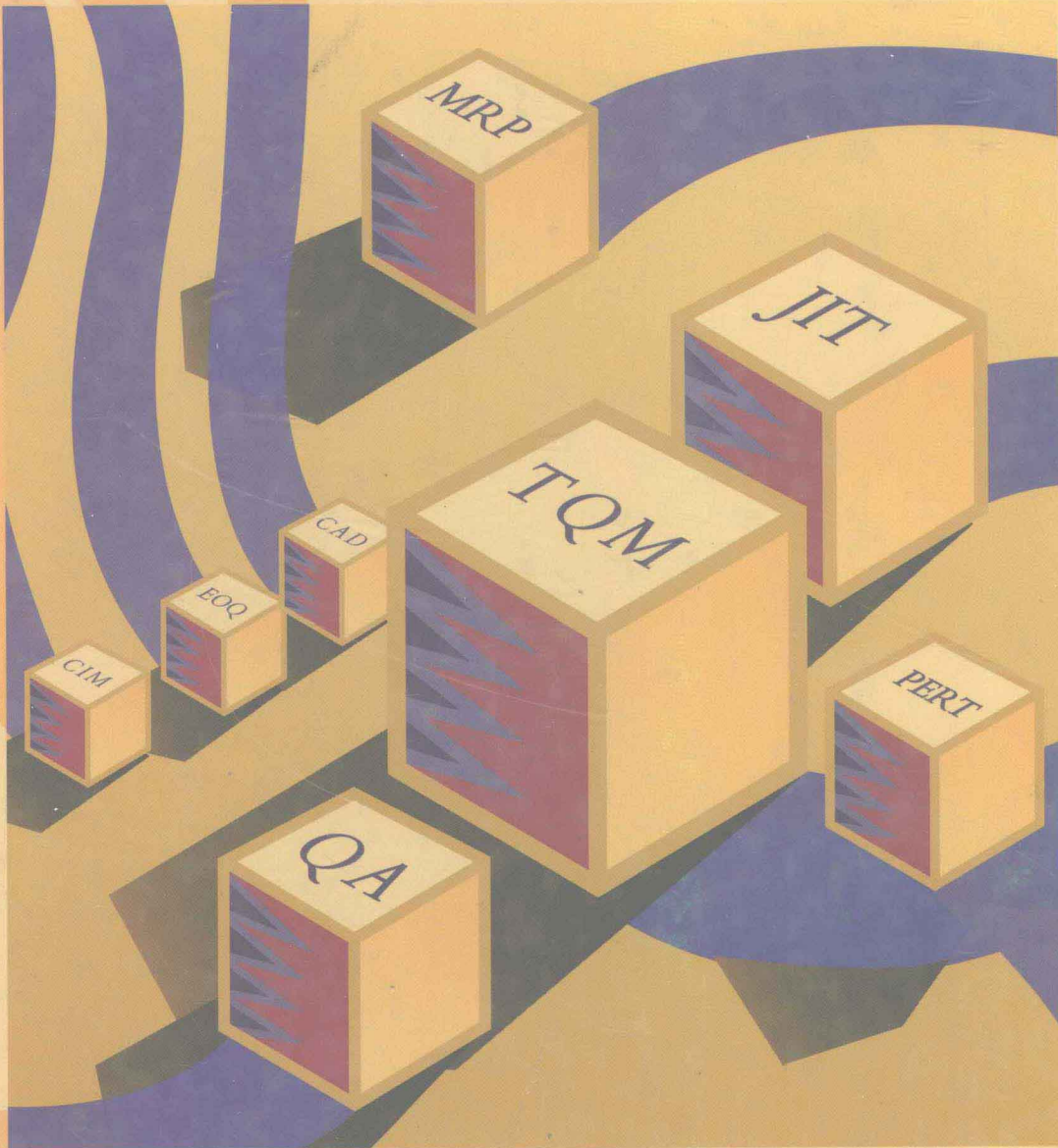

PRODUCTION/OPERATIONS MANAGEMENT

Fourth Edition



William J. Stevenson

PRODUCTION/OPERATIONS MANAGEMENT

Fourth Edition

WILLIAM J. STEVENSON

Rochester Institute of Technology

IRWIN

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Boston, MA 02116

This Book Is Dedicated to You

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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 subject matter is somewhat technical in parts. It represents a blend of concepts from industrial engineering, cost accounting, general management, quantitative methods, and statistics. Even so, readers should find the material interesting and informative. 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. Very often, the majority of employees and assets of an organization are controlled by the production/operations function. Some of you are—or will be—employed directly in a production/operations capacity, while others will have jobs that are indirectly related to this area. So whether this is your field of study or not, this field will probably have an impact on your work.

