

# CREATING Quality

*Process Design for Results*

William J. Kolarik



# CREATING QUALITY

## *Process Design for Results*

**William J. Kolarik**  
*Texas Tech University*



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## CREATING QUALITY: PROCESS DESIGN FOR RESULTS

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# PREFACE

Processes are essential. We can do nothing, and accomplish nothing, without a process—ad hoc or carefully defined, designed, controlled, and implemented. Therefore, it seems reasonable to study processes systematically, from perspectives of definition/redefinition, control, and improvement.

## BACKGROUND

Evidence is available to suggest that we sometimes focus on the glitter and promise of the latest technical and business initiatives to the exclusion of fundamental core technical/business issues and practices. Examination of textbooks and professional reference books suggests that this is so, as do direct observations of the manner in which we conduct our affairs. It is disheartening to observe an organization where more emphasis is placed on command of the latest buzzwords, initiatives, and tools than on fundamental processes and their products, relative to customer outcomes and business results. *Creating Quality: Process Design for Results* serves as a compass in redirecting our energy and creative abilities toward understanding and mastering fundamental processes.

*Creating Quality: Process Design for Results* aligns itself with both academics and professional practice. It addresses the fundamental processes used to create quality. These processes were originally introduced in Chapter 1 of the author's earlier book, *Creating Quality: Concepts, Systems, Strategies, and Tools*. This present book, *Creating Quality: Process Design for Results*, presents a detailed view of processes in terms of (1) process definition/redefinition, the conceptual essence of a process, (2) process control, in terms of both monitoring and adjustment, (3) process improvement in terms of continuous improvement, and (4) transformation to process-based organizations.

*Creating Quality: Process Design for Results* and *Creating Quality: Concepts, Systems, Strategies, and Tools* are complementary works. They can be used together or separately. Each is capable of standing on its own merits; both together provide wider perspectives.

## PURPOSE

The purpose of *Creating Quality: Process Design for Results* is to encourage/address natural means of enhancing competitive advantage in a production system. We stress scientifically based, process-related principles and creative thinking, as opposed to checklist and anecdotal approaches. *Creating Quality: Process Design for Results* focuses on processes—the fundamental means available to us to define, design, develop, produce, deliver, sell, use, and dispose or recycle products, and in general create quality and productivity for our customers and prosperity for our stakeholders and ourselves.

*Creating Quality: Process Design for Results* places the process—definition/redefinition, control, and improvement—in the foreground, and places initiatives and tools in the background. Initiatives and tools are not without value; to the contrary, they are invaluable when we need them and can use them to help us enhance our core processes in physical, economic, timeliness, and customer service performance. However, when initiatives and tools begin to drive organizations, a true focus/bearing is lost and ineffectiveness and inefficiency follow. A focus on creating value for customers and stakeholders—through value-created processes and their resulting products—is maintained throughout the book.

## CONTENTS

The materials in *Creating Quality: Process Design for Results* have been defined, designed, and developed with both academic and professional practice requirements in mind. They encourage a holistic view/understanding of a production system and its customers, yet provide for analytical detail in design, control, and implementation. The text points out that optimizing processes in a production system, one at a time, does not typically provide an optimal production system as a whole. All sections together offer a balanced, process-based organizational structure squarely positioned to address this critical issue.

All materials are sectioned to allow and encourage instructors to build a significant hands-on design project element into their instruction. Through design projects, students experience a living, growing, case-based environment. This environment encourages instructors and students to develop the meaningful dialogs necessary to hone cases to the point of mastery. Students stand to gain professional practice-based experience through planning and executing open-ended projects. In addition, the text supports professional practice settings (e.g., workshops), where we use hands-on projects to directly address organizational goals and objectives in real-time, yielding immediate organizational learning and improvement.

*Creating Quality: Process Design for Results* materials allow instructors to deliver a comprehensive course, centered in process definition/redefinition, control, and improvement. The text material allows several options to instructors for building either a one- or two-course sequence relating to production systems and processes. Course materials can be adapted for a wide range of college students, ranging from sophomores to seniors. The course materials, with some supplements, support graduate studies.

Materials are available to present a conceptual course, without significant mathematical prerequisites by focusing on Sections 1, 3, 5, 6, and the conceptual process control elements in Section 4. Highly quantitative approaches can be taken by focusing on Sections 1, 2 and 4, with side trips through Sections 3, 5, and 6. Regardless of course orientation, a case-based approach in any, or all, of the three areas—definition/redefinition, control, and improvement—is capable of producing impressive project portfolios. Trial usage of the materials has produced results well beyond the author's original (ambitious) expectations.

