers use the same tools and techniques but fail to understand that these are only fully effective within the context of an organization-wide approach to continuous improvement.

Lack of customer credibility

Suppliers need to be convinced that a customer is serious about continuous improvement. This requires the customer's behaviour and attitudes to be consistent with what they are saying to suppliers. The following are examples of how a credibility gap may emerge:

- Purchasing and supplies management practices such as a competitive pricing policy to force down prices, frequent switches from one supplier to another, unpredictable and inflated production schedules, last-minute changes to schedules, poor engineering design/production/supplier liaison, over-stringent specifications inconsistent decisions made by supplier quality assurance (SQA) personnel, abuse of power by SQA personnel and the use of 'loss of business' as a bargaining ploy in negotiating a reduction in price. It is not uncommon for a customer to talk quality to its suppliers and then act quite differently by relegating quality to secondary importance behind, for example, price and meeting the production schedule.
- The TQM and business excellence image which major purchasing organizations attempt to create in discussions with suppliers are not reflected in practice when supplier personnel visit their own manufacturing sites.
- A customer accepts non-conforming items over a long period of time, possibly unwittingly, and then suddenly criticizes the supplier for supplying non-conforming materials.
- A lack of a strategy for dealing with the tooling used for supplied parts. For example, a supplier may report to the customer that the customer-supplied tooling is reaching the end of its useful life. The customer then asks the supplier to carry out some minor refurbishment as a short-term measure; the supplier advises against this but is pressurized to do the repairs. When non-conforming parts are found in batches from the 'patched-up' tooling, the supplier acquires quality performance demerits.

- The customer fails to react positively to supplier concerns about design issues and is prepared to let the supplier carry the consequences.
- Failure to respond to a supplier's request for information and provide advice on queries.
- The use of supplied components that have not passed the initial sample approval procedure.
- The customer's SQA personnel are fooled by the camouflage measures, fakes and ruses employed by a supplier in an assessment of a vendor's quality system.
- The supplier is forced to hold stocks to cover a customer's inadequate scheduling and poor systems control.

Misconceptions regarding purchasing power

Purchasing power is a major issue in the buyer–supplier relationship. Lack of purchasing power is a commonly cited reason for the lack of success in improving supplier performance. The general view is that a purchaser's influence on its suppliers varies with its purchasing power, and the greater this is the more effective will be its SQA activities. These power imbalances can cause uneven levels of commitment in the relationship. However, purchasing power alone is no guarantee of improving supplier performance. Companies with considerable purchasing power may well improve the quality of purchased items but will not necessarily achieve lasting benefits or motivate their suppliers to internalize the benefits of a process of continuous improvement to satisfy all their customers, see Tanninen, et al. (2010), on how 'soft' issues of human resource development influence the effects on profitability, productivity and customer satisfaction.

Conditions of Partnership

One of the key points which stands out is the wide diversity of partnership arrangements and definitions of partnership which have developed within the UK over the last decade. Although, as might be expected, there are differences between the public and private sector purchasing practices, there are now probably greater differences within the private sector. This is neither surprising nor any cause for alarm. However, to get the best out of partnership it is vital to understand the relationship, its current state and how it can be developed. The main driving force behind the move to customer–supplier partnerships has been the establishment of Japanese transplants in Europe, especially in the UK. However, it has to be recognized that the conditions under which European customers and suppliers operate are markedly different to those in Japan, where many large organizations have dedicated suppliers – companies who supply only them. This has led to the phenomenon, in the motor industry for example, where it is not just Toyota vying with Nissan and Honda for supremacy but the entire Toyota supply chain battling against the Nissan and Honda supply chains. These are clearly not the conditions which operate in the UK and the rest of Europe.

In the UK, dedicated suppliers are few and far between. The leading suppliers will be dealing with most if not all of the main companies in their industry. These suppliers will work closely with a particular customer to develop a product, process or service. The way that this is done varies but includes obtaining a supplier's input on product development and sharing product planning and development data with suppliers. However, the benefit to that customer is likely to be short-lived because, in a commercial environment, the supplier has to work with all its customers in a similar way in order to retain their business. There are, of course, issues of confidentiality which a first-tier supplier needs to respect when dealing with competitors involved in similar activities. It is clear that many UK customers and suppliers are abandoning adversarial relationships in favour of more co-operative partnerships. However, they are correctly attempting to fit these to their circumstances and needs rather than merely copying what worked for Japanese companies in Japan.

Nevertheless, it does mean that customers and suppliers are having, in a relatively short space of time, to learn, adopt and adapt an approach to purchasing which has taken Japanese companies over 40 years to develop. Quite rightly, different companies, industries and sectors are developing partnerships in their own way to meet their own needs and circumstances. However, it must be recognized that no one enters into a partnership with their suppliers or customers out of any altruistic motive or wish to be 'nice' to them. Partnerships are driven by hard-headed business objectives, mainly the need to achieve/maintain competitiveness in an increasingly global and hostile business environment. For example, even partnership suppliers are being told that for an increasing amount of business they are expected to cut costs. Therefore it has to be recognized that customer–supplier partnerships are not an easy option or some sort of panacea. This is particularly the case where a supplier is expected to meet the global requirements of its major customers. Underlying the rhetoric of partnership are difficult choices not only about whether to enter into partnerships and the type to be adopted but also, and perhaps more importantly, the internal upheavals this requires for most organizations.

The Issues to be Considered in Partnership

Burnes and Whittle (1998) show the steps that organizations need to take to decide whether to undertake a partnership initiative. However, even when organizations have examined all the issues involved and decided that the partnership approach is for them, they should not attempt to rush into building new external relationships and mechanisms until they are sure that the internal equivalents are appropriate and effective. In particular, senior management should:

- Outline clear objectives for the partnership initiative and ensure that those involved understand what they are and are committed to the ideals.
- Develop a strategy and plan to accomplish these objectives.
- Establish a procedure for deciding which suppliers to involve.
- Ensure that the philosophy of the organization is in line with, or can be realigned with, the partnership approach to purchasing, especially the need for teamwork.

Though the above will not necessarily be easily achieved, in the first instance perhaps the most critical task will be for the organization to refocus and restructure those aspects of its own operations which are crucial to effective supplier performance. In effect, what is required is for it to put its own house in order before it asks its suppliers to do the same. In particular, the increasing complexity of the task of obtaining conforming supplies at the right time, at the right price and every time suggests that the conventional form and organization of the purchasing management function may no longer be adequate. Traditional staff structures based on tight functional groups have resulted in compartmentalized attitudes to suppliers which hinder supplier development. Companies will need to restructure their purchasing, quality and engineering departments to ensure that they have the right skills in dealing with suppliers, and that functional accountability and logistics are adequate to the task of supplier development. Enterprise resources planning (ERP) systems that link into personnel files, business functions of payroll, accounting, order-processing and sales, production-planning schedules and engineers' software are most useful in this regard. It is also important to establish a multi-functional teamwork approach to purchasing.

To be effective, partnership requires well-trained personnel capable of working with suppliers to achieve the objectives which have been agreed; in effect, these personnel act as change agents. Purchasing and other staff who liaise with suppliers will need to understand the capabilities of suppliers' processes, systems and value streams and have a good working knowledge of the philosophy, principles, techniques of improvement and shop-floor procedures. It is also important that a customer's staff can speak the same language as their supplier's counterparts, whether these be in production, quality, design, finance, or sales activities. Embarking on an action plan for partnership with insufficient regard to the needs of the purchasing organization's skills is likely to result in frustration and possibly eventual failure of the initiative.

It is also important that the most effective mechanisms and linkages for communication and feedback are used. Typically, purchasing, quality, design, engineering/technical and production personnel all talk to suppliers but with no single functional area accepting total responsibility for the quality, cost and delivery of the bought-out items. The need for clear accountability and co-ordination is a crucial factor in ensuring that channels of communication between customers and suppliers are effective and that suppliers receive a consistent message. Importantly, it must be clear who will be responsible for all negotiations and communications for current and future business with each supplier. An increasing number of organizations are conducting business with their suppliers via electronic transactions and real-time data. Typical of the documents involved in the transmission are planning schedules, goods receipt details and invoices. A number of major purchasers in particular market sectors (e.g. automotive, and defence and aerospace) have combined forces to establish e-marketplace systems that connect manufacturers, suppliers and customers by automating a range of processes and communication mechanisms.

For a company with many suppliers and bought-out items, it may take several years to introduce and develop an effective process of partnership. It has to be recognized, however, that not all suppliers will welcome or be capable of accepting this form of approach. Some, for whatever reason, will prefer to maintain a more adversarial approach. Though in the longer term a process of supply-base reduction will eliminate many of these, others may well remain. It will also be the case that while a few suppliers may be world-class, the majority will need to improve if they are to meet the company's expectations. Therefore, most companies will find that they will need to adopt different practices with different suppliers. Probably, in the majority of cases, a partnership approach based on a commitment to supplier improvement will be the order of the day. On the other hand, with those suppliers whose performance is already world-class, it may be the customers who find they are being improved. However, with some suppliers, relationships may well remain antagonistic.

Therefore, before starting a process of partnership a company will need to review its supplier base and identify those suppliers with whom it needs to work with in the long term and the type of relationship it will be able to establish. The strategy should reflect core organizational's expertise. As it will not be possible to launch a partnership approach with all its suppliers at once, the company will need to establish a mechanism for selecting the initial group of suppliers. One approach is to concentrate on new products, product and process modifications and new vendors. Another approach involves the use of Pareto analysis to focus priorities by ranking bought-out components and materials according to some appropriate parameter (e.g. gross annual spend). To assist their suppliers, some major organizations have documented the fundamental requirements for the control of quality and achievement of improvement, some have even produced explanatory booklets (QS 9000, as discussed in Chapter 13, is a good example of this). These organizations make it a condition of the purchase order agreement that suppliers' products comply with these requirements.

Assisting suppliers to improve their performance is important; however, it must be recognized that the delivery of non-conforming product from a supplier can often be attributed to an ambiguous purchasing specification and poorly detailed customer requirements. Purchasing specifications are working documents used by both customer and supplier and must be treated as such. The content of material and product specifications has become highly standardized, and usually includes such features as functional physical characteristics, dimensional details, reliability characteristics, methods of test and criteria for acceptance, conditions of manufacture, installation, storage and use, and so on. The purchasing department should review the accuracy and completeness of purchasing documents before they are released to suppliers. It is good practice to send these documents to the quality department for comment prior to transmission to the supplier.

It is also important to recognize that, just as suppliers can learn from customers, the reverse also applies. Suppliers are knowledgeable in their own field of operation and should be given every opportunity to provide a design input to the preparation of the specification. With the reduction in specialist technical staff in many customer organizations, this is now a common occurrence. Suppliers will be more likely to accept responsibility for defects and their associated costs if they are involved in the design of the product or formally agree with the customer the specification and drawing for the part to be produced. This supplier input to the design process is a key factor in cost avoidance and reduction and helps to reduce the product development lead time.

One outcome of partnerships is that an increasing number of major purchasing organizations are awarding more long-term contracts and contracts for the life of a part. Strategic sourcing (i.e. single or dual sourcing) is considered by many writers and practitioners to be a complementary policy. This will inevitably contribute to the reduction in the size of organizations' supplier bases. In the future the number of suppliers a customer uses will decrease as more and more customers buy upper-level assemblies. However, some organizations have sought to avoid single sourcing and being completely dependent on the supplier because of worries about being put into a difficult supply situation should the supplier experience problems or become insolvent. It is a balance of power situation on which careful judgment is needed. A reduction in the supplier base can result in benefits such as:

- Less variation in the characteristics of the supplied product
- Improved opportunity for improving processes, developing innovations and prototyping and proving
- Increases in the amount of time the customer's quality assurance and purchasing personnel can devote to vendors, and more frequent interactions
- Improved and simplified communications with vendors
- Less paperwork
- Less transportation
- Less handling and inspection activity
- Fewer accounts to be maintained and thus reduced costs for both parties

It is easier to develop a partnership relationship if the suppliers are in close proximity to the customer. Consequently, a number of customers are now reversing their international sourcing strategies to develop shorter supply lines and are recommending that suppliers set up operations close to their main manufacturing facilities. Closeness is also a vital element in the use of a JIT purchasing strategy when developing the supplier relationship.

The Process of Partnership

Having put its own house in order and selected suitable suppliers for inclusion in its partnership programme, the next step for the purchasing organization is to get the selected suppliers involved and obtain their commitment. This entails communicating to suppliers what is required and reaching an understanding with them on a set of common objectives.

The most practical way of setting about this task is to hold presentations to suppliers covering issues such as:

- The approach being taken to partnership.
- What is expected of suppliers and what assistance they can expect from the customer.
- The quality system standard to be used.
- How suppliers' performance will be assessed; how the results will be communicated.
- What assistance will be provided to help suppliers improve.

Presentations to suppliers can be held either on the customer's premises or at individual suppliers' sites. A supplier conference and/or presentation must give those involved an opportunity to air grievances and discuss problems in an open and honest manner and must be aimed at establishing a climate of co-operation and commitment.

Once a supplier's senior management team have agreed to participate in the partnership process, it is usual for the purchasing organization to visit the supplier's factory and carry out a formal vendor-approval survey. The objective of the survey is to assess the supplier's suitability as a business partner, including the identification of strengths and weaknesses, awareness of continuous improvement mechanisms and the cost-effectiveness of collaboration. The survey is a multidisciplinary task which usually involves the customer's purchasing, quality, engineering and technical personnel. The survey should cover areas such as controls, processes and capabilities, workshop environment, plant, technology, research and development, quality systems, staff attitudes, responses, tooling, and planning and administrative systems.

As part of its audit, a customer must assess the supplier's commitment to advanced product quality planning (APQP). A useful summary of APQP, which consists of five phases – plan and define the programme, product design and development, process design and development, product and process validation and feedback, assessment and corrective action – is provided by Thisse (1998). APQP commences with a joint review of the specification and classification of product characteristics and the production of an FMEA. The supplier should prepare a control plan to summarize the quality planning for significant product characteristics. This would typically include a description of the manufacturing operation and process flows, equipment used, control characteristics, control plans, specification limits, the use of SPC and mistake-proofing, inspection details, and corrective and preventative action methods. The next step is for the supplier to provide initial samples for evaluation; this would be supported by data on process capability on the key characteristics identified by both parties, plus test results. Following successful evaluation of initial samples, the supplier is in a position to start a trial production run prior to routine volume production.

Once the customer has assessed the adequacy of the supplier's policies, systems, procedures and manufacturing or business methods, and the supplier has been able to demonstrate the quality of its shipped product, the goods inward inspection of suppliers can be reduced considerably, in some cases down to the ideal situation of direct line supply. At this point, 'preferred' or 'certified' supplier status can be conferred on the supplier. Many companies now also operate a supplier award scheme to recognize excellent supplier performance.

This assessment should not be a one-off exercise. An increasing number of major purchasing organizations will audit all their suppliers at regular intervals. This is to ensure that suppliers' systems, processes and procedures are being maintained and improved. The frequency with which each supplier is reassessed is dependent on such factors as:

- The supplier's performance
- The status awarded to the supplier
- The type of item being supplied
- The volume of parts being supplied
- The occurrence of a major change at the supplier (e.g. change of management, change of facilities and process change)
- The supplier's request for assistance

The partnership process is ongoing, aimed at building up an effective business relationship based on openness – a relationship which demands a greater and quicker exchange of information between both parties. During the early days, the parameters of the new relationship are never completely clear to either party and it takes time to work out ground rules which are suitable for both of them. A number of major purchasing organizations have introduced electronic ordering and purchasing with their key suppliers and even the electronic sharing of product data. The more that this can be done to transfer data in digital format the better in terms of error reduction and improved communication. This linking of information systems and processes can often test the strength of the relationship, in particular when incompatibilities in customer and supplier systems are discovered. The electronic data exchange relates to quality data, technical requirements and specifications, schedules, business operations, manufacturing programmes, lead times, inventory management, and invoicing. Suppliers are obliged to communicate any changes to materials, processes or methods that may affect the dimensional, functional, compositional or appearance characteristics of the product. Customers are obliged to provide sufficient information and assistance to aid the development of their suppliers' approach to continuous improvement. In some cases this extends to joint problem-solving and cost-reduction activities. When the relationship has developed from problem-solving to problem avoidance, it indicates it has passed a major hurdle.

It is argued by writers such as He et al. (2013) and Ramanathan and Gunasekaran (2014) that the benefits of partnership are best achieved by spreading the concept to all members of the value chain from raw material to end product. This is perhaps best handled by a supplier association. Such an association is usually taken to be a group of first-level suppliers and a particular customer. This is a loose grouping who share knowledge and experience for the purpose of continuous improvement down the supply chain. This is characteristic of the Japanese supply chain, where it is also usual for first-tier supplier to develop its own supplier associations. Fruin (1992) points out that 'the Toyota Motor Corporation has three regional supplier associations and Nissan Motor has two'. These forms of co-operative supplier network are now starting to develop in Europe. For example, Morris and Imrie (1992) describe a network in place at Lucas Girling, and Hines (1992) describes how the Welsh Development Agency, through its 'Source Wales' initiative, has assisted Llanelli Radiators to form a supplier association.

Potential Difficulties of Operating Partnerships

In a partnership which is regarded as a success by both parties, everyone wins. If only one party is considered the winner, as is the case with typical adversarial purchasing arrangements, there can be little basis for a partnership. A partnership is about a long-term relationship between a customer and a set of suppliers in order to reduce total costs all round, develop and maintain a competitive position and satisfy the end-customer. It is important that the partnership is lived in the way it is articulated. This is far from easy and there are many potential obstacles.

The following, based on our practical and research work, are the main difficulties usually experienced in developing a partnership approach:

- An over-emphasis on cost reduction and piece price down, rather than the total cost of acquisition.
- Variations in the approaches of individuals and a general lack of cohesion.
- A perceived lack of understanding by the customer of the business implications of its actions, e.g. sudden and large-scale changes in production level and work mix, changes in priorities, and a failure to stick with delivery schedules.
- Poor and inconsistent communication.
- An unwillingness by customers to reciprocate openness with the suppliers.
- Poor reliability of information and systems.
- Inadequate project management.
- A tendency for the customer to blame all the problems that are encountered on the supplier.
- Inability to respond to things which have gone wrong and to resolve the problem.
- Failure to respond to suggestions and ideas for improvement.
- A lack of understanding from the customer of a supplier's constraints and problems.
- A customer asking the supplier to do things which they themselves have not achieved.
- A lack of understanding of the minor problems which undermine the creditability of the customer.
- A mismatch between what is requested and the existing infrastructure.

Summary

Suppliers are now recognized as an essential part of any organization's competitiveness. There are two major reasons for this: greater global specialization and changes in the nature of competition. Effective partnership requires purchasing organizations to treat suppliers as long-term business partners, and this necessitates a fundamental shift from the traditional adversarial buyer–supplier relationship towards Guanxi, the role of relationships and connections in buyer–supplier relationships (Wiegel and Bamford 2015). Properly implemented partnership will help to reduce costs and increase market share to the benefit of both parties, together with technology transfer issues surrounding product, process, practices, and systems. However, the nature and mechanisms of partnership must be related to the particular circumstances and needs of those involved. In conclusion, the following dos and don'ts developed from the work of Dale and Galt (1990) will help both customers and suppliers establish the type of partnership that is most appropriate for them:

Do

- Look at ways of reducing the size of the supplier base. By reducing incoming material, component and sub-assembly variability, outgoing product and service quality will improve.
- Ensure that, in support of the supplier development process and its various stages, your staff and those in the customer organization use the appropriate engineering quality tools. These tools include statistical process control, the seven quality control tools, the seven management tools, FMEA, fault tree analysis (FTA), QFD, design of experiments; the tools also facilitate design for manufacturability and cost avoidance.
- Involve suppliers in new product development and investigate the full range of ways of achieving this.
- Encourage suppliers to dispatch only conforming product, thereby eliminating the need to carry out duplicate testing and inspection on incoming goods.
- Award long-term contracts to key suppliers who have shown commitment and improvements in order to demonstrate the tangible benefits that can arise from a partnership.
- Consider implementing an assessment and rating scheme to select and measure the performance of suppliers. Poor selection will lead to increased costs as other suppliers are sought to compensate for the deficiencies of the one chosen without due care.
- Develop procedures, objectives and strategies for communicating with the supply base.
- Treat suppliers as partners, thereby establishing trust, co-operation and dependence.
- Ensure that the staff dealing with suppliers act in a consistent and courteous manner and match actions to words.
- Respond positively to suppliers' requests for information.
- Develop and decide upon mutually agreed purposes and values that define the relationship and measure its success. The approach by the customer must be seen by the supplier as helpful, constructive and of mutual benefit.
- Decide and agree on the best means of promoting and monitoring good communication in order to create a constructive dialogue and ensure the provision of reliable information. This requires defined points of communication to be established.
- Listen and be receptive to feedback and be willing to share information and ideas and discuss problems. Discover and respond to functional perceptions, in both customer and supplier, of the state of the partnership.
- Provide education to raise awareness of the partnership approach and specific training for the new skills required.
- Be honest about the state of the partnership and avoid complacency.

- Ensure that customer and supplier organizations are sufficiently knowledgeable about each other's business, products, procedures, and systems and how the respective organizations work.
- Remember: a flexible and open approach, which encourages positive constructive criticism, is crucial.

Don't

- Begin partnership unless senior management understand what is involved and support the concept.
- Overlook the fact that senior management commitment, in both customers and suppliers, to the ideals of partnership is necessary, along with their active participation in the process, including understanding its importance. Management must recognize that it is not a 'quick fix' solution to achieve cost reduction.
- Treat suppliers as adversaries.
- Keep suppliers short of information.
- Buy goods on price alone. Ensure other criteria such as quality and delivery performance, R&D potential, competitive manufacturing and engineering excellence are also taken into account.
- Constantly switch suppliers.
- Accept non-conforming goods.
- Talk quality but act production schedule and price per piece.
- Forget that the initial samples procedure is a key factor in receiving conforming supplies.
- Forget that the customer and supplier must be prepared to add value to each other's operations, through reducing costs and identifying opportunities for improvement.
- Forget that the move to partnering usually takes longer than expected.
- Overlook the fact that the principles and values of partnership must be cascaded to all relevant levels in the customer and the supplier and must be fully accepted, in particular by those staff at the day-to-day contact point.
- Forget that the effectiveness of the partnership must be measured and monitored.
- Forget that developments affecting both parties should be carried out with mutual consultation.
- Assume that there will be no problems; ensure that suitable counter-measures are ready to address the obstacles encountered.
- Forget that the partnership process and lean manufacture go together.

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Part Three

Quality Management Systems, Tools and Techniques

Quality management systems, tools and techniques are a fundamental part of an organization's approach to TQM and strategic process improvement. This part of the book deals with their use and application. In the individual chapters dealing with tools and techniques, each tool and technique is described, together with an indication of its range of application and how it is constructed and deployed. Part Three contains the following chapters:

Chapter 8 – Quality Management Systems and the ISO 9000 series
Chapter 9 – Quality Management Tools
Chapter 10 – Quality Management Techniques

Chapter 8 presents an overview of quality management systems along with the ISO 9000 series and argues that such a system is a key building block in an organization's approach to TQM and strategic process improvement. The review includes the fundamental purpose of a quality management system and the development of quality system standards. The ISO 9000 series of quality management system standards is reviewed, including implementation issues, guidelines, the assessment and registration process, and their benefits and limitations.

Chapter 9 opens by examining the role of quality management tools and techniques in the introduction and development of TQM and strategic process improvement. It then goes on to explore the issues which should be considered in selecting tools and techniques, and the typical problems found in their use and application. It describes a number of the basic quality control tools – checklists, flowcharts, check sheets, tally charts and histograms, graphs, Pareto analysis, cause-and-effect diagrams and scatter diagrams. It then briefly outlines the use of the seven management tools. Mistake-proofing and total productive maintenance are also presented. Examples of the tools and techniques are taken from a variety of organizations and situations.

Chapter 10 provides a review of the key concepts of specific quality management techniques: quality function deployment (QFD); design of experiments (DoE); failure mode and effects analysis (FMEA); statistical process control (SPC); benchmarking, business process re-engineering (BPR) and value stream mapping (VSM) and Six Sigma.

Chapter Eight

Quality Management Systems and the ISO 9000 series

B. G. Dale, B. Dehe and D. Bamford

Introduction

This chapter opens by examining the concept of quality assurance and the responsibilities of people within an organization for carrying out the activity. A quality system is defined and the background of quality system standards traced, the key features of the ISO 9000 series (2015) are examined, implementation guidelines and issues outlined, the quality system assessment and registration reviewed and the benefits and limitations highlighted. A model is also presented which outlines what is required for a small company to successfully achieve ISO 9000 series registration. Much has already been written about quality systems and standards (Dale and Oakland 1994; Davies 1997; Hall 1992; Jackson and Ashton 1993; Lamprecht 1992, 1993; Rothery 1993), and there are the standards themselves. This chapter is therefore restricted to an overview of the key features and issues.

What is Quality Assurance?

Quality assurance is defined by ISO 9000:2015 as:

> A part of quality management, which is focused on providing confidence that quality requirements will be fulfilled.

Quality assurance is often regarded as discreet policing by the quality assurance department. This is not so. The ideal role of the department is to oversee the whole process of quality assurance within an organization, provide guidance, advice on the assignment of roles and responsibilities to be undertaken by each function and person, and address weaknesses in the system. Quality assurance needs to be an integral part of all of an organization's processes and functions, from the conception of an idea and throughout the life cycle of the product or service: determining customer needs and requirements, planning and designing, production, delivery and after-sales service.

The objective should be to get every person in the organization to take personal responsibility for the quality of the processes for which they are accountable. This includes treating the following processes as 'customers' and endeavouring to transfer conforming products, services, materials and documents to them, monitoring quality performance, analysing non-conformance data, taking both short- and long-term action to prevent the repetition of mistakes, and promoting the feed forward and feedback of data. The emphasis should be on the pursuance of corrective and preventative actions and procedures and non-conformance investigation in a thorough manner with closed-loop effectiveness. It is also necessary for everyone to perform their tasks in accordance with their training and their procedures, as defined by the quality management system.

The main objective of quality assurance activity is to build quality into the product and/or service during the upstream design and planning processes and in this way give confidence to a customer that a product and/or service performs as they expect. Quality function deployment, FMEA, design of experiments, design for manufacturability/assembly and quality audits are all part of an advanced product quality planning process, and of considerable assistance in the pursuance of this goal.

Quality assurance activity which is planned and managed along these lines will strengthen an organization's TQM and strategic improvement process efforts.

What is a Quality Management System?

A quality management system is defined by ISO 9000:2015 as:

> A management system to support businesses and organizations to be more efficient and to improve customer satisfaction.

The purpose of a quality management system is to establish a framework of reference points to ensure that every time a process is performed the same information, methods, skills and controls are used and applied in a consistent manner. In this way, it helps to define clear requirements, communicate policies and procedures, monitor how work is performed and improve teamwork.

Documentary evidence about the quality management system is fundamental to quality assurance and takes several forms.

- A company quality manual (sometimes called a level 1 document) provides a concise statement of the quality policy and quality management objectives as part of the company objectives. ISO 10013:2001 provides useful guidelines on the development and preparation of quality manuals.

- A procedures manual (sometimes referred to as a level 2 document) describes how the system functions, gives the structure and responsibilities for each department/unit and details the practices to be followed in the organization.
- Work instructions, specifications, methods of performance and detailed methods for performing work activities for a third level of documents.
- In addition there is often a database containing all other reference documents (e.g. forms, standards, drawings, reference information, and supplier list).

The quality management system documentation helps to ensure that employees know what they should be doing, along with the appropriate means for doing it. It also provides evidence to those who wish to assess the system.

The quality management system should define and cover all facets of an organization's operation, from identifying and meeting the needs and requirements of customers to design, planning, purchasing, manufacturing, packaging, storage, delivery, installation and service, together with all relevant activities carried out within these functions. It deals with organization, responsibilities, procedures and processes. Put simply, a quality system is good management practice.

A quality management system, if it is to be comprehensive and effective, must cover all these activities and facets and must be developed in relation to the corporate strategy of the company.

A quality management system which embraces quality management objectives, policies, organization and procedures, and which can demonstrate, by assessment, compliance with ISO 9001:2015, provides an effective managerial framework on which to build a company-wide approach to a process of continuous improvement.

The Development of Quality Management System Standards

Irrespective of the approach taken to TQM or strategic process improvement and the quality management maturity of the organization, a business may need to demonstrate to customers that its processes are both effective and under control and that there is effective control over procedures and systems. The pressure for proof that systems and procedures are in place, and working in an effective manner, led to the demand for quality assurance based on the development of quality management system standards. The origins of this can be traced back to the 1950s when the US Department of Defense and the UK Ministry of Defence saw a need for greater reliability in purchased products and a reduced reliance on customer or purchaser inspection as the main assurances of quality.

In 1972 the British Standards Institution (BSI) published BS 4891 (1972), *A Guide to Quality Assurance*, which set out guidance to organizations on quality and its management, and was intended as a guide to companies developing their quality management systems; this standard was withdrawn in 1994. This was followed in 1974 by the issue of BS 5179, which was a three-part standard *A Guide to the Operation and Evaluation of Quality Assurance Systems*; this standard was withdrawn in 1981 after being superseded in 1979 by the first issue of BS 5750. During the mid-1970s there was a proliferation of quality system standards produced by a variety of second- and third-party organizations. The Warner report (1977), *Standards and Specifications in the Engineering Industries*, stressed the need for a national standard for quality management systems, to reduce the number of assessments to which suppliers were being subjected by their customers. It pointed to the shortcomings and fragmented nature of the British system of standards. It was recommended that British Standards be produced to provide the single base document for quality systems. Subsequently, in 1979, the British Standards Institution issued the BS 5750 series of quality management system standards.

It was the British Standards Institution which formally proposed the formation of a new technical committee (ISO/TC 176) to develop international standards for quality assurance, techniques and practices (this committee is responsible for developing and maintaining the ISO 9000 family of standards). Some 20 countries originally participated in the development of what was to become the ISO 9000 series. In 1987 the series of international standards on quality management systems was first published by the International Organization for Standardization (ISO – a federation of some 140 countries' national standards institutes). This initial version of the standards, while reflecting various national approaches and international requirements, was based largely on the 1979 version of the BS 5750 series and the eight or so years of UK user experience, mainly in the manufacturing industry, and the Canadian CSA Z299 series.

The ISO 9000 series was adopted by CEN (the European Committee for Standardization) and CENELEC (the European Committee for Electrotechnical Standardization) as the EN 29000 series, thus harmonizing the approach to quality systems in the European Community, the standard at this stage having three numbers: national, European and international. It has perhaps had the most significant and far-reaching impact on international standardization of any set of standards. An excellent account of the historical background of the ISO 9000 series was provided by Spickernell (1991). The ISO 9000 series has been revised on the basis of international implementation experience and was reissued in September 2015. These revisions help ensure that the series remains a useful tool for the marketplace. The major changes reflect that organizations evolved in more global and complex supply chains than they did in the past. The ISO 9000:2015 series is based on seven quality management principles (QMPs): Customer focus, Leadership, Engagement of people, Process approach, Improvement, Evidence-based decision making and Relationship management.

Acceptance of the ISO 9001 series of standards

The set of requirements outlined in ISO 9001 can be supplemented for specific industries or products by 'quality assurance specifications' and 'ISO guidance notes and codes of practice' which provide more detail.

The Chrysler Corporation, Ford Motor Company and General Motors Corporation (the so-called 'Big Three') have produced a common quality system assessment standard (QS 9000) which is an industry-specific scheme. This standard, on which development work started in 1988, was first released in August 1994, with a worldwide version in February 1995. It harmonizes the separate quality system standard requirements of these three companies and reduces the level of duplication in terms of information requested from suppliers, leading to economic advantage. These three organizations have had comprehensive quality assurance systems in place at their sites for some considerable time, and have required suppliers to meet the standards of these systems. They view this as a platform to enhance the quality and performance of their suppliers. The first section of QS 9000 aligns itself with the elements of ISO 9001. This industry standard has been incorporated into the ISO network and issued as ISO TS 16949. The following are some examples of the prescriptive requirements:

- Advanced product quality planning shall be in place, supported by a multidisciplinary approach for decision-making.
- Trends in quality, operational performance, current quality levels and customer satisfaction shall be determined and documented. These should be compared by competitive analysis and/or benchmarking and be reviewed by management.
- Failure mode and effects analysis shall be used.
- Capability studies are mandatory and minimum capability indices are stipulated.

The second (sector-specific) section contains additional but common and harmonized requirements of Chrysler, Ford and General Motors covering the production part approval process, continuous improvement, identification of key product and process parameters, process capability performance and measurement system studies on product and process parameters, and development of control plans. Sixteen typical examples are cited of areas of such activities, together with 14 techniques/methodologies to support them. The third section addresses customer-specific additional and non-general requirements.

QS 9000 was initially confined to the first-tier suppliers of manufacturing plants in the US, but its implementation has spread worldwide and down the supplier chain. Registration to QS 9000 has now become the norm in the automotive industry.

Registration to ISO 9001 is a useful foundation leading to the development of a quality system to meet the independent system requirements of customers. A number of major purchasers use this registration as the 'first pass' over a supplier's quality system. They will take ISO 9001 as the base, and only assess those elements of the system which they believe are particularly sensitive to them as purchasers.

In 1993 Dr John Symonds (internal consultant for environment, health and safety, and quality of Mobil Services Company) launched the first worldwide survey of ISO 9000 certificates issued in different countries by independent quality system certification bodies. The International Organization for Standardization has taken over responsibility for this annual survey, which has been extended to cover the ISO 14001 (2015) environmental management systems standards as well as six other standards. The survey reports details by region and country of registrations as well as an industry-sector breakdown by country. The latest cycle of the survey shows that in 2014, a total of 1,138,155 ISO 9001 certificates had been awarded worldwide. The survey also shows that in the same time frame 324,148 ISO 14000 certificates had been awarded, an increase of 7% from 2013 (The ISO Survey of Management System Standard Certifications 2014).

The ISO 9000 Series of Standards: An Overview

Introduction

In simple terms, the objective of the ISO 9000 series is to give purchasers an assurance that the quality of the products and/or services provided by a supplier meets their requirements. The series of standards defines and sets out a definitive list of features and characteristics which it is considered should be present in an organization's management control system through documented policies, manual and procedures. This helps to ensure that quality is built into a process and is achieved. Amongst other things it ensures that an organization has a quality policy, that procedures are standardized, that defects are monitored, that corrective and preventative action systems are in place, and that management reviews the system. The aim is systematic quality assurance and control. It is the broad principles of control, in general terms, which are defined in the standards, and not the specific methods by which control can be achieved. This allows the standard to be interpreted and applied in a wide range of situations and environments, and allows each organization to develop its own system and then test it against the standard. However, this leads to criticisms of vagueness.

The series of standards can be used in three ways:

- Provision of guidance to organizations to assist them in developing their quality systems.

- As a purchasing standard (when specified in contracts).
- As an assessment standard to be used by both second-party and third-party organizations.

Functions of the standards and their various parts

The ISO 9000 family of standards consists of four primary standards: ISO 9000:2015, ISO 9001:2015, ISO 9004:2009 and ISO 19011:2011.

- ISO 9000:2015 covers the basic concepts and language.
- ISO 9001:2015 sets out the requirements of a quality management system.
- ISO 9004:2009 focuses on how to make a quality management system more efficient and effective.
- ISO 19011:2011 sets out guidance on internal and external audits of quality management.

The standards have two main functions. The first function identifies the aspects to be covered by an organization's quality system and gives guidance on quality management and application of the standards. The second function defines in detail the features and characteristics of a quality management system, which are considered essential for the purpose of quality assurance in contractual situations.

ISO 9000 outlines the fundamentals of quality management systems and provides the definitions of the key terms used in ISO 9001 and ISO 9004.

ISO 9001 presents quality management system requirements applicable to all organizations' products and services. It is used for demonstrating system compliance to customers, for certification of quality management systems, and as the basis for contractual requirements. It requires the following:

- A detailed documentation of quality requirements, processing steps and results.
- Implementation of a set of controls to maintain the system.
- Compliance with the requirements of the 22 sub-elements.

ISO 9004:2009 is a quality management system guidance specification that embraces a holistic approach to performance improvement and customer satisfaction.

Both ISO 9001:2015 and ISO 9004:2009 are based on a process model that uses the following seven quality management principles (QMPs) that reflect best practice:

- QMP 1 – Customer focus
- QMP 2 – Leadership

- QMP 3 – Engagement of people
- QMP 4 – Process approach
- QMP 5 – Improvement
- QMP 6 – Evidence-based decision making
- QMP 7 – Relationship management

These two standards employ common vocabulary and structure to facilitate their use and are intended to be used together by organizations wishing to develop their systems beyond the minimum requirements of ISO 9001.

ISO 19011:2011 provides guidance on managing and conducting environmental and quality activities. This standard combines the quality system auditing standard (ISO 10011: Parts 1 to 3) with the environmental system audit standards (ISO 14010, ISO 14011 and ISO 14012).

