

QUALITY AND RELIABILITY 2

Quality Control for Profit

Second Edition
Revised and Expanded

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QUALITY AND RELIABILITY

A Series Edited by

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1. Designing for Minimal Maintenance Expense: The Practical Application of Reliability and Maintainability, *Marvin A. Moss*
2. Quality Control for Profit, Second Edition, Revised and Expanded, *Ronald H. Lester, Norbert L. Erick, and Nancy E. Mottley, Jr.*

In preparation

Statistical Quality Control, *Steven M. Zimmerman and Lio M. Conrad*

Quality by Experimental Design, *Thomas B. Baker*

Quality Management Handbook, *edited by Loren Walsh, Ralph Wurster, and Raymond J. Kimber*

Series Introduction

The genesis of modern methods of quality and reliability will be found in a simple memo dated May 16, 1924, in which Dr. Walter A. Shewhart of Western Electric Co. proposed the control chart for the analysis of inspection data. This led to a broadening of the concept of inspection from emphasis on detection and correction of defective material to control of quality through analysis and prevention of quality problems. Subsequent concern for product performance in the hands of the user stimulated development of the systems and techniques of reliability. Emphasis on the consumer as the ultimate judge of quality serves as the catalyst to bring about the integration of the methodology of quality with that of reliability. Thus, the innovations that came out of the control chart spawned a philosophy of control of quality and reliability that has come to include not only the methodology of the statistical sciences and engineering, but also the use of appropriate management methods together with various motivational procedures in a concerted effort dedicated to quality improvement.

This series is intended to provide a vehicle to foster interaction of the elements of the modern approach to quality including statistical applications, quality and reliability engineering, management, and motivational aspects. It is a forum in which the subject matter of these various areas can be brought together to allow for effective integration of appropriate techniques. This will promote the true benefit of each which can only be achieved through their interaction. In this sense, the whole of quality and reliability is greater than the sum of its parts, as each element augments the others.

The contributors to this series have been encouraged to discuss fundamental concepts as well as methodology, technology, and procedures at the

leading edge of the discipline. Thus, new concepts are placed in proper perspective in these evolving disciplines. The series is intended for those in manufacturing, engineering, marketing, and management as well as the consuming public, all of whom have an interest and a stake in the improvement and maintenance of quality and reliability in the products and services that are the lifeblood of the economic system.

The modern approach to quality and reliability concerns excellence: excellence when the product is designed, excellence when the product is made, excellence as the product is used, and excellence throughout its lifetime. But excellence does not result without effort, and products and services of superior quality and reliability require an appropriate combination of statistical, engineering, management, and motivational effort. This effort can only be directed for maximum benefit in light of timely knowledge of approaches and methods that have been developed and are available in these areas of expertise. Within the covers of this series, the reader will find the means to create, control, correct, and improve quality and reliability in ways that are cost effective, that enhance productivity, and that create a motivational atmosphere that is harmonious and constructive. It is dedicated to that end and to the readers whose study of quality and reliability will lead to greater understanding of their products, their processes, their workplace, and themselves.

Edward G. Schilling

Preface to the Second Edition

World-wide competition based on both price and quality has forced survival and growth conscious managements everywhere to realize that quality and reliability of product and processing require priority concern. With the growth of this awareness and experience in applying quality control methods, producers have learned to respect the powerful economic gains attainable from a good quality control program aided by statistical methods in the tasks of problem identification, analysis, and resolution. The principal lessons of such a program are:

- A product made right the first time does not incur scrap, rework, repairs, customer complaints, returns and allowances.
- A part made to high uniformity during one process can be made better more easily at the next stage, since a uniform product permits closer settings and adjustments of equipment.
- Uniformity gains from each stage accrue over all stages, resulting in a dramatically better quality and reliability in the final product.
- Cost savings in terms of material not wasted, labor spent on productive rather than repair work, and the morale value of worker participation in the quality-cost-productivity drive can be tremendous.