These materials work best in the context of extended team projects that last essentially the entire term, with oral and written/story-board reporting two or three times per term. Heavy emphasis is placed on graphical depictions, with supporting words, rather than the reverse. When we use this approach, we always cover Section 1 first. Then, we survey Chapter 18 with its teaming, leadership, and creativity topics. With the teaming, leadership, and creativity knowledge, we move into the technical sections and our projects. We use the initiatives and tools chapters, Chapters 19 and 20, as needed to support our projects.

A solid, two-course sequence is developed by incorporating all sections, in depth. The first course of this sequence serves as an introduction to process-based thinking and organizations, mostly on a conceptual and project-intensive basis. We use the materials to support a combination of lectures and team-based projects. The concept-based course can appear as early as the sophomore year. It serves to help students grasp the nature of processes and their criticality in our modern production systems, as they obtain the quantitative basis for in-depth process control work.

The second course in this sequence takes on a quantitative nature, focusing primarily on process characterization and control, e.g., Sections 2 and 4. This course requires a basic probability and statistics background, and can appear as early as the junior year. Here, we place the technical aspects of process characterization/exploration and control within the context of the production system, as a complement to process definition/redefinition and improvement.

Throughout the two-course sequence, we emphasize the importance of implementation, in addition to design and planning. The overall effect sought is one of balance, compatible with what students will ultimately experience in professional practice. Provided project portfolios are developed, students can impress potential employers with tangible evidence of their knowledge of and expertise in process issues.

## ACKNOWLEDGMENTS

The *Creating Quality: Process Design for Results* project has drawn deeply from several areas of expertise. These areas are supported by theory and practice. Searching out this information in both literary sources as well as professional practice required considerable time and effort. Many contributors helped and guided the project along.

The final result has taken several twists and turns along the ideation and development paths. Three primary resource groups deserve formal recognition. First, many students, ranging from freshmen to doctoral students, have participated in development work—reading, evaluating, and contributing to these materials. Traditional undergraduate and graduate students, as well as off-campus students, and practicing engineers and managers, shaped

the product—many of the cases developed in the book are a direct result of contributions from students. Explicit case contributions are denoted with initials, [XX], at the end of each contribution.

A second set of contributors have expedited development through their hard work and diligence in helping to write several sections and review the writing of other sections. Specifically, Babu Chinnam, Iulian Gherasoiu, Mehmud Karim, Huitian Lu, Shuxia Lu, Sanjuka Patro, Nawshaba Rahman, Michael Sanders, and Beverly Wiley have contributed many hours to the project. Valuable strategic guidance was provided through several project reviews. Specifically, Pirooz Vakili, *Boston University*; Karl D. Majeseke, *KM Consulting*; Gary S. Wasserman, *Wayne State University*; John R. English, *University of Arkansas*; D. L. Kimbler, *Kimbler Associates Inc.*; Jeremy D. Semrau, *University of Michigan*; Robert R. Safford, *University of Central Florida*; Diane Schaub,

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William J. Kolarik

# CONTENTS

## **SECTION 1**

### **PRODUCTION SYSTEMS AND PROCESS PERFORMANCE 1**

---

#### **Chapter 1**

#### **PRODUCTION SYSTEMS—THE BASICS 2**

- 1.0 Inquiry 2
- 1.1 Introduction and Overview 2
- 1.2 Basics 4
  - Quality 5
  - Productivity 8
  - Quality-Productivity Connection 11
- 1.3 Production System Linkages 13
- 1.4 Cooperative Efforts 14
- 1.5 Organizational Optimization and Synergy 15
- Review and Discovery Exercises 21
- References 23

#### **Chapter 2**

#### **SYSTEMS THINKING—CONCEPTS AND DEVELOPMENT 24**

- 2.0 Inquiry 24
- 2.1 Introduction 24
- 2.2 Analytical and Systems Philosophies 24
- 2.3 Models and Modeling 26
- 2.4 Systems Theory and Thinking 26
  - System Classification 27
  - Systems Thinking 28
  - Adaptations of General Systems Thinking 29
- 2.5 Production Systems 30
  - Craft Production System Paradigm 33
  - Factory Production System Paradigm 33
  - Mass Production System Paradigm 34
  - Lean Production System Paradigm 35
  - Agile Production System Paradigm 36
  - Common Ground 36
- 2.6 Systems Thinking—Science and Engineering 37
- Review and Discovery Exercises 40
- References 41