Implementation Guidelines for ISO 9001

At this point in the chapter it is useful to quote the guidelines, with some development by the authors and advanced by Long et al. (1991), based on their research into the application and use of the ISO 9000 quality system series in small and medium-sized enterprises; the guidelines are also applicable to larger organizations.

- An organization should be clear on the reasons for seeking ISO 9001. Implementation for the wrong reasons will prevent the organization from receiving the full benefits. In addition, it may be found that implementing and maintaining the requirements of the chosen standard is a burden in terms of costs and extra paperwork with no compensating benefits. ISO 9001 registration must therefore not be sought just to satisfy the contractual requirements of major customers or for marketing purposes. Indeed when most competitors have ISO 9001 registration there is little marketing advantage, and in many markets it is now a qualifying criterion.
- The development of a quality management system to meet the requirements of ISO 9001 should be managed as a project, with the identification of key steps, milestones and timescales. This will prevent progress being sporadic and variable.
- Prior to a programme of ISO 9001 implementation it is important that an internal quality audit is conducted of the existing quality management system by a qualified auditor. This will determine the initial status of the company's quality management system, enable management to assess the amount of work required to meet its requirements and also to plan for systematic implementation of the standard (i.e. a gap analysis). Without this knowledge

the project-planning process would be impossible. It is important that a realistic timetable is established, because if it is too tight there will be a tendency to do things artificially and this will result in considerable time spent later in debugging the system. On the other hand, if it is too relaxed there may be a tendency to do little in the initial period. Involvement of the appointed management representative during the quality audit is essential.
- For those organizations developing a quality management system for the first time, a steering committee should be established comprising all the heads of departments and chaired by the CEO. This type of representation is essential to gain cross-functional support for the project and to help ensure the smooth development and implementation of the system. Participation and commitment from all the heads of department is critical in order to gain employee support for the project, and this will help to ensure the smooth implementation and subsequent maintenance of the standard. In extremely small companies where there is little or no second-tier management the wholehearted commitment and involvement of the CEO is critical and essential.

Enhancement of the quality system

- ISO 9001 should be considered as the minimum requirement. Without a documented quality management system there is neither basis nor connected reliable data to monitor the process of quality improvement. Organizations should, however, aim to have a quality system which surpasses the standard's requirements, with new quality initiatives built into the system, as illustrated in Figure 8.1 (this is the objective of ISO 9004). A quality management system which meets the requirements of ISO 9001 should in no sense be regarded by senior management as the pinnacle of their quality management achievements. All it says to the outside world is that the organization has controls, procedures and disciplines in place. The organization should treat ISO 9001 registration as a precursor to developing its approach to TQM and strategic process improvement.
- There is a need to create a conducive environment for the development of a quality management system, which meets the requirements of ISO 9001. This can be achieved by the formulation of organizational quality policy and quality objectives. The responsibility of executives in the establishment, maintenance, and development of an ISO 9001 system cannot be over-emphasized. The leadership of senior management and their total commitment to the process of quality system registration to ISO 9001 are vital. The CEO, while accepting ultimate responsibility, has, as one would expect, to delegate a variety of tasks. Senior management must not only understand the principles of the ISO 9000 series but should ensure that the quality policy is implemented and understood by all employees, and that everyone in the organization has quality

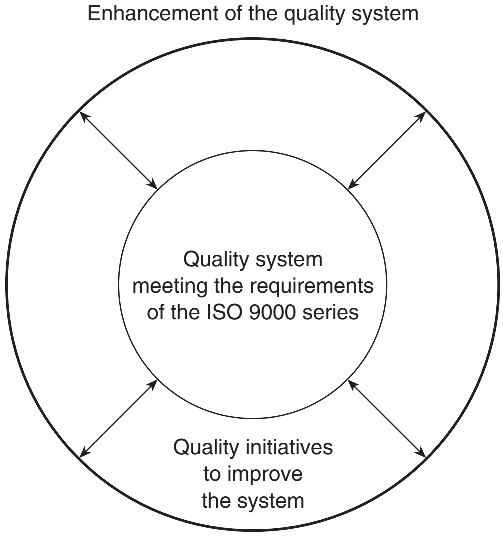

Figure 8.1 Quality system development

improvement objectives for their jobs. They also need to react positively to the actions resulting from quality audits.

- Training at all levels within the company is required on the importance of process, product and service quality in general, and for the quality system in particular. This will help to facilitate the right type of behaviour, attitude and values of employees towards the ISO 9000 series and will encourage total participation. It not only provides the opportunity to answer any questions which employees may have about the standard and the process and the reasons for registration; a systematic approach to quality, education and training will also reduce resistance to change and other obstacles.
- Once all the above steps have been taken the organization is in a position to commence developing its system to meet the requirements of ISO 9001. Accurate procedures, including operating and working instructions, are required. These procedures must be practical, workable and easily implemented. Only where the standard would suggest that some modification is required should it be introduced. In writing procedures it is worthwhile to keep in mind how to demonstrate to the auditor that the ISO 9001 requirements have been fulfilled. In simple terms this can be condensed into three principles:
  - Write down what you do
  - Do what you have written down
  - Be in a position to prove it
- 'Ownership' of the procedure is important as personnel who are given responsibilities for writing the procedures must be familiar with the requirements of the ISO 9000 series and be fully conversant with the procedures they are

drafting. The use of consultants and management specialists to write procedures is undesirable as they are unlikely to understand fully the 'style' of the company. It is often found that when procedures are written in isolation and then pushed into the working environment as required mandates, it leads to two main problems. Initially there is the problem of changing the way that people work without any perceived gain and benefit. Secondly, a formal assessment of the system may reveal differences between what is written and what is actually done. Also with respect to this, it is helpful to document a procedure before trying to improve it, unless the change is easy to make. The use of others to write procedures does not allow for the positive factor of employee involvement. The ownership of the processes by those operating them is lessened. This also happens when there is an overuse of technological aids in producing the procedures. The procedures as they are being developed and/or documented need to be checked to see that they meet the requirements of ISO 9001 and how they impact on other procedures, systems and activities.
- The quality management system must become an integral part of the management process. When it is treated in this way it will ensure that business improvements are incorporated into the system.

Quality Management System Assessment and Registration

When the organization has endorsed its process controls, written the necessary procedures and instructions, and developed its system to meet the requirements of ISO 9001 for which registration is sought, the following key activities need to be accomplished.

- Train and educate staff in the workings and operation of the system and test out the procedures which have been developed.
- It may be beneficial to arrange for a pre-assessment of the system to be carried out by the selected certification body.
- Decide the most appropriate time to go for assessment.
- ISO 9001 registration is conferred by certification bodies who have, in turn, been accredited in the UK by UKAS. The list of accredited certification bodies should be consulted and a 'supplier audit' of them carried out. It is important to establish the scope of the certification body's approval, its fee structure, relevant experience and knowledge in the organization's field of work, reputation, current workload, etc.
- Upon completion of the necessary forms, the chosen certification body will provide a quotation and details of fees. After agreeing a contract, the

appropriate documentation is then sent to the certification body to check initial compliance against the standard. In general, a certification body will usually want to see proof that the quality system has been in effective operation for a period of six months.

- If the documentation is acceptable as it stands, some certification bodies proceed to the on-site assessment for a preliminary review (pre-audit assessment). At this stage, the company is able to make appropriate modifications and establish corrective actions to take account of the assessors' initial findings and comments.
- The formal assessment involves an in-depth appraisal of the organization's quality management system for compliance with the appropriate part of the standard (see ISO 19011). This is carried out by a small team of independent assessors appointed by the certification body and generally under the supervision of a registered lead assessor, although increasingly for the smaller enterprise only one assessor is used. If the assessors discover a deviation from the requirements or identify a non-conformity with the procedures, a non-conformity report is raised. At the end of the assessment, the assessors make a verbal report to management with their recommendations.
- Once the organization is registered the certification bodies have a system of routine surveillance. The frequency of these surveillance visits varies with the certification body but is generally twice a year. The registration usually covers a fixed period of three years, subject to the successful surveillance visits. After three years a quality system reassessment is made.

ISO 9000 Series Registration: A Model for Small Companies

McTeer and Dale (1996) have developed a model which outlines what is needed for a small company to successfully achieve ISO 9001 registration. The model, which is shown in Figure 8.2, consists of the domains of motivation, information, resources and planning; by examining the interaction between them it highlights how progress towards ISO 9001 registration can be enhanced or diminished. The dynamics of the model require that the four domains are raised from their latent state through internal and external motivations. As the factors inflating or deflating the domains strengthen or weaken, so the rate of progress towards installing a quality management system to meet the requirements of ISO 9001 increases or decreases. It is argued that progress by a company towards ISO 9001 registration is only made when the demands of motivation, information and resources occlude.

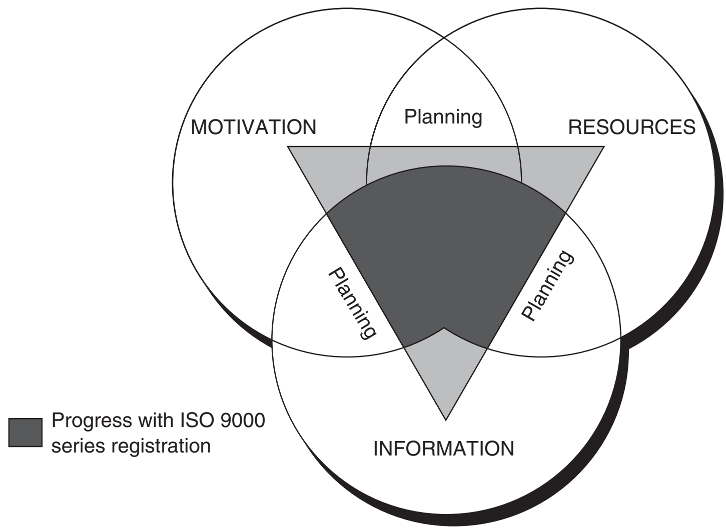

Figure 8.2 An active quality management system regime
Source: McTeer and Dale (1996)

Motivation

In a small company's journey from a primitive quality management system to attaining registration to ISO 9001, the degree of motivation can be regarded as the most important driving force. The degree of motivation can be influenced, both positively and negatively, by internal and external factors. The most powerful motivating force is demand from customers, in particular large ones, for registration and the fear of losing orders; this ensures that the momentum to introduce an ISO 9001 quality management system is maintained. Head office pressure and the impact of senior management are also factors influencing the degree of motivation, for example in making appropriate resources available. The motivation is also affected by employee attitudes and behaviour. Antagonism or apathy from employees towards the company's endeavours to obtain ISO 9001 registration makes it difficult to progress quality management system development. In addition to the primary forces there are a number of secondary forces, including the enhancement of company status in the marketplace, the urge to gain a commercial advantage, and advertising opportunities.

Information

As well as educating the company's quality management system champion to the requirements of ISO 9001, education and training on quality management system principles and practices must also be given to apprise the workforce of what is required from it. This can help to alleviate or avoid many of the problems associated with the acceptance of new working procedures, practices and disciplines. The solution for many companies is to employ management consultants to ensure that the detailed requirements of developing an ISO 9001 system are achieved, and this can help to overcome many of the problems of comprehending the requirements of the standards. By strengthening the reservoir of quality management knowledge the quality management system champion is better able to communicate effectively with their consultant and better placed to understand the problems and pitfalls of introducing a quality management system. In this way delays in the process of documenting the system, nugatory work and over-documented and bureaucratic quality manuals can be avoided. If a company is already able to build upon established quality assurance and quality control procedures (no matter how basic) this also helps to speed things up. Failure to raise the level of quality awareness and understand the demands of ISO 9001 leads to confused, frustrated and neglected employees and poorly briefed managers who will tend to restrict the progress towards registration.

Resources

Three resources are significant: time, finance and availability of personnel.

In failing to make or allocate time to the process of introducing a quality management system, programmes will slip, leading to suspension or abandonment as other more urgent tasks appear and take precedence. Time and the availability of personnel are closely coupled. If the quality management system champion is able to delegate work to staff or a management consultant, time pressures can be eased. Extra resources devoted to the development of a quality management system are also instrumental in increasing the pace of progress. In small companies there is usually little slack time available in the owner's or managing director's day-to-day work activities to dedicate to the development of a quality management system. Further, there is a shortage of staff time to assist in this process and the problem becomes more acute as the number of employees in the company diminishes. Unless compensated by a greater stimulus to produce a quality management system, a lack of time or conflicting priorities will delay or lead to termination of progress. Also for many small companies the budgeting for the process of introducing and then maintaining an ISO 9001 system requires some minor restructuring of finances.

Planning

Planning is crucial to the successful introduction of an ISO 9001 system. Only by formulating a sensible plan, which details a timetable of achievable events, milestones and target dates will a company succeed in this objective. This includes recognizing the need for education and training, additional skills, the use of external resources and, in some cases, the need to apprise company employees of the need for ISO 9001 registration. This domain is seen as both the magnet which draws the motivation, information and resources domains together and the glue that binds them.

Only by drawing together motivation, information and resources can progress be made towards the installation of a quality management system to meet the requirements of the ISO 9001. Figure 8.2 illustrates the situation where the progress of a small company towards ISO 9001 registration is advancing and maturing: the three elements are overlapping and locked together by the planning element. The size of the area of occlusion between these four elements provides a portrayal of the intensity of a small company's progress towards acquiring ISO 9001 registration.

Benefits and Limitations of the ISO 9000 Series of Standards

Since its introduction, the ISO 9000 quality system series has been widely accepted throughout the world. A number of benefits are claimed for the system, including:

- Improved controls, discipline, procedures, documentation, communication, dissemination and customer satisfaction, quicker identification and resolution of problems, greater consistency (i.e. the job is done the same way, time after time and best practices are shared), increased quality awareness, in particular from those departments and people who traditionally perceived 'quality' not to be their major concern.
- A reduction in errors, customer complaints and non-conforming products, services and costs and the retention of customers.
- Assistance with the liberalization of trade through common rules and language.
- Responsibility for quality issues is placed firmly where it belongs, with the supplier and not the customer.
- Reduction in the number of customer audits and assessments and also a reduction in the time taken, leading to a saving in resources needed for such activities.
- Identification of ineffective and surplus procedures and documents and other forms of waste.
- A better working environment.

On the other hand, a number of difficulties, problems and shortcomings have been reported and discussed. These include:

- Deciding whether registration should be sought for the whole company or just one unit/division/site/premises or even a specific operation carried out on one site or certain defined activities, as in the case of local authorities.
- Applicability of the standards to certain situations, particular sectors of business, and management styles.
- Interpretations of various sections of the standard and understanding the requirements of the standards.
- Terminology used.
- Lack of flexibility and perceived restrictions on creativity.
- Lack of relevance to the real needs of the business, resulting in a view that it was bureaucracy gone mad (e.g. paper-shuffling) and a 'why bother' attitude from people at the operating end of the organization.
- The time and resources needed in writing procedures and training and retraining staff in the requirements of the ISO 9000 series and the internal auditing of the system.
- The bureaucracy involved in documentation and accreditation and the lack of mutual recognition of certificated bodies between countries.
- The cost involved in achieving ISO 9001 registration and then maintaining it. This applies, in particular, to small companies. The cost comprises the additional workload incurred by company personnel in writing the procedures, managerial time, increased paperwork, etc., the fee of the management consultancy (if a consultant is used to assist with the process of registration) and the certification body's fees.
- Perceived by small companies to be only applicable to large companies.
- Considered by those companies who have mature TQM approaches to be of no value.
- In some cases, in particular sales/service situations, the rigour and applicability of the standards are perceived as restrictive and as barriers to providing a flexible and responsive service to customers.
- Lack of internal and external audit rigour.

The revised standards, with their provision for performance improvement; greater emphasis on the involvement of senior management; suitability for all sizes of organizations; increased compatibility; and user/customer-friendliness, should lead to a reduction in these types of difficulty and criticism.

What now follows is an overview of the benefits and limitations of the ISO 9000 series as seen by the authors.

- A quality management system is a fundamental pillar in an organization's approach to TQM and strategic process improvement and it helps to ensure that any improvements made are held in place (see Figure 8.3). However, ISO 9001 registration is not a prerequisite of TQM. Some organizations,

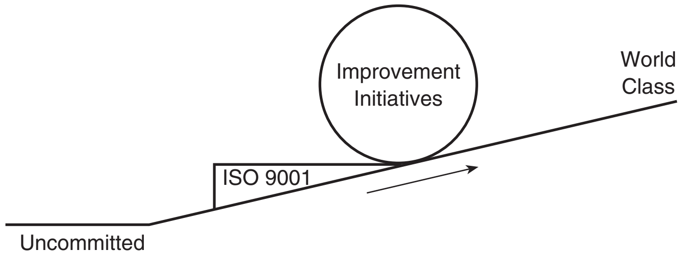

Figure 8.3 Quality improvement and the ISO 9000 series

in particular those from the non-manufacturing sector, have analysed and improved their systems and working practices and have then gone straight to TQM.

- The guidance provided in the requirements of ISO 9001 and ISO 9004, and the independent assessment surveillance, are an indisputable aid in developing and maintaining the procedures, controls and discipline required in a quality management system. This is of particular value for those companies that are just commencing their quality journey.
- However, experience indicates that, in most companies, it is not easy to get every function and person involved to take responsibility for their own quality assurance and to make quality improvements in the processes for which they are responsible. The ISO 9000 series of standards, albeit limited in respect of the point made above, can assist in making this happen.
- It is a contractual requirement of many customers that their suppliers are registered to ISO 9001; registration is also required to get on bid lists. Once a company has become registered, it is more than likely that it will ask its suppliers, distributors and providers of service to do the same, setting into motion a chain reaction, or what might be classed as a form of pyramid selling. Therefore, in many sectors of industry and government procurement agencies, it is necessary from a marketing viewpoint, and without it a company will simply not get orders. In much of the world it is now a prerequisite condition of doing business and in some sectors of industry (e.g. the automotive industry) the rate of certification is very high. An increasing number of long-standing suppliers to companies have been told by them that they must get ISO 9001 registration to continue to be a supplier. This is in spite of the supplier having been the supplier of choice for a considerable period of time. Once ISO 9001 registration has been achieved an organization may not be able to afford to lose it.
- Suppliers have a habit of doing what their customers want and many organizations have achieved ISO 9001 registration to provide documented proof that they have an adequate quality system in place just to satisfy the demands of their major customers. This may not produce the required improvement

ethos naturally, and any gains made will be short-lived if registration is perceived as a contractual condition rather than a foundation for ongoing improvement.

- A system based on the ISO 9000 series provides only the foundation blocks, and registration to ISO 9001 should be viewed as the minimum requirement; the objective should be to develop and improve the system in relation to the needs of the organization. An organization does not achieve superior-performing company status merely by ISO 9001 registration. It is clearly a pre-competitive issue, and separate from the ability to compete, which depends on many other factors. The winners will be those who have a dedicated commitment to company-wide improvement through continuous self-assessment of what they do.
- The preparation of systems, procedures, and working instructions to meet the requirements of ISO 9001 will have a beneficial effect on a company's performance in terms of improved process yields, reduced levels of non-conformance, and improved management control. However, the underlying mechanisms of the ISO 9000 series are such that they will tend towards a steady-state performance. The ISO 9000 series of standards is designed to produce consistency in actions, products and services. An organization can have a consistent performance with a high level of non-conformance.
- Experience indicates that the ISO 9000 series has a limited impact on the total improvement operation of an organization simply because it does not get to the root cause of problems. Most problems are resolved at branch level, and this is a failure in a number of businesses.
- In some quarters there is confusion about the relationship between the ISO 9000 series and TQM or strategic process improvement. They are not alternatives; a quality system is an essential feature of TQM. However, some organizations see ISO 9001 registration as the pinnacle of their TQM achievements and no plans are laid for building on this registration; a small number of people even believe that improvements driven through internal audits of the ISO 9001 will lead their organization to TQM. As previously mentioned, registration often results in a sense of complacency, in particular after successful third-party assessment of the system.
- It should be obvious from the above discussion that ISO 9001 registration, or for that matter any other quality system registration or certification or approvals, will not prevent a supplier from producing and delivering non-conforming products and/or services to its customers. The standards are a specification for the management of quality; there is a clear distinction between registration and capability, and this fundamental fact needs to be recognized. Product and/or service quality is determined by the individual organization and its people and processes and not by a quality management system standard.

Summary

A quality management system is one of the key building blocks for an organization's TQM and strategic process improvement activities. ISO 9001 and ISO 9004 define and set out a definitive list of features and characteristics which should be present in an organization's quality management system through documented policies, manual and procedures, whatever the product manufactured or offered, or the service provided, or the technology used. In this way, sound advice is provided on how an organization may develop a quality system.

In addition to incorporating the clauses of ISO 9001, a quality system design must maximize ownership, allow flexibility without loss of control, and be able to be developed to cope with changes in the business and capture improvements; above all it must be 'user-friendly'.

Seeking registration for the wrong reasons and a system which is too inflexible and bureaucratic are some of the major pitfalls. Assessment to ISO 9001 may improve an organization's systems, procedures and processes but on its own will not deliver continuous and company-wide improvement. To make best use of the ISO 9000 series it is important that the implementation is carried out in the right spirit and for the right reasons. This is an area in which management commitment is vital. Many of the reported difficulties, shortcomings and criticisms lie in the hands of an organization's senior management team. The saying 'you only get out what you put in' is so relevant to the ISO 9000 series and it is so important that the system is seen as being alive. All too often the ISO 9001 system is left solely in the hands of the quality department, often just one individual.

Registration to ISO 9001 is not the only way to achieve quality assurance, neither is it a prerequisite for TQM or strategic process improvement. It is, however, sometimes necessary to have the appropriate registration in order to do business at both a national and an international level, and in this respect it is a key marketing tool. It is the fear of loss of business and substitution in the marketplace that has caused many organizations to obtain ISO 9001 registration. The ISO 9000 series provides a common benchmark for good-quality management system practice, which is recognized throughout the world. An organization which is registered to ISO 9001:2015 should be working in an organized, structured and procedural way with defined methods of operating. It is important that organizations do not view ISO 9001 registration as their pinnacle of success in relation to quality assurance and quality management. It only provides the basic foundation blocks, and they must have strategies and business plans in place to move on and cater for areas which are not addressed by the standard and develop to TQM. This is particularly important in smaller businesses which, in a number of cases, attain ISO 9001 registration and have no interest in or vision of developing further their quality management activities.

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Chapter Nine

Quality Management Tools

B. G. Dale, B. Dehe and D. Bamford

Introduction

To support, develop and advance a process of continuous improvement it is necessary for an organization to use a selection of tools and techniques. Some of these tools and techniques are simple, while others are more complex. There are a considerable number of tools and techniques; the following are perhaps the most popular and best known:

- Checklists
- Flowcharts
- The seven quality control tools (QC7: cause-and-effect diagram, check sheet, control chart, graphs, histogram, Pareto diagram and scatter diagram)
- Quality costing
- Statistical process control
- Failure mode and effects analysis
- Fault tree analysis
- Design of experiments
- Quality function deployment
- The seven management tools (M7: affinity diagrams, relations diagrams, systematic diagrams, matrix diagrams, matrix data analysis, process decision programme chart, and arrow diagrams)
- Departmental purpose analysis
- Mistake-proofing
- Benchmarking
- Total productive maintenance
- Housekeeping and 5s

Tools and techniques have different roles to play in continuous improvement and if applied correctly give repeatable and reliable results (Bamford and Greatbanks 2005). Their roles include:

- Summarizing data and organizing its presentation
- Data-collection and structuring ideas
- Identifying relationships
- Discovering and understanding a problem
- Implementing actions
- Finding and removing the causes of the problem
- Selecting problems for improvement and assisting with the setting of priorities
- Monitoring and maintaining control
- Planning
- Performance measurement and capability assessment

A number of the tools and techniques in the above list will be detailed in the following chapters.

This chapter provides an overview of the tools, which are likely to be used in an organization's improvement process. The focus is on describing the tools and their uses and avoids detail on construction. A deliberate attempt has been made to choose examples from a variety of situations to give the reader a flavour of their applicability in a wide number of situations.

Selecting Tools and Techniques

The potential user must always be aware of the main uses of the particular tool or technique they are considering applying. There is often a danger of using a tool or technique in a blinkered manner, almost expecting it to solve the problem automatically.

When selecting tools and techniques there are two factors, which organizations should keep in mind:

- The application of any tool or technique in isolation without a strategy and plan will only provide short-term benefits. If tools and techniques are to be effective over the longer term, appropriate employee behaviour and attitudes are needed to make effective improvements.
- No one tool or technique is more important than another – they all have a role to play at some point in the improvement process. It is a mistake to single out one tool or technique for special attention and to become over-reliant on it. The Japanese make the point that a warrior should never have a favourite weapon. A common saying used to emphasize this is 'If you only have a hammer, it is surprising how many problems look like nails.'

A number of companies use tools and techniques without thinking through the implications for TQM or how the concept will be developed and advanced within the organization. This can give rise to misconceptions and misunderstandings, which eventually become barriers to progress. Many companies who use tools and techniques as the springboard to launch an improvement process usually single out a specific tool or technique, sometimes at random, and apply it with undue haste without giving sufficient thought to the following issues:

- What is the fundamental purpose of the technique?
- What will it achieve?
- Will it produce benefits if applied on its own?
- Is the technique right for the company's product, processes, people and culture?
- How will the technique facilitate improvement?
- How will it fit in with, complement or support other techniques, methods and quality management systems already in place, and any that might be introduced in the future?
- What organizational changes, if any, are necessary to make the most effective use of the technique?
- What is the best method of introducing and then using the technique?
- What are the resources, skills, information training, etc. required to introduce the technique successfully?
- Has the company the management skills and resources and the commitment to make the technique work successfully?
- What are the potential difficulties in using the technique?
- What are the limitations, if any, of the technique?

It is important for managers to address these questions when considering the introduction of any tool or technique. Unfortunately, some managers are always looking for tools and techniques as a quick-fix solution to the problems facing their organization at a particular point in time. In general, management teams that are 'technique reactive' tend to be unclear on the concept of TQM and strategic process improvement. They often confuse the implementation of a particular technique with TQM and tend to use the technique as an end in itself rather than as a means to an end.

If the management team is preoccupied with specific techniques and lacks an adequate understanding of TQM and the improvement process, the risk is that tools and techniques are picked up and discarded as fashion changes (see Figure 9.1). When this happens and a tool or technique fails to meet expectations, disillusionment sets in and the company experiences considerable difficulty convincing its employees that it is serious about improvement. This, of course, has an adverse effect on the use of techniques in the organization in the future.

One of the main reasons that companies fall into this trap is that they have unduly high expectations of the benefits arising from the use of a single tool or

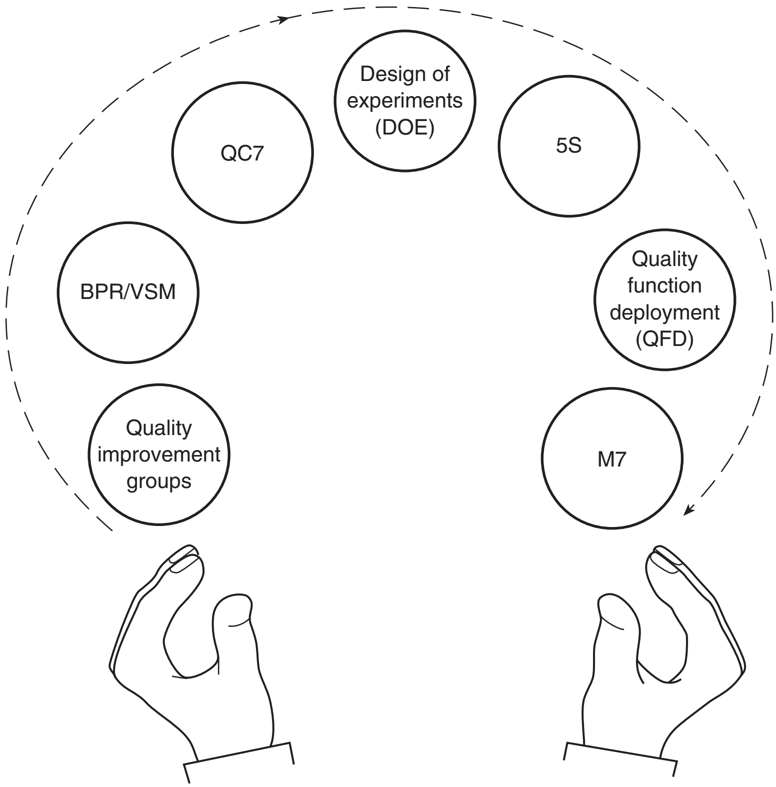

Figure 9.1 The use of quality management tools and techniques

technique which stem from the lack of clarity and in-depth understanding of it. Much of this is a result of the publicity and selling which often accompany a specific tool or technique. In general, on its own a single tool or technique may simply indicate or signify the presence of a problem which must be identified and resolved to produce only a small incremental improvement. It is only as a result of the cumulative effect of a series of tools and techniques within a TQM approach that the organization starts to see long-term benefits from its improvement endeavours (see Figure 9.2). Therefore, organizations should resist the temptation to isolate the benefits arising from any one tool or technique.

Motivation for the use of any particular tool or technique is a key factor in the success of its implementation (Bamford and Greatbanks 2005). They could be those specified as a contractual requirement by a major customer, they may be what management believe the marketplace will be expecting in the future, or the view may be taken that their use will give the organization an edge over its competitors.

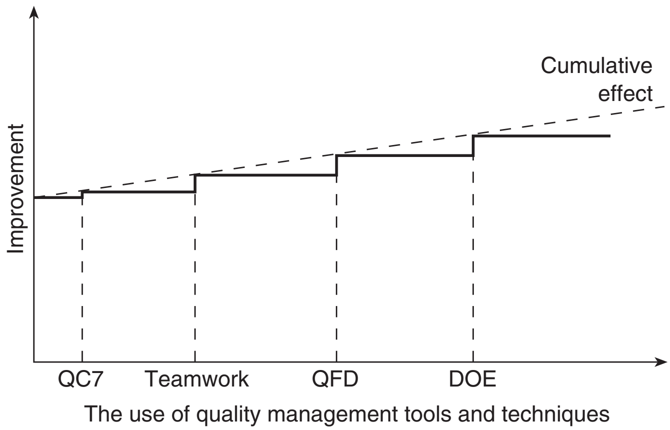

Figure 9.2 Incremental improvement through the use of quality management tools and techniques

Dale and Shaw (1990) found that when a major customer insists on the use of a specific technique as a contractual requirement of its suppliers, two phases can be identified in its use.

- The technique is applied by the supplier simply to satisfy the demands of the customer in order to maintain the business. To emphasize this they point out a case in which Statistical Process Control (SPC) has been used on a process for a particular customer's product, though when other customers' products were made with the same process SPC was not used. During this phase the supplier often resorts to a number of camouflage measures, fakes and ruses to convince the customer that the technique is being applied effectively and beneficially. The emphasis in this phase is on satisfying the customer's paperwork requirements. This phase is wasteful of time and resources, but suggests that suppliers appear to need this phase to develop their own awareness and understanding of the technique which is being applied.
- The second phase begins when the supplier's management team starts to question how they might best use the technique to enhance the company's competitive position. This is when real improvements begin to occur. They also point out that motor industry suppliers appear to have reached this phase in a shorter period of time with failure mode and effects analysis (FMEA) than they did with SPC, and suggest that this is due to the learning experience and also the depth of intellectual demands of each technique. Those organizations using techniques such as SPC for the sole reason of satisfying the quality system audits of major customers are missing the direct benefits of the correct use

of the technique and also the opportunity that it affords to launch a process of quality improvement. The danger in adopting this approach is that the improvement process goes only as far as the customer requires.

Because of the variety of starting points and motivations for improvement it is not possible to identify a universal implementation plan detailing the order in which specific techniques should be used by an organization. However, one piece of advice is that organizations should start with the simpler techniques, such as checklists, flowcharts and the seven original quality control tools. Simple tools and techniques can be just as effective as the more complex ones. In the West there is a tendency to ignore the simple tools and to use tools and techniques in isolation, whereas the Japanese companies tend to use the seven original quality control tools together and give high visibility to the results. In this way they are not only listening to the process through control charts, but also taking action to improve it. This combined use of the seven tools facilitates problem resolution and improvement action.

Difficulties and Issues Relating to the Use of Tools and Techniques

Research carried out by Dale et al. (1998) into the difficulties relating to the use of tools and techniques discovered that the critical success factors relating to the successful use and application of tools and techniques could be grouped into four main categories:

- Data collection
- Use and application
- Role in improvement
- Organization and infrastructure

Dale et al. (1998) identified a number of issues which relate to the difficulties experienced with all tools and techniques, including management support, user understanding, integral approach, discipline and application. A number of issues which relate to specific tools and techniques were also highlighted, including level of complexity, visual display, initial investment and overall status of TQM.

Building on this initial work, Dale and McQuater (1998) have identified five main influences on each of the four success factors (see Figure 9.3). The influences are experience, management, resources, education, and training. Based on these influences an assessment methodology has been developed for identifying

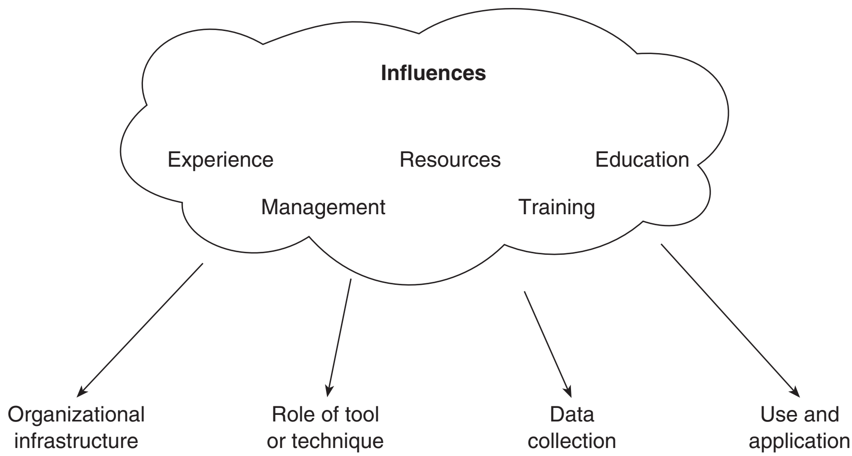

Figure 9.3 The effects of influences on continuous improvement

potential difficulties that impinge on the effective use of tools and techniques in an organization and for providing a diagnostic analysis. The methodology, described by Dale and McQuater (1998), consists mainly of an assessment grid, questionnaire and semi-structured interviews. These approaches can be used separately as well as in combinations, depending on the organization's objectives for carrying out the assessment. The assessment grid, which can be used on its own to undertake a 'health check' of potential areas for concern, is reproduced in Table 9.1.

Problem-Solving Methodology

The use of tools and techniques should be employed within a problem-solving approach for maximum effectiveness and efficiency. Probably the best-known problem-solving cycle is PDCA ('plan, do, check, act').

The *plan* aspect of the cycle is usually considered in four stages:

- Define the problem or improvement opportunity and specify objectives.
- Identify the likely causes of the problem.
- Pinpoint the root causes of the problem.
- Prepare solutions and develop and agree an action plan.

The *do* is concerned with implementing the action plan; *check* monitors the effectiveness of the actions which have been implemented and *act* relates to standardization of the results and transferring the practices to other processes.

Table 9.1 An assessment grid for a health check: (a) recognition and use grid; (b) application grid

Please indicate on the grid ONLY the techniques and tools you recognize. For those that you have recognized, if you use them for ***any*** purpose, not only for quality-related matters, please tick the box marked use.