But the story does not end with production. A quality controlled product is a more saleable product! A salesperson who does not have to visit a customer to receive complaints can spend time more constructively, with better motivation to sell. And as product quality reputation grows, as people gain confidence in the reliability of a firm's processing methods and output, their inclination to purchase from that organization grows. Moreover, the

costs saved by an effective quality control program permit highly competitive pricing in the marketplace.

It is up to management to achieve the atmosphere, climate, and motivation to promote a healthy, growing program of statistical process control towards quality and reliability products. From top executives down to the supervisory level and beyond, good management of quality means that the essentials of methods and procedures that have worked are understood. Some firms even go to the extent of providing courses for all those who work in production and must adjust equipment on the basis of gaging or other measurements, since making good adjustments requires an understanding of the statistical nature of variability and how this can affect individual readings and averages.

The new edition is designed as a guide to management in achieving effective operations under today's highly competitive quality, cost, and productivity conditions. Improvements on the first edition include:

1. Revision or enlargement of individual chapters to include newer concepts and techniques.
2. Chapter 25, *Principal Statistical Methods of Quality Control*, has been greatly expanded, adding essential material needed by management, supervision, and, preferably, the operator involved in quality.
3. Six new chapters round out the reader's understanding of quality control: Reliability – quality in the time dimension – and its essential concepts and methods has been covered.
4. Extensions of quality control to financial and administrative areas are illustrated. These show how management can increase profitability by applying statistical quality control techniques to broader areas of the organization. Moreover, these applications should enhance management confidence in the entire statistical-analytical approach as a valuable organization-wide concern.
5. Service industries' needs for quality control are discussed. Even where a firm is "industrial," it still has areas of function common to service industries, and the applications, methods, and ideas shown may be found highly useful and beneficial.
6. Quality Circles, how to promote them, organize them, help them, and benefit from their participative contributions, are outlined.
7. A chapter on sampling simulation provides detailed material for a work-shop type training seminar, in which interested persons – from top management to the production operator – can experience the nature of data variations, the normal curve, how data tend to interrelate, and how understanding of this material helps judgment and decision making on the basis of sampling information.

8. A final chapter on *Robotics, Automation, and On-Line Control* expands the reader's knowledge of this new technology to quality control.

Throughout, this new edition keeps its emphasis on crisp, clear presentations, avoidance of digressions, and use of practical, illustrative examples.

Ronald H. Lester
Norbert L. Enrick
Harry E. Mottley, Jr.

Preface to the First Edition

Increasing concern for consumer protection and the emphasis on product reliability provide the impetus for management to create effective systems for the control of quality in industry. Initially, management may tend to view these needs as burdensome. However, this attitude will soon give way to approval, when it is shown that major cost savings, energy economies, and profit values accrue. This experience has emerged in program after program.

How are these gains attained? We may note two important factors:

- A cost-effective quality program sets up inspections and tests at strategic locations. These are points at which early detection and correction of product or processing deficiencies will forestall and avoid scrap, rework, repair, as well as customer complaints.
- A quality-controlled product is a more saleable product. In the measure in which the manufacturer's reputation for conformance to specifications at reasonable prices increases, so will customer acceptance and product marketability grow.

Cost savings from avoidance of scrap, rework, repair, and returns have always been welcome. But it is particularly significant today that such savings also mean that scarce materials are not wasted, that labor is used productively rather than for repair and rework, and that energy is conserved when product is designed and produced on the principle of *make it right the first time*. Furthermore, as fewer quality problems are permitted to grow into major ones, delays for repair and rework are avoided, thus aiding production scheduling in meeting promised-delivery dates. Manufacturers and customers will both benefit from smoother production flow and prompt deliveries.

It is from these viewpoints, supported by a wealth of practical illustrations, that this book has been developed. We emphasize the systems approach. Procedures are laid out in detail for the technical and managerial achievement of a well-integrated approach that involves the entire organization in working towards objectives of acceptable quality within a context of cost savings and profitability.