#### **Chapter 3**

#### **PROCESS FUNDAMENTALS 43**

- 3.0 Inquiry 43
- 3.1 Introduction 43
- 3.2 Process Features and Synergy 43
  - Direction—Production Systems 44
  - Process Definition/Redefinition Concept 45
  - Process Control Concept 45
  - Process Improvement Concept 45
  - Scope—Define/Redefine, Control, Improve 45
  - Synergy 46
- 3.3 Purpose—Goals, Objectives, Targets, Tolerances—  
and Action 47
  - Location and Dispersion 48
- 3.4 Process Structures 51
- 3.5 Production System Views 53
- 3.6 Robust, Mistakeproof, and Benchmark  
Performance 55
  - Robustness 55
  - Mistakeproofing 57
  - Benchmarks 58
  - Review and Discovery Exercises 60

## **SECTION 2**

### **PROCESS CHARACTERIZATION, EXPLORATION, AND RESPONSE MODELING 62**

---

#### **Chapter 4**

#### **PROCESS CHARACTERIZATION 63**

- 4.0 Inquiry 63
- 4.1 Introduction 63
- 4.2 Process Understanding 63
- 4.3 Process Models 65
- 4.4 Process Measurement Scales 67
- 4.5 Process Levers and Leverage 69
- 4.6 Physical Characterization 69
- 4.7 Statistical Characterization 73
  - Data Collection 74
  - Graphical Assessment 75
  - Numerical Assessment 76

Review and Discovery Exercises	87
References	89

## **Chapter 5**

### **PROCESS EXPLORATION 90**

5.0 Inquiry	90
5.1 Introduction	90
5.2 Experimental Protocol	91
5.3 Single-Factor Experiments	92
Single-Factor CRD Models	92
Random Effects Model	96
Fixed Effects Model	100
Prediction and Residual Calculations	102
Treatment Level Interval Analysis (Fixed Effects Factors)	106
Treatment Mean Comparisons (Fixed Effects Factors)	107
5.4 Model Adequacy	109
5.5 Multiple-Factor Experiments	114
Multiple-Factor Analysis of Variance (ANOVA)	114
Pairwise Treatment Comparisons (Fixed Effects Factors)	122
5.6 Summary	124
Review and Discovery Exercises	124
References	125

## **Chapter 6**

### **PROCESS RESPONSE MODELING 126**

6.0 Inquiry	126
6.1 Introduction	126
6.2 Least Squares Estimation	126
Least Squares Estimators	127
Normal Equations	127
6.3 Regression Analysis	128
Regression ANOVAs	129
Response Surface Structure	131
Model Simplification	133
Model Fit and Adequacy	135
6.4 Response Surface Designs	146
$2^f$ with a Center Point	146
Central Composite Design	149
Review and Discovery Exercises	157
References	158

## **SECTION 3**

### **PROCESS DEFINITION AND REDEFINITION 159**

---

## **Chapter 7**

### **PROCESS DEFINITION/REDEFINITION— OUTPUT PERSPECTIVES 160**

7.0 Inquiry	160
7.1 Introduction	160
7.2 Timing, Personnel, and Exposure	163
7.3 Critical Elements	164
7.4 Production System Level Results Definition	164
7.5 Process Level Results Definition	175
Customers	175
Outcomes	177
Concepts	179
Review and Discovery Exercises	185
References	187

## **Chapter 8**

### **PROCESS DEFINITION/REDEFINITION— TRANSFORMATION AND INPUT PERSPECTIVES 188**

8.0 Inquiry	188
8.1 Introduction	188
8.2 Process Means	188
Options	189
Evaluation	194
Plan	198
8.3 Process Creation	210
Resources	210
Schedule	210
Action	213
Review and Discovery Exercises	217



**SECTION 4****PROCESS CONTROL 219****Chapter 9****PROCESS CONTROL—CONCEPTS AND OPTIONS 221**

- 9.0 Inquiry 221
- 9.1 Introduction 221
- 9.2 Critical Elements of Process Control 222
- 9.3 Process Control Options and Growth 224
- 9.4 Process Control Models Overview 227
- 9.5 Introduction to SPC Models 229
- Review and Discovery Exercises 232
- References 233