Example	Recognize	Use
QC7		
Cause and effect	✓	
Check sheets		
Control charts		
Graphs/charts	✓	✓
Histograms	✓	✓
Pareto analysis	✓	✓
Scatter diagrams	✓	

	Recognize	Use
QC7		
Cause and effect		
Check sheets		
Control charts		
Graphs/charts		
Histograms		
Pareto analysis		
Scatter diagrams		
M7		
Affinity diagrams		
Arrow diagrams/critical path analysis		
Matrix data analysis methods		
Matrix diagrams		
Process decision programme chart		
Relation diagrams		
Systematic diagrams/tree diagrams		
Techniques		
Benchmarking		
Brainstorming/brainwriting		
Departmental purpose analysis		
Design of experiments (Taguchi)		
Failure mode and effects analysis		
Flow charts		
Force field analysis		
Problem solving methodology		
Quality costs		
Quality function deployment		
Questionnaire		
Sampling		
Statistical process control		
*		
*		
*		
*		
*		

*Add any company-specific techniques and tools not indicated on the list

Table 9.1 (*Continued*)

Please complete the grid ONLY for the techniques or tools you indicated on the recognition and use grid. Do not attempt to fill it in its entirety. There may be occasions when some of the categories cannot be allocated a score; in that case insert 9 (not applicable)

Score out of 5 in each of the categories where:

1 = No value
2 = Low value (e.g. little used, not understood, little or poor training, etc.)
3 = Some value (e.g. basic understanding, small benefits, basic training, etc.)
4 = High value (e.g. good understanding, some benefits, reasonable training, etc.)
5 = Very high value (e.g. complete understanding, excellent benefits, effective training, etc.)
9 = Not applicable or no training

	Importance	Relevance	Use	Understand	Application	Resources	Management	Training	Benefit
For example: *Pareto analysis*	5	4	2	3	3	2	1	1	4

	Importance	Relevance	Use	Understand	Application	Resources	Management	Training	Benefit
QC7									
Cause and effect									
Check sheets									
Control charts									
Graphs/charts									
Histograms									
Pareto analysis									
Scatter diagrams									
QC7									
Affinity diagrams									
Arrow diagrams/critical path analysis									
Matrix data analysis methods									
Matrix diagrams									
Process decision programme chart									
Relation diagrams									
Systematic diagrams/tree diagrams									

(*continued*)

Table 9.1 (*Continued*)

Techniques									
Benchmarking									
Brainstorming/brainwriting									
Departmental purpose analysis									
Design of experiments (Taguchi)									
Failure mode and effects analysis									
Flow charts									
Force field analysis									
Problem solving methodology									
Quality costs									
Quality function deployment									
Questionnaire									
Sampling									
Statistical process control									
Other techniques, tools, systems									
For example:									
ISO9000 series									
Quality operating system QS9000									
Other awards (e.g. EQA)									

At each stage of the cycle a range of tools and techniques is employed. The Ford Motor Company has been at the forefront in developing a step-by-step process of ensuring that any improvement action is permanent. This is known as the TOPS (team-orientated problem-solving) 8D (eight-discipline) approach. The following is a summary of the eight disciplines.

- D1 Use a team approach
- D2 Describe the problem:
  - Review and analyse existing data
  - Establish problem definition and statement
  - Develop the problem profile
  - Confirm problem with the customer
- D3 Implement and verify interim containment actions (ICA):
  - Choose best ICA
  - Test for feasibility
  - Develop action plan and implement ICA to isolate the problem from the customer until permanent corrective action is available
  - Monitor and report effectiveness of ICA
- D4 Define and verify root cause(s):
  - Review, improve and update problem definition and description
  - Identify possible causes by comparison to the problem description
  - Select likely causes
  - Verify root causes
  - Report
- D5 Choose and verify permanent corrective actions (PCA):
  - Choose best PCA
  - Re-evaluate ICA
  - Verify PCA
  - Make choice
  - Report
- D6 Implement permanent corrective action:
  - Develop implementation plan
  - Remove ICA
  - Implement PCA
  - Monitor process and assess the effectiveness of problem elimination
  - Formalize changes, and update documents and system
  - Notify affected personnel
  - Report
- D7 Prevent recurrence:
  - Review current process
  - Identify critical areas or supporting PCA
  - Make recommendations for improvement current processes
  - Report
- D8 Congratulate the team

Checklists

Checklists (sometimes called inspection or validation checklists) are used as prompts and aids to personnel. They highlight the key features of a process, equipment, system and/or product/service to which attention needs to be given, and ensure that the procedures for an operation, housekeeping, inspection, and maintenance have been followed. Checklists are also used in audits of both product and systems. They are an invaluable aid for quality assurance.

The basic steps in constructing a checklist are:

- Study the activity for which the checklist is to be drawn up.
- Drawing on observations of the process, discussions with operatives, and appropriate working instructions and procedures, construct the checklist.
- Walk the checklist through the process by following what happens at each stage.
- Ask the person who is carrying out the process to check its accuracy.
- Display it next to the process.
- Assess its use in practice.

Flowcharts

Process mapping (sometimes called 'blueprinting' or process modelling) in either a structured or unstructured format, is a prerequisite to obtaining an in-depth understanding of a process, before the application of quality management tools and techniques such as FMEA, SPC and quality costing. A flowchart is employed to provide a diagrammatic picture, often by means of a set of established symbols, showing all the steps or stages in a process, project or sequence of events and is of considerable assistance in documenting and describing a process as an aid to understanding examination and improvement.

A chart, when used in a manufacturing context, may show the complete process from goods receipt through storage, manufacture, and assembly to dispatch of final product, or simply some part of this process in detail. What is important is that each 'activity' is included, to focus attention on aspects of the process or subset of the process where problems have occurred or may occur, to enable some corrective action to be taken or counter-measure put into place.

Traditionally charts (called process charts) have employed conventional symbols to define activities such as operation, inspection, delay or temporary storage, permanent storage and transportation, and are much used by operations and methods and industrial engineering personnel. In more recent times they have witnessed considerable use in business process re-engineering.

There are a number of variants of the classical process flowchart, including those tailored to an individual company's use, with different symbols being used to reflect the situation under study. What is important is not the format of the chart and/or flow diagram, but that the process has been mapped out with key inputs, value-adding steps and outputs defined, and that it is understood by those directly involved and responsible for initiating improvements. Analysing the data collected on a flowchart can help to uncover irregularities and potential problem points. Also in some organizations people are only aware of their own particular aspect of a process and process mapping helps to facilitate a greater understanding of the whole process: it is essential to the development of the internal customer–supplier relationship. Figure 9.4 is an example of flowcharting for the process of non-conformance identification and preventative action.

For an example of a specific process mapping see Crossfield and Dale (1990) who developed a methodology at Allied Signal Garrett Automotive plant in Skelmersdale. The following are the main steps in constructing a flowchart:

- Define the process and its boundaries, including start- and end-points.
- Decide the type and method of charting and the symbols to be used, and do not deviate from the convention chosen.
- Decide the detail with which the process is to be mapped.
- Describe the stages, in sequence, in the process using the agreed methodology.
- Assess if these stages are in the correct sequence.
- Ask people involved with the process to check its veracity.

Checksheets

These are a sheet or form used to record data. The checksheet is a simple and convenient recording method for collecting and determining the occurrence of events. The events relate to non-conformities, including the position in which they appear.

Checksheets are helpful in following the maxim of 'no checking or measurement without recording the data', and are effective in making the first attack on a problem.

They are prepared, in advance of the recording of data, by the operatives and staff being affected by a problem. Checksheets, in table, process, diagram or picture format, are extremely useful as a data-collection device and a record to supplement quality control charts. The data from a checksheet provide the factual basis for subsequent analysis and corrective action. There are many different kinds of checksheets: Figure 9.5 is one example.

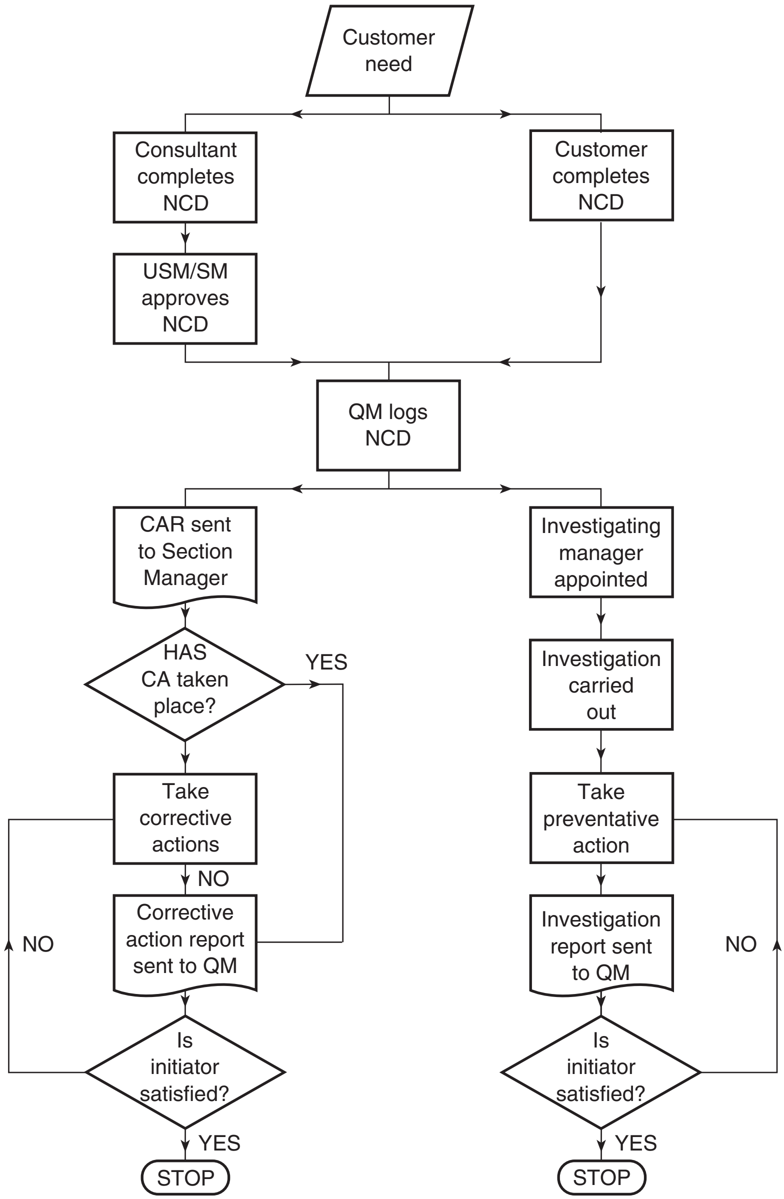

Figure 9.4 Flowchart: non-conformance identification and preventative action process

The following are the main steps in constructing a checksheet:

- Decide the type of data to be illustrated. The data can relate to: number of defectives, percentage of total defectives, cost of defectives, type of defective, process, equipment, shift, business unit, operator, etc.

Check item	Week no. Day 1	2	3	4	5	6	7
Warp board							
Board delamination							
Surface defect							
Incorrect board spec.							
Incorrect print density							
Shouldering							
Incorrect ink weight							
Off square feeding							
Print mis-registration							
Split bends							
Deep slots							
Narrow slots							
Ink smudging							

Figure 9.5 Checksheet: gluing/stitching department

- Decide which features/characteristics and items are to be checked.
- Determine the type of checksheet to use (i.e. tabular form or defect position chart).
- Design the sheet; ideally it should be flexible enough to allow the data to be arranged in a variety of ways. Data should always be arranged in the most meaningful way to make best use of them.
- Specify the format, instructions and sampling method for recording the data, including the use of appropriate symbols.
- Decide the time period over which data are to be collected.

Tally Charts and Histograms

Tally charts are a descriptive presentation of data and help to identify patterns in the data. They may be used as checksheets with attribute data (pass/fail, present/absent) but are more commonly used with measured or variable data (e.g. temperature, weight, length) to establish the pattern of variation displayed, prior to the assessment of capability and computation of process capability indices (see the SPC section of Chapter 10 for details). Tally charts are regarded as simple or crude frequency distribution curves and provide a quick way of recording and displaying data.

Statisticians would tend to construct histograms rather than tally charts, but for general analysis purposes they are more or less the same. A histogram is a

pH	*Frequency*	*Total*
4.75–5.25		0
5.25–5.75		0
5.75–6.25	I	1
6.25–6.75	IIII	4
6.75–7.25	~~IIII~~ III	8
7.25–7.75	~~IIII~~ ~~IIII~~ III	13
7.75–8.25	~~IIII~~ ~~IIII~~ IIII	14
8.25–8.75	~~IIII~~ ~~IIII~~ II	12
8.75–9.25	IIII	4
9.25–9.75	III	3
9.75–10.25	III	3
10.25–10.75	I	1

Figure 9.6 Tally chart: effluent analysis – pH

graphical representation of individual measured values in a data set according to the frequency or relative frequency of occurrence. It takes measured data from the tally sheet and displays its distribution using the class intervals or value as a base – it resembles a bar chart with the bars representing the frequency of data over a range of values. The histogram helps to visualize the distribution of data and in this way reveals the amount of variation within a process, and/or other factors such as edited data and poor sampling techniques. It can be used to assess performance to a given standard, specification or tolerance. There are several forms which should be recognized – normal, skewed, bimodal, isolated island, etc. There are a number of theoretical models which provide patterns and working tools for various shapes of distribution. The shape of distribution most often encountered is called Normal or Gaussian.

Figure 9.6 shows a tally chart; Figure 9.7 is a histogram which has been constructed from the data collected on the tally chart.

There are several ways of constructing histograms depending upon whether the data are discrete or continuous, whether they are single or grouped values, and whether there is a vast amount of data or not. The following guidelines are given for the treatment of continuous data of sufficient quantity that grouping is required.

- Subtract the smallest individual value from the largest.
- Divide this range by 8 or 9 to give that many classes or groups.
- The resultant value indicates the width or interval of the group. This should be rounded for convenience, e.g. 4.3 could be regarded as either 4 or 5 depending upon the data collected.
- These minor calculations are undertaken to give approximately eight or nine group class intervals of a rational width.

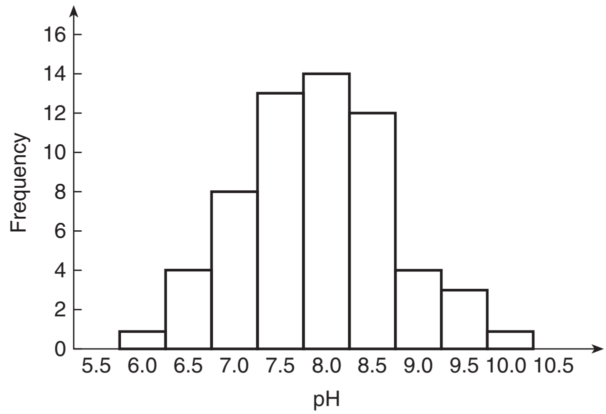

Figure 9.7 Histogram: effluent analysis – pH

- Each individual measurement now goes into its respective group or class.
- Construct the histogram with measurements on the horizontal scale and frequency (or number of measurements) on the vertical scale.
- The 'blocks' of the histogram should adjoin each other, i.e. there should be no gaps unless there is a recorded zero frequency.
- Clearly label the histogram and state the source of the data.

Graphs

Graphs, be they presentational (i.e. to convey data in a pictorial way), or mathematical (i.e. into which data may be interpolated or from which they may be extrapolated), are used to facilitate understanding and analysis of the collected data, investigate relationships between factors, attract attention, indicate trends and make the data memorable (a picture is worth a thousand words).

There is a wide choice of graphical methods available (line graphs, bar charts, pie charts, Gantt charts, radar charts, band charts) for different types of application. Figure 9.8 is a line graph which illustrates right-first-time production; Figure 9.9 is a bar chart showing right-first-time production.

The following are the types of issues which need to be considered in the construction of graphs:

- Use clear titles and indicate when and how the data were collected (i.e. the theme of the graphs and the source of data).
- Ensure that the scales are clear, understandable and represent the data accurately.
- When possible, use symbols for extra data to provide clarity of explanation.

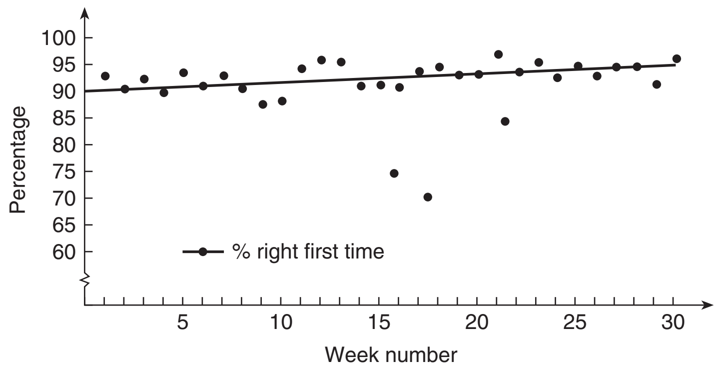

Figure 9.8 Line graph: right-first-time production

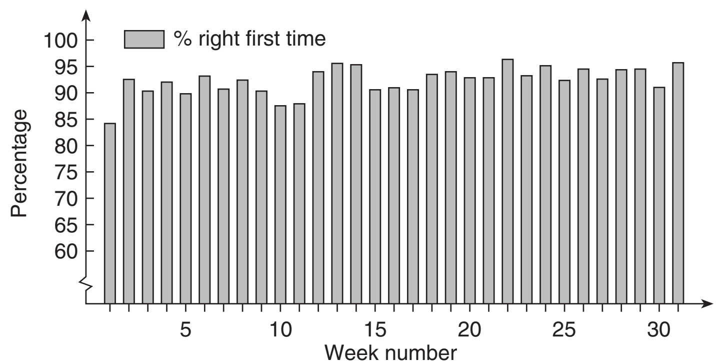

Figure 9.9 Bar chart: right-first-time production

- Always keep in mind the reason why a graph is being used (i.e. to highlight some information or data in a striking and unambiguous way); anything which facilitates this objective is desirable.

Pareto Analysis

This is a technique employed for prioritizing problems of any type; for example, quality, production, complaints, stock control, sickness, absenteeism, accident occurrences and resource allocation. The analysis highlights the fact that most problems come from a few causes, and it indicates what problems to solve and in what order (e.g. Juran's (1988) 'vital few and trivial many'). In this way improvement efforts and resources are directed where they will have the greatest impact. Pareto analysis is an extremely useful tool: it can be used to compare before and after situations and data over different time periods. It can provide insights or

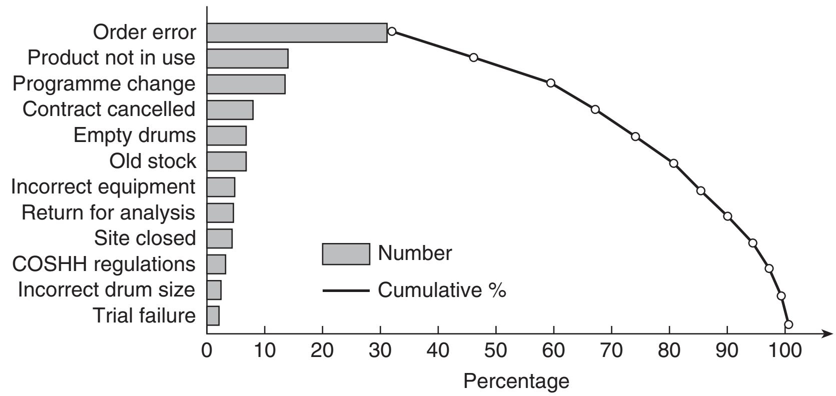

Figure 9.10 Pareto analysis: reasons for returned goods

problem-solving and process improvement. A Pareto diagram can be considered as a special form of bar chart, comprising a simple bar chart with a cumulative percentage curve overlaid on it.

The diagram is named after a nineteenth-century Italian economist, Wilfredo Pareto, who observed that a large proportion of a country's wealth is held by a small proportion of the population (hence the expression 'the 80/20 rule'). In the 1950s Juran, using a similar analogy, observed that a large proportion of quality problems were attributable to a small number of causes (i.e. 80 per cent of rejections are caused by 20 per cent of defect types).

The technique involves ranking the collected data, usually via a checksheet, with the most commonly occurring problem at the top and the least common at the bottom. The contribution of each problem to the grand total is expressed as a percentage, and cumulative percentages are used in compounding the effect of these problems. The ranking of the problems is usually in terms of occurrence and/or cost – just because one defect type happens more frequently than another it does not necessarily mean that it is the costliest or the one that should be tackled first. The results are often presented in two ways: (1) ranked data as a bar chart and (2) cumulative percentages as a graph. Figure 9.10 is an analysis of the reasons for returned goods.

Pareto analysis, while simple in terms of its construction, is extremely powerful in presenting data by focusing attention on the major contributor(s) to a quality problem in order to generate attention, efforts, ideas and suggestions to hopefully gain a significant overall reduction in these problems.

The following are the basic steps in constructing a Pareto diagram:

- Agree the problem that is to be analysed.
- Decide the time period over which data are to be collected.
- Identify the main causes or categories of the problem.
- Decide how the data will be measured.

- Collect the data using, for example, a checksheet.
- Tabulate the frequency of each category and list in descending order of frequency (if there are too many categories it is permissible to group some into a miscellaneous category, for the purpose of analysis and presentation).
- Arrange the data as a bar chart.
- Construct the Pareto diagram with the columns arranged in order of descending frequency.
- Determine cumulative totals and percentages and construct the cumulative percentage curve, superimposing it on the bar chart.
- Interpret the data portrayed on the diagram.

Cause-and-Effect Diagrams

This type of diagram was developed by Ishikawa (1976) to determine and break down the main causes of a given problem. Cause-and-effect diagrams are often called Ishikawa diagrams, and sometimes 'fishbone' diagrams, because of their skeletal appearance. They are usually employed where there is only one problem and the possible causes are hierarchical in nature.

The effect (a specific problem or a quality characteristic/condition) is considered to be the head, and potential causes and sub-causes of the problem or quality characteristic/condition to be the bone structure of the fish. The diagrams illustrate in a clear manner the possible relationships between some identified effect and the causes influencing it. They also assist in helping to uncover the root causes of a problem and in generating improvement ideas.

They are typically used by a quality control circle, quality improvement team, kaizen team, and problem-solving team, as part of a brainstorming exercise to solicit ideas and opinions as to the possible major cause(s) of a problem, and subsequently to offer recommendations to resolve or counteract it.

It is important to define the problem or abnormality clearly, giving as much detail as possible to enable the identification of potential causes. This can be quite a difficult task, and the team leader must assume responsibility for defining a manageable problem (if it is too large it may need subdividing into a number of subproblems) to ensure that the team's efforts and contributions are maximized in a constructive manner.

5M cause-and-effect diagram. The main 'bone' structure or branches typically comprise machinery, manpower, method, material and maintenance. Occasionally teams omit maintenance, and hence use a 4M diagram, while others may add a sixth M (Mother Nature) and so use a 6M diagram. The 4M, 5M, or 6M diagram is useful for those with little experience of constructing cause-and-effect diagrams and is a good starting point in the event of any uncertainty. In non-manufacturing areas the four Ps (policies, procedures, people and plant) are sometimes found

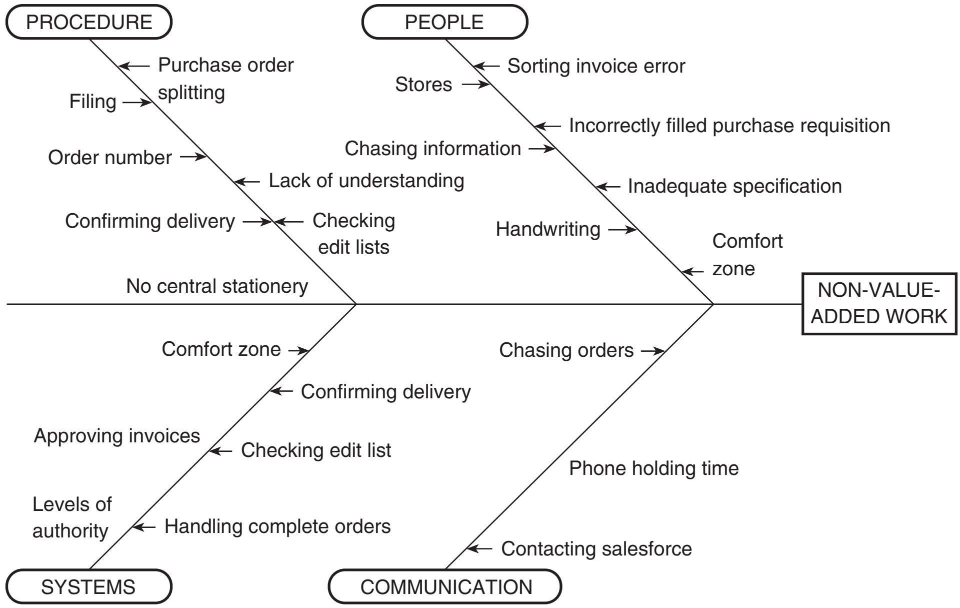

Figure 9.11 Cause-and-effect analysis: purchasing department non-value-added work analysis

to be more appropriate. As with any type of cause-and-effect diagram, the exact format is not so important as the process of bringing about appropriate countermeasures for the identified and agreed major cause(s) of the problem.

Figure 9.11 shows an example of a cause-and-effect diagram for a non-value-added work analysis carried out by a purchasing department.

Cause-and-effect diagrams are usually produced via a team approach and involve the following basic steps:

- Define with clarity and write in a box to the right the key symptom or effect of the problem and draw a horizontal line from the left of the box.
- Ensure that every team member understands the problem and develop a clear problem statement.
- Decide the major groupings or categories for the causes of the effect; these form the main branches of the diagram.
- In a brainstorming session, the group members speculate on causes of the effect and these are added to the branches or sub-branches of the diagram.
- In a following session the causes are discussed and analysed to determine those which are most likely to have caused the effect.
- The most likely, or major causes of the problems are ranked, by the group, in order of importance. This can be done by Pareto voting: 80 per cent of the votes should be cast for 20 per cent of the causes. (If, for example, there are

35 causes, using the figure of 20 per cent gives each member seven votes to allocate to what they believe are the causes of the effect.)
- Additional data are sometimes gathered to confirm the key causes.
- Improvement plans, actions, tests and experiments are decided upon to both verify and address the key causes.

Scatter Diagrams and Regression Analysis

Scatter diagrams or scatter plots are used when examining the possible relationship or association between two variables, characteristics or factors; they indicate the relationship as a pattern – cause and effect. For example, one variable may be a process parameter (e.g. temperature, pressure, screw speed), and the other may be some measurable characteristic or feature of the product (e.g. length, weight, thickness). As the process parameter is changed (independent variable) it is noted, together with any measured change in the product variable (dependent variable), and this is repeated until sufficient data have been collected. The results, when plotted on a graph, will give what is called a scatter graph, scatter plot or scatter diagram. In very simple terms, variables that are associated may show a linear pattern and those that are unrelated may portray an obvious or non-linear random pattern. An example of a linear scatter plot of an effluent analysis for solids/chemical oxygen demand is given in Figure 9.12.

Analysis should concern itself with the dispersion of the plots, and if some linear, or known non-linear, relationship exists between the two variables. In this way the scatter diagram is a valuable tool for diagnosis and problem-solving. Regression analysis would subsequently be used not only to establish lines of 'best fit', but to provide the basis for making estimates or predictions of, say, the product variable for a given value of the process parameter. In this way, it is possible to reduce the amount of data which is measured, collected, plotted and analysed.

How valid or reliable such estimates are, is largely a function of the degree of correlation which exists between the two variables (if indeed only two variables are under consideration), and whether the estimates are interpolated (i.e. from within the range of collected data) or extrapolated (i.e. outside that range).

Where there are more than two variables, multivariate regression analysis should be used, but a good background of statistical knowledge is required to undertake this analysis.

The Seven Management Tools

The so-called 'seven new management tools' of quality control were developed by the Japanese to collect and analyse non-qualitative and verbal data, in particular from sales and marketing and design and development activities. Most of the tools

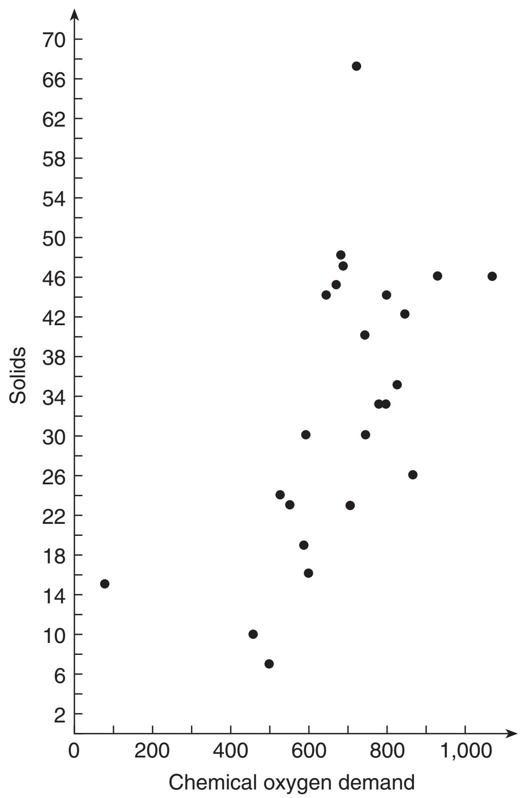

Figure 9.12 Scatter plot: effluent analysis: solids/chemical oxygen demand

have seen previous use in other than TQM applications (for example, value engineering and value analysis, critical path analysis, programme evaluation and review technique (PERT), organizational analysis); the choice of the term 'new' is unfortunate. In Japanese companies these tools are typically used by quality control circles in sales and design areas, and in quality function deployment. It is usual to find some of the tools used together (e.g. a systematic diagram being produced from the data contained in an affinity diagram). A full description of these tools is outside the scope of this chapter; however, further details and examples are provided in the previous (fifth) edition of this book. Moreover, they are covered in detail by Mizuno (1988), Ozeki and Asaka (1990) and Barker (1989). The tools are listed briefly below.

Relations diagram method (relationship diagraph or linkage diagram)

This is used to identify, understand and clarify complex cause-and-effect relationships to find the causes of and solutions to a problem and to determine the key factors in the situation under study. They are also employed to identify the key issues for some desired result. Relations diagrams are used when the causes are non-hierarchical and when there are multiple interrelated problems; they tend to be used when there is a strong feeling that the problem under discussion is only a symptom. They allow the problem to be analysed from a wide perspective, as a specific framework is not employed, and allow for the use of multidirectional rather than linear thinking.

Affinity diagram method (KJ – kawakita jiro – method)

This is used to categorize verbal and language data about previously unexplored issues, problems and themes which are hazy, uncertain, large, complex and difficult to understand, thereby helping to create order out of chaos. It is used in conjunction with or as an alternative to brainstorming and is useful when new thoughts and ideas are needed. This diagram uses the natural affinity between opinions and partial data from a variety of situations to help understand and structure the problem. It tends to be a creative rather than a logical process.

Systematic diagram method (tree diagram)

This is used to examine, in a systematic manner, the most appropriate and effective means of planning to accomplish a task ('how to') or solve a problem; events are represented in the form of a root-and-branch relationship. It displays in increasing detail the means and paths necessary to achieve a specific goal or to clarify the component parts which lead to the root cause of a problem. They are used when the causes that influence the problem are known, but a plan and a method for resolving the problem have not been developed. They can also be useful when a task has been considered to be simple but has run into implementation difficulties. A systematic diagram is usually used to evaluate several different methods and plans for solving a problem and thereby assist with complex implementation. It is used to identify dependencies in a given situation and to search for the most suitable improvement opportunities, and also when there are major consequences for missing key tasks.

Matrix diagram method

This is used to clarify the relationship and connecting points between results and causes or between objectives and methods and, by the use of codes, to indicate their relative importance and the direction of the influence. The diagram is also useful to draw conclusions between consequences and their causes. They are used when there are two sets of factors and methods which may have no relationship with each other and when there is a need to get a cumulative numerical score to compare one item to another. The factors are arranged in rows and columns on a chart with the intersections identifying the problem and its concentration; the intersecting points are the base for future action and problem-solving.

Matrix data-analysis method

This is used to quantify and arrange the data presented in a matrix diagram in a clear manner. It is a numerical analysis method and employs techniques such as multivariate analysis.

Process decision programme chart (PDPC) method

This is used to select the best processes to obtain the desired outcome from a problem statement by evaluating all possible events, contingencies and outcomes that can occur in any implementation plan. Considering the system as a whole, it is used to anticipate unexpected events and develop plans, counter-measures and actions for such outcomes. It is used to plan each possible chain of events that might occur when the problem or goal is unfamiliar, new, or unique, particularly when the stakes of potential failure are high. In this it is similar to failure mode and effects analysis and fault tree analysis. However, it is claimed to be more dynamic than these two methods since the relationship between the initiating condition/event and terminating condition/event has been thought out and mapped. It is based on a systematic diagram and uses a questioning technique – for example, 'What could go wrong?', 'What are the alternatives?' – and lists actions or counter-measures accordingly. The PDPC has no prescribed set of rules.

Arrow diagram method

This method applies systematic thinking to the planning and execution of a complex set of tasks. It is used to establish the most suitable plan and schedule for a series of activities in a project, and to monitor its progress in an efficient manner to ensure adherence to the schedule. Arrow diagrams are necessary to describe the interrelationship and dependencies of tasks within a job or project that is complex. They are deployed at the implementation planning stage of a project. The sequence of the steps involved and their relation to each other are indicated by an arrow, and in this way a network of activities is developed. This method, its form of construction, calculations and identification of critical path are well known and used in project management in relation to critical path analysis (CPA) and programme evaluation and review technique (PERT).

Housekeeping and the 5S technique

The discipline of cleanliness and housekeeping is a prerequisite for effective quality assurance. It creates a working environment which is comfortable and in harmony with all employees. Organizations need to make sufficient effort to define and quantify their housekeeping requirements. It is also necessary to ensure that employees local to an area accept that the condition of housekeeping is their responsibility. A variety of aids can be used to promote housekeeping under what is termed the 5s; the strength of this methodology is its simplicity. The 5s are Japanese words (seiri, seiton, seiso, seiketsu and shitsuke), which translate approximately as shown below.

- *Seiri*. Organization: separating what is required from that which is not, eliminating those which are not required and/or tidy them away.
- *Seiton*. Neatness: arranging the required items in a tidy manner and in a clearly defined place, so that they can be accessed quickly.
- *Seiso*. Cleaning: keeping the surrounding area and environment clean and tidy.
- *Seiketsu*. Standardization: clean the machinery and equipment according to laid-down standards and routines in order to identify deterioration.
- *Shitsuke*. Discipline: follow the procedures and previous four steps which have been laid down and continuously improve them.

They sometimes also translate in English as: sort, set in order, shine, standardize and sustain.

The 5s evaluation form used by NSK-RHP (Aerospace) is given in Table 9.2. Nissan Motor Manufacturing (UK) refer to this form of housekeeping as the 5 Cs:

- Clean out – determine what is necessary and unnecessary and dispose of the latter.
- Configure – provide a convenient, safe and orderly place for everything and keep it there.
- Clean and check – monitor the condition of the area during cleaning.
- Conformity – develop the habit of routinely maintaining cleanliness.
- Custom and practice – train people in the disciplines of the 5 Cs.

NSK-RHP (Blackburn) use the acronym CANDO – cleanliness, arrangement, neatness, discipline, orderliness.

Mistake-Proofing

Mistake-proofing is a technique which is used to prevent errors being converted into defects. The concept was developed by Shingo (1986). The technique is based on the assumption that, no matter how observant or skilled people are, mistakes

Table 9.2 The 5s evaluation form

Item # and description	*5S Evaluation Form*	*Item Score (0–5)*	*What is the team doing to improve to next level?*
1. Removing unnecessary items	All items not required for performing operations are removed from the work area, only tools and products are present at work stations.		
2. Storage of cleaning equipment	All cleaning equipment is stored in a neat manner; handy and readily available when needed.		
3. Floor cleaning	All floors are clean and free of debris, oil and dirt. Cleaning of floors is done routinely – daily at a minimum – posted schedule.		
4. Bulletin boards	All bulletins are arranged in a neat and orderly manner. No outdated, torn or soiled announcements are displayed.		
5. Emergency access	Fire hoses and emergency equipment are unobstructed and stored in a prominent easy-to-locate area. Stop switches and breakers are marked or colour-coded for visibility.		
6. Items on floor	Work-in-process, tools and any other material are not left to sit directly on the floor. Large items such as tote boxes are positioned on the floor in clearly marked areas, identified by painted lines.		
7. Aisleways – markings	Aisles and walkways are clearly marked and can be identified at a glance; lines are straight and at right angles with no chipped or worn paint.		
8. Aisleways – maintenance	Aisles are always free of material and obstructions; nothing is placed on the lines, and objects are always placed at right angles to the aisles.		
9. Storage and arrangement	Storage of boxes, containers and material is always neat and at right angles. When items are stacked, they are never crooked or in danger of toppling over.		
10. Equipment – painting	All machines and equipment are neatly painted; there are no places in the plant less than two metres high that are unpainted.		
	Subtotal pg 1		

(*continued*)

Table 9.2 (*Continued*)

Item # and description	*5S Evaluation Form*	*Item Score (0–5)*	*What is the team doing to improve to next level?*
11. Equipment – cleanliness	All machines and equipment are kept clean by routine daily care.		
12. Equipment – maintenance	Controls of machines are properly labelled and critical points for daily maintenance checks are clearly marked. Equipment checksheets are neatly displayed and clean.		
13. Equipment – storage	Nothing is placed on top of machines, cabinets and equipment; nothing leans against walls or columns. Guards and deflectors are used to keep chips and coolant from falling to the floor.		
14. Documents – storage	Only documents necessary to the operation are stored at the work stations and these are stored in a neat and orderly manner.		
15. Documents – control	All documents are labelled clearly as to content and responsibility for control and revision. Obsolete or unused documents are routinely removed.		
16. Tools and gauges arrangement	Tools, gauges and fixtures are arranged neatly and stored, kept clean and free of any risk of damage.		
17. Tools and gauges convenience	Tools, gauges and fixtures are arranged so they can be easily accessed when changeovers or setups are made.		
18. Shelves and benches – arrangement	Arranged, divided and clearly labelled. It is obvious where things are stored; status and condition is recorded.		
19. Workbench and desk – control	Kept free of objects including records and documents. Tools and fixtures are clean and placed in their proper location.		
20. 5S control and maintenance	A disciplined system of control is maintained at the highest possible level. It is the responsibility of everyone to maintain this system and environment.		
	Subtotal pg 2		
	+		
	Subtotal pg 1		
	Total		÷ 20 = 5S Score

will occur unless preventative measures are put in place. Shingo argues that using statistical methods is tantamount to accepting defects as inevitable and that instead of looking for and correcting the causes of defective work, the source of the mistake should be inspected, analysed and rectified. He places great emphasis on what he calls source inspection, which checks for factors which cause mistakes, and then on using poka-yoke or mistake-proofing devices to prevent their recurrence.

