

The Management of Quality and its Control

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Contents

Introduction	ix
1 The concept and the definition of quality	1
1.1 Introduction	1
1.2 The concept of quality	1
1.3 Quality and uncertainty	4
1.4 Quality in manufacturing	6
1.5 Quality and services	10
1.6 A Historical evolution of quality approaches	16
References	22
Appendix 1.A	24
2 Total Quality Management	27
2.1 Introduction	27
2.2 Measurements and controls in TQM	32
2.3 Approaches to TQM and quality improvement	43
2.4 Certification and ISO 9000/9004	53
2.5 Examples and applications	57
2.6 Total Productive Maintenance (TPM)	63
2.7 Reengineering and TQM	64
2.8 Implementation	66
References	69
Additional references	71
3 The tools of quality control and its management	73
3.1 Introduction	73
3.2 The tools of TQM	74
3.3 A statistical refresher	91
3.4 The reliability function	111
References	114
Appendix 3.A	115
Appendix 3.B	116
4 Decision theory and the management of quality	121

4.1	Introduction	121
4.2	Formulation of problems under uncertainty	122
4.3	Examples and applications	125
4.4	Decision rules	131
4.5	Bayes rule and Bayesian decision making	138
	References	148
	Additional references	149
	Mathematical appendix	150
5	Inspection and acceptance sampling	153
5.1	Introduction	153
5.2	Acceptance sampling	155
5.3	Rectifying inspection	172
5.4	Variables sampling plans	173
5.5	Inspection in a continuous process	176
5.6	Economic inspection sampling	178
	References	186
	Additional references	187
	Appendix 5.A	188
6	Control charts	191
6.1	Introduction	191
6.2	Process capability	196
6.3	Constructing control charts	202
6.4	Pre-control	217
6.5	Control charts and the ARL	219
6.6	CUSUM Charts	221
6.7	Interpreting charts	225
6.8	Economic control charts	227
6.9	The practice of control charts	228
	References	233
	Additional references	234
	Appendix 6.A	235
7	Experimental and robust design	239
7.1	Introduction	239
7.2	The experimental design approach	241
7.3	Experimental design	249
7.4	Factorial experiments	255
7.5	Robust design	289
	References	309
	Additional references	312
	Appendix 7.A	312
	Appendix 7.B	320

8 Strategic issues, producer-supplier relationships and the economics of quality	323
8.1 Introduction	323
8.2 Strategic issues and quality management	325
8.3 Audits and why do we have problems?	331
8.4 Contract and producer supplier relationships	337
8.5 Quality and contracts: In practice	339
8.6 Technology and strategic quality management	350
8.7 Information technology and quality	354
References	357
Appendix 8.A	358
Appendix 8.B	366
9 The control of quality in a temporal setting	369
9.1 Introduction	369
9.2 CSP, MA, EWMA, ARIMA and other models	369
9.3 Filtering and the management of quality	380
9.4 Applications	388
9.5 Control of the Range Process	391
9.6 Design of control schemes and economic charts	393
9.7 Other problems	395
References	399
Index	403

Introduction

Throughout the management literature, as elegantly trumpeted by management consultants and gurus, there seems to be a common message: *for a firm to be competitive it must produce quality goods or services*. This means that firms, to remain competitive, must at the same time produce at the least cost possible to be price competitive and deliver high quality products and services. As a result, quality has become strategic overnight, involving *all*, both in and out of the firm, in the management of its interfaces with clients and the environment. To give quality, suppliers, buyers, operations and marketing managers, as well as corporate management must become aware of the mutual relationships and inter-dependencies to which they are subjected, so that they will be able to function as a coherent whole. This involves human relations and people problems, organizational design issues, engineering design options, monitoring and control approaches and, most of all, a managerial philosophy that can integrate, monitor and control the multiple elements which render the firm a viable quality producing and profitable whole.

To realize the benefits of quality it is imperative that we design products to be compatible with market needs, market structure, competition and, of course, that we are constantly aware and abreast of consumers' tastes and the manufacturing technologies that are continuously emerging. It is also imperative that we design our manufacturing environment and tools by integrating the management of quality and that of quantity, both in the factory floor and in managing the manufacturing interfaces with consumers, suppliers, technology, government and all the myriad of business functions to which manufacturing relates. It is also necessary to integrate the process of product design and manufacture with that of post-sales management and services, so that greater profitability is achieved. As a result, the management of quality becomes pluri-disciplinary, involving simultaneously the many facets of management, men, machines and materials. The emerging broad framework underlying the management of quality, much more in tune with consumer desires, provides intellectual, managerial and operational challenges which require that far greater attention be given to the study and modelling of quality-related management processes and how they affect an organizations' performance.