**Chapter 10****PROCESS MONITORING—VARIABLES CONTROL CHARTS FOR GROUPED MEASUREMENTS 234**

- 10.0 Inquiry 234
- 10.1 Introduction 234
- 10.2 SPC Model Rationale for Variables Data 234
  - SPC Concept 235
  - Subgrouping Rationale 240
- 10.3 Notation for Subgrouped SPC Models 240
  - General Control Chart Symbols 240
  - $R$ ,  $S$ ,  $\bar{X}$ -bar Chart Symbols 241
  - Exponential Weighted Moving Average and Deviation (EWMA and EWMD) Chart Symbols 241
  - Cumulative Sum (CuSum) Chart Symbols 241
- 10.4 Shewhart  $\bar{X}$ -bar,  $R$ , and  $S$  Control Chart Concepts and Mechanics 242
  - Normal Model 242
  - $\bar{X}$ -bar Control Chart Mechanics 242
  - $R$  and  $S$  Control Chart Mechanics 244
- 10.5 Interpretation of Shewhart Control Charts 248
  - Basic Interpretation 249
  - Pragmatic Interpretation 252
- 10.6 Shewhart Control Chart OC Curves and Average Run Lengths 255
- 10.7 Probability Limits for Shewhart Control Charts 256

- 10.8 EWMA and EWMD Control Charts 259
- 10.9 CuSum Control Charts 263
- 10.10 Limited Duration Process Runs 269
  - Deviation from Target Charts 269
  - Standardized Charts 270
  - Limited Duration Process Run Summary 270
- Review and Discovery Exercises 270
- Appendix: OC Curve Construction and ARL Calculations 273
- References 279

**Chapter 11****PROCESS MONITORING—VARIABLES CONTROL CHARTS FOR INDIVIDUAL MEASUREMENTS AND RELATED TOPICS 280**

- 11.0 Inquiry 280
- 11.1 Introduction 280
- 11.2 SPC Model Rationale for Individuals Data 281
- 11.3 Notation for Individuals SPC Models 282
  - General Control Chart Symbols 282
  - $\bar{X}$ ,  $\bar{X}_M$ , and  $R_M$  Chart Symbols 282
  - Exponential Weighted Moving Average and Deviation (EWMA and EWMD) Chart Symbols 283
  - Cumulative Sum (CuSum) Chart Symbols 283
- 11.4  $\bar{X}$ ,  $\bar{X}_M$ , and  $R_M$  Control Chart Concepts and Mechanics 283
- 11.5 EWMA and EWMD Control Charts 291
- 11.6 CuSum Control Charts 294
  - Two-Sided CuSum Charts 295
  - One-Sided CuSum Charts 298
  - CuSum Charting Variations 298
- 11.7 Sampling Schemes 299
- 11.8 Production Source Level Control 300
- 11.9 Target-Based Control Charts 302
- 11.10 Process Capability 303
  - Process Capability Indices 303
  - Interpreting Capability Indices 306
- 11.11 Gauge Studies 309
- Review and Discovery Exercises 313
- Appendix: Additional Capability Indices 317
- References 318

**Chapter 12****PROCESS MONITORING—ATTRIBUTES  
CONTROL CHARTS FOR CLASSIFICATION  
MEASUREMENTS 320**

- 12.0 Inquiry 320
- 12.1 Introduction 320
- 12.2 Defects and Defectives 321
- 12.3 SPC Model Rationale for Attributes Data 322
- 12.4 Notation for Attributes SPC Models 325
  - General Symbols 325
  - P*-Chart Symbols 325
  - C*-, *U*-Chart Symbols 326
  - Binomial Model 326
  - Poisson Model 327
- 12.5 *P* Control Chart Concepts and Mechanics 327
  - P*-Chart Mechanics 328
- 12.6 *C* and *U* Control Chart Concepts and Mechanics 334
  - C*-Chart Mechanics 335
  - U*-Chart Mechanics 337
- 12.7 Process Logs and Pareto Charts 341
- Review and Discovery Exercises 344
- Reference 345

**Chapter 13****PROCESS MONITORING—NONTRADITIONAL  
SPC CONCEPTS AND MODELS 346**

- 13.0 Inquiry 346
- 13.1 Introduction 346
- 13.2 SPC Model Performance Evaluation 347
- 13.3 Performance Assessment with *Nid/lid* Data Streams 348
- 13.4 Performance Assessment with *Non-Nid* Data Streams 354
- 13.5 Introduction to Multivariate SPC Models 365
  - Multivariate SPC Characterization 365
  - $\chi^2$  Multivariate Location Chart—Subgrouped Data 368
  - Hotelling  $T^2$  Multivariate Location Chart—Subgrouped Data 368
  - Sample Generalized Variance Multivariate Dispersion  $|S|$  Chart—Subgrouped Data 375
  - Hotelling  $T^2$  Multivariate Location Chart—Individuals Data 379