Mistake-proofing has two main steps: preventing the occurrence of a defect and detecting the defect. In short, the purpose is to stop processes from operating when conditions exist that will lead to defects. The system is applied at three points in the process:

- In the event of an error, prevent the start of a process and shut it down.
- Prevent a non-conforming product from leaving a process.
- Prevent a non-conforming part being passed to the next process.

The mistake-proofing technique employs the ingenuity and skills not only of the engineers and/or technical specialists who may develop and fit the devices, but also of the operators who have first identified the cause of the mistake and participated in the corrective action measures. In Japanese companies, quality control circles are very active in developing and using mistake-proofing devices. The devices may be simple mechanical counters which ensure that the correct number of parts are fed into a machine, or they may be cut-off switches, limit switches or float switches which provide some regulatory control of the process or operation, thereby stopping a machine or process automatically. They may be devices which prevent a part being incorrectly fed into the machine, assembled incorrectly, fabricated incorrectly, or placed incorrectly into fixturing. In other words, the assumption is made that if the part can possibly be fed in wrongly it will be unless some preventative measure is taken. This is the essence of mistake-proofing. Patel et al. (2001) worked along four precision component manufacturing companies and found that the main types of control method used were: jigs, pegs or guide pins, beam sensors, reset and interlock devices and gauges. It is usual to supply the mistake-proofing device and signal with some audible or visual display or mimic diagrams and/or warning light to indicate that something has gone wrong, and not to plan to bring the abnormality to the attention of the operator. They are a relatively cheap and effective way of preventing defects.

Dale and Lightburn (1992), based on their research into mistake-proofing in a European motor industry supplier, offer the following guidelines to organizations approaching the development of mistake-proofing:

- Mistake-proof at the earliest possible opportunity, certainly at the development stage and before any pre-production activities are undertaken.
- Involve manufacturing and quality department personnel in the research and development activity and ensure that there is a forum for the discussion

of manufacturing and design problems and their interfaces; cross-functional teams, and concurrent and simultaneous engineering should facilitate this.

- The design and process FMEA, analysis of customer reject returns, warranty claims, field failure reports, in-house scrap and rework, and inspection data should help to pinpoint potential problems that could be resolved by mistake-proofing.
- It is much easier to mistake-proof new products than develop devices for existing products.
- A team approach should be taken to study potential problems and likely causes of mistakes, and the development of mistake-proofing ideas and devices. The team should be multidisciplinary and involve operators. Customers should also be involved as this helps to build up relationships and provides concrete proof that long-lasting improvement action is being taken. However, some suppliers are sensitive to their problems being exposed to customers.
- There should be some basic training in the principles, techniques, applications, and use of mistake-proofing as well as other activities such as problem-solving and team-building.
- To broaden the experience of mistake-proofing techniques and applications, information should be shared with other companies using the concept.

Total Productive Maintenance

The Japanese have evolved the concept of total productive maintenance (TPM), based on the planned approach to preventative maintenance (PM). Nakajima (1986) outlines how, in 1953, 20 Japanese companies formed a PM research group and, after a mission to the US in 1962 to study equipment maintenance, the Japan Institute of Plant Engineers (JIPE) was formed in 1969, which was the predecessor of the Japan Institute of Plant Maintenance (JIPM). In 1969 JIPE started working closely with the automotive component manufacturer Nippondenso on the issue of PM, and when the company decided to change the role of operators to allow them to carry out routine maintenance it was the beginning of TPM. Tajiri and Gotan (1992) point out that, while TPM was communicated throughout Japan, only a small number of factories took up the challenge. It was the severe economic situation in the early 1970s that accelerated the adaptation of TPM, propagated by the seven-step programme developed by the Tokai Rubber Industries (see Nakajima 1988).

TPM combines PM with TQM and employee involvement and is considered as a total method of management. Dale (1999), after missions to study Japanese manufacturing organizations, reports that in Japan 'TPM is considered as an additional driver which is complementary to TQM.' The condition of the equipment has a considerable influence on the quality of production output and is a key element in manufacturing a quality product. The machine needs the input of people to keep it lean and to improve its efficiency and operation, thereby promoting a sense of 'plant ownership' by the operators and a feeling of shop-floor goodwill. This is the purpose of TPM.

TPM is a scientific, company-wide approach in which every employee is concerned about the maintenance, quality and efficiency of their equipment. The objective is to reduce the whole-life cost of machinery and equipment through more efficient maintenance management, and as far as possible to integrate the maintenance and manufacturing departments. Teamwork is a key element of TPM. By analysing each piece of equipment it focuses on reducing manufacturing losses and costs (i.e. the six major losses: breakdown, set up/adjustment, speed, idling and minor stoppages, quality defects and start-up; see Nakajima 1988), and establishes a system of preventative maintenance over a machine's working life. The emphasis of TPM is to improve the skills of operators in relation to machine technology and to train and educate them to clean, maintain and make adjustments to their machine. The training and education of operators is carried out by maintenance and engineering staff. In this way machinery is kept at optimal operating efficiency. The 5s are essential activities in TPM, and they also promote visible management.

The main organizational characteristics of TPM are:

- Integration of maintenance and production departments
- Small teams of operators/maintainers
- Training is undertaken to make operators feel like owners
- Good habits are developed:
  - Cleaning becomes checking
  - Cleaning highlights abnormalities
  - Abnormalities are rectified
  - Continuous improvement of environment and equipment

The seven key steps of a TPM programme are usually considered to be:

Step 1 Initial cleaning, to identify problems with equipment that are not noticed during normal operations.
Step 2 Counter-measures at the source of problems, to minimize accumulation of dirt and other contaminants and put in place improvements to make it easy to access parts of the equipment which need cleaning.
Step 3 Set maintenance, cleaning and lubrication standards for groups of equipment and carry out appropriate training.
Step 4 General inspection procedures and schedules.
Step 5 Autonomous inspection procedures and schedules.
Step 6 Orderliness and tidiness.
Step 7 Full autonomous maintenance.

Summary

Irrespective of the TQM or strategic improvement approach chosen and followed, an organization will need to use a selection of tools and techniques to assist with the process of continuous improvement. It is recommended that the more simple tools and techniques, such as the seven quality control tools, are used in the beginning, and that it should be ensured that the tools and techniques which are currently employed are used effectively before attempts are made to introduce other techniques. A planned approach for the application of tools and techniques is necessary.

The temptation to single out one tool or technique for special attention should be resisted, and to get maximum benefit from the use of tools and techniques they should be used in combination. It should be recognized that tools and techniques play different roles, and management and staff should be fully aware of the main purpose and use of the tools and techniques they are considering applying in the organization; if this is not the case they could well be disappointed if a tool or technique fails to live up to expectations. It is also important to understand the limitations of how and when tools and techniques can best be used. The tools and techniques should be used to facilitate improvement and be integrated into the way the business works rather than being used and viewed as 'bolt-on' techniques. The ways in which the tool or technique is applied and how its results are interpreted are critical to its successful use; a tool or technique is only as good as the person who is using it.

From research by Bamford and Greatbanks (2005) the following are key for the successful implementation, use and success of applying the QC and M7 tools and techniques:

1 In-depth knowledge of the process
2 Formal training in problem solving techniques
3 Appropriateness of tools selected for use
4 Application simple models at all levels in the organization to aid communication and learning.

Tools and techniques on their own are not enough; they need an environment and technology conducive to improvement and to their use. An organization's CEO and senior managers have a key role to play in the effective use of tools and techniques. They should, for example:

- Develop their knowledge of the tools and, when appropriate, use them in their day-to-day activities and decision-making.
- Be fully aware of the main purpose and use of the particular tools and techniques which are being applied.

- Delegate responsibility for their promotion to suitable individuals.
- Maintain an active interest in the use of tools and the results.
- Endorse expenditure arising from the education and training required and the improvement activities resulting from the employment of tools.
- Recognize and reward those employees who utilize tools and techniques in their day-to-day work activities.

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Chapter Ten

Quality Management Techniques

B. G. Dale, B. Dehe and D. Bamford

Introduction

This chapter provides an overview of six core quality management techniques and of 'Six Sigma', a strategic improvement approach, often deployed in an organization's improvement process.

1 Quality Function Deployment
2 Design of Experiments
3 Failure Mode and Effects Analysis
4 Statistical Process Control
5 Benchmarking
6 Business Process Re-engineering and Value Stream Mapping
7 Six Sigma

Quality Function Deployment

With thanks to I. Ferguson and B. G. Dale (2007)

Quality Function Deployment (QFD) is a systematic procedure which is used to help build quality into the upstream processes and also into new product development. It helps to avoid problems in the downstream production and delivery processes and will consequently shorten the new product/service development time. The concept helps to promote proactive rather than reactive development by capturing and measuring the 'voice of the customer'.

QFD is a technique that is used in the first place for translating the needs of the customers into design requirements, being based on the philosophy that the 'voice of the customer' drives all company operations. It requires reliable data from the following diverse sources: customers, design functionality, costs and capital, reliability, reproducibility.

It employs a step-by-step approach from customer needs and expectations through the four planning phases of:

- Product planning
- Product development
- Process planning
- Production planning through to manufactured products and delivered services

The technique of QFD seeks to identify those features of a product or service which satisfy the real needs and requirements of customers (market- or customer-required quality). A critical part of the analysis is that it takes into account discussions with the people who actually use the product in order to obtain data on issues such as:

- What do they feel about existing products?
- What bothers them?
- What features should new products have?
- What is required to satisfy their needs, expectations, thinking and ideas?
- How and where is the product used?

Understanding Customer Needs

The voice of the customer is the cornerstone of QFD. Hence, talking and listening to the customer is paramount to understanding their real needs and requirements; of the three methods outlined below, the preferred method is direct contact with the customer.

1 Direct contact with the customer:
   - Customer questionnaires
   - Face-to-face discussions with customers
   - Consumer contact.
2 Failure-related information shows where customer needs are not being met and includes:
   - Field-failure data
   - Warranty returns
   - Customer complaints
   - Consumer association reports.
3 Survey:
   - Market surveys
   - Dealer information
   - Trade shows
   - Test marketing

- Product reports, as typically reported in trade magazines
- Product to market share trend information
- Competitive data.

In using these methods for understanding customer requirements typical issues that need to be considered include:

- What is wrong with the product and/or service
- Performance features that delight the customer
- The 'if only' factor and, in particular, when, how, and by whom it is used.

The QFD Road

The main objectives are to:

- Identify customer requirements
- Determine competitive opportunities
- Determine substitute quality characteristics
- Pinpoint requirements for further study.

An example of the 'house of quality' derived from the product-planning phase of QFD is shown in Figure 10.1.

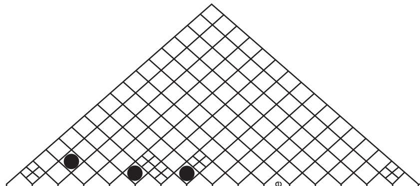
In simple terms, the key elements of the product planning stage comprise the following.

The project

The scope of the project should be clearly outlined, including targets, operating constraints and time scale. A clearly defined mission statement should be produced and a team formed. It is useful to create a business model which includes market definition and size, product life history, competitive products and prices, projected sales, prices and costs, and the estimated capital requirements and likely payback.

Customer needs

Gathering the voices of customers can be done in different ways as previously detailed. The information gathered can be entered into a chart similar to that shown in Figure 10.2, complete with full information on why the product is needed, for what purposes, who uses it and when, and where and how it is used. This information provides the basis for more easily translating the customer's voice into customer needs which can be satisfied by design features. For example, 'In



Relationships

● Positive

× Negative

Relationships

● Strong

○ Medium

△ Weak

Customer Needs		1 On-off response time	2 On/off depression force	3 Basic performance test	4 On-off button area	5 Width × length × thickness	6 Call button column distance	7 Call button area	8 Call button depression/release force	9 Call button font size	10 Screen font size and colour	11 Screen alight in start, call and finish mode	12 Redial and cancel buttons	13 Menu button	14 End call notice menu item	15 Key-pad locking mechanism	16 Keys active unless locked	Customer rating	Customer rating – Us	Customer rating – Company 1	Customer rating – Company 2	Planned level	Improvement ratio	Ranking factor	Importance weight	Relative weight
1.OPERATION the PHONE	1																									
Quick to turn on	2	●	○	●	●	○	○					○						3.0	2	3	3	3	1.5	1.0	4.5	6.7
Always turn on	3		●	●	●			○				○						4.0	3	4	4	4	1.3	1.0	5.3	8.0
Hold in one hand	4				○	●	●	○		△								5.0	5	4	5	5	1.0	1.0	5.0	7.5
Operate by thumb	5		●		●	●	●	●	○	○								5.0	4	4	4	4	1.0	1.0	5.0	7.5
Operate by finger	6		●		●	△	△	△	●	○								3.0	5	4	5	5	1.0	1.0	3.0	4.5
Easy to read button no's	7				○		○	○		●			●	●				5.0	5	5	5	5	1.0	1.0	5.0	7.5
Easy-to-read screen no's and text	8										●	●						5.0	5	5	5	5	1.0	1.0	5.0	7.5
Able to to redial	9												●					5.0	5	5	5	5	1.0	1.0	5.0	7.5
Able to cancel instruction	10												●					5.0	5	5	5	5	1.0	1.0	5.0	7.5
Easy to access phone facilities	11													●				4.0	4	4	4	4	1.0	1.0	4.0	6.0
Cut-off at call finish	12											○			●			5.0	5	5	5	5	1.0	1.0	5.0	7.5
Keys locked when phone in 'sleep' mode	13															●	○	5.0	4	3	5	5	1.3	1.0	6.3	9.3
Call available between on and off	14																●	5.0	5	5	5	5	1.0	1.0	5.0	7.5
Quick to close down phone	15	●																4.0	4	4	4	4	1.0	1.0	4.0	6.0

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Importance weight total	114	199	132	284	159	181	140	63	110	67	133	201	121	67	84	95
Relative weight total	5	9	6	13	7	8	7	3	5	3	6	9	6	3	4	4
Target	'x' mils/sec	'O' N	Test No: BK51	6 mm Dia.	40mm × 100mm × 18mm	13mm centres	10mm × 6mm × P	'C' N	10 point Black	Text 10, No's. 12 pt Black	'L' Lumens	Redial ^ Rt, Cancel C Lft	Centre Horiz. Line	See Menu 2 Matrix	Lock Mech. New Design	Unlock Mech, New Design
Benchmark																
Ideal value																
Our company	↓	⊙	⊙	↑	↓	⊙	↑	↓	⊙	⊙	↑	⊙	⊙	⊙	⊙	⊙
Company A	B	B	S	S	B	B	S	S	S	S	S	S	S	S	S	S
Company B	S	S	S	W	W	S	S	S	S	S	S	S	S	S	W	S
Service info	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Special requirements	Y	Y													Y	
Safety															Y	Y
Govt/ind standards																
Environmental																

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Figure 10.1 The house of quality
Source: Ferguson and Dale 2007:388

the UK, mainly men will use the mobile phone while on the move' will translate the needs of that group of customers into a requirement for one-handed operation of the phone, including the ability to dial and hold from the same hand. The phone will then conveniently have design features of the width and depth of the mobile phone, button areas and depression forces, etc. (see Figure 10.1).

Customer classification EXTERNAL/INTERNAL	Voice of customer *Actual information*	*Why needed*	*What*	*Who*	*When*	*Where*	*How*
SOCIO ECONOMIC GROUP AGE SEX	SPOKEN or WRITTEN WORDS	The answer to: WHY do you want, need this product?	The answer to: WHAT is or will it be used for?	The answer to: WHO uses or will use it?	The answer to: WHEN do or will customers use it?	The answer to: WHERE do or will customers use it?	The answer to: HOW is or will the product be used?
1							
2							
3							
4							
5							

Figure 10.2 Gathering the voice of the customer and interpreting it into customer needs
Source: Ferguson and Dale 2007:389

Customer priorities and competitive comparisons and planned improvements

This is the key to prioritization and decision-making on critical design features, which will be a common thread throughout all the stages of the QFD process. The columns to the right in Figure 10.1 are used in the following way.

1 *Degree of importance*. Information gathered during customer surveys together with team knowledge is the key for grading each 'need' on a scale of 1 to 5, with 5 being the most important.

2 *Our company rating*. Listed here is an objective view of the company's standing against each customer need from the perception of the customer on a scale of 5 to 1, with 5 being very good and 1 being poor. As much information as can be obtained from impartial sources should be used in this analysis.

3&4 *Competitors' rating*. Similar sources as used in 2 will obtain this information for the major competitors. Benchmarking should be used to supplement the information acquired in this way.

5 *Planned level*. This is the company's strategy for the new or modified product, influenced by competitive issues and strategic policy objectives.

6 *Improvement ratio*. This is obtained by dividing the planned level by the company rating.

7 *Sales point*. A maximum of 1.5 is given for a strong marketing feature down to 1.0 for the expected features. Only two or three such points should feature in this analysis. It is in this analysis that 'excitement' qualities are taken into consideration.

8 *Importance weight*. The result of multiplying the degree of importance by the improvement ratio and by the sales point.

9 *Relative weight*. This figure is obtained by taking each importance weight as a percentage of all the weights.

Design features or requirements

This is a very challenging step for engineers. The key is to look for characteristics, features and technical requirements that express the customers' needs and are recognizable as quality features of the product, rather than finite design specifications. This assists in examining the best option for a number of criteria.

The central relationship matrix: the whats vs. the hows

The centre block of the house of quality shown in Figure 10.1 represents the relationship strength of each customer need with every design feature. The solid circle symbol represents a strong relationship, the open circle a medium relationship, and the triangle a weak relationship. These relationships are usually equated to numbers 9, 3, and 1 respectively. The difference between them represents a means of emphasizing a design feature that is very important over one that is less so.

If there is no relationship between a customer need and a design feature, this will be highlighted by an empty row, indicating that the need will not be satisfied. On the other hand, if there is no relationship between a design feature and a customer need, it will result in an empty column, indicating that the design feature is not necessarily required from a customer perspective.

Relative weights of importance

This calculation indicates the strength of each design feature required in relation to other design features, and the priority from the customer's perspective of the need that created the design feature. To achieve these two parts the weight of importance of each design feature is the multiplication of the relative weight of the customer need and the particular relationship that has been designated in the central matrix. For example, from Figure 10.1 'Quick to turn on' is 6.7 in customer relative weight, satisfied by one of the design features 'On/off response time'. The relationship between them is strong (9). Thus $9 \times 6.7 = 60.3$ is one component part of the importance weight of the 'On/off response time' design feature.

Design feature interactions: the hows vs. the hows

Each design feature needs reconciling with other design features. This is recorded in the roof of the house of quality. Its purpose is to relate the interactions to the proposed target values of design features. A positive relationship is an opportunity to reduce a value that may help to reconcile an interacting negative relationship. Negative relationships require determined design alternatives to weaken the relationship, as they are potential sources of conflict and quality assurance problems.

Target values

Each design feature should have a target value assigned to it in order to act as a benchmark in the choice of design concepts at a later stage in the process. The target value will normally be best in class and one that will satisfy the customer to the point of delight. The values are not design specifications and could well be enhanced as the QFD process proceeds. They will certainly be equal to or better than any competitively benchmarked design. These target values may be modified in the light of the information contained in the roof of the house. The reconciliation between relationships is helped by declaring the feature that is a constraint and adjusting the other value according to its ideal value.

Technical comparisons

Technical comparisons are made with the design features, both from the company's existing product range and also those competitive ranges which are under investigation.

The comparisons may be made on some form of quantitative scale or on a 'same', 'better', and 'not so good' basis. Reference will be made to competitive designs where the feature has a higher assessment, and if this cannot be bettered it should be adopted. The customer's evaluation of the company's product and that of its competitors should also be considered. In theory, the engineer's technical evaluation and the customer's evaluation should agree. If this is not the case then the target value chosen is not perceived as the best one.

Service information and special requirements

Service information affecting design features from warranty, complaints, field failures, defect records, internal quality costs, and product performance is recorded. The purpose of this is to ensure that concepts and design work later in the process will eliminate these faults. Safety items, special regulatory items, and environmental issues affecting any design feature are also recorded. The purpose of this is that any concept or product definition must be seen to satisfy these requirements.

Implementation of QFD

The following are key steps in the effective implementation of QFD:

- Management issues
  - The process must be driven by senior management.
  - Appropriate resources and the provision of training need to be allocated and auctioned by management.
  - Appoint a steering committee and a QFD champion.
  - Use of a project management system to act as a communication vehicle.
- Project issues
  - Select the first project with a limited time frame and a good chance of an early success.
  - Establish a time frame for the project at the outset and keep to it.

  - Have a clear project definition and objectives and always have them in view; it is also important to identify any project limitations and operating constraints. This helps to create a focus on what is being done.
  - Develop a clear market definition and business model.
  - Provide a glossary of terms used in the QFD process.
- The QFD team
  - Train as a team using as many as company-specific examples as possible.
  - Establish a core team, which is multidisciplinary, of between five and seven people.
  - Hold short, regular team meetings.
  - Do detailed work outside the meeting and use the meeting for analysis and decision-making. It is important that each member of the team is prepared to make a significant time commitment to the project.
  - One of the cornerstones of QFD is the customer's voice – it is best for all the team to be part of the data-collection process which is involved in listening to that voice.
  - It takes longer, but consensus decisions generally work best.
  - Team energy can be created by paying attention to direction, structure, project management, human issues.
- Methods of working
  - Do as much concurrent work as possible (e.g. competitive benchmarking with existing product and process designs).
  - Create a planning matrix of customer needs to decide what should go into a house of quality; some items will be better achieved by traditional means.
  - Keep a realistic perspective on the detail entered about customer needs. Focus on the important, the difficult, and the new.
  - Try and ensure that the house of quality is kept to within an approximately 30×30 matrix.
  - Use the customer's voice and benchmarks as major decision-makers to achieve best in class.

Summary of QFD

The QFD process provides a powerful structure for product and process development. When it is used in an effective manner it can bring a correct customer focus to designs that will perform to a high degree of satisfaction with reliability and cost-worthiness. It shortens the development cycle for the design and results in fewer engineering changes. In this way the product/service which the customer receives not only meets their needs but also, if the customer interface has been done correctly, there can be unexpected product features which will cause delight and product loyalty. There will also be a common thread through all operations which is traceable back to what the customer really wants.

Design of Experiments

With thanks to I. Ferguson and B. G. Dale (2007)

The design of experiments is a series of techniques that involve the identification and control of parameters which have a potential impact on the performance and reliability of a product design and/or the output of a process, with the objective of optimizing product design, process design and process operation, and limiting the influence of noise factors. The methodology is used to analyse the significance of effects on system outputs of different values of design parameters. The objective is to optimize the values of these design parameters to make the performance of the system immune to variation. The concept can be applied to the design of new products and processes or to the redesign of existing ones, in order to:

- Optimize product design, process design and process operation.
- Achieve minimum variation of best system performance.
- Achieve reproducibility of best system performance in manufacture and use.
- Improve the productivity of design engineering activity.
- Evaluate the statistical significance of the effect of any controlling factor on the outputs.
- Reduce costs.

There are several methodologies of experiments such as the trial and error, the full factorial, the fractional factorial and the Taguchi method. In this section only an overview of the Taguchi technique is provided.

Taguchi: An Overview of his Approach

Design of experiments historically required a great deal of statistical knowledge and understanding, which most industrial users of experiments found somewhat intimidating. Over the years much effort has been devoted to simplifying the task of experimentation. In the late 1970s, the work of Genichi Taguchi on experimental design made what is regarded by many as a major breakthrough in its application. Dr Taguchi was a statistician and electrical engineer who was involved in rebuilding the Japanese telephone system, and has been involved in applying design of experiments in the Japanese electronics industry for over 30 years. Since the 1980s, Taguchi (1986) has been an acknowledged worldwide consultant in his methodology. He promotes three distinct stages of designing in quality:

- *System design*: the basic configuration of the system is developed. This involves the selection of parts and materials and the use of feasibility studies and prototyping. In system design technical knowledge and scientific skills are paramount.

- *Parameter design*: the numerical values for the system variables (product and process parameters – termed factors) are chosen so that the system performs well, no matter what disturbances or noises (i.e. uncontrollable variables) are encountered by the system (i.e. robustness). The objective is to identify optimum levels for these control factors so that the product and/or process is least sensitive to the effect of changes in noise factors. The experimentation pinpoints this best combination of product/process parameter levels. The emphasis in parameter design is on using low-cost materials and processes in the production of the system; it is a key stage of designing in quality.
- *Tolerance design*: the third stage in the design process, not to be confused with 'tolerancing'. The tolerance design process uses experimental design to investigate the effect on the variance of the output characteristic of:
  - Product design: choosing the upper specification limit (USL) and lower specification limit (LSL) around the nominals of key design parameters that have been prescribed by the parameter design study. Having done this, reconciling the choice of limits of the factors in the design that are predicted to cause most variation, with, typically, the cost of reducing the tolerance gap, or the choice of more expensive materials.
  - Process design: choosing the USL and LSL around the nominals of key process factors that have been prescribed by the parameter design study. Having done this, reconciling the choice of limits of the factors in the process that are predicted to cause most variation, with, typically, the cost of reducing the tolerance gap, or the choice of more expensive methods.

Taguchi's approach also addresses the following:

- Determining the quality level, as expressed in his loss function concept.
- Improving the quality level in a cost-effective manner by parameter and tolerance design.
- Monitoring the quality level using SPC. A feedback/feed-forward closed-loop system is also recommended.

Taguchi's methods (i.e. engineering, experimental design and data analysis) have proven successful both in Japan and the West, and those organizations which have adopted his methods have succeeded in making continuous improvement. There is little doubt that his work has led to increased interest by engineers in a variety of approaches and methodologies relating to design of experiments. He has provided a technique to analyse the effects of control factors on variability with respect to noise. However, it should not be overlooked that a number of other people have made significant improvements with the other approaches to experimental design.

Steps in Experimental Design

Based on Ferguson (1995) the key steps in designing and running a fractional factorial experiment are outlined in brief below.

Step 1: Define the project objectives.
Step 2: Select critical characteristics.
Step 3: Determine the issues that affect the critical characteristics.
Step 4: Identify control factors and noise factors.
Step 5: Select the control factors to be optimized during the experiment.
Step 6: Choose the orthogonal array and assign factors to columns in the array.
Step 7: Choose the levels of the control factors.
Step 8: Choose sample size.
Step 9: Organize the experiment and carry it out.
Step 10: Analyse the data.
Step 11: Predicting the result of the confirmation run.
Step 12: Interprete the confirmation run and decide if the project is finished.

Summary of DoE

Experimental design using a variety of matrices which suit different conditions is a key technique for understanding the effect of each controllable factor, be it a product or a process design, in minimizing variation while centring the output on a target value. It is a major technique in investigating quality problems. Statistical design of experiments is a complex subject, but it is possible to develop 'easy-to-use' methods.

Failure Mode and Effects Analysis

With thanks to J. R. Aldridge and B. G. Dale (2007)

This section provides an overview of the concept of failure mode and effects analysis (FMEA), and its value as a planning tool to assist with building quality into an organization's product, service and processes (Dale and Shaw 1990a).

The technique of FMEA was developed around 1962 in the aerospace and defense industries as a method of reliability analysis, risk analysis and risk management. It is a systematic and analytical quality planning tool for identifying, at the product, service and process design and development stages, what might potentially go wrong, either with a product (during manufacture, or during end-use by the customer), or with the provision of a service, thereby aiding fault diagnosis.

The use of FMEA is a powerful aid to advanced quality planning of new products and services, and can be applied to a wide range of problems which may occur in any system or process. Its effective use should lead to a reduction in:

- Defects during the production of initial samples and in volume production
- Customer complaints
- Failures in the field
- Performance-related deficiencies (these are less likely if a detailed development plan is generated from the design FMEA)
- Warranty claims
- Safety concerns.

In addition, there will be improved customer satisfaction and confidence as products and services are produced from robust and reliable production and delivery methods. It also has relevance in the case of product liability.

What is Failure Mode and Effects Analysis?

There are two categories of FMEA: design and process. A design FMEA assesses what could, if not corrected, go wrong with the product in service and during manufacture as a consequence of a weakness in the design. Design FMEA also assists in the identification or confirmation of critical characteristics. On the other hand, process FMEA is mainly concerned with the reasons for potential failure during manufacture and in service as a result of non-compliance with the original design intent, or failure to achieve the design specification.

The procedure involved in the development of FMEA examines ways in which a product service or process can fail and is known as progressive iteration. In brief, it involves the following steps:

- The function of the product, service and/or process is agreed, along with suitable identifications.
- Potential failure modes are identified.
- The effects of each potential failure are assessed and summarized.
- The causes of potential failure are examined.
- Current controls for the detection of the failure mode are identified and reviewed.
- A Risk Priority Number (RPN) is determined; the details are provided below.
- The corrective action which is to be taken to help eliminate potential concerns is decided.
- The potential failure modes in descending order of RPN are the focus for improvement action to reduce/eliminate the risk of failure occurring.
- The recommendations, corrective actions and counter-measures which have been put into place are monitored and reviewed for effectiveness.

The RPN comprises an assessment of occurrence, detection and severity of ranking and is the multiplication of the three rankings:

- The *occurrence* is the likelihood of a specific cause which will result in the identified failure mode, and is based on perceived or (in the case of process capability) estimated probability. It is ranked on a scale of 1–10.
- The *detection* criterion relates, in the case of a design FMEA, to the likelihood of the design verification programme pinpointing a potential failure mode before it reaches the customer; a ranking of 1–10 is again used. In the process FMEA, the detection criterion relates to the existing control plan.
- The *severity of effect*, on a scale of 1–10, indicates the likelihood of the customer noticing any difference in the functionality of the product or service.

The resulting RPN should always be checked against past experience of similar products, services and situations.

The requisite information and actions are recorded on a standard format in the appropriate columns. An example of a process FMEA from Allied Signal Automotive is shown in Figure 10.3. The FMEA is a live document and should always be modified in the light of new information or changes.

From the design FMEA, the potential causes of failure should be studied and actions taken before designs and drawings are finalized. When used in the proper manner, FMEA prevents potential failures occurring in the manufacturing, production and/or delivery processes or end product in use, and will ensure that processes, products and services are more robust and reliable. It is a powerful technique and a number of well-publicized product recall campaigns could conceivably be avoided by the effective use of FMEA. However, it is important that FMEA is seen not just as a catalogue of potential failures, but also as a means for pursuing continuous improvement. Nor should it be viewed as a paperwork exercise carried out to retain business, as this will limit its usefulness. The concept, procedures and logic involved with FMEA are not new: every forward-thinking design, planning and production engineer and technical specialist carries out, in an informal manner, various aspects of FMEA. In fact, most of us in our daily routines will subconsciously use a simple informal FMEA. However, this mental analysis is rarely committed to paper in a format which can be evaluated by others and discussed as the basis for a corrective action plan. What FMEA does is to provide a planned systematic method of capturing and documenting this knowledge. It also forces people to use a disciplined approach, and is a vehicle for obtaining collective knowledge and experience through a team activity.

A pilot study carried out at Girobank within the data capture services of the headquarters operations directorate has confirmed that FMEA is of benefit in paper processing-type activities. The technique has since been incorporated into an interdepartmental improvement project to address sub-process improvement relating to a particular stream of work. One of the main benefits of process FMEA is that it has helped to address the complex internal customer–supplier

Process Function / Requirements	Potential Failure Mode	Potential Effect(s) of Failure	Sev	Class	Potential Cause(s)/ Mechanism(s) of Failure	Occur	Current Process Controls	Detect	R.P.N.	Recommended Action(s)	Responsibility & Target Completion Date	Action Results				
												Actions Taken	Sev	Occ	Det	R.P.N.
Kit parts to the Assembly line	Incorrect parts used on build	Turbo failure	7		Wrong parts presented to the line at change over	2	Visual check by setter to the shop Packet. Introduced from the bulk issue area set up on the line Marking of the part number on the 'A' surface on Compressors to ID. Marking of the part number on the Turbine flange.	3	42							
Kit parts to the Assembly line	Contaminated parts	Turbo failure	7		Contaminated parts due to lack of cleanliness of holding containers, Organic material in spacer (GT)	2	Visual check, work instructions by Station describing method of Assembly.	7	98	Introduce cleaning process for all the boxes, which the parts are presented to the line. Euroboxes 300mm × 200mm, 400mm × 300mm & 600mm × 250mm	LM, DN, PE, BW, mid December 1997	Quotes collected, Capital approval sanctioned Delivery 12 December 1997	7	2	3	42
Check cross over holes	Cross over hole not drilled	No oil flow Turbo failure	8		Broken drill, missed operation	5	Air Gauge on assembly 100% prior to build; work instructions by Station describing method of Assembly.	3	120	New poka yoked fixture provided for an 'in process' end of line check. Will pressure test the Centre Housing and check that the cross over hole is present. If OK a letter 'T' will be stamped.	PC, DC, MB Oct 1997	New end of line test fixture, pressure tests CH and checks for Cross over hole, being debugged at supplier to be on stream 1st Dec 1997	8	2	3	48
Affix label to Center Housing	Wrongly orientated to Customer requirements or on Wrong side of Center Housing	Unable to read the customer no on the engine, reject unit which customer will have to adjust label to correct orientation and record ppm	5		Process controlled by the operator and is capable of producing defects	4	100% Visual check by operators; work instructions by Station describing method of Assembly.	5	100	Design new fixture to mistake proof, by Interlocking the fixture to prevent Assembly. Will prevent the Stick Screws from being supplied with air on the detection of incorrect label orientation.	LM, AM, FW, 15 November 1997	Design and detail drawings being modified to suit CH with Backplate assembled	5	2	3	30
Affix label to Center Housing or Compressor Hsg	Incorrect data on label	Customer Dissatisfaction Could use the wrong turbo	7		Wrong input	2	Software provides for a checksum so that the data has to be inputted twice to verify; work instructions by Station describing method of Assembly.	5	70							
Affix label to Center Housing or Compressor Hsg	Label not properly affixed	Label will fall off	5		Hole oversize from machining, stripped thread	4	100% Visual check by operators when recording the Serial Number on audit sheet; work instructions by Station describing method of Assembly.	3	60							
Affix label to Center Housing or Compressor Hsg	Label Missing	Unable to ID unit	5		Operation carried out incorrectly	4	100% Visual check by operators Serial Number recorded on audit sheet; work instructions by Station describing method of Assembly.	2	40							

Figure 10.3 Potential failure mode and effects analysis (process FMEA)

Source: Dale and Shaw (2007:428)

relationship while improving sub-process procedures. The application of process FMEA is considered by the bank as a valuable improvement tool and will be developed alongside other such tools with Girobank's ongoing training initiatives (see Gosling et al. 1992).

Development of a Design FMEA

For a design FMEA the potential failure mode may be caused, for example, by an incorrect material choice, part geometry, or inappropriate dimensional specification.

The procedure then identifies the effects of each potential failure mode, examines the causes of potential failure and reviews current controls for the design FMEA, which usually include some form of design verification programme. In the case of a turbocharger this includes items such as material pull tests, heat-cycling tests of components subject to high temperatures, life cycle fatigue tests to failure, static engine testing, and dynamic engine testing on development vehicles. With regard to the latter, these tests are often carried out by the customers as part of their overall engine/vehicle evaluation programme. Past experience on similar products is often used to verify the validity of certain component parts for a design.

The occurrence for a design FMEA is an estimate, on a scale of 1–10, of the potential failure occurring at the hands of the customer, a ranking of 1 indicating that the failure is unlikely (typifying a possible failure rate of <1 in a million), and a ranking of 10 indicating an almost inevitable failure (typically 1 in 2).

The detection criterion rests on the likelihood of a current design verification programme highlighting a potential failure mode before it reaches the customer. A ranking of 1 indicates almost certain detection, and a ranking of 10 indicates that the current controls are very unlikely to detect the failure mode before dispatch to the customer.

The severity-of-effect ranking is again on a 1–10 basis. A ranking of 1 indicates that the customer is unlikely to notice any real effect, in the case of a vehicle, on performance or the performance of the sub-system. A ranking of 10 implies that a potential failure mode could affect safe vehicle operation and/or non-compliance with government regulations. A severity ranking cannot be altered by any means other than by redesign of a component or assembly; it is a fixed feature. Clearly serious implications exist under product liability legislation for high-severity rankings and these high rankings must be addressed as a matter of urgency.