A large and important part of modern quality control and reliability assurance is concerned with statistical methods for the development of product sampling plans, process control charts and other analytical phases. We refer to these statistical techniques and give basic computational detail. Predominantly, however, we emphasize the technical/technological and operational procedures, the involvement of all management and staff functions, and the total systems approach in cost-effective, energy-economic and sales-building quality control.

The authors wish to extend their appreciation to Mr. Loren M. ("Chick") Walsh, editor of *QUALITY* (Hitchcock Publishing Company, Wheaton, Illinois) who reviewed the original manuscript. Relying on his vast experience and practical know-how in the quality control and editorial fields, he supplied numerous and significant recommendations—all of which helped shape the final form of this book. Responsibility for any deficiencies that may remain are those of the authors.

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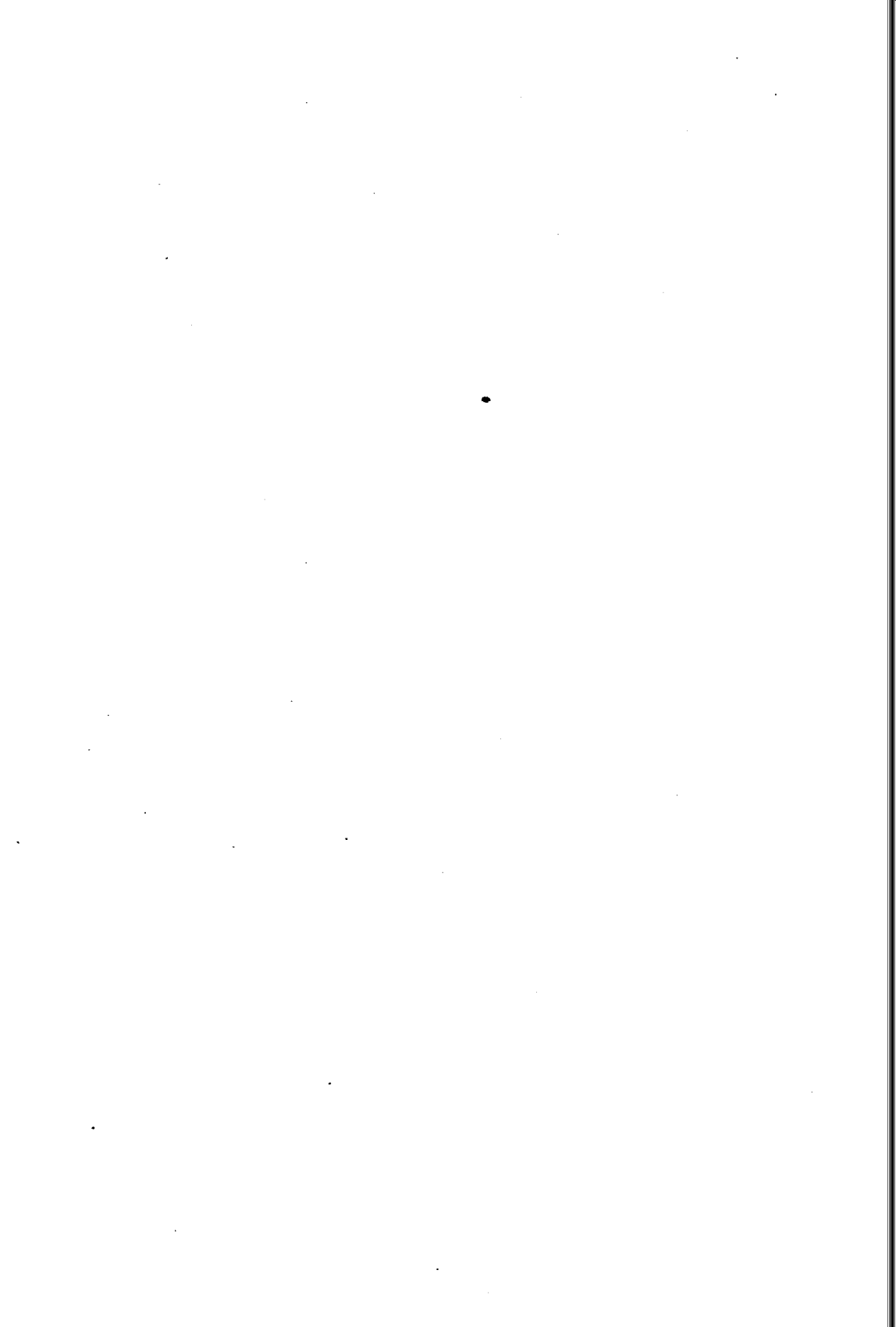
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PART I

