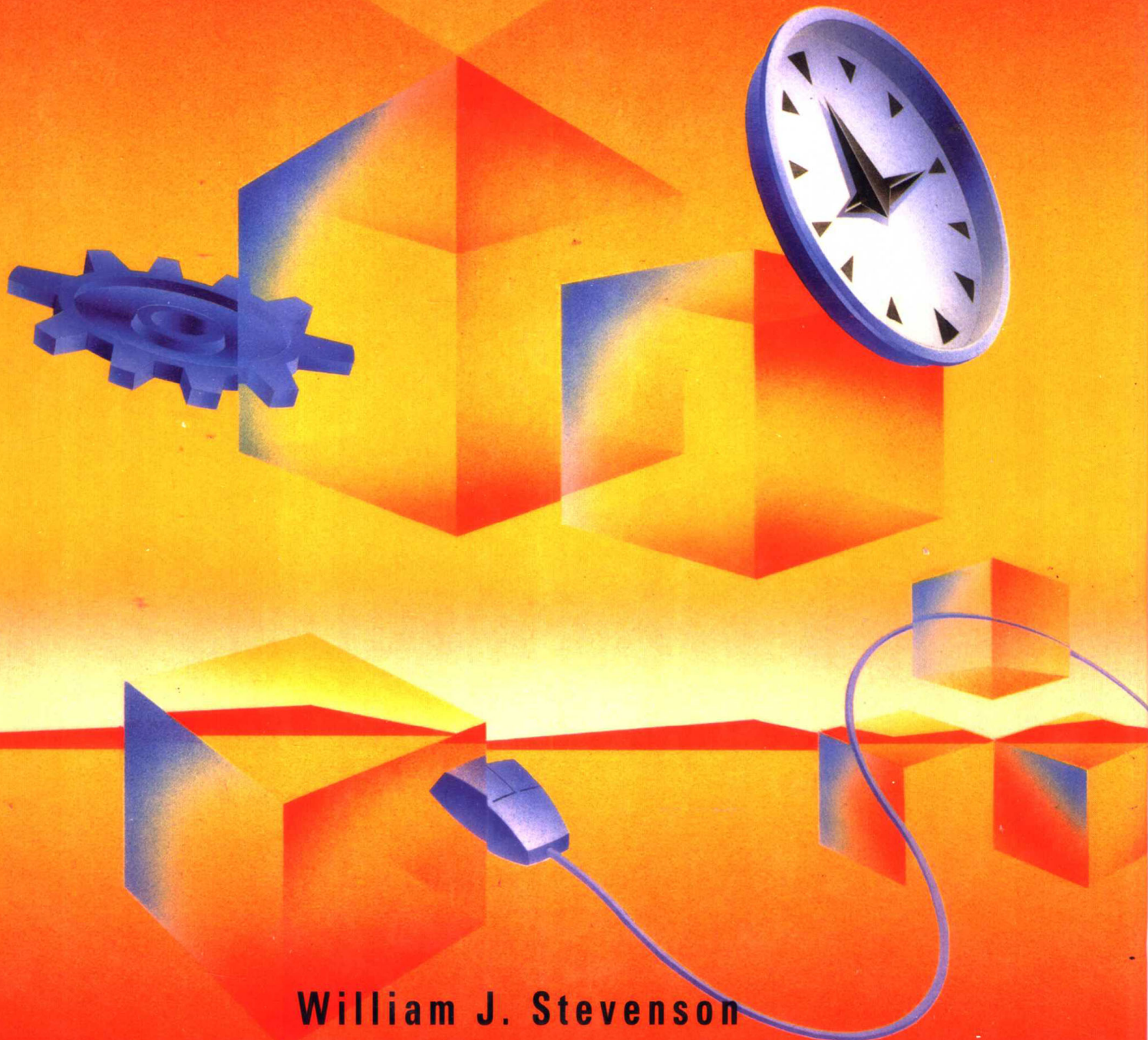


Fifth Edition

PRODUCTION/OPERATIONS MANAGEMENT



William J. Stevenson

PRODUCTION/OPERATIONS MANAGEMENT

Fifth Edition

William J. Stevenson
Rochester Institute of Technology

IRWIN

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PREFACE

The material in this book is intended as an introduction to the field of production and operations management. It is suitable for both undergraduate and graduate students. The field of production and operations management is dynamic, and very much a part of many of the good things that are happening in business organizations. The book is intended to be interesting and informative. Much of what you learn will have practical application.

The subject matter represents a blend of concepts from industrial engineering, cost accounting, general management, quantitative methods, and statistics. Production and operations activities, such as forecasting, choosing a location for an office or plant, allocating resources, designing products and services, scheduling activities, and assuring quality are core activities of most business organizations. Some of you are or will be employed directly in these areas, while others will have jobs that are indirectly related to this area. So whether this is your field of study or not, knowledge of this field will most certainly benefit you and the organization you work for.