The activity following the evaluation of current controls is the determination of the RPN.

Development of a Process FMEA

In the case of a process FMEA the potential failure mode may be caused by, for example, the operator assembling the part incorrectly, or by variation in the performance of the equipment or data entered incorrectly into a system by an operator.

The procedure then, as in the case of a design FMEA, identifies the effects of each potential failure mode, examines the causes of the potential failure mode, and reviews the current controls. For a process FMEA the current controls might be operator-performed inspection or SPC information on the capability of the process. The occurrence for a process FMEA is again based on a 1–10 scale, with a ranking of 1 indicating that a failure in the manufacturing process is almost certain not to occur. This is based on past experience of a similar process, both within the factory and in the field with the customer, typically identified by a high process capability value. Conversely, a ranking of 10 indicates that the failure is almost certain to occur and will almost definitely reach the subsequent operation or customer if counter-measures and controls are not put in place. An occurrence ranking of 10 suggests, and indeed demands, that corrective action be undertaken because it highlights a potentially incapable process.

Detection rankings for a process FMEA indicate for a ranking of 1 that the potential failure mode is unlikely to go undetected through the manufacturing process. A ranking of 10 suggests that current manufacturing inspection controls and procedures are unlikely to detect the potential failure mode in the component or the assembly before it leaves the factory, and that urgent corrective action is required. It is interesting to note that a successive inspection check (e.g. bolt torque conformance) does not result in the detection ranking being markedly reduced; it would still be assigned a ranking of between 7 and 10 since experience indicates that 100 per cent subsequent inspection is only capable of detecting 80 per cent or so of defects. The situation would be assessed differently in the case of automated inspection.

A much better method of detection is to introduce a successive check at a subsequent operation whereby the operator is unable to perform his or her operation unless the previous operation has been correctly executed. This can be achieved by designing fixturing in such a way that it will only accept conforming parts from a previous operation. Another method is to install error-proofing devices at the source.

The criterion for the severity-of-effect ranking is determined in a similar manner to that for a design FMEA.

The activity following the evaluation of current controls for a process FMEA is again the determination of the RPN.

Analysis of Failure Data

To apply FMEA effectively it is necessary to obtain some real figures for the calculation of the RPN, in particular for internal and external failure rates. These can then be used for compilation of the occurrence ranking. This was achieved at the plant by analysing and summarizing external failure and internal reject data.

External failure data are collated using computer aids by field service engineers. The data are obtained from visits to customers to review units which have failed, the disposition of which is determined (i.e. whether the failure liability is due to the plant or the customer or if, in some cases, there is in fact no fault found). Internal process failure rates are collated weekly by the quality assurance department. The data are obtained from rejection notes attached to non-conforming parts by production and inspection personnel.

It is important to realize that if a process FMEA is being compiled for a new product, for which no internal or external failure rate history is known, then it is acceptable to use judgment on failure rates for a similar product. At the plant an analysis was performed of the external failure rates over a five-year period using a spreadsheet program on a computer. These failure rates were then ranked highest to lowest to identify the highest occurring items. The external data were then compared with the internal failure rate data and comparisons made to identify trends in which external and internal failure rates were correlated. When looking at external failure rates, a degree of caution needs to be exercised. In terms of the company's products, a guarantee is given, from the time a product is sold, to the end-user. It is impractical to consider the previous year of warranty data only, since for many applications, particularly for the commercial diesel business, the completed vehicle may not be put into use for up to 18 months following the date of manufacture. Additionally some customers are relatively slow in requesting visits for claims evaluation. This obviously leads to a distorted overall picture – which makes the five-year evaluation more realistic. Consideration must also be taken of any high-occurrence failures attributable to one cause. Investigation should be undertaken to see if the cause has been eliminated and, if so, then these should be ignored. The emphasis should be placed on identifying consistent patterns of regularly occurring effects of failure. These types of failure are the ones to which corrective action should be applied.

Recommended Actions for Design and Process FMEA

Following the determination of the RPN it is usual to perform a Pareto analysis and address the potential failure modes in order of decreasing RPN. Determining the figure for an acceptable RPN is really a matter of the application of common sense. If 100 is assumed to be the acceptable maximum then this should be checked against past experience. The rule to be applied is to adopt a consistent approach for each of the rankings, and generally it will be found that the high RPNs are as expected. This takes the form of identifying recommended action(s) and assigning personnel to take appropriate improvement measures by a particular date, which should be before scheduled product release to the customer.

Following satisfactory completion of the actions the RPN can be recalculated, and if it is below the agreed acceptable limits then the corrective action can be assumed to be adequate. If this is not the case, then the design or process must be readdressed by appropriate corrective actions.

For a design FMEA the potential failure causes must be studied before drawings are released to production status. In the case of the process FMEA, all the controls and measures to ensure design intent which are carried forward into the final product must be implemented. If this is not done properly then problems relating to identified failure modes will occur during manufacture. In the case of a new process, potential failure modes may be overlooked because of lack of experience. However, if this is discovered at a later date, these must be included in both process and design FMEAs for future consideration.

Summary of FMEA

Finally, a few dos and don'ts are given which may help organizations to avoid some of the difficulties and traps typically encountered in the preparation and use of FMEA.

Do

- Develop a strategy for the use of FMEA.
- Drive the implementation with the full support of senior managers; it is the responsibility of the senior management to see that there is a positive attitude in the organization to FMEA.
- Ensure that all personnel who are to be involved with the FMEA are made aware of the potential benefits arising from the procedure and the necessity for corrective action to be implemented if improvements are to be made.
- Try to ensure that engineers feel that FMEAs are an important part of their job.
- Make FMEA meetings short but regular throughout the early stages of the product life cycle.
- Consider producing FMEA for product families, material categories, main assemblies and process routes (i.e. generic FMEA) rather than for each component.
- Put into place a procedure for review/update of the FMEA; it should always be treated as a living document.

Don't

- Overlook the benefits of involving customers and suppliers in the preparation of FMEA.
- Start the FMEA process when the design has reached an almost fixed state, when changes will be that much harder to effect.
- Allow the preparation of FMEA to be carried out in isolation by one individual.

- Allow important failure modes to be dismissed lightly with comments such as, 'we've always done it like this', or 'that will involve a considerable investment to change', without considering the feasibility and cost of the change.
- Use the technique as just window dressing for the customer. There is little difference in the effort made when using FMEA in this way from that required when using it in the correct manner.

Statistical Process Control

With thanks to B. G. Dale and P. Shaw (2007)

Introduction

Statistical process control (SPC) is not a new concept; its roots can be traced back to the work of Shewhart (1931) at Bell Laboratories in 1923. The control charts in use today for monitoring processes are little different from those developed by Shewhart for distinguishing between controlled and uncontrolled variation.

Today, in the West, there is considerable interest in quality and how it might be improved effectively and economically. It is the pursuit of quality improvement that has promoted the revitalized interest in SPC.

The aim of this section is to give an overview of SPC and its concepts, both statistical and philosophical, to examine the issues involved with implementation, and to illustrate some typical problems encountered in the introduction and application of SPC. For more detailed studies see Dale and Shaw (1989, 1990b and 1991) and Dale et al. (1990).

What is Statistical Process Control?

Statistical process control is generally accepted as a means to control the process through the use of statistics or statistical methods.

There are four main uses of SPC:

- To achieve process stability.
- To provide guidance and understanding on how the process may be improved by the reduction of variation and to keep it reduced.
- To assess the performance of a process.
- To provide information to assist with management decision-making.

SPC is about control, capability and improvement, but only if used correctly and in a working environment that is conducive to the pursuit of continuous improvement, with the full involvement of every company employee. It is the responsibility of the senior management team to create these conditions, and they must be prime motivators in the promotion of this goal and provide the necessary support to all those engaged in this activity.

It should be recognized at the outset that on its own SPC will not solve problems; the control charts only record the 'voice of the process' and SPC may, at a basic level, simply confirm the presence of a problem. There are many tools and techniques which guide and support improvement and, in many instances, they may have to be used prior to the application of SPC, and concurrently with it to facilitate analysis and improvement.

The application of SPC can potentially be extensive. It is not simply for use in high-volume 'metal cutting'; it can be used in most manufacturing areas, industrial or processing, and in non-manufacturing situations, including service and commerce.

The Development of Statistical Process Control

When first evolved, the control chart, using data that provided a good overall picture of the process under review, had control limits set out from the process average, which reflected the inherent variation of the process. This variation was established from an accurate review or study, and consequently the limits were deemed to reflect the actual 'capability' of the process. The charts so constructed were actually called 'charts for controlling the process within its known capability'. As the word 'capability' has in the last decade been taken to mean something slightly different, the charts tend now to be called 'performance-based' charts (i.e. to control the process within its known performance).

When this idea was discussed with potential users, the question was asked, 'But what if the control limits are outside the specification limits?' This resulted in the development of a chart where the control limits were set in from the specification limits. The distance these limits are set in is a function of the inherent variation in the process. Those processes with greater variation will have limits which are set in further from the specification limits than those with less variation.

If an organization's quality objective is to produce parts or services to specification, the so-called tolerance-based chart may prove useful, and signals are given to alert operational personnel to the likelihood of producing out-of-specification products. This type of chart does not encourage the pursuit of improvement in process performance.

Using the performance-based charts with limits which reflect the inherent variation of the process and having some statistical estimate of this variation, the objective is to establish its source(s), perhaps using experimental design tools and appropriate tools and techniques, and strive to reduce it on a continuous improvement basis. The consequence of this is that control limits should, over time, reduce, reflecting the reduction in process variation and thereby demonstrating an organization's commitment to continuous improvement. This reduction in variation is confirmed by increased values or measures of process capability.

If an organization is not using SPC in this manner, management needs to critically evaluate their use of SPC.

Variation and Process Improvement

Products manufactured under the same conditions and to the same specification are seldom identical; they will most certainly vary in some respect. The variation, which may be large or almost immeasurably small, comes from the main constituents of a process – machine, manpower, method, material, and Mother Nature. The measuring system itself may also give rise to variation in the recorded measurement; this is why repeatability and reproducibility studies are so important.

- *Repeatability* is the closeness between results of successive measurements of the same characteristics carried out under the same conditions.
- *Reproducibility* is the closeness between the results of measurement of the same characteristic carried out under changed conditions of measurement.

An important means of improvement is the reduction of variation. SPC is a very useful technique because, given the capability of the measuring system, it ascertains the extent of the variation and whether it is due to special or common causes of variation, process improvement being achieved by removal of either or both causes. It should be stressed that while SPC, if properly used, will give an indication of the magnitude of the variation, it will not give the source. The efforts of management, technical, engineering, and management services and site service activities should be directed at establishing the likely source or sources of variation and, more importantly, reducing them continuously.

The first step in the use of SPC is to collect data to a plan and plot the gathered data on a graph called a control chart, as shown in Figure 10.4. Once the process is rendered stable by the identification and rectification of special causes of variation, its process capability can be assessed. The next task is to reduce, as much as possible, the common causes of variation so that the output from the process is centred around a nominal or target value. This is a continuing process in the pursuit of continuous improvement. It is not the natural state of a process to be in statistical control, and a great deal of effort is required to achieve this status and a great deal more to keep it so. The amount of this effort and its focus is a function of senior management within their overall remit.

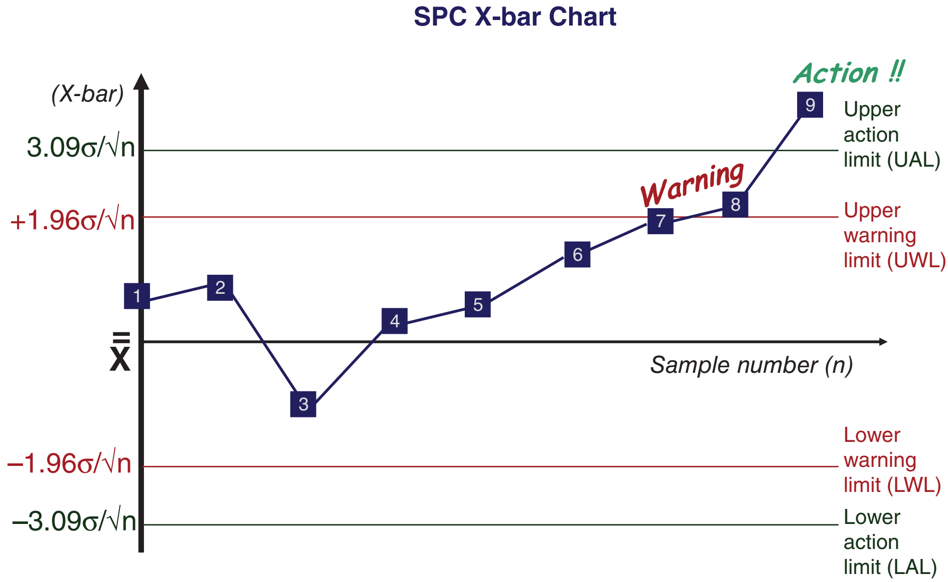

Figure 10.4 Sample SPC chart

What are special and common causes of variation?

Special (or *assignable*) *causes* of variation influence some or all the measurements in different ways. They occur intermittently in the form of shocks and disturbances to the system and reveal themselves as unusual patterns of variation on a control chart. Special causes should be identified and rectified and hopefully, with improved process or even product design, their occurrence will in the long term be minimized. In the short term, their presence should be highlighted and a response programme established to deal with them. It is imperative in the management and control of processes to record not only the occurrence of such causes, but any remedial action that has been taken, together with any changes that may occur or have been made in the process. This provides a valuable source of information in the form of a 'process log', to prevent the repetition of mistakes and enable the development of improved processes. Typical special causes may be:

- Change in raw material
- Change in machine setting
- Broken tool or die or pattern
- Failure to clean equipment
- Equipment malfunction
- Keying in incorrect data.

Common (or *unassignable*) *causes* influence all measurements in the same way. They produce the natural or random pattern of variation observed in data when they are free of special causes. Common causes arise from many sources and do not reveal themselves as unique patterns of variation; consequently, they are often difficult to identify. If only common cause variation is present, the process is considered to be stable, hence predictable. Typical common causes may be:

- Badly maintained machines
- Poor lighting
- Poor workstation layout
- Poor instructions
- Poor supervision
- Materials and equipment not suited to the requirements.

In the pursuit of process improvement it is important that a distinction is made between special and common cause sources of variation because their removal may call for different types and levels of resources and improvement action. Special causes can usually be corrected by operational personnel – the operator and/or first-line supervisor. Common causes require the attention of management, engineering, technical, management services, or site services personnel. Teams made up of relevant personnel are often set up to eliminate special and common causes of variation. Operational personnel often have a considerable knowledge of process parameters and they should be included in such teams.

Process Capability

The capability of a process is defined as three standard deviations on either side of the process average when the process is normally distributed. The C_p index is found as the result of comparing the perceived spread of the process with the appropriate specification width or tolerance band.

$$C_p = \frac{\text{total specified tolerance}}{\text{process spread}}$$

Today, customers are specifying to their suppliers minimum requirements for C_p; for example:

$C_p \geq 1.33$
$C_p \geq 1.67$
$C_p \geq 2.00$

In simple terms this means that all parts should lie comfortably inside the specification limits.

Given that the process 'spread' is equal to six standard deviations the following should be noted:

$C_p = 1.33$ implies the tolerance band = 8 standard deviations, i.e. $\frac{8}{6} = 1.33$

$C_p = 1.67$ implies the tolerance band = 10 standard deviations, i.e $\frac{10}{6} = 1.67$

$C_p = 2.00$ implies the tolerance band = 12 standard deviations, i.e. 12 $\frac{12}{6} = 2.00$

It follows that:

1 The specification limits have to be wide – commensurate with excellent physical and functional requirements of the product. *Or*
2 The process variation as determined by the standard deviation has to be small. *Or*
3 Both conditions (1) and (2) apply.

As the C_p index compares the 'spread of the process' with the tolerance band, it is primarily concerned with precision – it takes no account of the accuracy or setting of the process. It is for this reason that C_p is often defined as 'process potential' capability, i.e. what the process is potentially capable of achieving.

The C_{pk} index, however, takes into account both accuracy and precision by incorporating in the calculations, G or x-bar, i.e. the process (or grand) average. There are two formulae:

$$C_{pk} = \frac{\text{USL} - \text{ G or x-bar}}{\text{3 standard deviations}}$$

where USL is the upper specification limit, or:

$$C_{pk} = \frac{\text{G or x-bar} - \text{LSL}}{\text{3 standard deviations}}$$

and LSL is the lower specification limit.

It is customary to quote the smaller of the two values, giving the more critical part of the measurements distribution. Similar minimum requirements are often prescribed for C_{pk} as for C_p mentioned above.

Because C_{pk} indices assess both accuracy and precision, they are often defined as 'process performance capability' measures. That is, the C_{pk} gives an estimate of how the process actually performs (i.e. its capability) whereas the C_p gives an estimate of its potential (i.e. what it could do if the setting was on the nominal or target value of the specification).

In the calculation of both C_p and C_{pk} it is necessary to know or obtain an estimate of the process standard deviation (H). The standard deviation can be estimated by using the formula:

$$H = \frac{F}{d_2}$$

where d_2 is a constant derived from statistical tables and is dependent upon the sample size.

This exploits the relationship between the range and the standard deviation which was mentioned earlier in the chapter.

With reference to this the following points should be noted:

- F is the average within sample variation. There may be present in the process some considerable between sample variation which should be included in H. If this is not investigated, H could be underestimated, hence any C_p or C_{pk} index will be overestimated.
- The indices implicitly assume that the data (measurements) when drawn out as a histogram or frequency distribution curve, give a reasonable approximation to the Normal (or Gaussian) Distribution Curve. While many processes will offer data which comply with this, there are exceptions, and some modifications in the calculations may be necessary.

The comments made on capability relate to data collected over the long term (many days or shifts) from a stable, in-control and predictable process. Often short-term capability needs to be investigated, particularly for new products or processes (it may be required as part of supplier verification programme, i.e. initial sampling requirements or first article inspection). The time scale is then dramatically reduced to cover only a few hours' run of the process.

It is recommended that data are collected in the same manner as for initial control chart study, but the frequency of sampling is increased to get as many samples (of size n) as possible to give a good picture of the process (i.e. about 20 samples of size n). Data are plotted on the control chart with appropriate limits, but the following indices are calculated:

P_p = preliminary process potential

P_{pk} = preliminary process capability

The formula is exactly as for C_p and C_{pk} but the minimum requirements may be higher (e.g. $P_p \geq 1.67$), i.e. 1.67 implies the tolerance band is 10 standard deviations wide and the process 'spread' equals six standard deviations, i.e.

$$\frac{10}{6} = 1.67$$

It should not be forgotten that all capability indices are estimates derived from estimates of the process variation (σ). The reliability or confidence in the estimate of the process standard deviation is a function of:

- The amount of data which have been collected
- The manner in which the data were collected
- The capability of the measuring system (i.e. its accuracy and precision)
- The skill of the people using the measuring system
- People's knowledge and understanding of statistics

Difficulties Experienced in Introducing and Applying SPC

The purpose behind the application of SPC is straightforward – to reduce variation in process output, first by establishing whether or not a process is in a state of statistical control, and secondly, if it is not, getting it under control by eliminating 'special' causes of variation. Finally, SPC may be used to help reduce 'common' causes of variation, as shown in Figure 10.5.

However, a number of organizations do encounter problems in the introduction and application of SPC. According to Dale and Shaw (2007) the top three difficulties in introducing SPC were:

- Lack of knowledge of/expertise in SPC
- Poor understanding and awareness within the company of the purpose of SPC
- Lack of action from senior management.

The three main difficulties in its application were:

- Applying SPC to a particular process
- Resistance to change
- Deciding which characteristic and/or parameter to chart.

When the range of difficulties is studied further (see Dale et al. 2007) it is apparent that they can be categorized under two main headings: management commitment, and having the knowledge and confidence to use SPC successfully.

It is clear that the majority of difficulties are caused by the lack of commitment, awareness, understanding, involvement and leadership of middle and senior managers.

Summary of SPC

SPC, supported by the positive commitment of all employees in an organization within a framework of TQM and strategic process improvement, has proved to

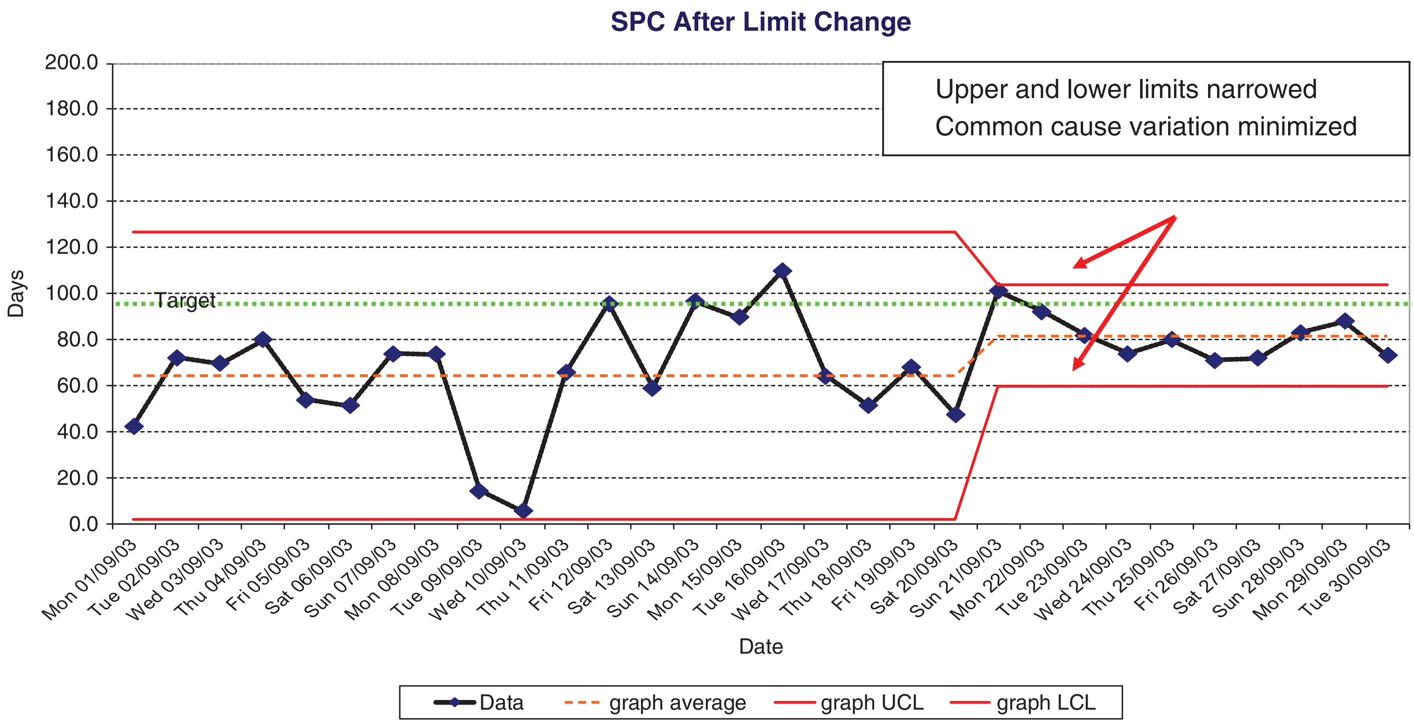

Figure 10.5 SPC Chart after limit change

be a major contribution in the pursuit of excellence. It supports the philosophy that products and services can always be improved. However, it is a technique which, by itself, will do little to improve quality. It is basically a measurement technique and it is only when a mechanism is in place to remove 'special' causes of variation and to squeeze out of the process 'common' causes of variation that an organization will have progressed from simply charting data to using SPC to its fullest potential. Management commitment and leadership and a structured and ongoing training programme correctly used are crucial to the success of SPC.

Benchmarking

With thanks to R. Love and B. G. Dale (2007)

Introduction

From the late 1980s onwards there has been a growth of interest in the subject of benchmarking as part of the culture of continuous improvement. This has been triggered by the success of the improvement methods used by the Xerox Corporation and by the development of the self-assessment methods promoted by the MBNQA and EFQM models for business excellence. Benchmarking as it is known today originated in Rank Xerox. It is now well documented that when Rank Xerox started to evaluate its copying machines against the Japanese competition it was found that the Japanese companies were selling their machines for what it cost Rank Xerox to make them. It was assumed that the Japanese-produced machines were of poor quality, but this proved not to be the case. This exposure of the corporation's vulnerability highlighted the need for change. In simple terms, the aim of benchmarking is to identify practices that can be implemented and adopted to improve company performance.

Benchmarking is an opportunity to learn from the experience of others. It helps to develop an improvement mindset amongst staff, facilitates an understanding of best practices and processes, helps to develop a better understanding of processes, challenges existing practices within the business, assists in setting goals based on fact and provides an educated viewpoint of what needs to be done rather than relying on whim and gut instinct.

Most organizations carry out what can be termed informal benchmarking. This traditional form of benchmarking has been carried out for years, beginning with military leaders. It takes two main forms:

- Visits to other companies to obtain ideas on how to facilitate improvement in one's own organization.
- The collection, in a variety of ways, of data about competitors.

This is often not done in any planned way; it is interesting but limited in its value owing to a lack of structure and clear objectives. This approach is often branded 'industrial tourism'. To make the most effective use of benchmarking and use it as a learning experience as part of a continuous process rather than a one-off exercise, a more formal approach is required.

There are three main types of formal benchmarking:

1 *Internal benchmarking*. This is the easiest and simplest form of benchmarking to conduct and involves benchmarking between businesses or functions within the same group of companies. Many companies commence benchmarking with this form of internal comparison. In this way best internal practice and initiatives are shared across the corporate business.
2 *Competitive benchmarking*. This is a comparison with direct competitors, whether of products, services or processes within a company's market. It is often difficult, if not impossible in some industries, to obtain the data for this form of benchmarking as by the very nature of being a competitor the company is seen as a threat.
3 *Functional/generic benchmarking*. This is comparison of specific processes with 'best in class' in different industries, often considered to be world class in their own right. 'Functional' relates to the functional similarities of organizations, while 'generic' looks at the broader similarities of businesses, usually in disparate operations. With functional benchmarking the partners will usually share common characteristics in the industry, whereas generic benchmarking is not restricted to an industry. It is usually not difficult to obtain access to other organizations to perform this type of benchmarking. Organizations are often keen to swap and share information in a network or partnership arrangement, particularly when no direct threat is presented to a company's business or market share.

There are a number of steps in a formal benchmarking process. They are now briefly described:

- Identify what is the subject to be benchmarked (e.g. the invoicing process), decide who will be in the team, the support they require (e.g. training, project champion) and their roles and responsibilities, reach agreement on the benchmark measures to be used (e.g. number of invoices per day, per person), create a draft project plan and communicate with the required internal parties.
- Identify which companies will be benchmarked from a set of selection criteria defined from the critical success factors of the project. Research potential partners and select the best partner(s).
- Develop a data-collection plan. Agree the most appropriate means of collecting the data, the type of data to be collected, who will be involved and a plan of action to obtain the data (e.g. explore benchmarking databases, identify

contacts in partnering organizations, the questionnaire(s) to be used and the composition, telephone surveys, site visits, etc.).
- Tabulate and analyse data. Determine the reasons for the current gap (positive or negative) in performance between the company and the best amongst the companies involved in the benchmarking exercise.
- Estimate, over an agreed time frame, the change in performance of the company and the benchmark company in order to assess whether the gap is going to grow or decrease, based on the plans and goals of the parties concerned.
- Define and establish the goals to close or increase the gap in performance. This step requires effective communication of the benchmarking exercise.
- Develop action plans to achieve the goals. This step involves gaining acceptance of the plans by all employees likely to be affected by the changes.
- Implement the actions, plans and strategies. This involves effective project planning and management.
- Assess and report the results of the action plans.
- Reassess or recalibrate the benchmark to assess if the actual performance/improvement is meeting that which has been projected. This should be conducted on a regular basis and involves maintaining good links with the benchmarking partners.

This section summarizes the main learning experiences as regards benchmarking from Dale et al. 2007. The '10-step' benchmarking process, as shown in Figure 10.6, provides a good outline for benchmarking teams to follow.

Success Factors

The choice of benchmarking partners is critical in the success and failure of the project, so it is important that due care and attention are paid to the selection. When contacting potential benchmarking partners it is helpful to identify the specific areas of activity and the measurement of success which are to be discussed during the visit. It was found to be important to send out a pack of information to those organizations that, in principle, had agreed to participate in a benchmarking project. The following is typical of the information it needed to include:

- Covering letter including the reason for undertaking the benchmarking project.
- Overview of the organization.
- Details of the process being benchmarked, including key performance indicators (KPIs) and their definitions and descriptions.
- Benchmarking code of conduct to be signed by both parties reaching agreement on this encourages openness and trust between the partners.
- Data-collection plan.

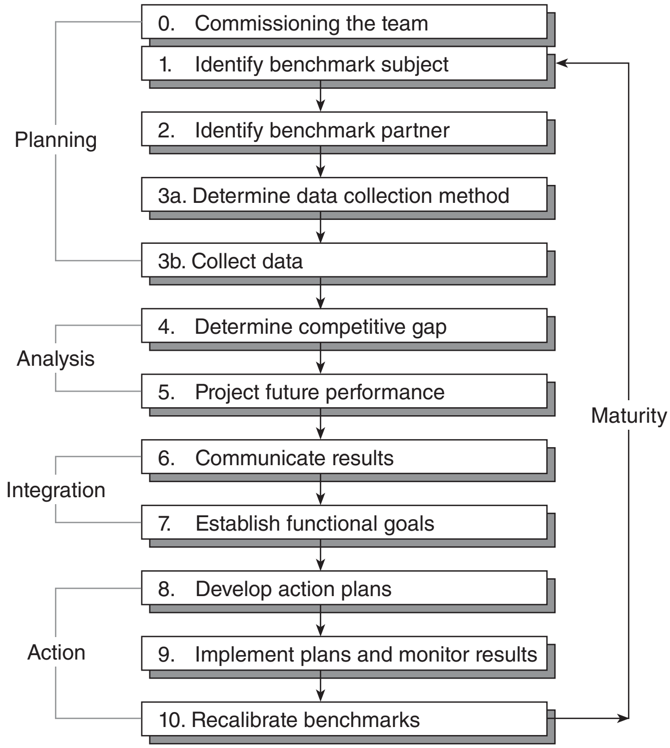

Figure 10.6 The United Utilities benchmarking process
Source: Dale et al. 2007

- Questionnaire seeking data from the benchmarking partner and a completed questionnaire by the benchmarking team reflecting the state of the art of the process being benchmarked.

The benchmarking teams rated and selected their partners on the basis of their critical success factors in terms of what needed to be achieved by the project as well as such aspects as comparable size, structure, geography (where deemed appropriate), reputation with respect to product and service quality and market position and segmentation using a criteria rating form to focus on the critical few. Consideration was also given to their understanding and experience with benchmarking.

The key findings from each benchmarking visit were related to an action plan with respect to what was being/had been implemented. This helped to ensure that the best practices identified were captured and acted upon. In addition, it was found to be important that the analysis identified common threads from the benchmarking visits. Simple graphical displays were used to communicate to all concerned the comparison of the KPI of the process being benchmarked with that of the partners. This assisted with the acceptance of changes that needed to be made, as well as with regular communication of progress, which was built into the project plan after the completion of each phase so that everyone concerned was up to speed before being presented with the project findings.

As benchmarking is about breakthrough improvement and the implementation of best practices, looking within the industry is insufficient as often the 'best' at particular practices are from diverse areas. This is a common problem for very specific benchmarking projects.

It is important to contact the benchmarking partners early. It can be more difficult than expected with respect to the time involved and the issue of identifying the right partner(s). Desk research into the companies being considered as benchmarking partners should be undertaken before making a decision, although this does depend on time constraints and the type of project being tackled. It has been found useful to visit four to five organizations, and to make all the visits within a period of one month. However, as the company is looking for high gains in the long term from benchmarking it is worthwhile taking the time to ensure that the company being benchmarked is suitable for analysis.

After each visit to a benchmarking partner it is important to detail and collate what has been learnt as quickly as possible while the experience is fresh in the team members' minds. It was also found helpful to summarize what the organization was doing better than the benchmark partner in a report format, identifying key points and providing quantitative as well as qualitative data.

Difficulties and Pitfalls

In order for a benchmarking project to be a success there are certain difficulties and pitfalls that must be avoided. Based on the projects undertaken the most common ones are:

- *Unrealistic assumptions.* When planning the actual project realistic assumptions need to be made about the time required to complete the individual steps of the benchmarking project, the resources needed and the commitment of employees, other than the team members. The planning of the project needs to be as pragmatic as possible. It is also important to 'manage' the expectations at senior management level in respect of quick results and instant benefits as well as their role in the benchmarking process.
- *The team members must be free to participate in the project.* The activities associated with the project should not become something else team members do as part of their normal working week as this will hamper progress and may seriously affect time scales, commitment, and eventually the findings of the project.
- *Lack of a contingency plan.* If the project plan is based on a single set of circumstances or conditions, it is extremely vulnerable to changes. It is essential that a

contingency plan be prepared to support the implementation and prepare for any unexpected major changes to the project. This contingency plan must be developed to cope with both favourable and adverse changes. If implementation is broken down into a number of sequential steps, then it must be possible to bring phase 2 forward if phase 1 takes less time than was initially expected, just as phase 2 would be delayed if phase 1 took longer than expected.

- *Failure to update the plan.* Too often the creation of a plan is seen as a means to an end. Instead the plan should be considered as a living document that is based on certain assumptions, such as time, cost, resources and levels of commitment, as well as external factors such as the benchmarking partner's response and the time of year. These assumptions will almost certainly change over the period of a benchmarking project, requiring the plan to be updated in terms of what is required and when. In any reconfiguration of the original project the assumptions should be taken into account and any necessary changes made. For example, if the project is to finish on time more money may have to be spent on resources than was originally estimated to achieve any results of significance.
- *Failure to communicate the plan.* Communication of what has been done, what is currently being done and what is planned is vital to the success of a project. If people are not fully aware of what is expected of them, the type of information which has been gathered about best practice, how the benchmark information is to be used to initiate improvements and the changes that will result from the implementation of best practices found from the benchmarking project, then it is highly likely that the plan will fail. It is also important to consider what needs to be communicated and the detail, as well as how it should be done.
- *Inadequate project definition.* If the benchmarking team is not aware of why it is doing a particular project and its capability to change a process then the project will lack direction and focus, leaving the team unsure of what to measure and what best practices it is looking for.
- *Inadequate process understanding.* When documenting a process which is being benchmarked, it is important that not only the processes should be described but also each process step plus the main practices. When carrying this out, the question 'How do we know this?' should be asked a number of times (i.e. the '5 whys' approach) in order to validate what the team considers to be the process with those who are involved at each step. If this is not done then any conclusions drawn from the benchmarking study may be invalid and a potential danger to the present process.
- *Team members try to do everything themselves.* It is important that the team members do not become insular and try to do everything in relation to the project by themselves. At times they will need to seek the advice and help of individuals who are not directly involved in the benchmarking project. This assistance may be in areas such as data collection, where the data required are already being collected by someone either within a department or externally.

- *The subject area is too large.* Unless the process is within the control of the team and within its comprehension then it is very difficult to both measure, in meaningful terms, what is done and ask the right questions of the benchmarking and business partners (e.g. customers and suppliers).
- *It seems like a good idea to use benchmarking* (i.e. it is the latest fad and fashion). Benchmarking, just like any other quality management technique, when used inappropriately, will not bring the expected benefit to the business. Therefore a balance should be reached between the scope of the problem, the return on investment which is expected and the level of improvement. There is little point in spending considerable time, money and resources on benchmarking a process which will not affect customers in any significant way by bringing breakthrough improvement to business operation.

Summary of Benchmarking

Benchmarking is a technique for the continuous improvement of processes. It is therefore important to ensure that the process of benchmarking is thought of in a similar vein; the objective is the continual improvement of the benchmarking process used for each project by sharing each project's successes, pitfalls, and failures and thereby promoting continuous learning. There is also a need to ensure that benchmarking is incorporated into an organization's culture of continuous improvement. A benchmarking project is likely to generate other additional benchmarking projects within the process studied or with interfacing processes. A project, in addition to the savings generated, is also helpful in promoting understanding of KPIs and measures of quality; in other words, what do we need to have in place to understand what we do, how we do it, why we do it, and how well we do it?

Business Process Re-engineering and Value Stream Mapping

With thanks to J. Macdonald and B. G. Dale (2007)

Introduction

In recent times business process re-engineering (BPR) has emerged as the concept which enables an organization to take a radical and revolutionary look at the way in which it operates and the way work is done, and references to it abound in management and technical publications with such words as 'radical', 'dramatic', 'rethinking', 'optimize', and 'redesign'. It has become popular in a short period of time, promising amazing results very quickly in relation to corporate and technological change, transformation and competitive pressures. The protagonists of BPR argue that it is a concept which enables an organization to make the necessary step changes, introducing originality and improvements to the business which will enable it to leapfrog the competition.