Interpretation of Multivariate SPC Charts 380

Other Multivariate Models 381

Review and Discovery Exercises 381

References 384

**Chapter 14****PROCESS ADJUSTMENT—INTRODUCTION  
TO AUTOMATIC PROCESS CONTROL,  
CONVENTIONAL MODELS 385**

- 14.0 Inquiry 385
- 14.1 Introduction 385
- 14.2 Classical Control Concepts 386
- 14.3 Discontinuous/Discrete Control Action 392
- 14.4 Continuous Control Action 397
  - Proportional Control 397
  - Integral Control 401
  - Derivative Control 405
  - PID Control 407
- 14.5 Controller Tuning 407
- 14.6 Transfer Functions and Block Diagram Representation 409
- Review and Discovery Exercises 415
- References 417

**Chapter 15****PROCESS ADJUSTMENT—INTRODUCTION  
TO AUTOMATIC PROCESS CONTROL,  
UNCONVENTIONAL MODELS 418**

- 15.0 Inquiry 418
- 15.1 Introduction 418
- 15.2 Advanced Concepts in Conventional APC 419
  - Cascade Control 419
  - Ratio Control 419
  - Feedforward Control 419
- 15.3 Process Identification and Nonparametric Models 420
  - Mathematical Models 420
  - Dynamic Process Modeling 421
  - Nonparametric Models 422
  - Artificial Neural Networks 422
  - Neural Network Architectures 424
  - Feedforward Networks 424
  - Recurrent Networks 424

Learning in Neural Networks	425
Applications of Neural Networks in Control	425
Expert Systems	426
Evolutionary Computation	428
15.4 Self-Tuning Control	429
15.5 APC/SPC Model Combinations	431
Review and Discovery Exercises	433
References	434

## **SECTION 5**

### **PROCESS ANALYSIS AND IMPROVEMENT 436**

#### **Chapter 16**

#### **PROCESS IMPROVEMENT—QUESTIONING PERSPECTIVES 437**

16.0 Inquiry	437
16.1 Introduction	437
16.2 Critical Elements	439
16.3 Process Improvement Opportunity	443
Observation	443
Concepts	445
Options	451
Review and Discovery Exercises	454

#### **Chapter 17**

#### **PROCESS IMPROVEMENT—ANALYSIS AND IMPLEMENTATION PERSPECTIVES 456**

17.0 Inquiry	456
17.1 Introduction	456
17.2 Process Change Description	456
Alternatives	457
Evaluation	462
Plan	466
17.3 Process Change	471
Resources	471
Schedule	473
Action	477
Review and Discovery Exercises	479

## **SECTION 6**

### **PROCESS-BASED TRANSFORMATIONS, INITIATIVES, AND TOOLS 481**

#### **Chapter 18**

#### **PROCESS-BASED TRANSFORMATIONS 482**

18.0 Inquiry	482
18.1 Introduction	482
18.2 Organization	483
Structure and Channels	484
Information Exchange and Archives	486
Reward Structure—Awards and Recognition	488
18.3 Creativity	492
Creative Thinking	493
Knowledge Base—Domain	498
Environment—Field	500
18.4 Leadership	500
Direction	502
Teamwork	503
Empowerment	508
Review and Discovery Exercises	509
References	510

#### **Chapter 19**

#### **PROCESS-COMPATIBLE INITIATIVES 511**

19.0 Inquiry	511
19.1 Introduction	511
19.2 Benchmarking	512
19.3 Concurrent Engineering	515
19.4 Continuous Improvement	516
19.5 Cycle Time/Waste Reduction	518
19.6 Fifth Discipline	521
19.7 Function-Value Analysis	522
19.8 ISO 9000	523
19.9 Mistakeproofing (Poka-Yoke)	525
19.10 Quality Awards	527
19.11 Quality Function Deployment	530
19.12 Reengineering	532
19.13 Robust Design	534
19.14 Six Sigma	535
19.15 Theory of Constraints	538
19.16 Total Quality Management	539
Discovery Exercises	542
References	542