The text contains more material than one could normally hope to cover in a one-semester course. Rather than rely on the author's personal bias, each instructor can choose those topics most suited to his or her own proclivities. Those who prefer quantitative emphasis, for example, will be quite comfortable with the abundance of student problems. Those who prefer a more qualitative approach will welcome the fact that some of the more quantitative material is placed in chapter supplements. Moreover, some of the chapter problems are less quantitative than others, and the cases and readings tend to be qualitative. Obviously, there are many possibilities between these two extremes.

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Many students and instructors offered valuable suggestions, and I want to thank them as well. And Roger Schoenfeldt and Lee Tangedahl did a superb job of error checking.

I would also like to thank the authors of the various supplements that are designed to accompany the textbook. In particular, Lee Tangedahl developed the spreadsheet templates; Vahid Lotfi and Carl Pegels revised the *Decision Support Systems for Operations Management and Management Science* software; Roger Schoenfeldt updated the Instructor's Manual; Ralph Butler developed Powerpoint® presentations; Charles Dane updated the Test Bank and the CompuTest; and Paul Van Ness coauthored the Study Guide.

Finally, I want to extend my thanks to all of the people at Irwin Publishing for their efforts and support. It is always a pleasure to work with such a competent and professional group of people. Special thank you's go to Dick Hercher, Wanda Zeman, Jean Lou Hess, and Carol Rose.

William J. Stevenson

NOTE TO THE STUDENT

The material in this text is part of the core knowledge in your education. Consequently, you will derive considerable benefit from your study of operations management, *regardless of your major*. Practically speaking, production and operations is a course in *management*.

This book describes principles and concepts of production and operations management. You should be aware that many of these principles and concepts are applicable to other aspects of your professional and personal life. Consequently, you should expect the benefits of your study of production and operations management to serve you in those other areas.

After reading each chapter or supplement in the text, attending related classroom lectures, and completing assigned questions and problems, you should be able to do each of the following:

1. *Identify the key features* of that material.
2. *Define and use terminology*.
3. *Solve typical problems*.
4. *Recognize applications* of the concepts and techniques covered.
5. *Discuss the subject matter* in some depth, including its relevance, managerial considerations, and advantages and limitations.

You will encounter a number of chapter supplements. Check with your instructor to determine whether or not to study them.

This book places an emphasis on problem solving. There are many examples throughout the text illustrating solutions. In addition, at the end of most chapters and supplements you will find a group of solved problems. The examples within the chapter itself serve to illustrate concepts and techniques. Too much detail at those points would be counterproductive. However, later on, when you begin to solve the end-of-chapter problems, you will find the *solved problems* quite helpful. Moreover, those solved problems usually illustrate more and different details than the problems within the chapter.

I suggest the following approach for studying and problem solving:

1. Look over the chapter outline and learning objectives.
2. Read the chapter summary, and then skim the chapter.
3. Read the chapter and reread the summary.
4. Look over and try to answer the discussion and review questions.
5. Solve the problems, referring to the solved problems and chapter examples as needed.

Note that the answers to many problems are given at the end of the book. Try to solve each problem before turning to the answer. Remember—tests don't usually come with answers.

You may be assigned some of the memo writing exercises that are provided throughout the book. Here is a sample memo:

To: Tom Jones

From: Mike Dugan

Date: Jan. 17, 1996

Subject: Memo writing exercises

I think it's a great idea to assign some of the memo writing exercises to your students. I strongly believe that good communication skills will be a real asset to them in the business world.

I know of several instances where companies have missed some good opportunities because of poorly written documents. Also, I know that many managers include written and oral communication in their annual employee evaluations.

A study guide is also available. If your bookstore does not stock it, you can ask them to order it for you.

Enjoy!

W. J. S.

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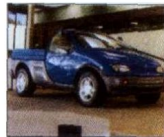
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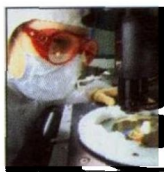
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INTRODUCTION

Introduction to production/operations management involves:

- 1 Production/operations management, *Chapter 1*
- 2 Productivity, competitiveness, and strategy, *Chapter 2*
- 3 Quality management, *Chapter 3*

Chapter 1 introduces you to the field of operations management. It describes the nature and scope of operations management, and how it relates to other parts of the organization. Among the important topics it covers are the different types of production systems, a comparison of manufacturing and service operations, a brief history of operations management, and a list of recent trends in operations. After you have read this chapter, you will have a fair understanding of what the operations function of a business organization encompasses.

Chapter 2 discusses operations management in a broader context, and presents the issues of productivity, competition, and strategy. After you have read Chapter 2, you will understand the importance of the operations function relative to the goals of a business organization. This chapter also describes time-based strategies, which many organizations are now adopting as they seek to become more competitive and to better serve their customers.