Historically, production and operations management (POM) techniques developed in manufacturing organizations. However, as time went on, it became more and more apparent that nonmanufacturing organizations have to contend with problems similar to those encountered in manufacturing settings. Consequently, the scope of POM has been expanded to cover both manufacturing and service organizations. Moreover, many of the techniques can be directly applied to both areas without modification.

The text contains more material than one could normally hope to cover in a one-semester course. Rather than relying 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.

ACKNOWLEDGMENTS

I have gained a great deal in revising this book. I was fortunate again to have an excellent panel of reviewers and focus group who contributed significantly to the final product. The are: Layth Alwan, University of Wisconsin–Milwaukee; Robert T. Amsden, University of Dayton; Donna Bush, Middle Tennessee State University; Charles Dane, Oregon State University; Kiran Desai, Middle Tennessee State University; Edward Gillenwater, University of Mississippi; Marilyn Helms, University of Tennessee–Chattanooga; Shirley Hopkins, University of Denver; Gary Kern, Indiana University–South Bend; Michael Lanier, Murray State University; John Liu, University of Wisconsin–Milwaukee; Murat H. Mercan, Cleveland State University; Joseph Ormsby, Stephen F. Austin State University; Michael Peters, Middle Tennessee State University; Roberta Russell, Virginia Polytech Institute and State University; Bob Schlesinger, San Diego State University; Roger Schoenfeldt, Murray State University; Dwight Smith-Daniels, Arizona State University; Stan Stockton, Emeritus Professor, Indiana University.

Many students offered comments and suggestions, and many others are to be commended for suffering through revisions of problems and solutions and text material. The manuscript went through several stages of proofing and error-checking. Roger Schoenfeldt of Murray State University, Javad Varzandeh of California State University–San Bernardino, W. Rocky Newman of Miami University, and Clyde Brant of Miami University, tirelessly endeavored to ensure the accuracy of the final product and I owe them a great debt of thanks. All four did a terrific job.

Special thanks go to Byron Finch and Rich Luebbe of Miami University of Ohio who developed the *Spreadsheet Applications* text (which may be used with this as well as other POM texts) and Vahid Lotfi of University of Michigan, Flint, and Carl Pegels of SUNY/Buffalo who developed the *Decision Support Systems for Production/Operations Management* software package.

I would also like to thank all the professors who contributed their time by assisting with the supplements. Roger Schoenfeldt assisted me in preparing the Instructor's Manual and Transparency Masters, F. Dean Booth of University of Missouri–Kansas City revised the Test Bank, Lee Tangedahl of University of Montana wrote the Lotus Templates, and Paul Van Ness coauthored the Study Guide.

Finally, I extend my thanks to all the people at Irwin for all of their effort and support. It was a pleasure to be able to work with such a competent and professional group of people. Special thanks go to Dick Hercher, Jim Minatel, and Jean Lou Hess.

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 assumptions and limitations* which underlie each model or technique covered.

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 detrimental to learning. 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.

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

Good luck!

W. J. S.

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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 covered 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.

