CREATING Quality

Process Design for Results

William J. Kolarik

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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, *University of Florida;* Ali A. Houshmand, *University of Cincinnati;* Suraj M. Alexander, *University of Louisville;* Karl J. Arunski, *Texas Instruments;* Hoang Pham, *Rutgers University;* K. N. Balasubramanian, *California Polytechnic State University–San Luis Obispo;* and M. Jeya Chandra, *Pennsylvania State University* deserve credit for supplying guidance and support for the project. My deepest appreciation goes to Eric Munson and Ken Case for their executive direction, regarding essence and organization, throughout the *Creating Quality: Process Design for Results* project.

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William J. Kolarik

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SECTION 1

PRODUCTION SYSTEMS AND PROCESS PERFORMANCE

The 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.

Chapter

1

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.

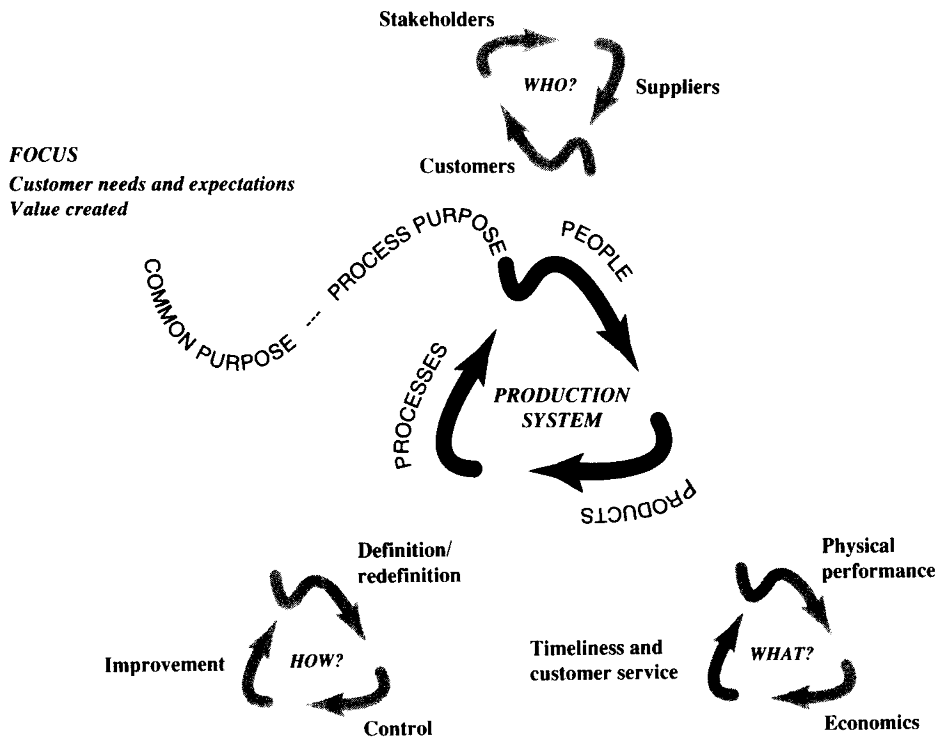

Figure 1.1 Production system overview.

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 1.2*a*. Figure 1.2*b* 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

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

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

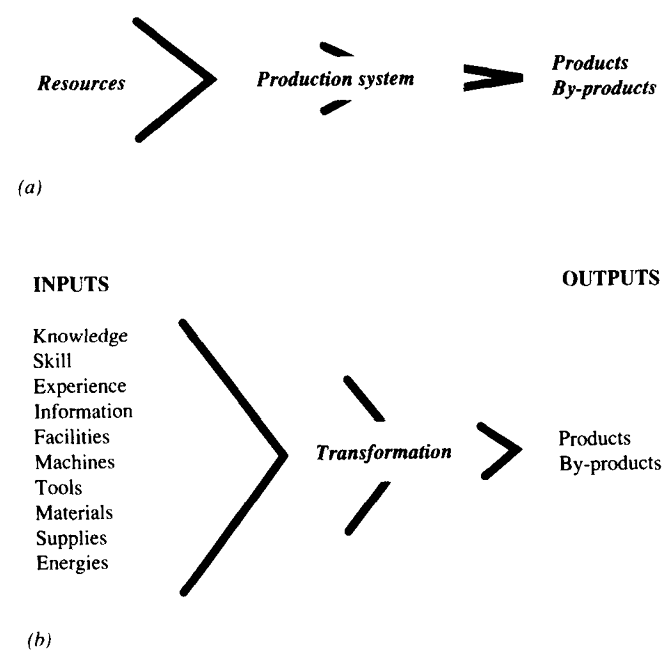

Figure 1.2 (*a*) Production system and (*b*) process concepts.

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.**