The supplement of Chapter 2 describes *decision theory*.

Chapter 3 focuses on quality management. After you have read the chapter, you will have a good understanding of why the entire business community is stressing quality. The description of *total quality management (TQM)* is of particular interest.

PRODUCTION AND OPERATIONS MANAGEMENT



LEARNING OBJECTIVES

After completing this chapter, you should be able to:

1. Define the term *production/operations management* (POM).
2. Identify the three major functional areas of organizations and describe how they interrelate.
3. Describe the operations function and the nature of the operations manager's job.
4. Differentiate between design and operation of production systems.
5. Provide a general description of the different types of operations.
6. Compare and contrast service and manufacturing operations.
7. Briefly describe the historical evolution of POM.
8. Describe the key aspects of operations management decision making.
9. Identify some of the current trends in operations management.
10. Describe the *Pareto phenomenon* and tell why it is important in problem solving.

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This book is about production and operations management (POM), which involves the planning, coordinating, and executing of all activities that create goods or services. The subject matter is fascinating and timely: productivity, quality, foreign competition, and customer service are very much in the news. All are part of production and operations management. This first chapter presents an introduction and overview of POM. Among the issues it addresses are: What is operations management? Why is it important? What does an operations manager do?

The goal of the book is to present a broad conceptual framework for the management of the operations function in organizations. This chapter lays the groundwork. It begins with a brief description of the various functions of business organizations and their relationships to each other. The operations function is then described in more detail, including methods of classifying production systems and a comparison of manufacturing and service systems. The chapter concludes with a brief description of the historical evolution of POM and a discussion of the major issues that confront POM managers today.

INTRODUCTION

To many people, the term *production* conjures up images of factories, machines, and assembly lines. Interestingly enough, the field of production management in the past focused almost exclusively on manufacturing management, with a heavy emphasis on the methods and techniques used in operating a factory. In recent years, the scope of production management has broadened considerably. Production concepts and techniques are applied to a wide range of activities and situations *outside* manufacturing; that is, in *services* such as health care, food service, recreation, banking, hotel management, retail sales, education, transportation, and government. This broadened scope has given the field the name *production/operations management*, or more simply, **operations management**, a term that more closely reflects the diverse nature of activities to which its concepts and techniques are applied.

Operations management

The management of systems or processes that *create goods and/or provide services*.

A luxury cruise ship provides an example of an operations management system. Most of the activities performed by the captain and crew during a cruise or in preparation for the cruise fall within the realm of operations management. Among those activities are running the ship, managing food service, providing medical services, training and supervision of the crew, overseeing activities of passengers, and housekeeping. Navigation, maintenance, and general repairs are required to keep the ship on course and in good operating condition. Food and beverages must be ordered, meals must be prepared and served in an appetizing manner, and dining areas must be kept clean. Medical supplies must be on hand and personnel sufficiently prepared to handle a wide range of illnesses and emergencies. Motivation, training, productivity, job assignments, and personal appearance of crew members are important. Passengers must be assigned to cabins, activities must be scheduled, trips ashore at ports of call must be arranged, and other needs must be attended to in order to maintain satisfactory customer relations. This gives you some idea of the nature and scope of operations management on a luxury ship.

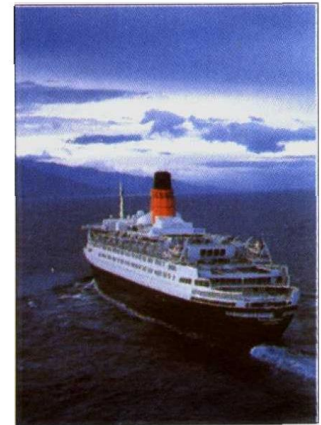
Now consider a bicycle factory. This might be primarily an *assembly* operation: buying components such as frames, tires, wheels, gears, and other items from suppliers, and then assembling bicycles. The factory might also do some of the *fabrication* work itself, forming frames, making the gears and chains, and buy mainly raw materials and a few parts and materials such as paint, nuts and bolts, and tires. Among the key management tasks in either case are scheduling production, deciding which components to make and which to buy, ordering parts and materials, making decisions on the style of bicycle to produce and how many, purchasing new equipment to replace old or worn out equipment, maintaining equipment, motivating workers, and ensuring that quality standards are met.

Obviously, a cruise ship and a bicycle factory are completely different types of operations. One is primarily a service operation, the other a producer of goods. Nonetheless, these two operations have much in common. Both involve scheduling of activities, motivating employees, ordering and managing supplies, selecting and maintaining equipment, satisfying quality standards, and—above all—satisfying customers. In both systems, the success of the business depends on short- and long-term planning.