While TQM is based, in general, on continuous improvement in processes over a relatively long period of time, BPR emphasizes structural process redesign, process re-engineering and fundamental rethinking of the business by ignoring the status quo, leading to claims of producing faster returns in a relatively short period of time through its one-step solution to a problem. They are both approaches to improve the performance of a business, but in the authors' view continuous improvement should come first and provide the base for the more radical change and improvements generated by BPR. It should also not be overlooked that TQM also drives breakthrough improvements.

The underlying issues in BPR are not necessarily new, although the language and approach are modern.

There is some confusion as to what constitutes BPR, what it covers, which initiatives it embraces, and its relationship with TQM. This is not helped by the variety of terms (e.g. business process improvement, business process redesign, business process re-engineering, core value-driven process re-engineering, process redesign, business restructuring, new industrial engineering, process simplification and value management) that authors use in their description of BPR, along with the lack of precision with which they use them. However, most of the terms refer to roughly the same type of activity, pointing out that gains in performance can be achieved by taking a holistic and objective view of business processes.

The authors view TQM and BPR as complementary and integral approaches rather than ones that are in opposition to each other. In fact many of the tools and techniques which have been proved and used in continuous improvement are employed in BPR projects, and a number of the principles and practices of BPR are very similar to those which underpin TQM and strategic process improvement.

Our combined practical and research evidence points to the fact that those companies which have been successful in building continuous improvement principles into their business operation in an evolutionary manner have created the solid platform and environment in which to develop the concept of BPR. Those organizations starting with TQM will have a better understanding of processes, which is central to both TQM and BPR. Having learned how to change using the continuous improvement philosophy, they are more ready to deal with the increasingly radical designing of new processes that is demanded by BPR. In general, it has been service industries and public sector organizations that have taken up the theme of BPR rather than manufacturing industry. It would be argued by managers in the former that, without BPR having been undertaken as part of the natural management process of running a business, they would simply not have survived. In general, service industries and the public sector have only relatively recently felt the winds of change.

The aim is to present, in simple terms, what BPR means, its main approaches and methods, techniques employed, and main principles and practices.

Approaches Used in BPR

The two main approaches employed in BPR are process redesign and process re-engineering, and these are examined below. The approaches are based on taking a holistic and objective view of the core processes that are needed to accomplish specific business objectives without being constrained by what already exists (i.e. 'clean slate'). BPR covers a range of activities that result in radical change, to either individual processes or to the total organization. The main differences between the two approaches are that the latter involves greater structural change and risk while the former is quicker and less costly to implement but with potentially fewer benefits and improvements.

Business process redesign

Hammer and Champy (1993) point out that every re-engineering measure usually starts with process redesign. Process redesign can be carried out in many different ways depending on the degree to which the process is to be changed; it usually takes the existing process(es) as the base. It concentrates on those core processes with cross-functional boundaries and is generally customer-focused, with a view to process simplification, streamlining, mistake-proofing the process, efficiency and adaptability. It tends to seek answers to questions such as:

- What is this process doing?
- What are the core competencies?
- What are the key elements?
- What are its key measurables?
- What are the main information flows?
- Is the process necessary?
- Is it adding value?
- Is it producing an output which fully meets customer requirements?
- How can it be improved?
- How can it be done differently?
- Who is the process owner?
- Can it be done by someone less skilled?
- Is the technology employed used to best advantage?
- Can new technology provide new solutions?
- Can activities be integrated?
- Can activities be done in parallel?

It also uses many of the techniques used in a TQM and strategic process improvement initiatives, such as the value stream mapping, and employs modern methods of information technology to best advantage, in particular for integrating process activities.

Business process re-engineering

Process re-engineering or new process design demands more imagination and inductive thinking and radical change than process redesign, with those charged with the implementation of a project encouraged to abandon their belief in the rules, procedures, practices, systems and values that have shaped the current organization. It raises and challenges assumptions such as make or buy decisions, structures, functional responsibilities and tasks, systems and documentation (e.g. supplier payment), elimination of specialist departments, etc. Hammer and Champy (1993) define re-engineering as:

> A fundamental rethink and radical redesign of business processes to achieve dramatic improvements in critical contemporary measures of performance, such as cost, quality, service and speed.

The approach is based on the view that continuous improvement is not sufficient to meet the organizational expectations for business development and change. Business process re-engineering seeks to make major fundamental, radical and dramatic breakthroughs in performance and is holistic in nature. The main focus is to ensure a 'clean slate' or 'greenfield' approach to processes, pinpointing that part of the organization on which to put the emphasis and highlighting the processes which add value. It is, however, not without risks and the demands on resources, time and costs which are associated with the efforts involved in a re-engineering project.

The concept is based on making best use of information technology (IT) in terms of communication and information-handling systems. It harnesses the enablers of technology and the release of the innovative potential of people to achieve breakthrough improvements, requiring a change from functional thinking to process thinking.

The Principles of BPR

The fundamental principles of BPR represent good management practice. Despite the difference in emphasis and terminology used by various authors the principles and values remain relatively common. From publications such as Coulson-Thomas

(1994), Hammer and Champy (1993), Macdonald (1995a, 1995b), and Tinnila (1995) the main principles of BPR can be summarized as follows:

- Strategic in concept
- Customer-focused
- Output- rather than input-focused
- Focused on key business processes
- Process responsibility and decisions at the point where work is performed
- Cross-functional in nature
- Involves internal and external customer–supplier relationships
- Involves senior management commitment and involvement
- Involves networking people and their activities
- Involves integration of people and technical aspects
- Requires clear communication and visibility
- Has a mindset of outrageous improvement
- People at all levels of the organization must be prepared to question the status quo in terms of technology, practices, procedures, approaches, strategies.

Value Stream Mapping

Within a BPR initiative, it is critical to thoroughly understand and visualize the selected process in the first instance, and then to collect its associated performance data, in terms of cycle time, speed, quality and cost (Venkataraman et al. 2014). Hence value stream mapping (VSM) is a cornerstone technique within BPR. VSM builds on process maps and flowcharts to provide fact-based process description for understanding the current problems and thinking about the future states. It is powerful to allow the team to communicate and assess how the process should work and perform once the waste and non-added-value activities have been removed. It is an excellent vehicle for involvement and participation (Bicheno and Holweg 2009).

George et al. (2005) explained that VSM is an elaborated process map encompassing data on WIP, set up time, processing time, error rates, idle time, etc., as well as the information regarding the flows. It is a fundamental technique as part of a Lean, Six Sigma, TQM or BRP approach (Gurumurthy and Kodaly 2011; Abdulmalek and Rajgopal 2006; and Winkel et al. 2015). It is relevant for the team to decide on the appropriate level and on the boundaries of the VSM. A high-level perspective is often recommended at the start in order to depict the major elements and their interactions. Bicheno and Holweg (2009) promote that VSM should consider and analyse the big picture (production, human resources, marketing, finance, engineering, etc.), which will allow to determine a strategic indication of the opportunities. However, a low-level view depicting the specific value-added and non-value-added activities will be essential to generate the breakthrough improvement aimed at. In this logic, it is appropriate to consider the current process first and then the ideal and future state. This should encourage the team to think outside of the constraints and think innovatively by stretching their imagination.

George et al. (2005) provide a 7-step method to create a VSM:

1 Determine the process, product or service
2 Draw the process flow
3 Add the material flow
4 Add the information flow
5 Collect the process data and add them to the VSM
6 Add process and lead time data to the VSM
7 Verify and validate it.

Similarly Bicheno and Holweg (2009) suggested the following cycle to implement a VSM:

1 Organizing the team in synch with the BPR team
2 Pre-mapping the selected processes
3 Developing the basic VSM
4 Collecting the process data and engaging with the different stakeholders
5 Identifying the current state
6 Visualizing the future state
7 Running some simulation and collecting performance data
8 Implementing the changes
9 Reviewing the improvement.

The core application of VSM involves creating a 'Current State' map (see Figure 10.7) then identifying the necessary improvements.

These are agreed and defined; then communicated using a 'Future State' map (See Figure 10.8).

Summary of BPR and VSM

The authors are of the view that BPR is complementary to TQM, rather than being an alternative or in opposition to it. For example, TQM can help to 'hold the gains' achieved through BPR and can create an environment that will help to ensure the success of BPR projects.

BPR is based, in general, on radical and breakthrough change over a relatively short period and TQM is based, in general, on incremental improvement over the longer term and on working within existing framework systems and procedures

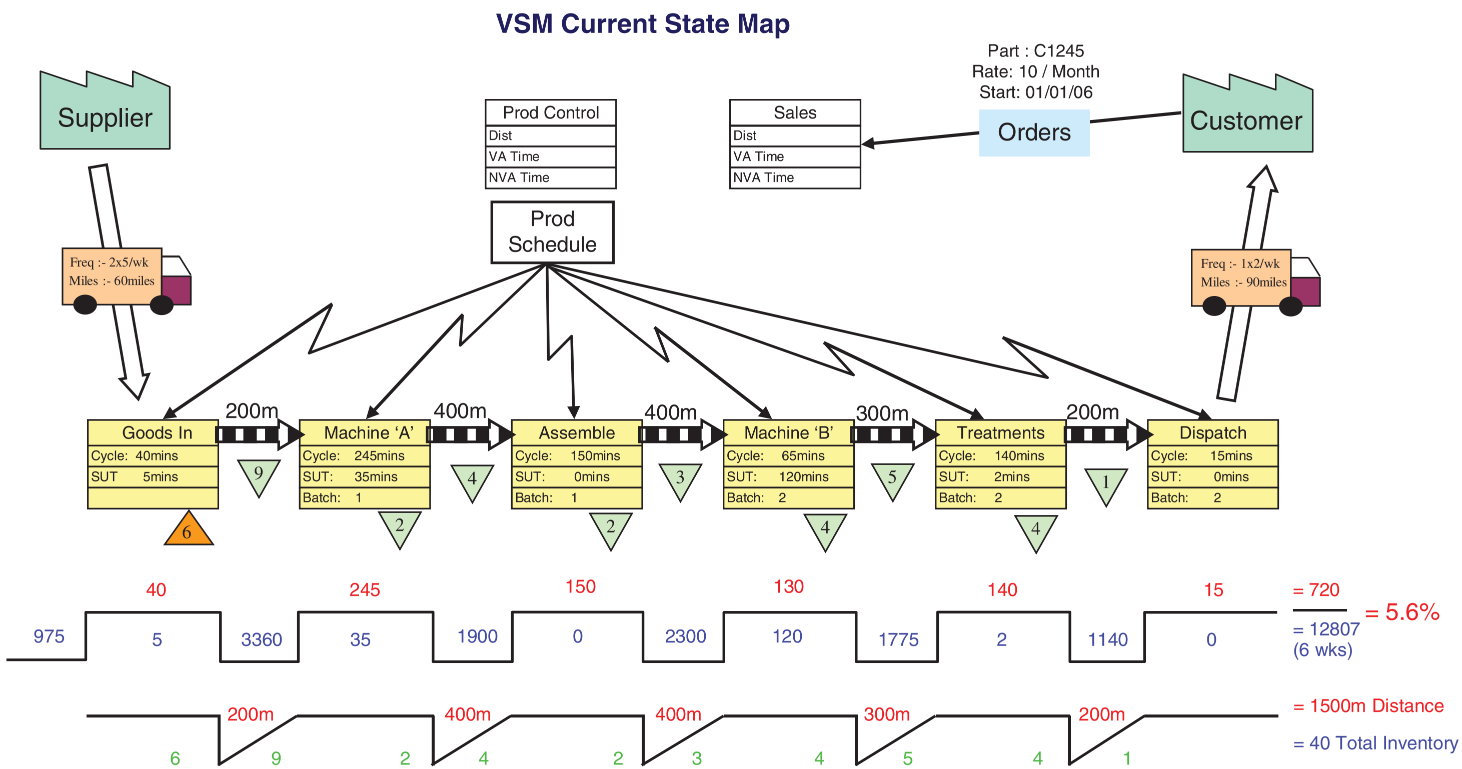

Figure 10.7 VSM current state map

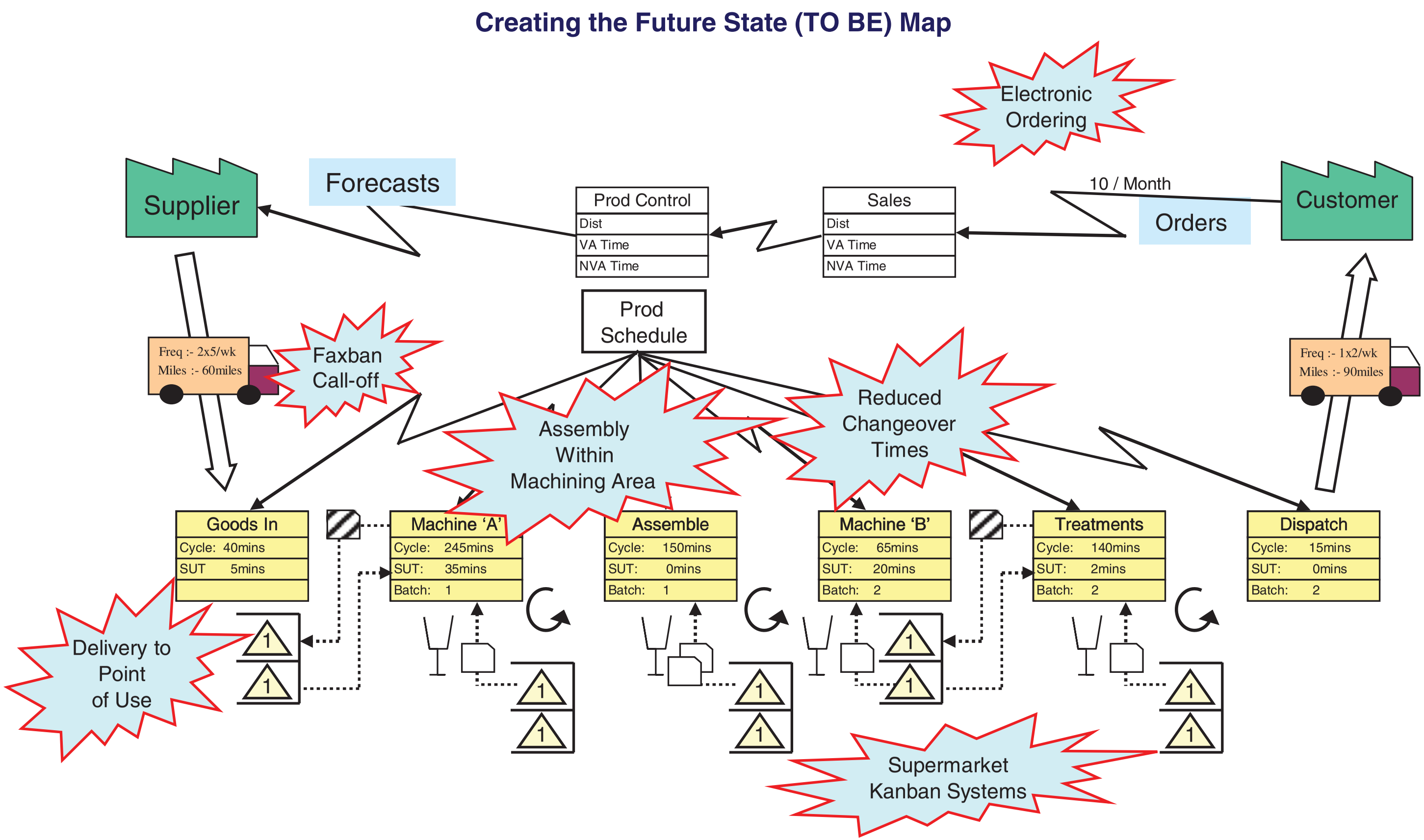

Figure 10.8 VSM future state map

by improving them. In the authors' view, aiming for large step changes makes a project riskier and more complex, and also involves greater expense. Incremental change is safer and costs less. The simplicity of incremental improvement often overshadows the fact that in practice it requires effort and constant application to implement in an effective and efficient manner.

TQM and BPR do share common themes, such as a focus on customers, key processes, eliminating waste, and benchmarking. BPR tends to concentrate on one process at a time using a value stream mapping, whereas TQM takes a more holistic view of the organization culture, building improvement into all its areas of operation. TQM acts as the foundation for an organization's day-to-day functioning and continual improvement that allows and supports the development of BPR as an effective business improvement technique. To get the best out of both concepts they should be combined and integrated to produce a comprehensive approach to business improvement. TQM can sometimes stall and plateau, and other initiatives, within the overall framework of the approach, can often provide the spark to revitalize it. BPR could provide this type of excitement, but to do so it needs to be positioned within the broader TQM approach.

BPR requires dedication, acceptance of risk and considerable upheaval. It is important that an organization is clear on this because it is so easy to find it in conflict with the potential cost savings. Not every organization is capable of accomplishing the level of change required, but any organization that has the ambition to be the best cannot ignore BPR but must accept the challenge. Some industries which operate in dynamic environments are more suited to taking on the risks associated with BPR than others, where the disturbance of processes could have severe consequences. It is also important for organizations to be clear on whether they need business process redesign or the more radical process re-engineering. Both are important to stimulate process innovation so that organizations can become more agile in responding to unpredictable changes and respond quickly to the needs and demands of customers.

Managers are central to the success of re-engineering projects and they must be prepared to change their role and power structures and provide the necessary leadership.

Six Sigma

With thanks to A. van der Wiele, J. D. van Iwaarden, B. G. Dale and A. R. T. Williams (2007)

Introduction

In this last section of this substantive chapter, Six Sigma is going to be presented, discussed and reviewed. The authors consider Six Sigma as a data-driven integrated process improvement and problem-solving approach, which encompasses and is built on all of the techniques described previously in this chapter: QFD, DoE, FMEA, SPC, Benchmarking and BPR and VSM, and many more.

Motorola created the concept of Six Sigma in the mid-1980s to improve the performance, productivity and quality of their key processes. The main factor behind its development was continuous improvement in the manufacture of complex devices involving a large number of parts with a high probability of defects in the end product. At the same time, customers were demanding that Motorola improve quality in their final product offerings. This external driver supported the need for continuous improvement. The goal of Six Sigma is value creation through quality improvement. The process by which this is attained would involve training of employees in tools and techniques as well as a problem-solving protocol. Six Sigma makes use of quality engineering methods within a defined problem-solving structure to identify and eliminate process defects and solve problems, and in this way improve yield, productivity, operating effectiveness and customer satisfaction (Bhote and Bhote 1991; Harry and Schroeder 1999; McFadden 1993; Pande et al. 2000; Pyzdek 2003; Gijo et al. 2014; Jesus et al. 2015). It is based on the well-established quality management ideas of understanding and eliminating the causes of variation and robust designing for manufacture and assembly. Therefore, its roots are in Statistical Process Control (SPC). The well-publicized bottom-line benefits achieved by Motorola (De Feo 2000) led to its adoption by high-profile organizations such as AlliedSignal (now Honeywell) and General Electric. Interest is currently very high and a wide range of organizations are following the adoption of Six Sigma. The concept is variously described in books and papers (Breyfogle 1999; Harry and Schroeder 1999; Snee and Hoerl 2003; Linderman et al. 2003; De Mast and Lokkerbol 2012; Shafer and Moeller 2012), and its protagonists claim it is a complete management system.

Many of the objectives of Six Sigma are similar to those of Total Quality Management (e.g. customer orientation and focus, team-based activity, comprehensive education and training, and problem-solving methodology) and it undoubtedly builds on TQM. There is no doubt that Six Sigma brings engineering and statistical analysis back into quality and is returning quality back to its roots.

Many of the success stories in the literature are from American organizations. AlliedSignal and General Electric have both used the financial benefits achieved through Six Sigma to persuade financial analysts that their firms' stock prices should be higher. This is perhaps the first time that executives have been able to argue that their quality initiatives will result in financial benefits that should be taken into account in the valuation of their companies.

It seems that Six Sigma is interpreted by different organizations in different ways. Some organizations interpret it simply as a measurement and improvement device, while others use it as a label for their organization-wide quality approach

(Breyfogle 1999; Dusharme 2001; Harry and Schroeder 1999; Snee and Hoerl 2003; Jacobs et al. 2015).

What Does Six Sigma Mean?

A sigma is a statistical indication of variation in terms of the standard deviation of the characteristic under consideration. It indicates the spread of each unit around the target value, and therefore it is essentially an indication of how good a product or service is. Traditionally, designers used the three-sigma rule to evaluate whether or not a part would meet specification. When a part's specifications are consistent with a spread of six standard deviations of process variation (three sigma to either side of the target value), around 99.73 per cent of the parts for a process which is centred would be expected to conform to specification. The higher the sigma value, the lower the number of defects associated with the process, the lower the costs of rework and scrap and the lower the cycle time of the process. In essence, sigma measures the capability of a process to produce defect-free work and is a means of calibrating process performance to meet the requirements of customers. For example, a process that is at a quality level of three sigma means 66,807 defects per million opportunities (DPMO), while Six Sigma is 3.4 DPMO. Other sigma levels and their corresponding number of defects are presented in Table 10.1.

The question of how organizations perceive Six Sigma and what they are doing under the umbrella of a Six Sigma approach has been the focus of research undertaken by van Iwaarden et al. (2008). They conducted a survey project amongst British, American and Dutch companies that use Six Sigma. Their results indicate that the Six Sigma approach is universal in the three countries surveyed, and that Six Sigma improves efficiency and profitability. The latter issue is the major driving force for organizations to start a Six Sigma implementation process. Looking into the tools and techniques that are found to be important within the context of a Six Sigma approach, it is clear that the basic (statistical) quality tools and techniques are seen as the cornerstone of Six Sigma. However, many of these tools and techniques were found to already be in place before the companies started implementing Six Sigma, indicating that Six Sigma is usually based on existing knowledge and practices.

Table 10.1 Six Sigma and defects per million opportunities

Sigma	Defects per million opportunities (DPMO)
2	308,537
3	66,807
4	6,210
5	233
6	3.4

Six Sigma Prerequisites

Six Sigma, like any major organizational change programme, is not easy. Its success will depend on at least four major factors.

Firstly, it involves high levels of commitment and involvement of management. It is based on an understanding of statistics and this is not a popular area for most managers. It also requires that high-performing managers are released to be trained and, after training, that they commit a significant amount of their time to the Six Sigma concept. So it needs to be led by senior management.

Secondly, it cannot be treated as yet another stand-alone activity. Like TQM, it requires adherence to a whole philosophy rather than usage of a few tools and techniques, however sophisticated. A Six Sigma-style initiative demands a degree of sophistication from the organization adopting it and the organization must be ripe for the change. For example, the organization must be used to working with cross-functional teams and should have its major processes identified and under some degree of control. In short, it must have many of the fundamentals of TQM already in place.

Thirdly, Six Sigma is about reducing defects. Improvement depends on how opportunities for defects or failure are defined and measured (i.e. the possible defects). What matters in a Six Sigma approach, as in any other quality approach, is what the customer wants or needs; this is why QFD (see above) is also a technique strongly associated with Six Sigma. The most critical effects or failures are those that most concern the customer.

Fourthly, Six Sigma needs to be concentrated on those elements of a business which will result in customers perceiving that they would rather deal with them than with one of its competitors. Therefore Six Sigma, like any performance improvement drive, should start from strategy – where does a company want to be? What will really make a difference to getting there? And, therefore, where must it concentrate its improvement drives? For many organizations the key factors influencing whether they will achieve their desired strategy are: How many customers will stay loyal? What really governs a customer's actual purchasing behaviour (as opposed to what he or she *says* governs it)? Will enough customers continue to be willing to pay a slight premium for their products? Can the organization increase its market share?

In the aforementioned international survey project on Six Sigma by van Iwaarden et al. (2008), respondents were asked what was the required level of quality experience at the start of the Six Sigma implementation, and what factors influenced the sustainability of a Six Sigma approach. From the survey it was concluded that a successful Six Sigma implementation had to build on experience of earlier quality management programmes. Having developed quality awareness and a quality culture, and having reached a certain level of quality management maturity, are essential prerequisites for the success of Six Sigma. For the sustainability of a Six Sigma approach, a wide range of items were found to be important, indicating that it is difficult, as with any management approach, to follow a specific approach over a long period of time. There will always be potential obstacles: the benefits of projects may diminish over time, management's focus may shift to other priorities, and important players in the organization may lose interest.

Six Sigma Core Elements

Six Sigma builds on a range of improvement methods that have proven to be effective. This can be seen in its central themes, which can be considered to be the following:

- *Focus on the customer.* Six Sigma measures start with customer satisfaction. The emphasis is on understanding customer expectations and requirements.
- *Data- and fact-driven management.* This is a classical quality management theme, including speaking with data, management decisions based on fact, developing an in-depth understanding of internal processes.
- *Specific training.* A defined and formal infrastructure (based on the martial arts hierarchy) of champions, master black belts, black belts and green belts that head and influence Six Sigma projects (see Pyzdek 2003). Master black belts are the technical experts who provide training and support for the other belts; they also lead major cross-functional Six Sigma projects. The black belts undertake full-time work on Six Sigma projects and lead the project teams. The green belts are part-time process owners, and usually undertake work on a small scale, in contrast to the black belts.
- *Structured approach.* Six Sigma is based on a structured problem-solving approach. For existing processes, the approach consists of the following steps: define, measure, analyse, improve and control (DMAIC); for new processes the steps are define, measure, analyse, design and verify (DMADV). Both approaches are discussed below.
- *Quality engineering.* Six Sigma uses a full range of tools and techniques, as typically described in Chapters 9 and 10 of this book. A number of writers on Six Sigma suggest the application of specific tools and techniques against each stage of the DMAIC and DMADV problem-solving approaches.
- *Process focus, control and improvement.* The key aspect is understanding the process in order to control its input and thereby facilitate its improvement. This involves an examination of potential defects, root causes and potential corrective and long-term actions. It is important to understand the relationship between inputs (X) and outputs (Y) with respect to issues such as: which Xs have the biggest positive effect on Ys; reduction of variation in inputs; and improvement in process outputs.
- *Proactive management.* Management at all levels must attempt to understand the key principles of Six Sigma. They must be active in challenging why 'things'

are done in a certain way, defining root causes of problems, setting and maintaining aggressive improvement targets, and being prepared to devote a large amount of their time. Managers must expect that, with Six Sigma, pressure on them will increase.
- *'Boundaryless' collaboration*. Teamwork is an essential part of Six Sigma and it is important to have a range of skills within the team.
- *Drive for perfection*. In the drive to eliminate defects it is important to accept that from time to time things will go wrong and some projects will not achieve their goals. It is important to understand the reasons for failure, to learn from experiments, and to put in place counter-measures to prevent defects occurring in the future.
- *Cost savings of each project*. A sense of urgency is created with Six Sigma, through the financial targets linked to each project. Each Six Sigma project should lead to verifiable bottom-line results.
- *Short-term improvement projects*. A key requirement is that a time scale is agreed for a specific project's completion. Moreover, the duration of each project is relatively short, with a typical project lasting between three and six months.

Structured Problem-Solving Approaches

Six Sigma improvement projects adhere to strict problem-solving approaches. Depending on the organizational processes to which they are applied (i.e. existing processes or new processes), improvement projects use either the DMAIC or DMADV approach. In the practice of consultancy firms, new acronyms are occasionally developed; however, they do not differ markedly from DMAIC and DMADV.

A number of writers (e.g. Eckes 2000; Pande et al. 2000) outline how the implementation of Six Sigma involves three aspects of process development:

- Process improvement
- Process design/redesign
- Process management.

Process improvement

This primarily concerns the elimination of the root causes of process problems and is clearly associated with continuous improvement activities (i.e. improve what you already have). Most Six Sigma activities are initially based on process improvement. It involves the identification of the vital few (Xs) that influence results (Ys).

The DMAIC structured problem-solving approach, which is employed in making improvements to existing processes and products, is related to other problem-solving approaches, including Deming's PDCA cycle. The DMAIC approach takes the following steps:

- *Define* in clear terms the specific problem to be worked on and the process to be improved. The problem needs to be one where it is critical to succeed and/or one that will give the quickest or greatest returns. This phase also involves defining the project scope and boundary conditions, selecting appropriate performance metrics, and agreeing the goals of the selected project, its financial impact, and the project champion, process owner and team members.
- *Measure* the factors which are critical to quality (Xs). This involves selecting the process outputs to be improved, developing a data collection plan, gathering data to evaluate current performance and an assessment of the performance measurement systems and their capability.
- *Analyse* the relationship between the cost of defects and key process variables. The purpose of this is to determine the root cause of variation and defects.
- *Improve* the process using experimentation, pilot studies and simulation techniques to address the root causes of the problems identified in the analysis phase. This involves various improvement loops, with appropriate confirmation studies related to each phase of process improvement.
- *Control* the process outputs (Ys) to ensure the long-term gains and improved performance of the process. This involves verifying the benefits and savings, ensuring that the changes are fully integrated into procedures, and communicating the findings as appropriate.

Process design/redesign

This is normally the second stage after process improvement. The emphasis is on new processes rather than fixes to existing ones and in this there are similarities to Business Process Re-engineering (see Chapter 10).

The method used is the DMADV approach, also called design for Six Sigma (DFSS). The steps are different from those of the DMAIC method, and can be described as:

- *Define* the project goals and customer (internal and external) deliverables
- *Measure* and determine customer needs and specifications
- *Analyse* the process options to meet the customer needs
- *Design* (detailed) the process to meet the customer needs
- *Verify* the design performance and ability to meet customer needs.

Process management

This third phase reflects a change of emphasis from oversight and direction of functions to understanding and process facilitation. The key activities include: processes are managed end to end; customer requirements are clearly identified; meaningful measures of input, process activities, and output are developed.

A Six Sigma approach can be considered to have the following five stages:

Stage 1 – Identify the need. Gather data; analyse data; define cost of poor quality; consider the voice of the customer.

Stage 2 – Clarify the vision. Define project brief; set goals/target objectives; establish realistic time scales.

Stage 3 – Develop the plan. Establish the project initiative; identify the project champion; select the team; understand the present documentation system; review the current process; understand current process performance; consider training requirements; define the available resources.

Stage 4 – Implement the plan. Promote clear process ownership; optimize the process; record progress results and display using appropriate visual management methods; evaluate improvement and process management; review cost savings; establish continuous improvement mechanisms.

Stage 5 – Sustain improvement. Document the initiative; maintain team responsibility; apply knowledge gained across the board; communicate and recognize success; identify the next project.

Summary of Six Sigma

Six Sigma is a well-structured improvement approach with verifiable financial results. However, organizations' quality initiatives should not be driven solely by the savings needed to impress the financial analysts. This can be a dangerous approach because its focus is too short-term. Most organizations need a longer-term focus on customers, and not solely on suppliers of capital. A successful Six Sigma implementation should build upon a number of prerequisites such as an existing quality culture and a certain level of quality maturity. The sustainability of Six Sigma in the long term depends on many factors, such as top management commitment, being able to show successful projects, high investment in training, high investment in management time, and the involvement of key players in the organization.

Six Sigma can revolutionize an organization and it will go deep into its fabric; it therefore needs top management drive behind it. It must be seen as part of a total approach, and it demands a level of quality competence from the organization before the benefits can begin to be delivered. Quality improvement methods such as Six Sigma may be very powerful but they have to be directed and need a clear strategy to measure and interpret customers' needs successfully. Managers must also realize that, if their organization has no clear power structure and the desired level of competence is not present, then a Six Sigma programme is unlikely to work.

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Part Four

TQM through Continuous Improvement

This part of the book covers challenges for the quality management discipline and draws together some of the common themes which have emerged in the individual chapters so far.

Chapter 11 – Teams and Teamwork
Chapter 12 – Self-Assessment Models and Quality Awards
Chapter 13 – Managing Quality: New Challenges
Chapter 14 – Managing Quality: The Future

Chapter 11 deals with the use of teams and teamwork in TQM and Strategic Process Improvement (SPI). The operating characteristics of project teams, quality circles and quality improvement teams are outlined. A set of guidelines to help ensure that teams are both active and effective is provided.

Chapter 12 deals with quality awards and self-assessment and their role in the advancement of TQM. It examines the influence of TQM, SPI and business performance. The key points of the Deming Application Prize, Malcolm Baldrige National Quality Award and European Quality Award are reviewed. The various ways of undertaking self-assessment against a Business Excellence Model are outlined, and the key lessons from the use of self-assessment by European business are highlighted.

Chapter 13 discusses new challenges, including the opportunities presented by the BRIC economies. In this chapter two kinds of quality management are identified 'old' or classical quality management and 'new' quality management. The challenge for the quality management discipline is to come up with new concepts, new approaches, new systems and new tools and techniques, which are needed to cope with the challenges that many organizations currently face in the complex and dynamic environment in which they operate. In Chapter 14 some of the common themes that have emerged in the individual chapters are brought together. This chapter covers a number of issues, including the importance of quality, TQM as a continuous process, and measuring progress towards TQM. The chapter also identifies and describes a number of TQM and SPI issues to which organizations need to give attention if they are to achieve world-class quality status. These issues also present potential research challenges.

Chapter Eleven

Teams and Teamwork

B. G. Dale, J. Bamford, D. Bamford and A. van der Wiele

Introduction

The development of people and their involvement in improvement activities both individually and through teamwork is a key feature in a company's approach to TQM and Strategic Process Improvement (SPI). A key aspect of this is making full use of the skills and knowledge of all employees to the benefit of the individuals and the organization and to create a group culture. There are a number of different types of teams with different operating characteristics, all of which can act as a vehicle for getting people involved in improvement activities and improving organizational performance. Teams can be found everywhere and for almost everything, and most organizations have them. Some teams have a narrow focus, with members coming from one functional area; others are wider and cross-functional, dealing with the deep-rooted problems between internal customers and suppliers. Each type of team has its advantages.

It is sometimes the case that management will decide to launch some form of team activity as part of an improvement initiative, put the members together and expect the team to work in an effective manner without training, coaching, direction, management attention, counselling or team-building. In such circumstances it is little wonder that the team may flounder within a few months of its creation.

This chapter, which is based on research on teams and practical experience of working with teams in many different types of organization, examines the role of teamwork and outlines the operating characteristics of project teams, quality circles and quality improvement teams. The key constituents of teams in terms of sponsor, facilitator, leader and member are outlined. A method for evaluating the health of teams is described. Some guidelines are also given which should help to ensure that teams are both active and effective.

The Role of Teams in Continuous Improvement

Teams have a number of roles to play as a component in a process of continuous improvement. Teams can:

- Aid the commitment of people to the principles of TQM.
- Improve communication within and across functions, and with customers and suppliers.
- Allow people to participate in decision-making about how the business operates.
- Improve morale, relationships and knowledge, develop trust, facilitate co-operative activity, problem-solving, and adjustment to change.
- Help to develop people and encourage leadership traits.
- Build collective responsibility and develop a sense of ownership.
- Aid personal development and build confidence.
- Facilitate awareness of quality improvement potential, leading to behaviour and attitude change.
- Improve the adoption of new products to the production line.
- Improve operating effectiveness as people work in a common direction and through this generate interaction and synergy.

RHP Bearings (manufacturer of industrial, precision and aerospace bearings) reported that scrap rates halved and productivity increased by 35–40% through the deployment of Quality Teams.

Types of Teams

Successful organizations exploit the benefits of teamwork. Not only do senior management and managers of the various operating and functional units work together as an effective team, but also staff from different functions co-operate in the team activities which are needed in FMEA, SPC, simultaneous engineering, benchmarking, supplier development, etc. Some (see e.g. Crosby 1979) teams may be hierarchical in nature – a corrective action team is formed on a directive from a quality improvement team. Unless effective team working and cohesion is seen at the top of an organization, it is unlikely that the managers will encourage their employees to work effectively in teams. The superior-performing organizations use a variety of ways to facilitate team-building, improve relationships and reinforce the teamwork ethic. Having made the case for teams it is important for the management of an organization to decide when and how to use teams, and on the appropriate conditions that need to be present.

There are many types of teams with differing characteristics in terms of membership, autonomy, scope of activity, decision-making authority, access to information, problem-solving potential, resources, and lifespan which can be used in the improvement process. It is important that the right type of team is formed for the project, problem, or activity under consideration and that a working definition of the team is decided upon. Some of the most popular types of teams are discussed below.

Project teams

As discussed in Chapter 1, the drive to improve quality originates at the top of an organization. Once the main problems facing the organization are identified they can be developed into a portfolio of one-off projects. The project owner will select the team members and can choose to either lead the team themselves or act as ‘sponsor’ to the team. Through participation in project teams, managers better understand the problem-solving process and become more sensitive to the problems faced by other types of teams. The typical characteristics of such teams are:

- The objective has been defined by senior management.
- The team is led by management.
- It is temporary in nature.
- The project is specific and significant, perhaps addressing issues of strategic change, and will have clear deliverables within a set timescale.
- The team is organized to ensure that it employs the appropriate talents, skills, and functions which are suitable in resolution of the project.
- The scope of activity tends to be cross-functional.
- Participation is not usually voluntary – a person is requested by senior management to join the team and this is done on the basis of their expertise in areas related to the project being tackled.
- Team meetings tend to be of long rather than of short duration, although they occur on a regular basis.

