# Part II

# A Process View of Quality

Before a product can be produced, one needs to establish the production process. A production process entails a transformation process, which consists of equipment and facilities required to produce the work and policies and procedures on how work is accomplished, and a control process, which guides workers and managers in operating and checking the process. These topics are discussed in Chapters 7 and 8.

The production of quality products requires effective work processes. In order to create an effective work process, it is useful to bear in mind the following conceptual model of how work is accomplished. The production of any product, large or small, requires four steps: First, the requirements must be understood; second, a plan must be developed for accomplishing what is required; third, the basic work of constructing the required product must be carried out; and finally, it must be checked whether the product meets the established requirements. The four steps of this paradigm—specify, design, create, and examine—are discussed in detail in Chapters 9 through 12.

The specification (or analysis) process has to do with assessing the customer requirements; one must determine what the customer truly wants. Several useful tools for making this assessment are reviewed in Chapter 9. Design is the creative process of converting customer requirements into a design concept and into a set of product requirements that are complete, clear, and consistent; quality function deployment, discussed in Chapter 10, can help accomplish this task. The actual construction of the product has a huge impact on quality, and these issues are discussed in Chapter 11. The examine step has to do with checking whether the created product meets its requirements; several useful tools for examining products and processes are discussed in Chapter 12.

# Chapter 7
# The Production Process

## 7.1 Introduction

To create an effective work process, it is helpful to have conceptual models of how work is accomplished. We will present such a model, a paradigm of work. Following that, we will describe briefly the four major steps of a production process: specify, design, create, and examine. We conclude the chapter with some comments about the management of work and the work process.

### A Historical Note

Work is a condition of humankind. Amazingly, however, the first scientific study of work did not take place until almost 1900, when Frederick W. Taylor (1856–1915) introduced the notion of "scientific management." Taylor was the first person not to take work for granted, but to study it in order to understand it and improve the work process.

Taylor introduced many important concepts that are common knowledge today: delineation of authority and responsibility, management by exception, separation of planning from operations, functional organization, use of standards in control, and task specialization. Some of Taylor's disciples continued his analysis of work: Henry Gantt (1861–1919) concentrated on work as a process and introduced the concept of a Gantt chart for work scheduling; Frank and Lillian Gilbreth (1868–1924, 1878–1972) conducted extensive time and motion studies to improve work standards.

In spite of his pioneering effort, in some circles today it is fashionable to discount Taylor's work as being mechanistic and inhumane—emphasizing job design at the expense of human factors. But perhaps that is a little like blaming the Wright brothers for not inventing the jet airplane. Taylor made great contributions toward making work productive; it remained for others to concentrate on making workers achieving.

### Note on Terminology

Until recently, there was no standard terminology for the people involved in providing goods and services to others. However, ISO 9000 has provided terminology that is likely to be adopted by quality professionals and those who audit firms for compliance with ISO requirements. Therefore,

we have elected to use it in our detailed discussion of production processes, which we begin here.

In the ISO 9000 terminology, an organization or person providing a product to another is referred to as a **supplier**. The person or organization receiving the product is called a **customer**. In providing a product to a customer, a supplier may receive goods or services from another supplier, who is called a **subcontractor**. Thus, the product chain is from subcontractor to supplier to customer.

## 7.2 Production Process Components

Performing work in an organization requires a production process that is capable of developing the required product. Such a process consists of two components. One is a **transformation process**consisting of the machines, equipment, and facilities needed to produce the product, together with the policies, procedures, and instructions relating to the work activities to be performed. The other basic component is a **control process** to guide workers and managers in operating the process and to collect information on their accomplishments.

A production process can be very complex, and quality problems can and do arise with all aspects of the process. A quality problem with a transformation process might mean altering the equipment or changing subcontractors. A quality problem in controlling the work effort might involve debugging the information system used to plan and control production. A quality problem associated with operating the process might mean correcting the work instructions or altering worker motivation, recruitment, or training.

In analyzing quality, we might consider the entire company as a production process. Alternatively, we might consider separate production processes of, say, marketing, manufacturing, service, information systems, finance, and personnel. Or we might consider a specific production process, say, the process for assembling a particular component or for processing an order.