FUNCTIONS WITHIN BUSINESS ORGANIZATIONS

Organizations are formed to pursue goals that are achieved more efficiently by the concerted efforts of a group of people than by individuals working alone. Business organizations are devoted to producing goods and/or providing services. They may be for-profit or nonprofit organizations. Their goals, products, and services may be similar or quite different. Nonetheless, their functions and the way they operate are similar.

A typical business organization has three basic functions: finance, marketing, and production/operations (see Figure 1-1). These three functions, and other supporting functions, perform different but *related* activities necessary for the operation of the organization. The interdependency of the major functions is depicted by overlapping circles in Figure 1-2. The functions must interact to achieve the goals and objectives of the organization, and each makes an important contribution. Often the success of an organization depends not only on how well each area performs but also on how well the areas *interface* with each other. For instance, in manufacturing, it is essential that production and marketing work together. Otherwise, marketing may promote goods that production cannot profitably produce, or production may turn out items that have no demand. Similarly, unless finance and production people work closely, funds for expansion or new equipment may not be available when needed.



A luxury cruise ship is primarily a service operation. Most of the activities performed by the captain and crew are operations management.

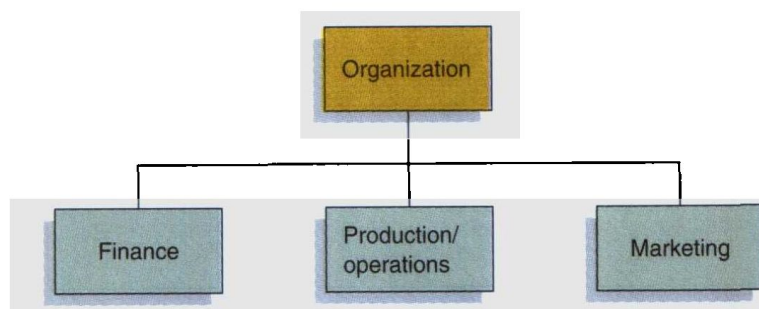


FIGURE 1-1

The three basic functions of business organizations

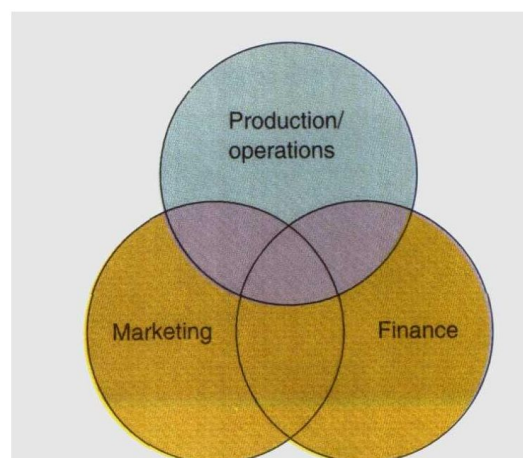


FIGURE 1-2

The three major functions of business organizations overlap

In addition to the three primary functions, many organizations have a number of supporting functions, such as personnel, accounting, and engineering. The existence of these functions and the emphasis placed on each depend on the type of business a firm is engaged in.

Let's take a closer look at these functions, beginning with the three primary ones.

Operations

The operational function consists of all activities *directly* related to producing goods or providing services. The production function exists not only in manufacturing and assembly operations, which are *goods-oriented*, but also in areas such as health care, transportation, food handling, and retailing, which are primarily *service-oriented*. Table 1-1 provides illustrations of the diversity of operations management settings.

The operations function is the core of most business organizations; it is responsible for the creation of an organization's goods or services. Inputs are used to obtain finished goods or services using one or more *transformation processes* (e.g., storing, transporting, cutting). To ensure that the desired outputs are obtained, measurements are taken at various points in the transformation process (*feedback*) and then compared with previously established standards to determine whether corrective action is needed (*control*). Figure 1-3 shows the conversion process.

Table 1-2 provides some examples of inputs, transformation processes, and outputs.

The essence of the operations function is to *add value* during the transformation process: **Value-added** is the term used to describe the difference between the cost of inputs and the value or price of outputs. In nonprofit organizations, the value of outputs (e.g., highway construction, police and fire protection) is their value to society; the greater the value

Value added

The difference between the cost of inputs and the value or price of outputs.

TABLE 1-1

Examples of types of operations

Type of operations	Examples
Goods producing	Farming, mining, construction, manufacturing, power generation
Storage/transportation	Warehousing, trucking, mail service, moving, taxis, buses, hotels, airlines
Exchange	Retailing, wholesaling, banking, renting or leasing, library loans
Entertainment	Films, radio and television, plays, concerts, recording
Communication	Newspapers, radio and TV newscasts, telephone, satellites

FIGURE 1-3

The operations function involves the conversion of inputs into outputs