Quality circles

Quality circles (QC) have characteristics which are different from other methods of teamwork. They have been the subject of much research (e.g. Glassop 2002; Li and Doolen 2013; Seo et al. 2015). Although QCs, in the classical sense, have been viewed as not being too ‘successful’ in Western organizations in that they were short-lived and tended to fade out in the mid-1980s. This may have been because they were introduced at a time when organizations and their management did not fully understand and practice the principles of TQM and their experience of collaboration in the work environment was limited. However, a vast amount of experience was acquired in the operation of QCs, much of which has been well documented, including much good advice on facilitation, problem-solving skills, organization of meetings and maintaining the momentum.

A quality circle is a voluntary group of six to eight employees from the same work area. They meet, usually in company time, for one hour every week or fortnight, under the leadership of their work supervisor, to solve problems relating to improving their work activities and environment. The typical characteristics of QCs are:

- Membership is voluntary and people can opt out as and when they wish.
- Members are usually drawn from a single department and are doing similar work.
- All members are of equal status.
- Members are free to select, from their own work area, the problems and projects which they wish to tackle – these tend to be the ones they have to live with every day; there is little or no interference from management.
- Members are trained in the use of the seven basic quality control tools, meeting skills, facilitation, team-building, project management, and presentation techniques.
- Appropriate data collection, problem-solving skills and decision-making methods are applied by QC members to the project under consideration.
- Meetings are generally short, but a large number are held.
- There is minimum pressure to solve the problem within a set time frame.
- A facilitator is available to assist the QC with the project.
- The solutions are evaluated in terms of their cost-effectiveness.
- The findings, solutions and recommendations of the QC are shown to management for comment and approval, usually in a formal presentation.
- The QC implements the recommendations, where practicable.
- Once implemented, the QC monitors the effects of the solution and considers future improvements.
- The QC carries out a critical review of all its activities related to the completed project.

Quality improvement teams

Teams of this type can comprise members of a single department, be cross-functional, and include representatives of either or both customers and suppliers. The objectives of these teams fall under the general headings of improving quality, eliminating waste and non-value-added activity, and improving productivity.

Typical characteristics of quality improvement teams, which are more varied than for any other type of team, are:

- Membership can be voluntary or mandatory and can comprise line workers, management or a mixture of both. Some teams involve a complete range of personnel from different levels in the organizational hierarchy.
- Projects can arise as a result of a management initiative, a need to undertake some form of corrective action, a high incidence of defects, supplier/customer problems, or opportunities for improvement. It is usual to agree the project brief with management.
- The team is usually formed to meet a specific objective.
- In the first place, the team leader will have been appointed by management and briefed regarding objectives and timescales.
- The team is more permanent than project teams but less so than QCs. In some cases teams disband after a project; in others they continue.
- Members are usually experienced personnel and well versed in problem-solving skills and methods.
- The team is self-contained and empowered to take whatever action is required to resolve the problem and improve the process.
- The assistance of a facilitator is sometimes required to provide advice on problem-solving, use of specific quality management tools and techniques and keeping the team activity on course. In most cases a facilitator is assigned to a number of teams.

All teams are composed of a number of key ingredients, and require more than an enthusiastic membership to be successful. The work of Belbin (2010) on the characteristics of successful and unsuccessful groups demonstrated that, for successful team working, a combination of types is required. Belbin identified nine types or roles within a team: Plant, Monitor Evaluator, Coordinator, Resource Investigator, Implementer, Completer Finisher, Team Worker, Shaper, Specialist (See www.belbin.com for more information). The following team roles are adapted from guidelines developed by Betz Dearborn and Chesterfield Cylinders.

Team sponsor

- Quality steering group (QSG) member and a senior manager. See Box 11.1.
- Actively supports the team in its task, especially by contributing to the removal of roadblocks, and helps to resolve priority conflicts.
- Mentor to the team leader.
- Ensures that the team leader has the skills and training required to lead the team.

- Communications link between the team and QSG and also with departments which are affected by the project.
- Ensures that the team's activities are accepted by the department in which it is working (e.g. holds meetings with the area management, staff and operators to help to generate a total understanding of the project and the reasons for it).
- The sponsor agrees a charter (Objectives, outcomes, resources, boundaries, timescales) with the team.
- Ensures that other people and teams are not addressing the same project as this team.
- Holds regular meetings with the team's facilitator.

BOX 11.1 TEAM MENTORS

At Chesterfield Cylinders (a manufacturer of steel cylinders) the procedure and responsibilities for setting up a quality improvement team are as follows:

- The total quality steering group (TQSG) agrees the project for the team.
- The TQSG appoints one of its members to act as mentor for that team.
- The TQSG discusses possible candidates for team leader. The mentor then approaches the proposed team leader and invites him or her to lead the project.
- The mentor clearly identifies the problem to be addressed with the team leader.
- The mentor and the team leader agree the team. From this point, the mentor's role is as follows:
  - To guide the team leader when required.
  - To monitor the team progress and ensure that the team is addressing the identified and agreed project.
  - To give support to the team leader when problems arise that cannot be resolved by the team leader.
  - To introduce outside expertise when required.
  - To report back to the steering group on team progress.

Team facilitator

- Helps the team mentor and team leader establish the team.
- Ensures the right balance of skills is present within the team.
- Acts as coach to the team leader.
- Responsible for team progress and direction.
- Ensures all team members contribute.
- Responsible for communication from the team to the outside world.

- Communicates team roadblocks to team sponsor and helps remove them.
- Identifies training needs of the team and provides and implements solutions as appropriate.
- Assists the team in preparing recommendations and presentations to management.
- Helps the team sponsor resolve external resource/priority conflicts.
- Celebrates success with the team.

Team leader

- The leader of a team can be chosen by management or be appointed by the team. Another issue to be considered is whether the role of team leader should be rotated amongst team members.
- Organizes and sends out agenda for meetings.
- Ensures the team members are familiar with the protocol of team meetings.
- Needs to be an active contributor and listener.
- Ensures that team members know what is expected of them.
- Leads the definition and implementation of team processes.
- Responsible for team progress and direction.
- Understands and is sympathetic to the various stages of development that teams go through in the journey towards independence and accountability, i.e. the forming-storming-norming-performing cycle (Tuckman 1965; Tuckman and Jensen 1977).
- Identifies any training needs of the team and its members.
- Provides regular verbal reports and copies of team minutes to the mentor about the progress of the team.

Team member

- Needs to be enthusiastic about the project; its resolution must be of direct benefit to them.
- Must be a willing team member; not coerced into joining the team.
- Should contribute relevant experience.
- Is prepared to commit time outside team meetings to collect data and carry out agreed actions.
- Takes responsibility, as requested, for follow-up actions.
- Respects the role of team leader.
- Needs to be an active contributor and listener.
- Needs to be able to follow through actions.
- Should respect the ideas and views of other members.

Table 11.1 The observable characteristics of an effective and ineffective team

Observable characteristics of an effective team	*Observable characteristics of an ineffective team*
• Everyone is participating, making a contribution and involved in actions and through this is achieving their personal potential. • Relationships are open. • Team members trust, respect and support each other and are prepared to adapt and be co-operative. • Members listen closely to the views of other members of the team and have an open mind and maintain a positive attitude. • Everyone expresses their views, ideas and problems and all available means are used to support ideas. • Members respect the operating procedures and principles of the team and they own the team process. • There is clarity of focus on the project being tackled and members know what is expected of them. • The team leader has the ability to translate ideas into action.	• Poor leadership. • Cliques, defensiveness, closed minds and blame culture within the team membership. • Downright hostilities, conflict, competition and lack of tolerance between team members. • Members are not all participating in the activities of the team. • Limited communications between team members, and members have a tendency to act on their own. • Insufficient attention to the team process. • There is no pride displayed in the team activity. • Members feel they are being taken advantage of and the higher performers reduce their efforts to those of the lowest performer.

Evaluation of Teams

It is not easy to evaluate the effectiveness of team working, other than by the effectiveness of the actual solutions produced and improvements made. It is, however, important that the 'health' of a team is regularly assessed. The observable characteristics of an effective and ineffective team are shown in Table 11.1.

Dale and Agha's (2000) empirical research has identified the following measures for tracking the improvements to a business arising from teamwork:

- Achievement of service-level agreements
- Achievement of regulatory targets
- Customer satisfaction perception levels
- Recognition awards
- Employee motivation levels
- Employee satisfaction levels

- Level of team cohesion
- Level of training
- Unit cost (e.g. call-handling costs)
- Multi-skilling levels
- Error rates
- Willingness to become involved in terms of panel sessions, escorting visitors, and team presentations outside the plant.

Team Competition

To formally recognize and celebrate team activity and encourage role model behaviour a number of organizations hold an annual team competition/conference, usually held off-site, in which those team activities considered to be the best are presented. The judging committee of internal staff and external experts assesses the team projects in terms of theme selection, problem analysis and solution, members' participation and contribution, results and benefits, and presentation. See Box 11.2.

BOX 11.2 ANNUAL TEAM COMPETITION AT RHP BEARINGS

At RHP Bearings each site holds its own internal team competition to decide which team will represent it at the annual competition. Each site team submits a project brief detailing team members, project objective and details, how data is analysed, the problem-solving approach used, results and outcomes, and future opportunities.

Each member of a team that makes it through to the final receives a certificate and a small financial reward to be spent on a team development activity such as a dinner, attendance at a sports event, theatre visit, a picnic, attendance at a training event, etc. The winning team gets a similar certificate and reward but, in addition, the annual trophy.

This competition has had real impacts on business performance – scrap rates have halved and productivity has increased by 35–40%.

Guidelines for Developing Effective Teams

As outlined in Chapter 1, a continuous improvement process will encounter periods of stagnation when nothing appears to be moving. This phenomenon is mirrored by teams whose members begin with high levels of energy but can quickly slump and suffer frequent periods of inactivity.

To ensure that teams work effectively and efficiently the following factors should be taken into account:

- Management must commit themselves to nurturing and supporting teams. They need to release, on a gradual basis, authority, decision-making and accountability and put in place a suitable organizational support structure and connections between the team and the individuals and functions which it affects.
- Prior to launching any form of team activity in relation to the introduction and development of TQM, it must be ensured that the appropriate awareness training and education with regard to TQM have been undertaken.
- Each member must be clear about the aims and objectives of the team, the work to be accomplished by the team and its potential contribution to day-to-day operations.
- The team should have specific goals, an action plan with completion dates related to the objective. This not only assists in setting boundaries to the project but also helps the team to stay focused on it. The project must not be too large to discourage team members; an early success is vital.
- Team members must be trained in appropriate and robust data collection, problem-solving, and decision-making methods. Training should include project planning, team-building and team dynamics in order to provide an understanding of the behavioural needs which may determine team effectiveness.
- Special coaching and counselling should be provided to the team leaders since they are critical to a team's success. They must have the appropriate leadership skills in relation to the team.
- The team mentors must be seen to be actively supporting and contributing to the team. This applies, in particular, to requests for resources and support from key organizational functions.
- Teams should meet on a regular basis and work to an agenda. The team must never leave a meeting without agreeing future actions and the date and time of the next meeting. Once a team meeting has been agreed only in exceptional circumstances should the leader or any team member fail to attend the meeting.
- Regular reports to management and the 'mentor' on team activities must be prepared. The results and decisions should be communicated accurately to the rest of the workforce. It is also important that management carry out a periodic review of each team's progress.
- People who are likely to be affected by the results of the project should be involved in the team activity.
- The team should receive appropriate recognition and celebration for successful improvements.

- The performance of the team on completion of a project should be evaluated and reviewed to see what worked, what did not and what could be done better, including the identification of training needs and pinpointing of barriers.

Summary

Teamwork is a key element of any TQM and Strategic Process Improvement approach. There are a variety of teams with different operating characteristics which can be used in TQM and Strategic Process Improvement. Superior-performing organizations employ a number of different types of teams. Different types of teams can be used at different stages of an organization's development of TQM. Some teams are drawn from one functional area of the business and have a narrow focus with perhaps limited problem-solving potential. Other types of teams are wider in focus and tend to be cross-functional. The type of team will depend on the nature of the problem and objectives and management must decide which type is needed. This chapter has concentrated on three types – project teams, quality circles and quality improvement teams – and described their operating characteristics.

It is surprising how many organizations make a number of fundamental mistakes in establishing teamwork as part of their TQM and Strategic Process Improvement approach:

- Teams are not given any training.
- The wrong type of team is established for the project being tackled.
- The team is structured in such a way that members discuss their views on the cause of the problem and these ideas are then passed over to technical personnel and engineers for them to come up with a solution: the result is that team members feel they have achieved nothing and become disaffected with the team process.
- Too many teams are introduced at one time, which the infrastructure cannot support.
- The leader is unaware of the importance of their role to the success of the team.

The setting up of teams usually occurs within the first six months of introducing TQM. To help organizations avoid some of the common mistakes, guidelines have been outlined which should be considered prior to setting up any form of team activity. However, even if these are followed, teams are likely to encounter periods of stagnation when nothing appears to be happening. The importance of assessing the health of teams has been discussed to help team members analyse strengths and areas for improvement and thereby overcome these periods of inertia and maintain performance and effectiveness. It is vital that teams learn from experience and make the necessary changes for the good of the team. It must be remembered that it takes hard work and commitment to develop effective team working.

Teams and groups are important, as has been outlined in this chapter, but their effects must not be over-emphasized in relation to individuals working alongside on organizational improvement initiatives.

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Chapter Twelve

Self-Assessment, Models and Quality Awards

B. G. Dale, J. Bamford, D. Bamford and A. van der Wiele

Introduction

If a process of continuous improvement is to be sustained and its pace increased it is essential that organizations monitor on a regular basis what activities are going well, which have stagnated, what needs to be improved and what is missing. Self-assessment provides the framework for generating this type of feedback about an organization's approach to continuous improvement. Self-assessment against the criteria of a quality award/excellence model on which evaluation and diagnostics can be based is now being given a considerable amount of attention by organizations throughout the world. The criteria of these awards encapsulate a comprehensive and holistic management model covering its various activities, practices and processes, and provide the mechanism for quantifying an organization's current state of TQM development by means of a points score. There are many definitions of self-assessment provided by writers such as Conti (1993, 1997) and Hillman (1994), but an all-embracing definition is provided by the European Foundation for Quality Management (EFQM) (2015):

> Self-assessment is a comprehensive, systematic and regular review of an organization's activities and results referenced against the EFQM excellence model. The self-assessment process allows the organization to discern clearly its strengths and areas in which improvements can be made and culminates in planned improvement actions that are then monitored for progress.

There are a number of internationally recognized models, the main ones being the Deming Prize in Japan, the Malcolm Baldridge National Quality Award (MBNQA) in America and the EFQM Excellence Award in Europe. Although there are some differences between the models, they have a number of common elements and themes. In addition, there are many national quality/excellence awards and regional quality awards. Most of the national and regional awards are more or less duplicates of the international models, with some modifications to suit issues which are of national or local interest. In America alone there are over 70 state and regional award schemes.

The models on which the awards are based and the guidelines for application are helpful in defining TQM and Strategic Process Improvement in a way that the management of all types of organizations – small, large, public, private, manufacturing and service – can easily understand. This is one of the reasons behind the distribution of thousands of booklets outlining the guidelines and award criteria. The majority of companies requesting them have no intention, in the short term, of applying for the respective awards; they are simply using the criteria of the chosen model to help them diagnose the state of health of their improvement process and provide indications of how to achieve business excellence. They help organizations to develop and manage their improvement activities in a number of ways. For example:

- They provide a definition and description of TQM and Strategic Process Improvement, within a defined framework, which gives a better understanding of the concept, improves awareness and generates ownership amongst senior managers.
- They enable measurement of the progress with TQM and Strategic Process Improvement to be made in a structured and systematic manner, along with its benefits and outcomes.
- Annual improvement is encouraged, and this provides the basis for assessing the rate of improvement.
- They force management to think about the basic elements of their business and how it operates, the relationship between actions and results, and how organizational change is facilitated: 'Where are we now and where do we need to be in the future?'
- The scoring criteria provide an objective, fact-based measurement system, and help gain consensus within the organization on the strengths and areas for improvement of the current approach, and pinpoint the key improvement opportunities.
- Sharing of best practices and organizational learning is facilitated.
- Education of management and employees on the basic principles of TQM and Strategic Process Improvement is improved.
- They help develop a more cohesive company working environment.

Based on detailed research carried out in 10 companies Ritchie and Dale (2000) have summarized the benefits of self-assessment against a quality/excellence award model (see Table 12.1).

Table 12.1 Benefits of the self-assessment process

Category	*Benefits*
Immediate	• Facilitates benchmarking • Drives continuous improvement • Encourages employee involvement and ownership • Provides visibility in direction • Raises understanding and awareness of quality-related issues • Develops a common approach to improvement across the company • Used as a marketing strategy, raising the profile of the organization • Produces ‘people-friendly’ business plans
Long-term	• Keeps costs down • Improves business results • Balances long and short-term investments • Provides a disciplined approach to business planning • Develops a holistic approach to quality • Increases the ability to meet and exceed customers’ expectations • Provides a link between customers and suppliers supporting TQM
Supporting TQM	• Helps to refocus employees’ attention on quality • Provides a ‘health check’ of processes and operations • Encourages a focus on processes and not just the end-product • Encourages improvements in performance

To use any self-assessment method effectively as a business tool for continuous improvement, various elements and practices have got to be in place and management need to have had some experience with TQM or Strategic Process Improvement to understand the questions underpinning the concept. What has not been implemented cannot be assessed. The decision to undertake self-assessment needs to be fully considered from all angles, and management must be fully committed to its use. In the authors’ view the use of self-assessment methods based on the quality/excellence award models is best suited to those organizations that have had a formal improvement process in place for at least three years, although there is a clear need to assess progress in some way before this time has elapsed. A similar point is made in the *Deming Prize Guide* for overseas companies (Deming Prize Committee 2000):

> It is advisable to apply for the prize after two to three years of company-wide TQM implementation efforts or after top management has become fully committed and has begun to assume a leadership role.

Having made this point, the models underpinning the quality/excellence awards are also helpful in demonstrating what is involved to managers in organizations that are not experienced in TQM. However, they must understand the potential gap that can exist between where they currently stand in relation to TQM and the model of the award being used in order to make comparisons.

This chapter opens by investigating the replacement of Strategic Process Improvement and TQM by excellence in the award models, and this is followed by a description of the Deming, MBNQA and EFQM models. It then examines the self-assessment process, and the associated success factors and difficulties.

Quality, TQM, Strategic Process Improvement and Excellence

In recent times there has been a drive to change from Strategic Process Improvement and TQM to excellence in the criteria of the quality/excellence models. This originated with the EFQM and management consultancies, the former in response to the perceived tarnished image of TQM and Strategic Process Improvement initiatives and the latter seeing a diminishing demand and/or increasing competition for their services. In response to the 'fallen star' image of TQM and Strategic Improvement Initiatives the EFQM, in their excellence model, have progressively stripped out reference to TQM and quality in both the criteria and the areas to address.

However, de Dommartin (2000), who was the CEO of the EFQM, brackets TQM and business excellence together in describing the background to the revised model: 'Their objective became to provide a model that ideally represents the business excellence (TQM) philosophy …'.

This development in terminology has also been followed by national quality bodies such as the British Quality Foundation (BQF). However, it is noted that there is a lack of consistency in the use of 'quality', 'excellence' and 'business excellence' in the designations made by national bodies in their specific quality/excellence awards.

The potential for confusion in terms of the language used in the description of what used to be termed TQM, but is now classed as business excellence or excellence, is considerable. The words 'business excellence' and, latterly, 'excellence' in terms of the EFQM model have been in regular use for at least three years, but it was only in the 1999 guidelines that a definition was put forward and the principles outlined. There is no rigorous definition of excellence and what, if any, is the distinction between this and business excellence. This leads to the view that it is just a play on words. In the EFQM (2013) guidelines, excellence is defined as:

> Outstanding practice in managing the organization and achieving results, all based on a set of 8 fundamental concepts.

These fundamental concepts of excellence are:

> Adding value for customers; creating a sustainable future; developing organizational capability; harnessing creativity and innovation; leading with vision, inspiration and integrity; managing with agility; succeeding through the talent of people; and sustaining outstanding results. (EFQM, 2013)

In the 2015 revision of the ISO 9000 series, the principles of quality management are defined in BS EN ISO 9001 (2015) as:

> Customer focus; leadership; engagement of people; process approach; improvement; evidenced-based decision-making; relationship management.

Allowing for interpretation of these individual principles it can be seen that there is little or no difference between quality management and excellence. This lack of clear water in definitions is confirmed when comparison is made with the 10 and 14-point cluster summaries of the teachings of Crosby, Deming, Feigenbaum and Juran and with what has been written about earlier in this book as the elements and practices of TQM.

Award Models

Deming Prize

The Deming Prize (see www.juse.or.jp) was set up in honour of Dr W. E. Deming back in 1951, in recognition of his friendship and achievements in the cause of industrial quality. It was developed to ensure that good results are achieved through the implementation of company-wide control activities, and is based on the application of a set of principles and statistical techniques.

Barrie G. Dale has led four missions of European manufacturing executives to Japan to study how they manage quality. It is clear from the evidence collected that the Deming Application criteria have produced an almost standard method of managing quality (see Dale 1993). Compared to the West, there is much less company-to-company variation in the level of understanding of TQM and in the degree of attainment. This has helped to promote a deep understanding of TQM amongst all employees. Rather than argue about the merits of a particular approach, system, method or technique, the Japanese tend to discuss how to apply the TQM approach more vigorously through a common core level of understanding. JUSE (2016) outlines the following benefits of applying for the Deming Prize:

- New product development and launch will be promoted.
- New technology can be obtained.
- Sales target will be achieved continuously.
- Become capable of following a policy and fulfilling an objective.
- Organization's functionality will be enhanced.

The original intention of the Deming Prize was to assess a company's use and application of statistical methods. Later, in 1964, it was broadened out to assess how TQM activities were being practised. The award is managed by the Deming Application Prize Committee and administered by the Union of Japanese Scientists and Engineers (JUSE). It recognizes outstanding achievements in quality strategy, management and execution. There are four separate divisions for the award: the Deming Prize, the Deming Prize for Individuals, the Deming Distinguished Service Award for Dissemination and Promotion (Overseas), and the Deming Grand Prize. The Deming Prize is open to individual sites, a division of a company, small companies and overseas companies.

The Deming Prize was initially restricted to Japanese companies, but since 1984 has been open to companies outside Japan. It is awarded each year and there is no limit on the number of winners. On the other hand, the committee reserves the right not to award the prize in any year. It is made to those 'organizations that have implemented TQM suitable for their management philosophy, scope/type/scale of business, and management environment' (JUSE, 2016).

The Deming Prize consists of six primary categories (see Table 12.2) which are divided into a total of nine sub-categories. The examiners for the Deming Prize are selected by JUSE from quality management experts from not-for-profit organizations. The applicants are required to submit a detailed document on each of the prize's criteria. The size of the report is dependent upon the number of employees in each of the applicant company's business units, including the head office. The Deming Prize Committee examines the application document and decides if the applicant is eligible for on-site examination. The committee chooses two or more examiners to conduct this examination. Discussions with JUSE suggest that considerable emphasis is placed on the on-site examination of the applicant organization's practices. It is also evident that the applicant organization relies a great deal on advice from the JUSE consultants. JUSE would also advise an organization when it should apply for the prize.

In 1996 the Japanese Quality Award was established, it was renamed the Deming Grand Prize in 2012. This is an annual award that recognizes the continuous excellence of the management of quality. The concept of the award is similar to that of the EFQM model, with emphasis placed on the measurement of quality with respect to the customer.

Table 12.2 Quality award criteria

Deming Prize	
Category	*Max.*
Management policies and their deployment regarding quality management	20
New product development and/or work process innovation	20
Maintenance and improvement of product and operational qualities	20
Establishment of systems for managing quality, quantity, delivery, costs, safety, environment, etc.	10
Collection and analysis of quality information and utilization of IT	15
Human Resources development	15
Total	**100**
Malcolm Baldridge National Quality Award	
Category	*Max.*
Leadership	120
Strategic planning	85
Customer focus	85
Measurement, analysis, and knowledge management	90
Workforce focus	85
Operations focus	85
Results	450
Total	**1000**
European Foundation for Quality Management	
Category	*Max.*
Leadership	10%
People	10%
Strategy	10%
Partnerships and resources	10%
Processes, products, and services	10%
People results	10%
Customer results	15%
Society results	10%
Business results	15%
Total	**100%**

The Malcolm Baldrige National Quality Award

In a bid to improve the quality management practices and competitiveness of US firms, the Malcolm Baldrige National Quality Improvement Act 1987 established this annual US quality award, some 37 years after the introduction of the Deming Prize. The award is named after a former American Secretary of Commerce, Malcolm Baldrige, who served from 1981 until his death in 1987. The Baldrige National Quality Program is the result of the co-operative efforts of government leaders and American business. The purposes of the award are to raise awareness of quality management and recognize US companies that have implemented successful quality management systems. The Baldrige National Quality Program guidelines contain detailed criteria that describe a world-class total quality organization. The programme and award are managed by the National Institute of Standards and Technology (NIST), an agency of the US Department of Commerce. The American Society for Quality (ASQ) administers the MBNQA under contract to NIST. It is claimed that each year up to 30,000 organizations request copies of the MBNQA criteria.

Up to three awards can be given each year, and there is an average of 60 applicants in each of six categories: manufacturing, service company, small business, education, healthcare, and non-profit. The applicants can be a whole firm or a legitimate business unit. The award is made by the President of the United States, with the recipients receiving a specially designed crystal trophy mounted with a gold-plated medallion. They may publicize and advertise their award provided they agree to share information and best practice about their successful quality management and improvement strategies with other American organizations.

Every Baldrige Award application is evaluated in seven major categories with a maximum total score of 1,000 (US Department of Commerce 2001). These are: leadership (120 points), strategic planning (85 points), customer focus (85 points), measurement, analysis and knowledge management (90 points), workforce focus (85 points), operations focus (85 points) and results (450 points) – see Table 12.2. The seven categories are subdivided into 17 items to address. It is claimed that 'In the most competitive business sectors, organizations with world class business results are able to achieve a score above 700 on the 1000 point Baldrige scale' (US Department of Commerce 2001).

The criteria and processes are reviewed each year to ensure that they remain relevant and reflect current thinking and, based on experience during the intervening period, their wording and relative scores are updated. It should be mentioned that like the EFQM model the MBNQA criteria were developed originally by the business fraternity, management consultants and academics (See http://www.nist.gov/baldridge/index.cfm).

The EFQM Excellence Award

Originally called The European Quality Award (EQA) this award was launched in October 1991 and first awarded in 1992. The award is assessed using the criteria of the EFQM excellence model. This was created by Europe's leading senior managers, academics and consultants under the auspices of the EFQM and European Organization for Quality (EOQ) and supported by the European Commission. According to the EFQM the EQA was intended to: 'focus attention on business excellence, provide a stimulus to companies and individuals to develop business improvement initiatives and demonstrate results achievable in all aspects of organizational activity'.

To win the EFQM Excellence Award organizations must be able to demonstrate that their performance not only exceeds that of their peers in one of the eight categories listed below, but that this advantage will be maintained in the future:

- Adding value for customers
- Creating a sustainable future
- Developing organizational capability
- Harnessing creativity and innovation
- Leading with vision, inspiration and integrity
- Managing with agility
- Succeeding through the talent of people
- Sustaining outstanding results.

The EFQM excellence model is intended to help the management of European organizations to better understand best practices and to support them in their leadership role. The model provides a generic framework of criteria that can be applied to any organization or its component parts. The model is based on eight fundamental concepts – results orientation; customer focus; leadership and constancy of purpose; management by processes and facts; people development and involvement; continuous learning, improvement and innovation; partnership development; and public responsibility. The EQA is administered by the EFQM. In developing the model and the EQA, the EFQM drew on the experience in use and application of the MBNQA. The model (EFQM 2013) is structured on the following nine criteria, which organizations can use to assess and measure their own performance:

1. Leadership: (10%)
2. Strategy: (10%)
3. People: (10%)
4. Partnerships and resources: (10%)
5. Processes, products and services: (10%)
6. Customer results: (15%)
7. People results: (10%)
8. Society results: (10%)
9. Business results: (15%)

The criteria, which are shown in Table 12.2, are split into two groups: 'enablers' and 'results' (illustrated in Figure 12.1). The feedback arrow indicates the importance of sharing knowledge, and encouraging learning and innovation; this improves the enablers which in turn leads to improved results. The nine elements

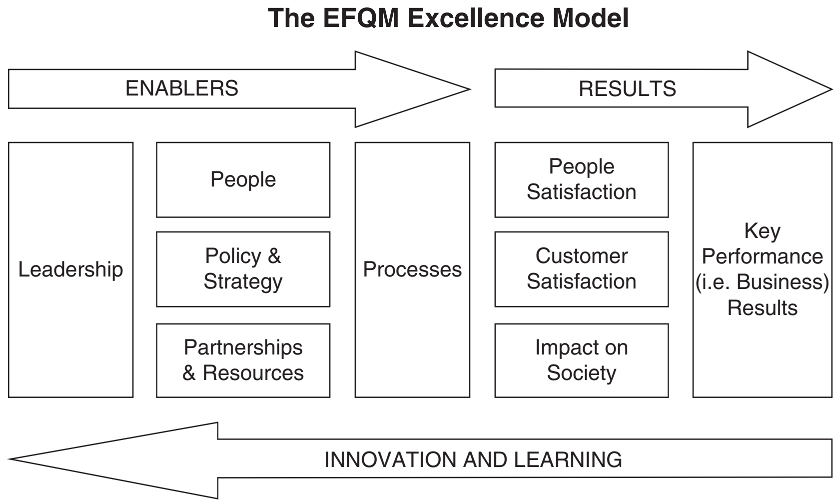

Figure 12.1 The EFQM excellence model

of the model are further divided into 32 criteria parts (see www.efqm.org). The model is based on the principle that processes are the means by which the organization harnesses and releases the talents of its people to produce results. In other words, the processes and the people are the enablers which provide the results. The results aspects of the model are concerned with what the organization has achieved and is continuing to achieve, and the enablers aspects with how the organization undertakes key activities and how the results are being achieved.

The EFQM model is based on what is termed the RADAR logic: results, approach, deployment, assessment and review. The last four elements are used when assessing the enablers and the result element is obviously used to assess results.

- *Results* cover what an organization achieves and looks for: the existence of positive trends and sustained good performance, comparisons with previous, current and future targets, comparison of results with competitors and best-in-class organizations, understanding the cause-and-effect relationships that prompt improvements, and ensuring that the scope of the results category covers all relevant areas.
- *Approach* covers what an organization plans to do, along with its underlying reasons for this. It needs to be sound, systematic, appropriate, prevention-based, focused on relevant needs and integrated with normal operations, and support organizational strategy.
- *Deployment* is the extent to which the approach has been systematically deployed and implemented down and across the organization in all relevant areas.

- *Assessment and Review* relate to both approach and deployment. Progress will be subject to regular review cycles analysis and measurement, with appropriate learning and improvements planned, prioritized and actioned.

The Self-Assessment Process

Self-assessment uses one of the models underpinning an award to pinpoint improvement opportunities and identify new ways in which to encourage organizational excellence. On the other hand, audits (often confused with self-assessment by less advanced organizations with respect to their development of TQM) are carried out with respect to a quality system standard such as the ISO 9001 series and are, in the main, looking for non-compliance and assessing to see if the system and underlying procedures are being followed.

The first European survey on self-assessment was completed by a research team drawn from UMIST (UK), the Ecole Supérieure de Commerce de Paris (France), the Universitat de València (Spain), the Universität Kaiserslautern (Germany), the University of Limerick (Ireland) and Erasmus Universiteit Rotterdam (The Netherlands) (van der Wiele et al. 1995; 1996). The five most important reasons for organizations starting self-assessment were to:

- Find opportunities for improvement.
- Create a focus on a TQM based on either the EFQM or MBNQA model criteria.
- Direct the improvement process.
- Provide new motivation for the improvement process.
- Manage the business.

This ranking provides a clear indication that internal issues are the most important motivation for organizations starting formal self-assessment. In some organizations a self-assessment process is introduced in response to changes in operating environment, company direction, and competitors. The need for improvement is now recognized in most cases, however well an organization may be doing.

After gaining the commitment of management to the self-assessment process and carrying out the necessary education and training, the following are the main steps which an organization should follow in setting about self-assessment:

- Assess what the organization has done well.
- Identify what aspects could be improved upon.
- Pinpoint gaps and what elements are missing.
- Develop an action plan to pick up the pace of the improvement process.

A key aspect of the process is taking an honest look at the organization in order to identify its shortcomings; this process usually takes about three months.

There are several methods by which an organization may undertake self-assessment, varying in complexity, rigour and resources and the effort required. Each method has advantages and disadvantages and an organization must choose the one(s) most suited to its circumstances. Some organizations prefer to go for a full award simulation approach after using a matrix chart or questionnaire for educational purposes. Other organizations choose a more incremental approach. In general, organizations develop from using a simple approach to a more complex one, unless they have some external stimulus affecting the pace at which they address the process. These methods are outlined in detail in *Assessing for Excellence: A Practical Guide for successfully developing, executing and reviewing an Assessment strategy for your organization* (EFQM 2013).

The choice of approach is dependent upon the level of TQM maturity. Organizations with less experience should use the simpler methods, while those that are more advanced should adopt the more searching and rigorous methods.

Assessment against a model, whether by internal or external assessors, has three discrete phases:

1 Gathering data for each criterion.
2 Assessing the data gathered.
3 Developing plans and actions arising from the assessment and monitoring the progress and effectiveness of the plan of action.

The key issues which need to be considered by those organizations undertaking self-assessment for the first time include:

- Reach agreement and be clear on the motivation for undertaking self-assessment and articulate the long-term expectations of the process.
- Senior management must be committed to the self-assessment process and be prepared to use the results to develop improvement plans.
- The people involved in the process need to be trained (i.e. training of assessors, data collectors, etc.).
- Communicate within the business the reasons for and what is involved in self-assessment.
- Decide the self-assessment method(s) to be used.
- Plan the means of collecting the data.
  - Decide the team and allocate roles and responsibilities for each criterion of the model.
  - Develop a data-collection methodology and identify data sources.
  - Agree an activity schedule and manage as a project.
- Decide the best way of organizing the data which have been collected.
- Agree the means of coordinating the process.

- Present the data, reach agreement on strengths and areas for improvement and agree the scores for the criteria.
- Feedback to facilitate organizational learning.
- Prioritize the improvements, develop an action plan and ensure that the ownership is with appropriate people.
- Regularly review progress against the plan.
- Ensure that self-assessment is linked with the business planning process. This is important to ensure that the areas for improvement are turned into actions which are implemented.
- Repeat the self-assessment.

Success Factors for Self-Assessment

A key to the success of self-assessments is that they have to be written down by the assessors. If they are purely verbal they will have far less power. Something written down has a life of its own and can be referred to again and again. It can also be related to a business plan and a subsequent improvement plan, and can be part of a PDCA cycle (see https://www.deming.org/theman/theories/pdsacycle). Written assessments also mean they will be taken much more seriously by both assessors and the assessed.

Ritchie and Dale (2000) have identified the following criteria which are necessary for a successful self-assessment process:

- Gaining commitment and support from all levels of staff.
- Awareness of the use of the model as a measurement tool.
- Incorporation of self-assessment into the business planning process.
- Not allowing the process to be 'added on' to employees' existing workload.
- Developing a framework for performance monitoring.

It is always difficult to clarify the impact of self-assessment on an organization's business results. However, those organizations with considerable experience of self-assessment do have a very positive perception of the impact of the techniques on their business performance.

Difficulties with Self-Assessment

There are a number of problems that hinder the self-assessment process: these are nicely summarized in Box 12.1. These types of problems are created by a lack of senior management support, an inability to plan self-assessment effectively and a low level of TQM maturity.

BOX 12.1 DIFFICULTIES EXPERIENCED WITH THE SELF-ASSESSMENT PROCESS

1 Lack of commitment and enthusiasm
2 The time-consuming nature of the process
3 Not knowing where to start
4 Selling the concept to the staff as something other than an 'add-on' to their existing duties
5 People not realizing the need for documented evidence
6 Lack of resources; time, manpower, finance
7 Maintaining the self-assessment skills of the assessors
8 Lack of cross-functional integration between departments and units
9 Getting the assessment done in time to link it into the business plans

Source: Ritchie and Dale (2000)

One set of problems relates to scoring against the criteria of the model; these are identified by Yang et al. (2001), who argue:

> The credibility and acceptance of the results from the self-assessment process against the EFQM model is dependent upon many factors, including the variability of scores obtained; the non-scientific method in which the scores are determined; the subjective judgments of the assessors and how they interpret criteria; and assessor's knowledge of TQM / excellence / continuous improvement. These problems are compounded if the assessors are inexperienced and there is a mix of experienced and inexperienced assessors in the same assessment team.