## 7.3 The Status of Production Processes

Quality is an attribute of a product, and it takes a quality process to produce a quality product. Some quality problems have to do with the *work process itself*. Typical situations are the following.

- *The process was not designed, it just grew.* Years ago a need arose in the office to handle some matter; a secretary was assigned the task and devised a way to do it. As secretaries came and went, this process was passed from one to another. It was also adjusted over time to handle variations of the original need. Eventually, people followed the process because "this is the way we do it." But is it the way it should be done?
- *The process is not documented.* Lack of process documentation is a common problem. A usual assumption is that long-term employees know the process and new hires can learn from them. One danger with this approach is that everyone may think they know

the process, but they may not all be performing it in the same way. Another danger is that over time the process can "shift" without anyone really being aware. What was once a very good process can degenerate into a mediocre one.

One of the authors once knew a first sergeant in charge of an Army regimental office. On being given the assignment, his first undertaking was a complete change of the office filing system to a new, undocumented one. He was the only person who understood the new system—which he regarded as job security and an excellent way to keep away from the battlefield.

- *Quality records are not kept.* In the past, many organizations have been remiss in keeping quality records—that is, records of the management reviews of their quality system, records of reviews of contracts with customers, records of their assessment of subcontractors, inspection and test records, employee training records, and the like. But this situation is starting to change because having such records is a requirement of the ISO 9000 standard, with which many firms throughout the world are attempting to comply.
- *Process responsibility is not always clear.* A root cause of many process problems is that authority over the process is not clearly defined. If a process exists entirely within a functional area, the head of that area generally has responsibility for the process. A problem arises, however, with processes that cross functional lines. For example, who has responsibility for an order entry system: Sales (which enters orders), Information Systems (which builds and maintains the system), Production (which makes major use of the system), or Accounting (which tracks billing and payments)?

Sometimes the problem involves the *operation of the process:*

- *A process is documented, but the documented process is not followed.* Most IS departments have a documented procedure for developing new software systems, called a Project Methodology. When you ask to examine their methodology, it is not uncommon for some searching to go on until a dusty document is retrieved from the bottom of some cabinet, the dust is blown off, and it is handed to you for perusal.
- *Operators of the process are not properly trained.* Sometimes training is left to the manager, but the manager is too busy to do it properly. Sometimes more seasoned workers do not want to share their know-how with the newcomers—a form of job security. Sometimes the training program is inadequate. Sometimes a new employee has exaggerated his ability in order to get the job and now doesn't want to admit that training is needed.
- *A process is adjusted for convenience, not effectiveness.* Even when a process is documented, some people cut corners for convenience or in an attempt to conserve resources or reduce production time. Sometimes this is a sign that the process is not optimal and needs to be improved; sometimes it is a sign that the person who is to follow the process is not aware of the importance of the step and the adverse effect of trimming it.

Some problems involve the *management of the process:*

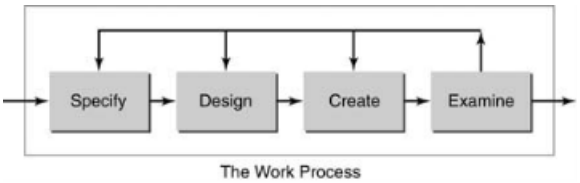
- *Management does not have a process focus.* A prevalent cause of process problems is the lack of management attention. Their interest is in getting an order, not in the process of getting orders; or in producing software, not in the software development process.
- *Processes are not measured.* Measurement is viewed as too costly, too disruptive. But without measurement, how does one know how the process is performing, and what might be done to improve performance?
- *Processes are not reviewed.* Every process should be reviewed on a regular basis to determine whether it should be modified or replaced. A common problem is a failure to conduct such a review. Using an outmoded process can be a competitive disadvantage. Moreover, it is an open invitation for people not to follow the process or to make unauthorized changes.
- *Processes are not improved.* Some processes are universally known to be inefficient or ineffective, but nothing is done about them. No mechanism or management support exists for making process improvements.
- *Quality is not a paramount concern; time, quantity, and budget are more important.* A root cause of many process problems is the failure of top management to make a firm commitment to quality.