**Chapter 20****PROCESS-COMPATIBLE TOOLS 544**

- 20.0 Inquiry 544
- 20.1 Introduction 544
- 20.2 Activity/Sequence List 545
- 20.3 Break-Even Analysis 545
- 20.4 Capability Analysis 546
- 20.5 Cash-Flow Analysis 547
- 20.6 Cause-Effect Diagram 548
- 20.7 Check Sheet 550
- 20.8 Control Chart 550
- 20.9 Correlation/Autocorrelation Analysis 551
- 20.10 Critical Path Method (CPM) 551
- 20.11 Experimental Design 553
- 20.12 Failure Mode and Effects Analysis (FMEA) 554
- 20.13 Fault Tree Analysis 556
- 20.14 Flowchart 557
- 20.15 Force Field Analysis 559
- 20.16 Gantt Chart 560
- 20.17 Histogram 561
- 20.18 Matrix Diagram 561
- 20.19 Pareto Analysis 562
- 20.20 Process Value Chain Analysis 563
- 20.21 Relations Diagram 564
- 20.22 Root Cause Analysis 565
- 20.23 Runs Chart 566
- 20.24 Scatter Diagram 567
- 20.25 Stratification Analysis 568
- Discovery Exercises 569
- References 569

**SECTION 7****PROCESS CASES—DESCRIPTIONS AND DATA 571**

- VII.1 Introduction 571
- VII.2 Data Extensions 572
- VII.3 Cases 573
  - Case VII.1 AA Fiberglass 573
  - Case VII.2 Apple Core—Dehydration 574
  - Case VII.3 Apple Dehydration Exploration 575
  - Case VII.4 Back-of-the-Moon—Mining 576
  - Case VII.5 Big City Waterworks 578

- Case VII.6 Big Dog—Dog Food Packaging 578
- Case VII.7 Bushings International—Machining 579
- Case VII.8 Door-to-Door—Pizza Delivery 580
- Case VII.9 Downtown Bakery—Bread Dough 582
- Case VII.10 Downtown Bakery—pH Measurement 583
- Case VII.11 Fix-Up—Automobile Repair 584
- Case VII.12 Hard-Shell Aquaculture 585
- Case VII.13 Health Assist—Service 586
- Case VII.14 High-Precision—Collar Machining 587
- Case VII.15 High-Precision—Collar Measurement 588
- Case VII.16 Link-Lock Chain 589
- Case VII.17 LNG—Natural Gas Liquefaction 590
- Case VII.18 M-Stick Manufacturing 591
- Case VII.19 Night Hauler Trucking 593
- Case VII.20 PCB—Printed Circuit Boards 593
- Case VII.21 Punch-Out—Sheet Metal Fabrication 594
- Case VII.22 Reuse—Recycling 596
- Case VII.23 Reuse—Sensor Precision 597
- Case VII.24 Silver Bird—Baggage 599
- Case VII.25 Snappy—Plastic Injection Molding 600
- Case VII.26 Squeaky Clean Laundry 601
- Case VII.27 Rainbow—Paint Coating 601
- Case VII.28 Sure-Stick Adhesive 603
- Case VII.29 TexRosa—Salsa 604
- Case VII.30 Tough-Skin—Sheet Metal Welding 606

**SECTION 8****STATISTICAL TABLES 608**

- Table VIII.1 Cumulative Standard Normal Distribution Table 609
- Table VIII.2  $t$  Distribution Table—Critical Values 611
- Table VIII.3 Chi-Squared Distribution Table—Critical Values 612
- Table VIII.4  $F$  Distribution Tables—Critical Values 613
- Table VIII.5  $\bar{X}$ ,  $R$ , and  $S$  Control Chart—3-Sigma Limit Constants 617
- Table VIII.6  $\bar{X}$ ,  $R$ , and  $S$  Control Chart—Probability Limit Constants 618
- Table VIII.7 EWMA and EWMD Control Chart Limit Constants 619
- Table VIII.8 Tabled Pseudo-Standard Normal Random Numbers 619
- Table VIII.9 Normal Probability Plotting Paper 622

---

## **SECTION**

# **1**

## **PRODUCTION SYSTEMS AND PROCESS PERFORMANCE**

**T**he purpose of Section 1 is to introduce both the essence and nature of process-based organizational concepts.

---

### **PART OUTLINE**

#### **Chapter 1: Production Systems—The Basics**

The purpose of Chapter 1 is to introduce the process-based concepts and their relationships to organizational synergy in terms of effectiveness (quality) and efficiency (productivity).

#### **Chapter 2: Systems Thinking—Concepts and Development**

The purpose of Chapter 2 is to give an overview of both analytical and systems thinking in the context of production system evolution.

#### **Chapter 3: Process Fundamentals**

The purpose of Chapter 3 is to introduce whole-process thinking through process purpose, definition/redefinition, control, and improvement elements.