They have developed a model based on the evidential reasoning approach from multiple attribute decision-making which, it is argued, helps to reduce the variability of the scoring amongst the members of a team selected to an organization's EQA application document in award simulation mode.

Summary

Self-assessment on a systematic basis by an organization against one of the models described in this chapter can prove extremely useful in assisting it to improve its business performance. However, if the organization is just starting out on the quality journey and the senior management does not have an adequate vision of TQM it will not provide the necessary results and may even push the organization down blind alleys. It can also lead to the risk of gathering a considerable amount of data which cannot be put to effective use. When used in such a way the emphasis tends to be on training staff as assessors, assembling data, preparing long reports, and assessment and annual point scoring, without the development of the all important action plans and the solving of the day-to-day quality problems. The focus tends to be on meeting a minimum set number of points for an internal award and which activities should be concentrated on to increase the score by a set number of points, rather than on what priorities are going to increase the speed of the improvement process. As a consequence, the ongoing day-to-day quality problems which beset the organization will not be resolved. It is also observed that senior management can become obsessive about gaining some form of award (regional or national) within a set time frame.

In using self-assessment it is important that management attention is focused on the identification and implementation of planned and prioritized improvements and not on the mechanics and techniques of the assessment process or an obsession with scoring points. If this is not done they will run into the problem of self-deception.

The benefit of using self-assessment against one of the recognized models is not the winning of the award but its adoption as a methodology to assess progress, using appropriate diagnostics, and identifying opportunities for improvement, not forgetting the need to satisfy and delight customers. This measurement of progress on a regular basis and comparison of scores from assessments is a confirmation to the management team that real improvement and achievement have taken place. The quantification of performance in terms of numbers is important for senior management. It is also important that the management team of the organization should buy in to the self-assessment process and be enthusiastic about its use. This applies, in particular, to developing action plans to address the outcomes of the self-assessment. They must also be clear on their objectives for self-assessment. When used in the correct manner, the challenge, effort and involvement help to generate an environment in which it is enjoyable to work.

It would appear that the quality awards have generated an industry of their own in running training courses and advising organizations about how to understand the assessment process and the detailed requirements of the award criteria. In organizations this often creates an internal expert who, after intensive external training, applies the knowledge gained in providing advice to the local management team as to how each of the individual criteria can be interpreted and applied to their own particular area of activity. A danger inherent in this is that the 'expert' keen to demonstrate their knowledge ends up in detailed discussion on the mechanics of self-assessment and consequently the purpose of self-assessment is often lost. Another worrying trend is that some organizations seem to believe that using one of the models as the standard and almost as a checklist will automatically lead them to TQM. In such organizations people will continually use the terms 'excellence model' and 'quality award' almost as a talisman to guarantee that all will be right with their Strategic Process Improvement efforts. There is also the danger of treating self-assessment against one of the recognized models as a panacea, which is clearly not the case.

An organization has to be fairly advanced in TQM to be able to use self-assessment in an effective manner: what is not in place cannot be assessed. Registration to the requirements of ISO 9001 can be a useful first step towards TQM; however, there is a large gap between these requirements and what is portrayed in the EFQM and MBNQA models. Those organizations which have recently acquired ISO 9001 registration, and are not advanced in their quality management activity, would benefit from studying one of these models to gain an insight into what is necessary in order to develop a TQM approach to managing the business. Having identified the gap, they need to look at methods of introducing the basics of TQM, such as a consultancy package, the teachings of the quality management gurus, or a simple improvement framework. Once the basics are in place the organization should return to self-assessment to assess progress, and identify the next steps.

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Chapter Thirteen

Managing Quality: New Challenges

B. G. Dale, J. Bamford, D. Bamford and A. van der Wiele

Introduction

This chapter puts forward the argument that there are two kinds of quality management – 'old' or classical quality management and 'new' quality management. The aim of classical quality management was to analyse errors and eliminate their causes and the associated variation by improved product and process design. In recent times a number of major changes have taken place, resulting in increased volatility in key areas of business which 'old' quality management has difficulty in addressing. These changes are being driven by developments in production operations, competitive pressure, the need for improved results from the financial market and reduction of buying points. This has led to pressure on prices, performance and innovation and the need for increased flexibility, agility and economics of scale, with a concentration on core competencies within the business. This situation demanded the development of a 'new' form of quality management.

Developments

The management and improvement of quality have gone through a number of key learning points. They are, in approximate chronological order:

- Detection and elimination of defects by traditional quality control and engineering methods.
- Specification and use of quality management systems.
- The impact of Japanese competition on businesses, in particular the automotive and electronics sector. This resulted in accelerated quality management learning from visits to Japanese companies and working with them within a supplier network. (Nakamura et al. 1998).

- The influence and teachings of internationally respected quality management experts such as Crosby (1979), Deming (1986), Feigenbaum (1961), and Juran (Juran and Godfrey 1998).
- Increased usage of basic quality control tools and SPC.
- Recognition that internal improvement had its limitations, with the need to involve suppliers in the improvement process. This led to the development of supply chain management and partnership practices.
- Total Quality Management became the umbrella concept for a range of initiatives being put forward to improve quality.
- Increased recognition of the importance of people issues in quality management as emphasized by human resources specialists (Snape et al. 1995).
- Increased usage of advanced techniques such as failure mode and effects analysis, design of experiments and quality function deployment, as part of an advanced quality planning process.
- Emergence of approaches such as total productive maintenance, Six Sigma, Toyota production system and lean thinking. These were sometimes seen as alternatives to TQM and Strategic Process Improvement and sometimes as complementary.
- A rise to prominence of benchmarking, business process re-engineering and self-assessment against a quality/excellence model for recognized award status.
- Recognition that there was commonality of tools and techniques within improvement approaches.
- Interest in TQM faded, with renewed interest in approaches such as Six Sigma and lean thinking.
- The impact of globalization, in particular the emergence of the BRIC (Brazil, Russia, India and China) Economies (O'Neil 2011) has led to a renewed interest in TQM and Strategic process Improvement, with an emphasis on how it can be applied in this new context.

Many of these earlier developments can be considered as classical quality management with the aim of reducing inspection, waste and variation in routine situations, within a single stand-alone business or legal entity. We term this 'old' quality management.

In recent times, major changes have taken place which mean that the business contexts within which organizations now operate are very different than was the case in the 1980s and early 1990s, when many of the quality management developments took place. The following are a few examples of these changes:

- Companies have started offering a wide range of product variants to their customers, and these product variants are updated frequently in an effort to stay up to date and maintain high sales levels. This has led to the traditional mass

production approach being replaced by very small batch or even individual production runs in some industries.
- Manufacturing industries have shifted from individual parts assembly to modular assembly, forcing suppliers to take more responsibility for development and production of the end product.
- Pressure to produce increased profits means that companies in the supply chain are continually experimenting with cheaper, more effective materials, suppliers, technologies, etc. This has increased the likelihood of defects.
- In many industries all simple technological advances have been completed. The pressure is now on innovation with a shift to technological breakthrough (e.g. software has become more important in products/services but software reliability is difficult to test). This drive for technological breakthrough can result in disruption and increased volatility.
- Changes in distribution patterns means that there are fewer buying points with more power in the hands of a small number of suppliers/distributors, with less flexibility in terms of delivery, timing and quality.

Changes such as these are resulting in an increasing number of quality-related crises within organizations. This, coupled with the need for increased flexibility, speed of reaction, economies of scale, and a concentration on core competencies (Roberts et al. 2004) is driving a need for organizations to ensure that they are effective in responding to crises. This changing and less predictable situation requires a new form of quality management with an emphasis on improved relations and co-operation within the supplier and customer value chain.

Before highlighting the problems facing organizations we will review the features of classical or 'old' quality management.

'Old' Quality Management

The traditional or classical quality management system was initially based on a detection approach to quality which quickly developed to place more emphasis on upstream process preventative methods. The system was well equipped for the more routine and simple world in which it was originally developed. It aimed to solve the problem of too much inspection and waste in its various forms.

Excessive inspection and waste was reduced by analysing faults and eliminating causes through improved product and process design, leading to reduced variation. The classic tools and techniques of quality management are central to this problem-solving approach. The target, which was within the power of those involved to influence, was an agreed level of stakeholder satisfaction within a clear structured product or service specification. These were the kinds of measurements which appealed to engineers or technical specialists, were understood by them, and which they were motivated and challenged to improve.

The target was clear, technical and hard (e.g. reduce defect levels from 'x' to 'y' within a time frame of 'z') so was relatively easy to communicate and measure. Some measures were regarded as more meaningful than others (e.g. comparative measures against competitors were more meaningful than just internal measures, as were measures of past and potential new customers). There was also an emphasis on actively soliciting customer complaints.

Given an adequate quality management system, the feedback of these measures was normally possible within a short time frame to those who were responsible for improvement. And since the products/services were mostly produced in house, the improvement process could also run smoothly. This meant that the reward/punishment system could relatively easily be linked in some way to the stakeholder satisfaction data.

'New' Quality Management

Changing conditions such as developments in production operations, increasing competition, increasing levels of technological innovation, pressure for results from the money markets, and shrinkage of buying points in many markets, coupled with the way in which businesses are now organizing their manufacturing and service delivery systems and processes, are giving rise to major problems in the management of quality because they demand new measures which have not yet been developed. The 'new' quality management is not concerned so much to gradually reduce routine variation within the organization as to ensure effectiveness in responding to crises as and when they occur.

The measurement problems are concerned with four major areas: (1) the shift from a focus on initial quality to durability; (2) the increased importance of non-technical, softer influences on customer satisfaction; (3) the growing importance of software within products; and (4) the need for closer co-operation both internally between functions and externally between partners in the supply chain.

Durability as a measure of quality

The trend in the business-to-business market towards a longer-term vision regarding quality means that customer satisfaction has to be measured in a very different way. The customer is no longer solely interested in satisfaction with the product or service on delivery, but rather over its lifetime. This is a much more complicated and vague factor to measure. For example, how can satisfaction be measured in the future? What influences satisfaction in the future? What influence does after-sales support, training costs, cost of upgrades, speed of maintenance, cost of maintenance contracts, and experience with all these possible factors have on customer expectations of future satisfaction? In addition, after-sales lifetime experience factors can vary strongly from one culture to another. For example, paying extra for maintenance contracts might be normal in some regions, such as the USA, but others, such as Southeast Asia, might expect such maintenance to be free of charge.

Durability is highly dependent on the way the customer uses a product, which is something the manufacturer has little influence on. The automotive industry has shown some examples of the durability issue. Metal door handles are replaced with plastic ones because the plastic ones are cheaper, will last long enough and are easier to recycle. However, the technical lifespan of a door handle depends on how often the handle is used and how it is treated. How can manufacturers predict this? Another example is truck cab tilt systems, which are designed to last for a certain number of operations and no more. However, some logistics companies require their drivers/operators to tilt the truck's cab and check the engine every morning, while others will only do it when the truck is serviced. So what is the required number of times the tilt system should last?

Not only are measurements difficult in this type of situation but their timing may also make a considerable difference. Experience with products or services is ongoing, so judgments about quality are not only subjective but may also shift in response to recent events rather than being based on considered experience over a longer period.

Therefore the problem is partly targeting, but very much at the measurement level. And if it cannot be measured successfully then it will be very difficult to manage.

The impact of softer influences on customer satisfaction

Another problem area is the increasing importance for many businesses of the customer's emotional reactions to products. Customers may be happy that the product or service meets specification and does what it was intended to do, but are still not totally satisfied because they had other hopes and expectations.

This is often complicated as a result of the brand image which the organization is attempting to develop; brand image is complex and difficult to measure. For example, if the brand of a car has to be seen as sleek, sophisticated and luxurious to justify its high price tag then many different variables, besides its actual performance on the road, may play a role:

- The sound of the car door closing must be different from the sound of a door on a cheaper car closing.
- The smell of the interior of a luxury car must be different from that of a cheaper model.

Customers' opinions of what is necessary for a vehicle to be classified in their eyes as sleek, sophisticated and luxurious are likely to differ much more widely than their attitudes just on the car's performance. These types of factors cannot be captured simply by use of quality function deployment; as would be the answer in 'classical' quality management.

The impact of emotional quality issues on organizations has increased in recent years, parallel with the increase of globalization. As manufacturers have tried to reduce costs by standardizing their product offerings in all parts of the world, they have realized that customers in one region may be dissatisfied with a product, while in another region they are satisfied. This poses a major dilemma to these manufacturers, since the product is not technically broken and therefore fixing it, in the 'classical' quality management approach, will not solve the problem.

Many companies in highly competitive markets (e.g. fashion, food, clothing and drinks) are now not so much selling a product or a service, but an experience (Palmer 2010). And how do you measure the quality of an experience? The key issue for organizations facing this type of problem is to identify which businesses have been doing this for a long period of time and what can be learnt from them.

The importance of software

Another rapidly growing area that is very difficult to measure is the increase in the amount of software in many products. Software lines of code used nowadays in many products can run into millions. The increased use of electronics and software means that simple checks during assembly have become nearly impossible. Manufacturers are having problems with integrating different electronic components in one product because they were developed on the basis of differing technologies and software standards. Modular production has worsened these problems because products are assembled from a relatively small number of building blocks, each incorporating one or more complete functions of the product. Combining different modules into a final product regularly leads to unanticipated problems because of incompatibility between two or more modules. The 'classical' root cause analyses are very complicated in these situations because the cause is not in one individual module, but in a complicated interplay between different modules.

The key issues with this type of problem are:

- How do you measure software quality before the product is used widely on the market?
- How can you get rid of bugs?
- What are the goals in dealing with software reliability?
- What are successful examples of software quality assessment systems and their usage/success?
- What is the importance of peer review and peer testing?

The need for closer co-operation both internally between functions and externally between partners in the supply chain

Today, actual improvement has become far more complicated and difficult to manage. Time is now of the essence in both manufacturing systems and the process of delivery of services. That means there are three potentially weak areas.

First, the innovation process needs to accelerate. Innovation is continuous but it is undertaken against tight deadlines to ensure timely appearance in the marketplace. Delays can mean missing a key window of opportunity and thus reducing the chance of financial success.

Second, poor quality has to be prevented. Competition is now widespread and this, coupled with the power of the reduced number of purchasing points, means that brand image is becoming all-important. No producer or service provider can afford to have poor quality damage either his brand image or the reputation of his company. For example, in a manufacturing situation there is no time or money available for comprehensive end-of-line inspections, nor for the large buffer stocks of parts and components which would enable on-line improvements and snagging to take place. And today many of the products are so complex and the production process spread over so many suppliers that once faults occur any causes are likely to be multiple and difficult to trace. So any after-the-event rectification will take too much time and money. This was well known in the 'old' quality management era, but it is far more important in the situation which exists today.

Third, while it is inevitable that some mistakes will always happen, it is essential that they be cured fast. The whole supply chain, up to and including the customer, operates on a just-in-time basis and so is susceptible to disruptions. Products must not just meet customers' expectations in performance terms but they must also arrive on time and budget. There are few second chances.

Disruptions and delays due to inadequate quality are therefore major operational risks, which go hand in hand with lean manufacturing/service. There are a number of ways to manage these risks: through careful prevention to avoid their occurrence in the first place; through continuous step-by-step performance improvement; and through very fast emergency reactions if and when mistakes do occur. The relation between risk management and quality management is examined in detail by Williams et al. (2006).

These three areas of weakness demand major changes in internal and external relationships. In terms of prevention, increasing the speed and accuracy of innovation means that, inside the organization, more decision-making power and autonomy has to be delegated downwards and more co-operation is required horizontally between functions.

Continuous improvement means that all functions will be involved, but only if there is trust between them will improvement be realized. And externally, because of the growth of outsourcing, the consequent major increase in reliance on outside suppliers means that closer co-operation both with and between them is essential if later production and market problems are to be avoided. Continuous improvement to existing product models and services can come from many possible inputs and functions.

But all these efforts at performance improvement can clash with production/quality department objectives of fault-free and no-waste production and service delivery. So these types of changes require cross functional co-operation for successful solution. This requires process thinking, not different functions or departments working as individuals. It also requires supportive budgetary systems, which means that top management and the finance and accounting function must also be involved. Continuous performance improvement, if it is to be successfully implemented, involves close co-operative relationships between the many functions involved.

But despite the care taken during innovation and continuous improvement on the shop floor, some mistakes are bound to occur. And when mistakes do occur, then there is no time for legal niceties such as whose fault it may be, or who should pay for the damage according to the contract. In today's environment, successful rapid reactions are crucial. And this again will involve not just the various relevant functions from within the organization but also representatives of relevant suppliers in diagnosis and immediate improvement actions. It therefore also requires full and immediate co-operation. This means that a combination of hard and soft control systems is used, while 'classical' quality management approaches would focus either on hard or on soft controls.

If the quality of relationships is so important to achieving high levels of performance improvement and quality, then we clearly need reliable, acceptable ways to measure this. How can relationship quality be managed if it cannot be measured? This is a challenge facing quality management.

TQM and Strategic Process Improvement in the BRIC Economies

Implementation of TQM and Strategic Process Improvement has not reached maturity in many BRIC (Brazil, Russia, India, China) economies (Moosa et al. 2010). This presents an opportunity as well as a challenge for TQM practitioners. Although the key factors for successful implementation of TQM and Strategic Process Improvement appear to be the same in these economies (Kumar, Sahay and Ranjan 2011) there is some recognition that the cultural and contextual factors will be crucial to the successful implementation of TQM and Strategic Process Improvement (Kumar, Garg and Garg 2011; Sik Cho and Jung 2014).

This has implications for practitioners operating within international or global firms or industries. Simply attempting to implement TQM and Strategic Process Improvement in the same manner, utilizing the same tools and techniques and adopting the same style of leadership has been seen to work (Brown 2013). The challenge is to alter and adapt the approach and leadership style to best suit the culture of the organization and country that you are operating within.

This assumes that the cultural factors that will affect the implementation of TQM and Strategic Process Improvement can be identified and a strategy for altering your approach be devised. However, this can be a challenge in itself, and has been the subject of much research and discussion (see www.geert-hofstede.com for an introduction to the challenges of working across national cultures).

Summary

This chapter has set out the argument that there are two types of quality management – 'old' and 'new'. The old or classical quality management is based on preventing defects, reducing waste, improving operating efficiency, reducing variation, etc. and utilizes a range of improvement approaches, systems, tools and techniques. It has its roots in the quality management thinking of the 1980s, enhanced by more recent developments such as Six Sigma, total productive maintenance, lean thinking, etc. This type of quality management is still very important to an organization, but its effectiveness will depend upon how much the organization's environment has changed since these methods were first implemented.

We suggest that major changes have taken place which means that the business contexts within which many organizations operate are now very different and 'old'-style quality management will only have a limited influence in addressing the issues that organizations face. Clarifying causes of defects or ensuring that an error will not occur again is not as important as it was, since not only will the specific complexity of causes be difficult to determine but they will be unlikely to happen again in exactly the same way. However, given increasing unpredictability, another crisis will happen. So the focus is on rapid crisis containment and problem-solving, rather than on analysing past causal linkages and total prevention in the future.

There are a number of problems caused by operating on an international or global scale. In particular the need to adopt and adjust the approach to the implementation of TQM and Strategic Process Improvement to match the culture of the organization and country that you are operating within the new situation, including: problems caused by the shift to durability issues; problems caused by softer influences on customer satisfaction; problems caused by the growing importance of software; and problems caused by the need for closer co-operation both between internal functions and between various partners in the supply chain. New thinking and methods of quality management need to be developed to address these types of problems, as 'old' quality management will not suffice.

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Chapter Fourteen

Managing Quality: The Future

B. G. Dale, J. Bamford, D. Bamford and
A. van der Wiele

Introduction

This concluding chapter of *Managing Quality* pulls together the main themes and strands running through the book and identifies issues to which organizations will need to give particular attention in the future. It opens by examining what quality means to different people and its importance in business transactions. The case is made that improvement is a continuous process which is systematic, incremental and cyclic. It is argued that the senior management of an organization are always keen to know both where they are positioned in relation to the competition and also their perceived status within the industry and the marketplace. The means of carrying out such an assessment are explored. The chapter (and the book) is concluded by outlining a number of issues to which organizations will need to give more attention if they are to achieve world-class quality status.

The Importance of Quality

Most people now accept that quality is an important business issue. But what is quality? What do people mean when they speak of the quality of product, service, communications, or people? It is important for them to have a clear understanding of what they mean when the word is used in whatever context, so that they know what to do to attain it and to continuously improve on it. It is unfortunate that there are so many different interpretations of quality. But by being amenable to wide and differing interpretations it remains appropriate in widely differing situations and circumstances. Thus it has a unifying effect, in that all genuine aspirations to improve are known to be going in the same direction, irrespective of definitions of quality in individual cases. Indeed, it may be that quality has become a common goal rather more readily than other desirable aims (e.g. productivity, profit, market share) simply because everyone understands its importance and can identify with it. It perhaps matters little that the designer, the human resources manager, the operations manager, the manufacturing engineer, the salesman, the installer, and the service engineer all have different interpretations of quality to assist them in developing their own contributions to the total quality image. The total quality image is the sum of a set of attributes, each of which has its own quality criteria. However, it is the responsibility of senior management to see to it that every contributor plays his or her part fully in fashioning the image held by the customer of the organization and its products and services.

Common threads running through all the contributions to this book are that customers are increasingly demanding improvements in the quality of products and services they receive and that the provision, improvement and maintenance of quality have become an important part of business policy in superior performing enterprises. It is rare these days to find a thriving and successful organization where quality is not a basic business principle integrated with corporate objectives and strategies. Many businesses are experiencing massive changes in customer expectations, changes in technology, pressure for instantaneous delivery, radical changes in distribution methods and an attitude of 'more value for less money'. An organization which does not continually satisfy its customers' needs and expectations will almost inevitably suffer a fall in market share and return on assets. Indeed, it is significant that an increasing number of organizations are talking not just about satisfying customers but delighting them, by exceeding and going beyond their expectations (e.g. meeting latent requirements); selling value to the customer is a prime organizational theme. The enlightened executive knows that, while price and delivery are negotiable, quality in its widest sense is not.

There are also clear signs that the argument that ensuring products and services conform to customer requirements causes productivity to fall and costs to rise is now recognized by many executives as being untrue: quality and productivity improvements and cost reduction should always be joint organizational objectives in striving for good business results.

Quality Management: A Continuous Process

From the contributions to this book the reader should have got the clear message that improvement is a process which, once started, should never end, with all employees getting to grips with changing the organization in a gradual manner. This process of improvement also concentrates on the elimination of waste and non-value-added activity through the creative involvement of all employees. The process is based on systematic, incremental and habitual improvement rather than, for example, relying on 'breakthrough' and 'innovative' advances as is the case with BPR. The argument advanced is that small-step improvements are cumulative in nature and can ultimately lead to a greater overall effect than a single large and radical change, which can lose its value with time (see Imai 1986 and Chapter 1 of this book). It should be said that TQM can also deliver ‘breakthrough’ or ‘outrageous’ improvements through activities such as benchmarking.

A question commonly encountered is, ‘How will an organization know when it has achieved total quality management?’ The short answer is that it won’t. Because TQM and Strategic Process Improvement is based on a continuous process which is both proactive and reactive to changing needs, the marketplace, the environment, the business and to its customers and competitors, an organization will never arrive at TQM; it can only keep going further along the road. Phrases commonly used to describe this are ‘a race without a finishing line’, ‘a road without an end’ and ‘attempting to get to the bottom of a rainbow’.

There are many ways of getting a TQM or Strategic Process Improvement approach incorporated into an organization’s day-to-day activities. There is no single route leading to success; different management styles and corporate cultures will need to take different paths. The introduction and subsequent development of TQM and Strategic Process Improvement must be led by the company’s senior managers and it must be accepted from the outset that it will be liable to setbacks, owing mainly to resistance to change (see Chapter 3). There will be points in the process at which little headway will appear to be made, and only if the senior management team is monitoring the process proactively using a set of key metrics will it be able to act positively in order to maintain progress. Management’s commitment to TQM and Strategic Process Improvement must be demonstrated to all employees through, for example, the time they devote to the concept, their day-to-day leadership actions, behaviour and decision-making, and by proving to employees that they genuinely care about improvement.

It is also wise for an organization to understand that its competitors are making continual advances and that, to catch up or keep ahead, it is necessary to develop the process at a faster rate than that which the competition are achieving; today’s state of the art, delight and latent features become tomorrow’s standard performance. Because competitors’ position can never be known with certainty, there is no prudent alternative other than to pursue perfection in all aspects of organizational activity.

Measuring Progress towards Quality Management

The evidence presented by the contributors to this book corroborates the case argued in Chapter 1: that there are distinct stages or levels in the evolution of quality management, the stages being broadly characterized as inspection, quality control, quality assurance and TQM. It is evident that in some organizations, because of the type of business they are in, their cultures, systems, and procedures will be heavily biased towards inspection and quality-control-type activities. Clearly these organizations will have greater difficulty in progressing from one stage to the next than companies without such limitations and they will tend to display the characteristics of 'uncommitted', 'drifters' or 'tool-pushers' rather than 'improvers'.

The issues which seem to concern executives are where they stand in relation to their competitors, and their perceived status within the industry and the marketplace. There are many widely accepted business performance criteria which can be applied using readily available information. Examples include market share, sales turnover, volume of exports, profit, return on net assets, share price, and manufacturing output. However, a company's senior managers should be no less interested in issues such as the organization's progress towards TQM, the effectiveness of its quality assurance and improvement activities, and the effectiveness of its expenditure on promoting TQM. This assessment of quality standing is not as straightforward as assessing other aspects of the organization. Scrap rates, process capability indices, quality costs, non-conformances found at product audit, customer complaints, warranty claims, service quality index, number of hours of defect-free operations recorded by employees and departments, number of quality-related incidents, and the number of product recall programmes are all measures which can provide some indication of a company's progress from an internal baseline, but it is unlikely that similar detailed data will be available from competitors, even though there is an increased sharing of data through the formation of benchmarking clubs and other types of networks. If no such comparative data are available, and there are no absolute measures, the question remains how to gauge a company's progress towards TQM.

This kind of assessment can be approached in a number of ways:

- By regular assessment of the progress being made by a company against internal benchmarks, including past performance and a 'perfect' situation. It is usual to quantify these key measurables and plot and monitor their performance over time.
- Self-assessment of internal performance using the EFQM and MBNQA models' criteria.
- By general comparison of the level of TQM activity against companies of high standing within and outside the particular industrial sector, for example, by benchmarking.
- Analysis of internal and external audit results and assessments by people external to the company.
- By attempting to understand how an outside independent observer might see the company.

These different approaches raise again the question of the definition of quality.

- The first measure, using internal benchmarks, will employ scrap costs, level of quality costs, customer complaints, quality levels as measured by the customer, number of line complaints raised at customer plants, defect reports, etc. as its measures (i.e. quality can be expressed in numbers).

- The second measure is critical self-assessment of the organization's activities and results against a specific framework and set of criteria. For each of the EFQM model's nine criteria, data are available on the scores achieved by the 'best in class' per criterion for applicants.
- The third measure, comparison with companies of high standing, will use published information, visits to companies and discussions with managers, and will be concerned with advanced quality planning, improvement teams, SPC, mistake-proofing, quality skills and competencies, cycle time reduction, internal recognition, etc. Thus the measures of quality become subjective assessment of tools and techniques in use, systems in place, sophistication of TQM, and achievements and benefits.
- The fourth measure will mainly be concerned with reports and comments on systems, planning carried out, attitudes of management, training undertaken and customer awards based on such criteria.
- In the final measure, an outside observer, who is not necessarily knowledgeable about TQM and Strategic Process Improvement, will have other criteria. This could very well be the end-user or customer, who may not be able to articulate their views and subsequently vote with their feet. Their judgment will probably be subjective, perhaps based on superficial knowledge of the product or service, perhaps based on little experience, and influenced by hearsay and propaganda. Their measures of quality will include appearance, utility, cost, value for money, reported performance, reliability and serviceability. This type of qualitative assessment can extend beyond the product and/or service by making a judgment on the manner in which the producer, seller, or service provider conducts their business (i.e. ethical, moral, economic and environmental issues).

Clearly these measures are so different it is not possible to reconcile them one with another, and managers must make the best judgments they can from them.

However, it is the in-house measures of quality and those based on customers' direct measures of product and service quality which are of the most immediate and direct use because they are the most visible, meaningful and motivational to the company's workforce. Among the in-house and active performance indicators which surface when attempting to assess an organization's standing with respect to TQM are:

- Scores attained using the EFQM or MBNQA models' criteria.
- Number of second and third party approvals and regional and national quality awards held.
- Number of preferred supplier status awards held.

- Scores allocated by customers in their formal assessments of the organization's quality management system.
- Strengths and weaknesses of the quality management system indicated in a second or third party assessment.
- Frequency of quality management system failures.
- Internal and external quality levels per product, production line, and service.
- Lead time and schedule compliance.
- Number of defect-free hours of work registered by employees and departments.
- Total quality costs.
- Process capability indices.
- Proportion of indirect personnel employed in the quality department.
- Number of invoice queries.
- Time taken to respond to customer problems.
- Resources allocated by management to long-term corrective actions, including budget and staff.
- Training budget as a percentage of annual sales and extent of staff training in TQM.
- Number of improvement teams in operation.
- Number of staff and areas involved in teamwork and improvement activities.
- Number of improvement projects being pursued and those which are successfully completed.
- Proportion of staff that have identified their internal customers and suppliers.
- Proportion of employees who practise continuous improvement.
- Proportion of employees who are satisfied that the company is customer-focused.
- Proportion of employees who are satisfied that the company is a 'quality' organization.
- Number of agreed departmental performance measures being used.
- Number of staff who speak the common language of improvement.
- Customer access to staff and attitudes of staff to customer complaints.
- Number of product recall programmes.
- Number of new products and services introduced and time to market.
- Staff turnover and absenteeism rate.
- Training days per person each year.

While in-house performance indicators are important, it is the customer assessment of the product and/or service which really counts, and it is important to have a set of measures which reflect the customer's viewpoint. There are a variety of means used to assess customer perceptions, obtain customer feedback and understand the marketplace, including surveys, interviews, customer focus meetings, shows, product launches and mystery shoppers (see Chapters 5 and 11). It is helpful to combine the data collected in this way into a customer satisfaction index.

Measurement of performance and progress in meaningful terms is a difficult subject and one to which more research effort needs to be devoted. However, it is vital to review the performance trend of the key measurables to ensure that the improvement initiatives and projects are having the desired impact and that the organization is progressing towards world class.

Quality Management Issues which Need to be Considered in the Future

Chapter 1 was brought to a close by outlining a number of issues which need to be considered by an organization to help it develop TQM. Here we conclude *Managing Quality* by listing a number of issues to which organizations will need to give more attention if they are to achieve world-class quality status.

1 The importance of quality will come to the fore in e-commerce in the near future. One of the challenges will be to explore and adapt the quality tools and techniques to the e-commerce environment. For example, as Duffy and Dale (2002) report, QFD can be used to capture the voice of the customer and the data used to build a website that the customer wants; SPC can be employed to monitor the voice of the process, to check if the processes are in control and provide guidance for improvement; and design of experiments can be used to find the optimum interaction of technical features in a site with marketing requirements.

   There will be an increasing emphasis on the use of an evidential reasoning approach and multiple attribute decision methods by researchers into quality management issues. Yang et al. (2001) show how these methods have been used in the self-assessment process against the criteria of the EFQM model to help minimize scoring variation.

2 A considerable number of organizations have based their quality systems on the ISO 9000 series of quality standards (Chapter 8), or those of a major purchaser (e.g. QS 9000) and remain stuck on this quality management foundation stone. Looking forward, organizations without an ISO 9001 certificate of registration will find it increasingly difficult to do business in the world marketplace. However, this series of quality management system standards should be regarded by organizations as the minimum, and the objective should be to surpass the specified requirements. In particular, the challenge is to develop effective preventative disciplines and mechanisms and ensure that these drive continuous improvement and broaden the vision from being merely a paperwork system audit.

3 The impact of corporate culture on TQM and Strategic Process Improvement and vice versa needs to be fully evaluated. Amongst the issues that need to be examined are:
   - How does an organization develop its culture so that everyone is committed to continuous improvement?
   - What is the best means of managing the change process?
   - Did those companies which are successful with TQM and Strategic Process Improvement have a culture, prior to its introduction, different from that typified by traditionally managed companies?
   - What is the effect of national cultures on TQM and Strategic Process Improvement?
4 There will be a greater focus on process streams linked directly to customer groups and suppliers, replacing the traditional function-oriented structure. The challenge will be to integrate these process streams owned by different business organizations and align them to satisfy the requirements of a common end-user and to exploit specific market opportunities.
5 The best means of managing and organizing across a number of sites and locations is an issue being faced by many businesses with multi-site operations, in particular when this embraces a number of countries. They typically seek answers to questions such as: What is the right type of organization, structure and framework? What are the benefits of a controlled and managed development across sites compared with a 'do as they feel fit' approach? How to cater for site-to-site and country-to-country differences?
6 How to revitalize TQM and Strategic Process Improvement initiatives after a period of stagnation is currently being faced by a number of organizations. Typical issues which organizations are wrestling with include: Why has stagnation occurred? Is it a natural phenomenon? What are the best means of revitalization? Chapter 3 provides some guidance to identifying these problems and what can be done to overcome them. Most people in an organization will know why the initiatives have stagnated, but of more immediate concern is what is the best means of getting it going again and sustaining its momentum. This will continue in the future, with management coping with the effects of redundancy, recession, organizational restructuring, downsizing and changes in senior management, products, services and process and attempting to minimize the effects of these on improvement efforts.
7 A key concern of major organizations is how to develop effective working relationships with their supplier base and jointly pursue improvement initiatives (Chapter 7). While there have been a number of attempts at this, doubts still remain among some major purchasers about their ability to convert all their suppliers to focus on quality and, where it is possible, the most effective means of achieving it and integrating them into the improvement process. One clear principle for success is that the purchaser must be a good

role model. There is also evidence that some organizations talk partnership but, in practice, do not act it. There are also different kinds of partnerships, and organizations must decide which best suits them and their suppliers. These types of issues are explored in Burnes and Dale (1998); they will continue to dominate the partnership sourcing and supplier development literature.

8 From a quality management perspective e-commerce is still relatively immature. As it develops and starts to flatten the value chain it will be necessary to undertake quality management-related research using this environment as the focus. Preliminary work has already been undertaken in identifying the main quality issues involved in website design (Cox and Dale 2002) and exploring, using the service quality gap model, the key quality factors and determinants in satisfying customers when they interact with businesses over the internet (Cox and Dale 2001).

9 In many countries government legislation and industry accreditation requirements have driven organizations to ensure that they comply with regulations and laws. This has led to a culture that overemphasises proving you are 'doing things right' rather than focusing on 'doing the right things'. As we have already discussed this represents a minimalist approach to quality.

Whilst some of these requirements may be quality driven, the aim of much legislation is to ensure minimum standards are provided to customers.

The challenge is to market improvement initiatives so they are not seen as compliance related and therefore adding little of real value to the organization. The initiatives need to be seen to improve the jobs, and workplace of the employees rather than distracting them from their core work.

10 Management consultants have made an industry out of taking old ideas and recycling them by giving them new titles, which appear to offer something new. Ideas appear to go through roughly 30 year cycles. For example Six Sigma which was first developed in the 1980s has been revitalized in the twenty-first century.

It is important that leaders recognize that organizations and employees can suffer from 'change fatigue' from being subjected to a seemingly endless stream of new (or repackaged) improvement initiatives.

11 Despite a widespread awareness that quality pays, it does not necessarily ensure an organizations survival. Organizations in the more developed economies have gone out of business as they cannot compete with organizations that operate in low cost areas such as Asia and Eastern Europe. The alternative for many organizations is to move their manufacturing or service centres off shore. Home produced goods and service may be of superior design, safety and life span, but in times of fierce competition and financial constraints both consumer and business customers may opt to purchase the cheaper version over a higher quality, but more expensive alternative.

Companies who choose to offer a superior quality product or service may not be able to compete in a price sensitive market. Competing on cost may be the primary business strategy rather than quality. Organizations need to influence the buying behaviour of consumers to purchase on the basis of attributes other than price.

Summary

During the course of the research on TQM and Strategic Process Improvement carried out over the last 25 or so years we have observed and been involved in a large number of initiatives. A number of these have been successful, others not so. What are the reasons for this? The lack of success is certainly not related to the concepts of TQM and Strategic Process Improvement. Rather, it is the way in which these concepts have been introduced. It is surprising how many fundamental mistakes are made by senior managers and their advisers (both internal and external) in relation to issues such as communication, training, infrastructure, teams and projects, involvement and measurement. In addition there is a fundamental failure to stick at the basics and a tendency to become distracted by in-vogue concepts, systems and techniques. These mistakes are avoidable through improved knowledge and understanding of the subject and better planning. We hope this book will assist on all three counts.

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