## 7.4 The Basic Paradigm of Work

The production of any product, large or small, requires four steps. First, the requirements must be understood; second, a plan must be developed for accomplishing what is required; third, the basic work must be done to produce the required product; fourth, a check must be made to determine that the product does meet the established requirements. This basic paradigm for work means that any work process can be viewed as consisting of four subprocesses:

- Specify requirements.
- Design the product.
- Create the product.
- Examine the product.

Because these four subprocesses are executed sequentially, they are sometimes referred to as the four *phases* of the work process. From the first initials of these subprocesses, for simplicity we shall refer to this as the *SDCE paradigm* (see Display 7.1).




*Display 7.1 Basic Paradigm of Work*

Requirements specification brings an understanding of *what* the customers require. Design entails research and development, architecting the product, and determining *how* the customer's requirements will be met. Create covers manufacturing, construction, or whatever is done to bring the product into existence. Examine entails verification that the product meets requirements.

> **Example.** For the task of writing a term paper, all four activities are accomplished by the same person. Specifying requirements is a matter of understanding the assignment and applicable standards; design involves gathering facts and deciding how the assignment can be accomplished; create covers writing the paper; and examine is a review to see that the paper satisfies the assignment and applicable standards.

For a large product, each step of the work paradigm is a significant activity requiring specialized knowledge and experience. Separate departments, such as Market Research, Design, Production, and Testing, might be established to perform the four activities. Each major step results in a product; for example, specification results in a set of customer requirements. Thus, each major step can be viewed as an activity itself, to which the basic paradigm can be applied.

The effort required for each of the basic steps is not the same from one situation to the next. For a task that is well understood, requirements and design might be perfunctory; the major effort would be in creating the product and examining it for correctness. For another task, specification of requirements might be a major effort; producing the product might be easy once requirements are established.

## Ordering of Subprocesses

Often the four subprocesses—specify, design, create, and examine—of the basic paradigm will be accomplished sequentially, as depicted in Display 7.1. At times, however, it is preferable to have some phases operate in parallel.

> **Example.** In constructing a large computer software system, it can be effective to establish broad requirements for the system, create a high-level design for the system, and identify the major components to be constructed. These components then might be created somewhat

independently, so that one component might be in the detailed requirements phase while another is in a test phase.

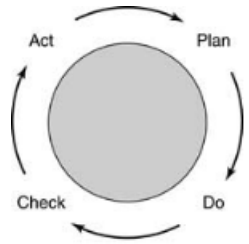
This example illustrates that the basic paradigm of work should be regarded as an effective model for accomplishing work, not as a straightjacket that stifles creativity. It is a conceptual view of work that can be applied to any situation. Perhaps its greatest benefit is to emphasize that one must understand all the requirements for a product before jumping into creating it.

## The PDCA Cycle

PDCA is an acronym for Plan, Do, Check, and Act. It describes a cycle of actions based on a product life cycle. The PDCA cycle is the creation of Walter A. Shewhart (see Section 2.9). It has gained considerable attention, much of it stemming from the fact that W. Edwards Deming presented the cycle in Japan as part of his introduction of quality concepts. Because of these presentations, the Japanese call the PDCA cycle the **Deming Cycle** or sometimes the **Deming Wheel**. Those names are used by many people; Deming, however, always referred to PDCA as the **Shewhart Cycle**.

The phases of the PDCA cycle are shown in Display 7.2. They are:

- *Plan.* Plan for change. What changes are desirable? What data are available? Are other data needed? On the bases of all available data, decide on actions to be taken; plan for actions.
- *Do.* Carry out the actions that have been planned—make the planned change.
- *Check.* Observe the effects of the change. Determine if the change has the desired effect.
- *Act.* Observe the results. What has been learned? What does this experience suggest about future needs? future changes?