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# PRODUCTION SYSTEMS—THE BASICS

---

## 1.0 INQUIRY

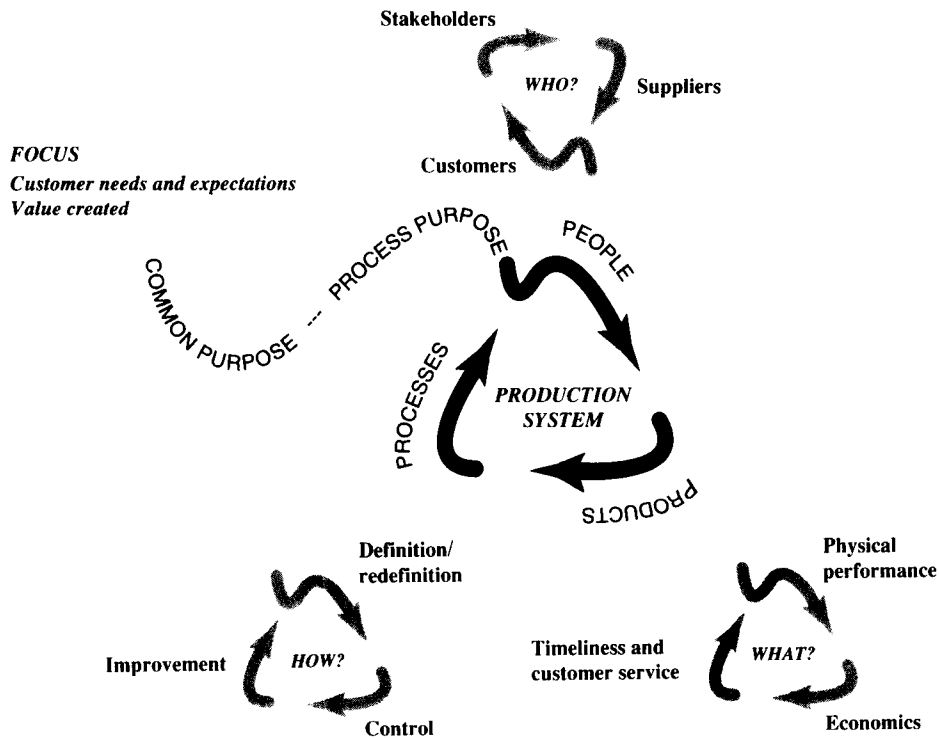
1. What is a production system?
2. How do production systems work?
3. What is quality? What is productivity? How are they related?
4. What is a cooperative effort? How do they start? How are they sustained?
5. How are organizations focused? Optimized?

---

## 1.1 INTRODUCTION AND OVERVIEW

**Every product in existence—hard-good, perishable, or service—can be traced back to a production system.** Some production systems depend primarily on nature's bounty, e.g., agriculture, mining, and petroleum. Some depend on intricate machinery, e.g., electronics, automobiles, and textiles. Some depend on personal attention to consumer needs, e.g., education, banking, retail, and food service. In short, our lives are impacted and sustained by production systems. **A production system is an integrated collection of people and processes that together transforms resources into products.**

**Our purpose in this textbook is to explore the fundamental nature of production systems, specifically their constituent working parts: people, products, and processes.** Figure 1.1 provides a graphical overview depicting and relating the three constituent elements of any production system. Customer needs, demands, and expectations drive the intricate network of production systems that surround us today. People participate in many of these for-profit and not-for-profit production systems simultaneously as consumers or external customers, producers or internal customers, suppliers of affiliated production systems, or stakeholders—owners, creditors, and so on.



**Figure 1.1** Production system overview.

**Products are ultimately judged by customers in terms of the benefits they generate against the burdens incurred.** More specifically, we describe these benefits and burdens in terms of physical, economic, timeliness, and customer service performance. Here, physical performance encompasses function (how it works for the customers), form (how it looks to the customers), and fit (how it addresses specific customer applications). Economic performance involves both the price that a customer pays up front, in money, and the cost to sustain the product, as well as revenues, if any, ultimately generated by the product. Timeliness performance includes the time it takes to produce a product, the time we must wait to obtain a good or service, or delays we encounter during the course of product usage later in the product life cycle. Customer service performance includes how we treat our customers, in terms of customer perception of our attention to their needs and responses to their demands.

**Every endeavor associated with a product involves a process—planned and practiced, or improvised and executed in an ad hoc manner. There are no exceptions. All processes require some level of definition, control, and improvement.** This process triad is our primary focus and is expanded in the course of our discussions in all seven sections.