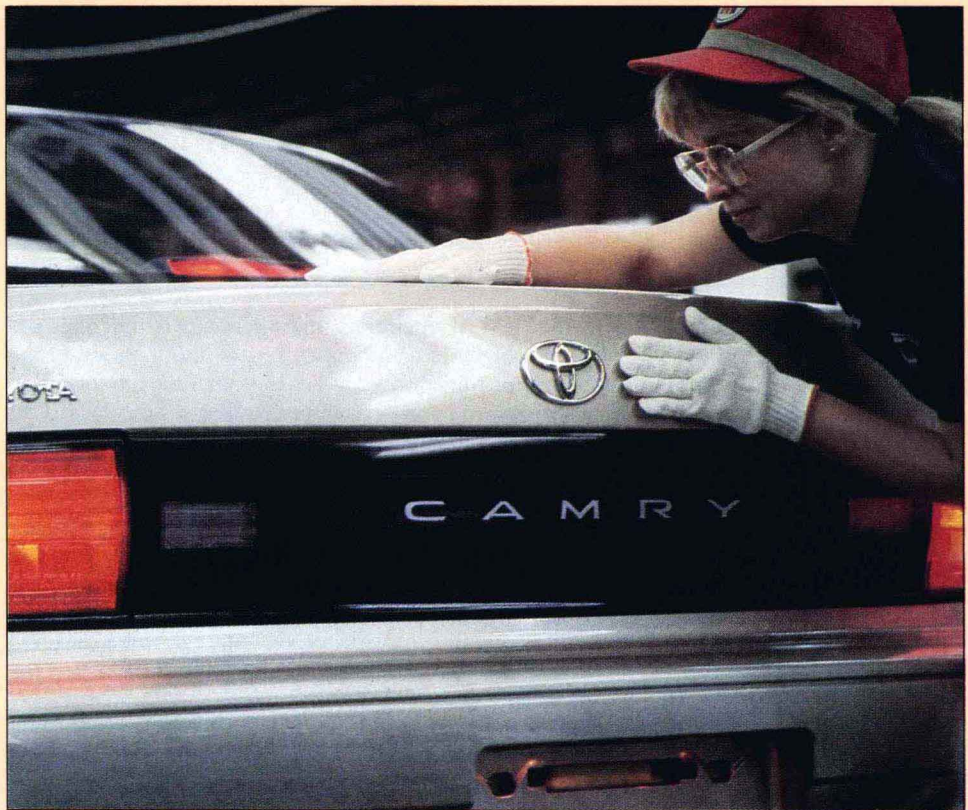
Chapter 2 discusses operations management in a broader context, and presents the issues of productivity, competition, and strategy. After you have read Chapter 2, you will understand the importance of the operations function relative to the goals of a business organization. Also described in Chapter 2 are time-based strategies, which many organizations are now adopting as they seek to become more competitive, and seek 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 quality is being stressed throughout the business community. Of particular interest is the description of *total quality management (TQM)*.

CHAPTER ONE

PRODUCTION AND OPERATIONS MANAGEMENT



After completing this chapter, you should be able to:

1. Define the term *production/operations management* (P/OM) and give examples.
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 P/OM.
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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CHAPTER OUTLINE



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 very timely: productivity, quality, foreign competition, and customer service are very much in the news. These are all a 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?

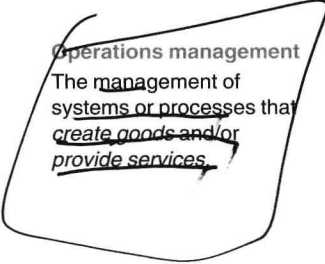
The goal of the book is to present a broad conceptual framework for the management of the operations function in organizations. This chapter lays the groundwork for the book. It begins with a brief description of the various functions of business organizations and their relationships to each other. Then the operations function is described in more detail, including a description of 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. Heavy emphasis was placed on methods and techniques that dealt with operating a factory. In recent years, the scope of production management has broadened considerably. Currently, production concepts and techniques are being applied to a wide range of activities and situations *outside of manufacturing*, that is, in *services* as well as in *manufacturing*. Among the services are health care, food service, recreation, banking, hotel management, retail sales, education, transportation, and government. Because of this broadened scope, the field has taken on the name *production/operations management* (P/OM), or more simply, **operations management**, a term that more closely reflects the diverse nature of activities to which its concepts and techniques are applied.

As an example of an operations management system, consider a luxury cruise ship. 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 eating 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. Of course, there are other activities involved in operating a luxury ship, but this gives you some idea of the nature and scope of operations management in that regard.

Now consider a bicycle factory. This might be primarily an *assembly* operation: buying components such as frames, tires, wheels, gears, and other items from



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