*Display 7.2 The Shewhart (Deming) Wheel: PDCA*

The PDCA cycle can easily be mapped onto the basic paradigm: Plan corresponds to Design, Do to Create, Check to Examine, and Act to Specify. Of course, our basic SDCE paradigm begins with Specify, which is the last step listed in the PDCA cycle. But because it is a cycle, the starting

point is artificial; no matter where you start, you continue through the four steps in a cyclical manner. Starting with Act, the PDCA corresponds step by step to our basic paradigm.

## 7.5 Production Steps

The paradigm of work can be applied to view a production process as comprised of four subprocesses, as depicted in Display 7.3:

1. *Specify*

   Translating what the customer wants into customer requirements, that is, specifying the customer requirements. This step answers the question, "What does the customer require?"

2. *Design*

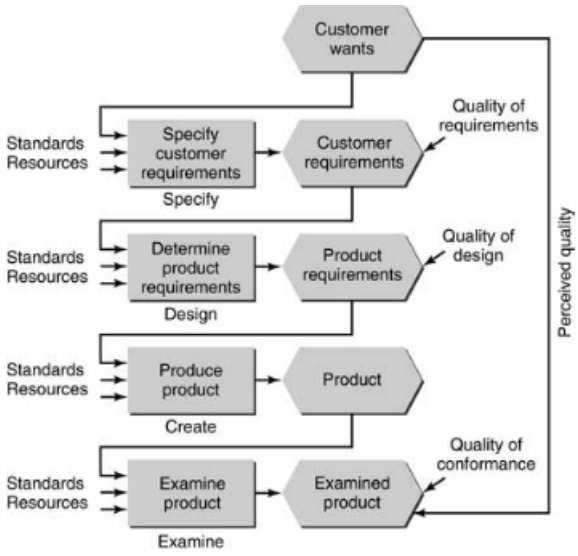
   Translating customer requirements into product requirements, that is, specifying product requirements. This step answers the question, "How can the customer requirements be met?"

3. *Create*

   Creating the product to product requirements.

4. *Examine*

   Validating that the created product meets customer requirements.




*Display 7.3 Steps of the Production Process*

The first two steps of production have to do with determining requirements for the product; together they are referred to as the **requirements specification** or **requirements determination** process. The last two steps are referred to as **build** and **test**, respectively.

For a physical product, such as a car, it is relatively easy to distinguish the four steps of production and their various outputs. Specifying customer requirements involves market research and other activities to learn as nearly as possible what the customer wants in a car. These wants must be expressed in writing—a statement of customer requirements. The second step is to design a product that meets these requirements. This involves balancing quality aspects, such as function, against price and delivery date. The outcome of this step is a detailed description of the car that is to be built—the product requirements. The third step is to assemble the necessary components into the final product—the car. The fourth step is to validate that the car meets the customer requirements.

## 7.6 Customer Wants

**Customer wants** are desirable attributes or characteristics of a product that the customer would like to have. Some of these wants are very specific and can be described clearly by the customer:

"I want a red car" or "I want a fish sandwich." Another example is a Request for Price Quotation issued by a company describing in detail a computer system it wants to purchase. But some wants are vague and can be expressed only in general terms, followed by "you know what I mean." Many are wants that a customer is not even aware of until an appealing product brings out his or her latent desire. In Japan, customer wants are referred to as **true requirements** because they reflect what the customer truly wants.

> **Example.** Customers always have latent wants of which they are unaware. In the mid-1960s, few customers for cars expressed a desire for an error-free product—a car with no "bugs"—because nothing like that was then available. Today, even though quality might not be openly expressed as a requirement, pity the car manufacturer who brings out a lemon.

Suppliers want to produce products that delight customers at a price they are willing to pay. To do this, however, they cannot simply consider the wants that a customer openly states. They must go further and attempt to determine what the customer really wants.

> **Example.** Customer wants for hotel accommodations vary with customer type. The want of a business traveler might be for a hotel near the business district with a reasonable room, fine restaurants, and fast check-out facilities; price might be a secondary consideration. On the other hand, the want of a foreign tourist might be for a hotel with a reputation for dependability that is located near tourist attractions.

## 7.7 Specify

**Customer requirements** are a written statement of what the supplier thinks the customer wants. The process of converting customer wants into customer requirements is called **specification** or, sometimes, **analysis**.