## 1.2 BASICS

A production system in its broadest perspective transforms a set of resources into a set of products and by-products; see Figure 1.2a. Figure 1.2b depicts a process where a variety of resources serve as inputs and are transformed into products and by-products, the outputs. Typically, we see a wide variety of inputs/resources transformed into a limited number of products and by-products. The transformation literally acts as a funnel. It is critical that this funneling effect add value. Added value requires that customer benefits increase faster than customer burdens.

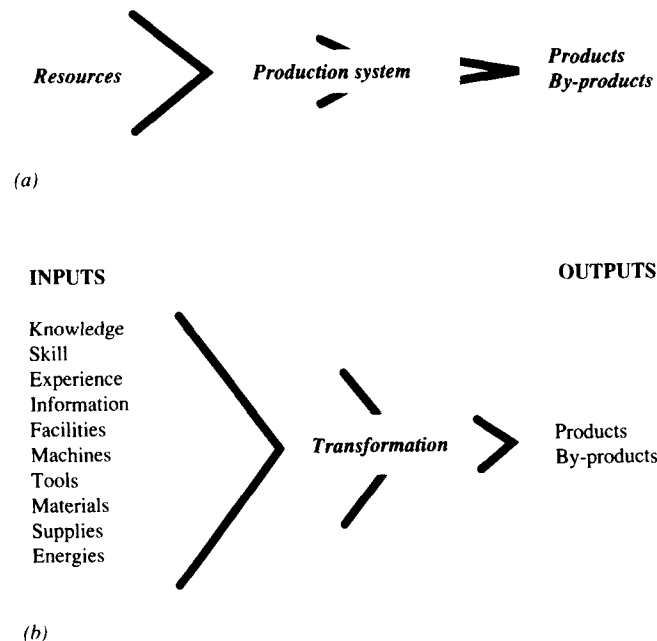
Here, we define **value** broadly as

$$\text{Value} = \frac{\text{customer benefits}}{\text{customer burdens}} \quad [1.1]$$

where customer benefits constitute fulfillment of customer needs and expectations, and customer burdens constitute what the customer gives up to obtain the product: money, time, and so on. The definition in Equation (1.1) is sometimes expressed as a ratio of worth to cost.

**The process concept is fundamental to all production systems.** Every production system is literally an integrated series of processes working in harmony to serve both internal and external customers with products that meet their needs and expectations.

**There are any number of ways that resources can be transformed into products and by-products.** These ways are referred to as **process configurations**. The best of these process



**Figure 1.2** (a) Production system and (b) process concepts.



configurations usually lead to a competitive edge or advantage for their owners in extracting benefits and/or suppressing burdens. In order to develop and maintain a competitive edge, we must address the effectiveness and efficiency of our processes. In general, **the concept of quality addresses effectiveness, while the concept of productivity addresses efficiency.**

## QUALITY

**The quality concept is complicated.** A number of authors have put forth definitions based on both customer benefits as well as customer burdens (primarily regarding products). Some definitions are expressed in a rigid manner:

Quality is meeting and exceeding customer needs and expectations; common expression.

Quality is fitness for use; Juran [1].

Quality is conformance to requirements (clearly stated); Crosby [2].

Quality should be aimed at the needs of the consumer, present and future; Deming [3].

Quality is the total composite product and service characteristics of marketing, engineering, manufacture, and maintenance through which the product and service in use will meet the expectations of the customer; Feigenbaum [4].

Quality is the loss (from function variation and harmful effects) a product causes to society after being shipped, other than any losses caused by its intrinsic functions; Taguchi [5].

Quality is the totality of features and characteristics of a product or service that bear on its ability to satisfy stated or implied needs; ISO 9000 [6].

Other quality definitions are stated in a more flexible manner:

Quality, as applied to the products turned out by industry, means the characteristic or group or combination of characteristics which distinguishes one article from another, or the goods of one manufacturer from those of competitors, or one grade of product from a certain factory from another grade turned out by the same factory; Radford [7].

There are two common aspects of quality. One of these has to do with the consideration of the quality of a thing as an objective reality independent of the existence of humans. The other has to do with what we think, feel, or sense as a result of the objective reality; this subjective side of quality is closely linked to value; Shewhart [8].

The extent of quality is determined by how well the true quality characteristics (customer needs, expressed in customer language) match substitute quality characteristics (product specifications, expressed by a producer in technical language); Ishikawa [9].

The Shewhart and Ishikawa definitions lead us to view quality through the customer's eyes. **True quality characteristics echo customer needs and set up subjective customer expectations. We translate these expectations into substitute quality characteristics** that are defined in technical terms sufficient to design and produce products. Ultimately, **customer satisfaction results from the degree of correspondence between the customer's true quality characteristics and our substitute characteristics.**