The purpose of this book is to deal with the management of quality and

its control. Unlike the important contributions of 'Quality management and control theorists' such as Deming, Juran, Duncan, Leavenworth, Wetherhill, Montgomery, John and many others, this book adopts managerial and modelling points of view, seeking to integrate quality and its control in the basic managerial functions of the firm and, as a result, to reach a better design and appreciation of quality management-related functions. The recent growth of books in quality control, total quality management, experimental and robust design have spearheaded a new sensitivity to the management of quality, and a spirit of managerial integration. Nevertheless, the development of models which allow a commensurate understanding of inspection, assurance and control processes have been lacking. For these reasons, a modelling approach, illustrated by many examples and exercises dealing with problems often discussed in quality management books, but rarely integrated explicitly in models, is emphasized. For example, models for the assessment, management and control of services are developed, and models for integrating quality-related issues in an industrial strategy are presented and discussed. Attention is devoted to the control of quality in technology-intensive manufacturing systems. New ideas for the control of quality incentive contracts (based on game theory) are introduced. Through such ideas, we develop a greater understanding for the application of quality control tools in a conflictual environment (as exists in some producer supplier contracts). We also construct a framework for the control of quality in an organizational framework by introducing and elaborating on the effects of information, and the asymmetry of information, in organizations on the management of quality. Applications such as the control of quality in franchises and producer supplier management are then highlighted. To properly apply methods of statistical control, experimental and robust design and the economic evaluation of quality programs and control schemes, we devote particular attention to the foundations in statistics and decision making under uncertainty. The study of these tools is illustrated through quality management examples. Of course, much further knowledge in probability and statistical theory would be useful, but the current availability of software packages in quality control and in experimental design simplifies these quantitative requirements. There are many issues, both in planning experiments and in analysing data, which require expert statistical advice. While this book does not give a complete treatment of these topics, it provides a basic and working knowledge which is necessary to communicate with statisticians. Some topics are not covered at all in this text, but can be found elsewhere. For example, problems of statistical data analysis, linear and multiple linear regression, analysis of variance and non parametric statistics, although important in statistical quality control and experimental design, are barely covered. It is, therefore, essential that such topics are studied as well, prior to or following this book. The book has a planned 'unevenness', assuming for the most part

little quantitative background, while in certain places it deals with certain problems quantitatively. These topics can be skipped by the quantitatively unmotivated reader without losing the book's continuity. These topics are, nevertheless, important, as they clearly point out to the mutual relevance and importance of basic management science and quality tools.

The book is divided into three parts. The first part introduces the basic concepts, definitions and the management of total quality (or TQM Total Quality Management). Concepts are defined and expanded. In addition, learning, quality improvement and other factors of importance in applying a program of TQM are briefly discussed, with further study in subsequent chapters. We review a number of applications and approaches to quality management, such as Deming, Juran, Crosby, and the Japanese and European approaches. At the same time, we develop the underlying foundations of TQM embedded in data collection, measurement and communication. A number of applications by some leading firms are also used as case studies.

The second part of the book is oriented towards techniques. We first provide a brief overview of a managerial tool-kit applied in the management of quality, including Pareto charts, Fish bone or cause effect diagrams. In addition, methods such as FMECA, quality circles, and so on, are presented, linking these tools with the underlying industrial and managerial strategies upon which they are based. After a review of statistical and decision theory principles, motivated through a large number of quality management and control examples, we consider the basic SQC/SPC tools. The managerial and quantitative approach to acceptance sampling, to control charts, to experimental and robust design, to Taguchi's techniques and, finally, to RSM-Response Surface Methodology are outlined.

In part three, we consider application areas of particular importance in quality management. The applications and themes considered include among others, the control of quality in producer supplier contractual agreements, quality in franchises and in various organizational structures, strategic issues and approaches to quality management and reengineering, and quality in a technology-intensive manufacturing environment. Finally, we consider intertemporal issues in the control of quality. This last chapter is of an advanced nature, however, and provides further study for some of the topics covered in the book. Through such application areas, the book opens up a broader perspective to both the study of quality management and its control and application.

The book is intended as a textbook in 'Quality management and its control' for courses given in business and industrial engineering schools. It is also intended for advanced students and academics who, on the one hand, find the technical texts of quality control limited and the broad managerial texts on TQM not specific enough. The technical level of the book is intermediate but will be accessible to second year MBA students,

industrial engineers and students, and professionals and managers with a year's background in statistics and probability theory. Many sections of the book do not require any previous such background however and provide an introduction to management models for quality control. Other sections, however, may require some prior technical background. These can, of course, be bypassed by the unprepared reader without loss of continuity.

It is impossible to thank all those who have helped and encouraged me to write this book. Throughout this project, I have been helped by my students at ESSEC (Ecole Superieure des Sciences Economiques et Commerciales), at the Universite Louis Pasteur (Strasbourg), Case Western Reserve University in Cleveland, Ohio, where my interest in the management of quality began, Ecole des Mines Nantes, the University of Washington in Seattle and the University of Texas in Austin. Many colleagues have made many suggestions which I have included in the book. Some of these include Pillar Arroyo at Monterey Tech (Mexico), who shared her practical experience of experimental design, Leon Lasdon, Peter John and Jim Dyer at the University of Texas, Frank van der Duyn Schouten at Tilburg University, Diane Reyniers at the London School of Economics, Vincent Giard at the University of Paris I, Menahem Berg at Haifa University, Morton Posner at the University of Toronto, Elizabeth Murf at the University of Texas, and so many others who have made useful suggestions in the professional meetings where I had the opportunity to present some of the ideas in this book. The Economic Union Human Mobility grant given to ESSEC and other European universities, for the study of quality, maintenance and reliability, has also been a major source of encouragement and support, providing the opportunity to exchange ideas in these important fields at a European level. My greatest debt, however, is to my children, Daniel, Dafna and Oren, who give me satisfaction and happiness, and to whom I dedicate this book.

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