Customers always have both specific and general requirements; they require an information system that will supply certain reports (a specific requirement) and is easy to use (a general requirement). It would be convenient for suppliers if customers could state exactly what they require, but most of the time, they can't do this. In the information area for example, customers might ask for a system with new function, increased complexity, and one that makes fundamental changes in the way information is processed. They ask for something entirely new that has never existed before; how can they know precisely what it is they want?

In determining customer requirements, it is important to consider *all* customers for a product. Who are the customers for a car? Certainly the person who buys the car and his immediate family. But what about the mechanic who repairs it? He has requirements, too. And the community in which the car is driven has requirements concerning safety, pollution, and use of resources.

Customers might state requirements that are conflicting—one customer wants the product to be blue, the other green. During the requirements determination process, such conflicts must be resolved. The final set of customer requirements should be complete and nonconflicting.

# 7.8 Design

**Product requirements** are a written statement of *what* is to be produced. **Design** is the process of converting customer requirements and product standards into product requirements. It is the process of creating a description or representation of the product to be built.

> **Example.** For a house, an architect often handles the design process. The customer requires a three-bedroom ranch-style house with certain heating, plumbing, and so on. The architect examines the customer requirements, the building code, and other regulations, and then creates blueprints and other documents that serve as requirements for the builder.

> **Example.** A professor wants you to write a term paper. After analyzing the assignment, selecting a topic, and deciding what points to make, you design the term paper. That is, you decide how your points will be presented and perhaps construct an outline of the paper.

As these two examples suggest, design is a process requiring skill and special knowledge of the production area involved.

All product requirements must be specific because vague, nonverifiable requirements lead to product variability. If the person who actually builds the product must interpret a requirement, then the product will be shaped by that interpretation. For example, you can be certain that an IS professional's view of a user-friendly information system is a far cry from that of the typical customer of the system. All product requirements must be specific, yet they must be specified so as to support all customer requirements, specific and general.

> **Example.** An automobile manufacturer might decide that a customer requirement is for fast acceleration. Then in the design process, all factors affecting acceleration—engine power, transmission performance, body weight, air resistance, and so on—must be specified with this requirement in mind.

## Contrasting Customer Requirements and Product Requirements

Customer requirements describe *what* a product should be like—the function to be provided by the product, its appearance, how it can be used, its performance characteristics, and so on. Product requirements must embody all of this information and more. Because they will guide the people who do the actual building, product requirements must state *how* desired attributes will be provided.

# 7.9 Create

**Create** is the process of actually producing the required product. Whether the product is a house, a gourmet meal, a term paper, or a clean office, this stage involves the creation of a product according to the product requirements.

The terminology commonly used for this stage of a work process varies depending on the product being produced. One **builds** a house, **manufactures** a product, **operates** a machine, **delivers** a lecture or **teaches** a class, **sells** a product, **drives** a truck, **acts** a part, **cooks** a meal, and so on.

Although the general process is the same, the actual work done in the create stage varies, and the skills required depend on the product involved. For creating a term paper, the producer must be skilled at expressing ideas in writing. For creating a house, the producer must be skilled in the use of construction equipment.

## 7.10 Examine

The fourth step in the production process is to examine the product to learn if it meets all requirements. Basically, examination is done in one of two ways: you look at the product or you operate the product. Often you do both.

If the product is a house, you walk through it to observe if there are any visible defects: Is the paint applied properly? Are there any cracks in the plaster? Does everything look level? Then you operate the various systems in the house: Does the heating system work? Does the water system work? Does the lighting system work? Does the house leak when it rains?

If the house passes inspection, you celebrate. If it doesn't, you start a new process called "correcting the mistakes."

## 7.11 Quality Terminology

The production process calls for creating three major work products: customer requirements, product requirements, and the product. Traditional quality control has focused on the third task: creating the product, a task performed on the production line for manufactured products. Insufficient attention was directed to the specify and design tasks. But all three tasks—specify, design, and create—must be performed well for the final product to satisfy the customer, who is the ultimate judge.

We know what it means to do production well: It means producing a quality product, one that meets requirements. But *exactly the same is true of the first and second tasks*: Doing quality specification means producing a set of customer requirements that meets the standards and customer wants for that product. Doing quality design means producing a set of product requirements that meet standards and customer requirements for that product. For each process, one measures quality according to whether or not the product produced meets the requirements and standards established for it. Thus, "meets requirements" is a single standard for the quality of all activities.

For a product to meet the wants and true requirements of a customer, it is necessary to do a quality job of specifying requirements, a quality job of design, and a quality job of production. We can use the terms **quality of requirements**, **quality of design**, and **quality of conformance**, respectively, for the degree to which these tasks are performed correctly.

## 7.12 Examples of Producing Products

One general type of work is to operate a system; another is to produce a work system. Both operating a system and producing a work system accomplish work by employing the basic paradigm. However, the terminology involved and the complexity of the work efforts differ significantly for the two. To illustrate these differences, let's look at several examples.

### Producing a Custom Product

First, let's examine how the SDCE paradigm applies to the task of producing a typical custom product. We will consider the task of building a house.

#### Specify the Requirements

The first step in building a house is to determine customer requirements. This involves interviewing the buyer; examining the local building code and ordinances, learning the various standards for safety, health environmental protection, and the like; learning the requirements of insurance companies and mortgage agencies; and learning requirements for utility, waste disposal, and other agencies that will provide service to the new house. The result of this step is a set of requirements for the house.

#### Design the Product

The second step is to create a design or architecture for the house. Often done by an architect, this involves analyzing the requirements and conceiving a satisfactory, perhaps elegant way of meeting the requirements. The output of this step is a design consisting of sketches, blueprints, and other documents that meet the specified requirements for the house. This design is a major input to the create process.

#### Create the Product

The third step is to build the house: lay the foundation, frame the house, install major utility systems, finish the interior, and so on.

#### Examine the Product

The fourth step is to examine the product. If all goes well, the buyer, building inspector, and possibly a mortgage agency inspect the house and give their approval. In practice, as most home

buyers know, it doesn't run that smoothly; that's another way of saying that in practice the house-building process has quality problems.

## Producing a Consumer Product

Next, consider the task of producing a consumer product. The basic SDCE paradigm also applies to this task, but there are several significant differences in the complexity of the effort. Let's examine the work effort required to produce an automobile and highlight how this differs from producing a custom product.

### Specify the Requirements

For a commodity product such as a car, there are no buyers in the beginning—only potential buyers. Moreover, these potential buyers, whoever they are, have few specific requirements and many general wants. The challenge in determining requirements for a commodity product is to anticipate the marketplace while still meeting the legal needs, environmental requirements, and needs of other customers, such as governmental agencies, insurance organizations, and consumer groups.

### Design the Product

A major aspect of producing a commodity product such as a car is that you really need two products: the car and the car production process. These must be designed in tandem because the design of the car will directly impact the car production process and vice versa. Failure to coordinate the design of the product and the design of the production process can have tremendous adverse consequences.

Designing a car is a complex task, but in theory it is similar to designing a house. Designing a production line is another story, and we will examine this in more detail in Chapter 8.

### Create the Product

Producing a consumer product means operating the production line. For some products, this is a simple, routine task. For building a car, this is a complex task requiring various skills, careful control of quality, and considerable coordination.

### Examine the Product

It is impractical to examine thoroughly each car coming off the production line. Doing so would be very costly; moreover, some examinations are by nature destructive. Examination usually means making an exhaustive test of a few initial cars, making a cursory inspection of all, and randomly selecting others from the production lines for more extensive checks.

## 7.13 Applying the Paradigm Recursively

Production is a **recursive function** in that it can be applied repetitively to divide work. For example, building a product is accomplished through specification, design, creating, and examination. But the specification activity itself can be viewed as a production process. One obtains customer requirements (the output of the specification step) by determining what requirements are needed (specify) and how they should be determined (design). Then requirements are gathered (create) and checked (examined) to see that they are complete and nonconflicting. Moving down a level, each of these four activities can be divided further into basic steps.