The Basic Program for Quality Control



Organization for Quality Control

The term *quality control* refers to a system within a manufacturing plant or other organization, by which assurance is sought that the output produced conforms to specific parameters that define product or service quality. An effective quality control program not only assures management that good product quality can be attained and maintained; it also reduces costs and enhances productivity. Effective organization is needed as a framework within which a company can operate toward these goals. This includes adequate communication and the avoidance of gaps or conflicts in activities and responsibilities. It is thus appropriate to begin this book with a consideration of the principles of good organization for quality control. We stress the concept of a self-governing organization.

Self-Governing Organization

A self-governing organization is one in which feedback and control mechanisms serve to attain and maintain desired goals. In particular, (1) the outputs of the system are monitored continuously and (2) the information gained serves to modify inputs and operations toward stated aims.

For a quality control program, the goal is an end product of acceptable quality at competitive costs. The organization established must thus coordinate consumer-oriented marketing and sales efforts with production, engineering, and design operations. Quality, cost, and productivity are all considered at the same time. The communication of customer needs to the production department, via the marketing and sales organization, provides the key data for needed revisions in production, engineering, and design. These relationships are outlined in Fig. 1-1.

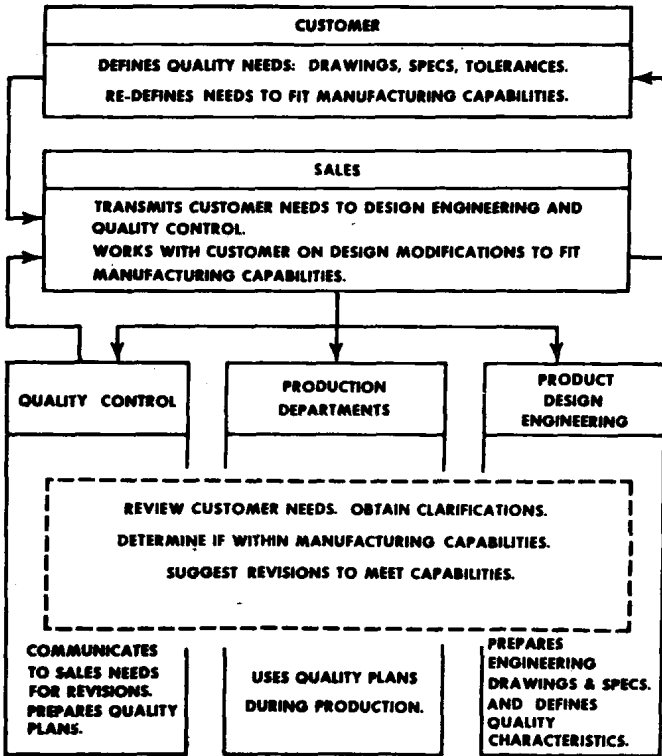


Fig. 1-1. Design of a self-governing quality control organization. Emphasis is on multiple communication within-house and with customers via the sales department. Customer needs are integrated with manufacturing capabilities.

Organization Chart

While quality control functions can be fitted into an organization in many ways, one of the most effective is to place quality control at a level equal to such other functions as shop operations, personnel, and manufacturing engineering. In this type of staff structuring, illustrated in Fig. 1-2, the quality control manager reports to the factory manager as an integral part of the production function of the organization. Although not shown specifically on the diagram, it is customary for the factory manager, design engineering manager, and sales manager to report to the president of the company. A good balance between the forces representing quantity and quality of output results. Moreover, this form of organization encourages the pursuit of the following major objectives through quality control: