

# The definitive guide to organizational excellence—completely updated

Fully revised for the latest American Society for Quality (ASQ) Certified Manager of Quality/Organizational Excellence (CMQ/QE) Body of Knowledge, *The Handbook for Quality Management: A Complete Guide to Operational Excellence*, Second Edition offers in-depth guidance on effectively applying the principles of quality management in today's business environment and delivering superior results. Designed to help you prepare for and pass the ASQ CMQ/QE exam, this authoritative volume also serves as an essential on-the-job reference.

Coverage includes:

- Business-integrated quality systems
- Organizational structures
- The quality function
- Approaches to quality
- Customer-focused organizations
- Integrated planning
- Strategic planning
- Understanding customer expectations and needs
- Benchmarking
- Organizational assessment
- Process control
- Quantifying process variation
- Quality audits
- Supply chain management
- Continuous improvement
- Effective change management
- Six Sigma methodology, including detailed descriptions of the DMAIC and DMADV approaches
- Management of human resources
- Motivation theories and principles
- Management styles
- Resource requirements to manage the quality function

Follow us on Twitter @MHengineering

Learn more.  Do more.  
MHPROFESSIONAL.COM

ISBN 978-0-07-179924-9  
MHID 0-07-179924-9



9 780071 799249

THE HANDBOOK FOR  
Quality Management

SECOND EDITION

Pyzdek  
Keller

Mc  
Graw  
Hill

SECOND EDITION

Mc  
Graw  
Hill

# THE HANDBOOK FOR QUALITY MANAGEMENT

*A Complete Guide to  
Operational Excellence*

Thomas Pyzdek  
Paul Keller



Cataloging-in-Publication Data is on file with the Library of Congress.

McGraw-Hill books are available at special quantity discounts to use as premiums and sales promotions, or for use in corporate training programs. To contact a representative please e-mail us at [bulksales@mcgraw-hill.com](mailto:bulksales@mcgraw-hill.com).

**The Handbook for Quality Management**

Copyright © 2013 by The McGraw-Hill Companies, Inc. All rights reserved. Printed in the United States of America. Except as permitted under the United States Copyright Act of 1976, no part of this publication may be reproduced or distributed in any form or by any means, or stored in a data base or retrieval system, without the prior written permission of the publisher.

1 2 3 4 5 6 7 8 9 0 DOC/DOC 1 9 8 7 6 5 4 3 2

ISBN 978-0-07-179924-9  
MHID 0-07-179924-9

The pages within this book were printed on acid-free paper.

|  |   |
|--|---|
| <b>Sponsoring Editor</b><br>Judy Bass                                  | <b>Proofreader</b><br>Surendra Nath Shivam, Cenveo Publisher Services |
| <b>Acquisitions Coordinator</b><br>Bridget Thoreson                    | <b>Indexer</b><br>ARC Films Inc.                                      |
| <b>Editorial Supervisor</b><br>David E. Fogarty                        | <b>Production Supervisor</b><br>Pamela A. Pelton                      |
| <b>Project Manager</b><br>Vastavikta Sharma, Cenveo Publisher Services | <b>Composition</b><br>Cenveo Publisher Services                       |
| <b>Copy Editor</b><br>Kate Bresnahan                                   | <b>Art Director, Cover</b><br>Jeff Weeks                              |

Information contained in this work has been obtained by The McGraw-Hill Companies, Inc. ("McGraw-Hill") from sources believed to be reliable. However, neither McGraw-Hill nor its authors guarantee the accuracy or completeness of any information published herein, and neither McGraw-Hill nor its authors shall be responsible for any errors, omissions, or damages arising out of use of this information. This work is published with the understanding that McGraw-Hill and its authors are supplying information but are not attempting to render engineering or other professional services. If such services are required, the assistance of an appropriate professional should be sought.

# Contents

Preface ..... xi

**Part I Business-Integrated Quality Systems**

**1 Organizational Structures** ..... 3  
 General Theory of Organization Structure ..... 5  
 The Functional/Hierarchical Structure ..... 6  
 Matrix Organizations ..... 8  
 Cross-Functional Organization Structure ..... 9  
 Process- or Product-Based (Horizontal) Organization Structures ..... 10  
 Forms of Organization ..... 12

**2 The Quality Function** ..... 15  
 Juran Trilogy ..... 17  
 Related Business Functions ..... 23  
     Safety ..... 23  
     Regulatory Issues ..... 24  
     Product Liability ..... 24  
 Environmental Issues Relating to the Quality Function ..... 28

**3 Approaches to Quality** ..... 31  
 Deming's Approach ..... 34  
 Total Quality Control in Japan ..... 36  
 ISO 9000 Series ..... 41  
 Malcolm Baldrige National Quality Award ..... 45  
 Deming Prize ..... 48  
 European Quality Award ..... 49  
 Total Quality Management (TQM) ..... 51  
 Six Sigma ..... 52

**4 Customer-Focused Organizations** ..... 57

**Part II Integrated Planning**

**5 Strategic Planning** ..... 65  
 Organizational Vision ..... 67  
 Strategy Development ..... 69



|  |            |
|--|------------|
| Strategic Styles .....                                       | 71         |
| Possibilities-Based Strategic Decisions .....                | 72         |
| Strategic Development Using Constraint Theory .....          | 74         |
| The Systems Approach .....                                   | 75         |
| Basic Constraint Management Principles<br>and Concepts ..... | 78         |
| Tools of Constraint Management .....                         | 87         |
| Constraint Management Measurements .....                     | 98         |
| <b>6 Understanding Customer Expectations and Needs .....</b> | <b>105</b> |
| Customer Classifications .....                               | 108        |
| Customer Identification and Segmentation .....               | 110        |
| Collecting Data on Customer Expectations and Needs .....     | 113        |
| Customer Service and Support .....                           | 114        |
| Surveys .....  | 117        |
| Focus Groups .....   | 127        |
| <b>7 Benchmarking .....</b>                                  | <b>129</b> |
| Getting Started with Benchmarking .....                      | 132        |
| Why Benchmarking Efforts Fail .....                          | 134        |
| <b>8 Organizational Assessment .....</b>                     | <b>137</b> |
| Assessing Quality Culture .....                              | 139        |
| Organizational Metrics .....                                 | 140        |
| Cost of Quality .....  | 142        |

---

### Part III Process Control

|   |            |
|---|------------|
| <b>9 Quantifying Process Variation .....</b>          | <b>153</b> |
| Descriptive Statistics .....                          | 155        |
| Enumerative and Analytic Studies .....                | 155        |
| Acceptance Sampling .....                             | 158        |
| Statistical Control Charts .....                      | 160        |
| Variable Control Charts .....                         | 165        |
| Control Charts for Attributes Data .....              | 176        |
| Control Chart Selection .....                         | 189        |
| Control Chart Interpretation .....                    | 190        |
| Using Specifications for Process Control .....        | 196        |
| Process Capability Studies .....                      | 200        |
| How to Perform a Process Capability Study .....       | 200        |
| Statistical Analysis of Process Capability Data ..... | 202        |
| Interpreting Capability Indexes .....                 | 205        |

|  |            |
|--|------------|
| <b>10 Quality Audits .....</b>                               | <b>209</b> |
| Types of Quality Audits .....                                | 212        |
| Product Audits .....   | 212        |
| Process Audits .....   | 214        |
| Systems Audits .....   | 214        |
| Internal Audits .....  | 215        |
| Two-Party Audits .....                                       | 215        |
| Third-Party Audits .....                                     | 215        |
| Desk Audits .....  | 216        |
| Planning and Conducting the Audit .....                      | 216        |
| Auditor Qualifications .....                                 | 217        |
| Internal Quality Surveys as Preparation .....                | 218        |
| Steps in Conducting an Audit .....                           | 218        |
| Audit Reporting Process .....                                | 219        |
| Post-Audit Activities (Corrective Action, Verification) .... | 220        |
| Product, Process, and Materials Control .....                | 221        |
| Work Instructions .....                                      | 221        |
| Classification of Characteristics .....                      | 223        |
| Identification of Materials and Status .....                 | 224        |
| Purchased Materials .....                                    | 224        |
| Customer-Supplied Materials .....                            | 224        |
| Work-in-Process (WIP) .....                                  | 224        |
| Finished Goods .....   | 225        |
| Lot Traceability .....                                       | 225        |
| Materials Segregation Practices .....                        | 225        |
| Configuration Control .....                                  | 225        |
| Deviations and Waivers .....                                 | 226        |
| <b>11 Supply Chain Management .....</b>                      | <b>227</b> |
| Scope of Vendor Quality Control .....                        | 230        |
| Evaluating Vendor Quality Capability .....                   | 230        |
| Vendor Quality Planning .....                                | 233        |
| Post-Award Surveillance .....                                | 234        |
| Vendor Rating Schemes .....                                  | 235        |
| Special Processes .....                                      | 236        |
| Partnership and Alliances .....                              | 237        |

---

### Part IV Continuous Improvement

|   |            |
|---|------------|
| <b>12 Effective Change Management .....</b> | <b>243</b> |
| Roles .....                                 | 246        |
| Goals .....                                 | 247        |



|  |            |
|--|------------|
| Mechanisms Used by Change Agents .....           | 248        |
| Building Buy-in .....                            | 248        |
| Project Deployment .....                         | 254        |
| Selecting Projects .....                         | 254        |
| DMAIC/DMADV Methodology .....                    | 262        |
| <b>13 Define Stage .....</b>                     | <b>265</b> |
| Project Definition .....                         | 267        |
| Work Breakdown Structure .....                   | 268        |
| Pareto Diagrams .....                            | 269        |
| Project Charters .....                           | 270        |
| Resources .....                                  | 281        |
| Top-Level Process Definition .....               | 285        |
| Team Formation .....                             | 285        |
| Team Dynamics Management, Including Conflict     |            |
| Resolution .....                                 | 287        |
| Stages in Group Development .....                | 288        |
| Common Team Problems .....                       | 289        |
| Productive Group Roles .....                     | 289        |
| Counterproductive Group Roles .....              | 290        |
| Management's Role .....                          | 292        |
| <b>14 Measure Stage .....</b>                    | <b>293</b> |
| Process Definition .....                         | 295        |
| Metric Definition .....                          | 296        |
| Establishing Process Baselines .....             | 297        |
| Measurement Systems Analysis .....               | 298        |
| Levels of Measurement .....                      | 298        |
| Definitions .....                                | 301        |
| <b>15 Analyze Stage .....</b>                    | <b>305</b> |
| Value Stream Analysis .....                      | 307        |
| Analyze Sources of Process Variation .....       | 314        |
| Quality Function Deployment .....                | 315        |
| Cause-and-Effect Diagrams .....                  | 318        |
| Scatter Diagrams .....                           | 319        |
| Determine Process Drivers .....                  | 324        |
| Correlation and Regression Analysis .....        | 324        |
| Least-Squares Fit .....                          | 326        |
| Interpretation of Computer Output for Regression |            |
| Analysis .....                                   | 328        |

|  |            |
|--|------------|
| Analysis of Residuals .....                            | 330        |
| Designed Experiments .....                             | 331        |
| <b>16 Improve/Design Stage .....</b>                   | <b>335</b> |
| Define New Operating/Design Conditions .....           | 337        |
| Define and Mitigate Failure Modes .....                | 340        |
| Process Decision Program Chart .....                   | 340        |
| Preventing Failures .....                              | 340        |
| Failure Mode and Effects Analysis .....                | 344        |
| <b>17 Control/Verify Stage .....</b>                   | <b>349</b> |
| Performance Evaluation .....                           | 352        |
| Recognition and Reward .....                           | 353        |
| Principles of Effective Reward Systems .....           | 355        |
| Training .....   | 356        |
| Job Training .....                                     | 357        |
| Developing a Structured OJT Program .....              | 358        |
| Instructional Games, Simulations, and Role-Plays ..... | 359        |

---

## Part V Management of Human Resources

|  |            |
|--|------------|
| <b>18 Motivation Theories and Principles .....</b>                 | <b>367</b> |
| Maslow's Hierarchy of Needs .....                                  | 369        |
| Herzberg's Hygiene Theory .....                                    | 370        |
| Theories X, Y, and Z .....   | 370        |
| <b>19 Management Styles .....</b>                                  | <b>373</b> |
| Judgmental Management Style .....                                  | 375        |
| Data-Based Management Style .....                                  | 375        |
| Combination Data-Based/Judgment Management                         |            |
| Style .....  | 376        |
| Participatory Management Style .....                               | 376        |
| Autocratic Management Style .....                                  | 377        |
| Management by Wandering Around .....                               | 377        |
| Fourth Generation Management .....                                 | 378        |
| The Fifth Discipline .....   | 379        |
| <b>20 Resource Requirements to Manage the Quality Function ...</b> | <b>381</b> |
| Performance Evaluation .....                                       | 385        |
| Traditional Performance Appraisals .....                           | 385        |
| Criticisms of Traditional Employee Appraisals .....                | 386        |
| Alternatives to Traditional Appraisals .....                       | 388        |



|   |            |
|---|------------|
| Professional Development .....                        | 393        |
| Credentials .....                                     | 393        |
| Professional Certification .....                      | 393        |
| Professional Development Courses .....                | 394        |
| Achieving the Goals .....                             | 395        |
| Coaching .....  | 395        |
| Situations That Require Coaching to Improve           |            |
| Performance .....                                     | 396        |
| Forms of Coaching .....                               | 397        |
| <b>A Control Chart Constants .....</b>                | <b>399</b> |
| <b>B Control Chart Equations .....</b>                | <b>403</b> |
| <b>C Area under the Standard Normal Curve .....</b>   | <b>407</b> |
| <b>D Simulated Certification Exam Questions .....</b> | <b>413</b> |
| <b>References .....</b>                               | <b>455</b> |
| <b>Index .....</b>                                    | <b>465</b> |

---

## Preface

Thank you for your interest in McGraw Hill's *The Handbook for Quality Management*.

The original version of the text, first released in 1996 by Quality Publishing, was written exclusively by Tom Pyzdek. I had the pleasure of editing a revision released in 2000, which included Six Sigma and Lean method chapters (written by myself), as well as Bill Dettmer's Constraint Management material, which is repeated in this edition. The early editions sold several thousand copies by the end of 2000, establishing the *Handbook* as an essential desktop reference for the quality professional.

The earlier versions relied heavily on the American Society for Quality (ASQ) body of knowledge for quality managers, even to the extent that the chapter headings and sub-headings matched those in the body of knowledge. Although this may have helped those seeking to check off items they learned, it tended to disrupt the flow of the topics. A main objective of *this* edition was the reorganization of the material into more naturally flowing discussions of the concepts and methods essential to quality management and operational excellence. For those who want to use this as a reference for the ASQ CMQ/OE exam, the information is still in the book, with sample questions at the back, and answers available on the affiliated website: [www.mhprofessional.com/HQM2](http://www.mhprofessional.com/HQM2)

The essential body of knowledge for achieving operational excellence is heavily influenced by the works of Deming and Juran, most of which date from the period of 1950 through the mid 1980s. These authors spent their careers advocating a scientific approach to quality, displacing the widely held notion that quality assurance inspections prevalent in the post-war era were sufficient or even credible approaches to achieving quality.

Over the last 40 years, the quality management discipline has undergone steady evolution from internally focused command-and-control to more proactive, customer-focused functions. The market certainly encouraged that, as economies shifted from dominance of product-based manufacturers