### Quality Control

The fact that the basic paradigm can be applied recursively helps explain what at first appears to be a contradiction: Quality is everyone's job; therefore, every product should be verified against its requirements. Doesn't that imply that there should be a block to indicate a test activity after the activities of specify and design in Display 7.1 as well as after create?

Such additional blocks are unnecessary because the tasks of specify, design, create—even examine itself—will be accomplished by applying the paradigm iteratively to each subtask. This means that there will be an examine activity as part of specify, one as part of design, one as part of create—even one at the end of the examine phase to check that the examine activity was performed correctly. In effect, *an iterative application of the basic paradigm ensures that quality control is built into every activity*.

## Exercises and Additional Readings

1. Describe the steps of the SDCE (specify, design, create, examine) paradigm for interviewing a job applicant.
2. Describe the steps of the SDCE paradigm for taking a vacation.
3. The *management cycle* consists of four steps:

   Plan work.

   Organize to accomplish it.

   Execute the work plan.

   Evaluate and take corrective action.

   Discuss this cycle as an application of the work paradigm.
4. One variation of the basic paradigm of work is a procedure described by Lauchland Henry for accomplishing a job assignment in a professional manner[1]

   Phase 1. Defining the assignment

Phase 2. Planning how to accomplish the assignment

Phase 3. Executing your plan

Phase 4. Reviewing at the end

(a) Discuss how this is an application of the work paradigm.

(b) People sometimes jump into action without fully understanding an assignment. Give an example.

5. IDEA is an acronym for inspect, devise, execute, and affirm, the four steps of a problem-solving procedure developed by one of the authors[2]

   Step 1. Inspect the problem.

   Step 2. Devise a strategy.

   Step 3. Execute the strategy.

   Step 4. Affirm the solution.

   (a) Discuss how this is another application of the paradigm of work.

   (b) A person recently moved into a new community and has a problem in meeting people. Describe how the IDEA strategy might be employed to solve the problem.

6. What are the four basic steps of the paradigm of work as applied to the task of filling an order?
7. The create process of SDCE is described in various ways: You write a term paper, construct a design, and perform in a play. What are some other examples of the create process for goods? information products? services?
8. (a) State your customer requirements for a hamburger. (b) State producer requirements that will meet these customer requirements. (c) Match each producer requirement with the customer requirement(s) to which it relates.
9. Repeat Exercise 8 for a taxi ride.
10. For a term paper that you have written recently, list the steps you took to construct it. Could your process have been improved? How?
11. (a) Map the course registration process at your institution onto the basic paradigm of work. Describe clearly the product of that process.

    (b) Do the same for the add-drop process.

12. List additional problems associated with production processes, beyond those discussed in Section 7.3.
13. Imagine yourself as a manufacturer of apparel items. Outline the various steps of your production process.
14. Following the SDCE paradigm, describe a process for

(a) Cutting your lawn.

(b) Going on a date.

15. Summarize the new concept in production processes described in the article "Reconfigurable Manufacturing Systems to Help U.S. Firms Compete," *Quality Progress*, August 1996, p. 14.
16. Read "More Retailers Are Embracing Customer-Focused Operations and Technologies," *Quality Progress*, November 1996, p. 21. Summarize how some retailers are modifying their production processes.
17. Read "Employee Involvement Helps Honeywell in Branch Integration," *Quality Progress*, February 1995, p. 18. Describe how a team of employees helped Honeywell to integrate three separate branch offices into one.
18. In this book we talk about a four-step production process, consisting of specify, design, create, and examine. In the book *Juran on Planning for Quality* (published by Macmillan, 1988), Juran discusses an alternate system. Discuss the major steps in his system and relate them to the framework in this book.

# Notes

[1] A. Henry Lauchland, *The Professional's Guide to Working Smarter*, (Tenafly, N.J.: Burrill-Ellsworth Associates, 1988), Chapter 3.

[2] J. Ledolter and C. W. Burrill, *Statistical Quality Control: Strategies and Tools for Continual Improvement* (New York: John Wiley, 1999), Chapter 3.