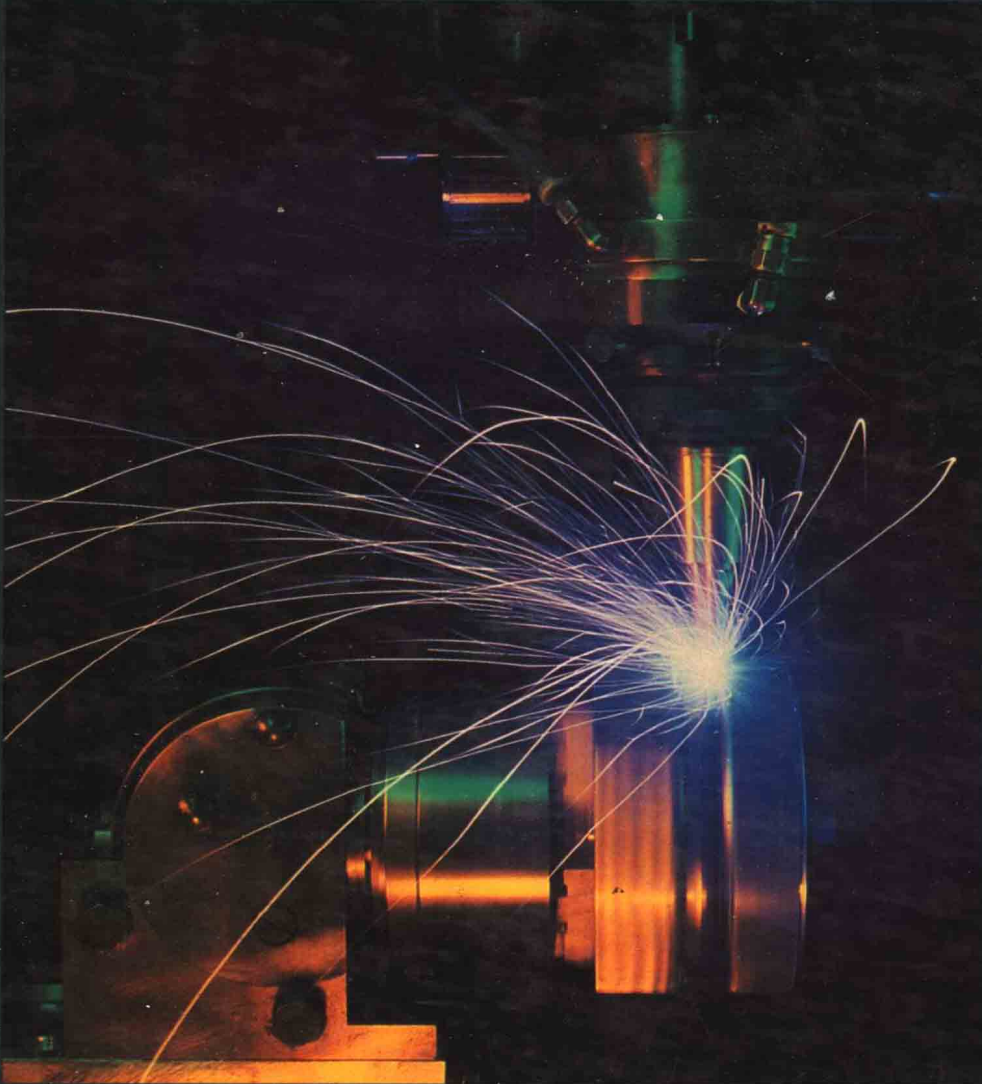


**NORMAN GAITHER**

# ***PRODUCTION AND OPERATIONS MANAGEMENT***

***A PROBLEM-SOLVING AND DECISION-MAKING APPROACH***



**FOURTH EDITION**

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***A PROBLEM-SOLVING AND DECISION-MAKING APPROACH***

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***Dedicated to:***

**The professors who actually stand in classrooms and teach production and operations management.**

While the faces of the students change from semester to semester, the challenge continues—to prepare students to cope and succeed in tomorrow's business world. Somewhat like our students, professors are trying to survive another semester, but something else is driving them. Knowing that our students can make a difference in the future of our manufacturing and service operations, we may often seem deadly serious, intense, and doggedly persistent. It is hoped that in some small way this text can make the teaching and learning of POM more effective.

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## PREFACE

The American Assembly of Collegiate Schools of Business (AACSB) requires that all accredited schools include production and operations management (POM) in their curriculum. Schools of business in growing numbers have included POM courses in their academic programs at both the undergraduate and graduate levels. This book has been developed to meet the need for comprehensive text materials in these and other POM courses.

The fourth edition retains the distinctive features of the earlier editions:

1. **Production/operations function perspective.** The text places the student squarely in the production/operations function in a variety of organizations. The problems of operations managers in many diverse manufacturing, service, and government units are studied.
2. **Practical view of POM.** Most of the problems and examples in the text have been abstracted from actual situations that have been analyzed by the author or his associates. The view presented is one of realism about real-world problems.
3. **Nontheoretical approach.** The text presents the quantitative topics of POM side by side with managerial issues and concepts for a balanced view of POM problems. When quantitative approaches are appropriate, the text presents these approaches in a nontheoretical way. This objective is accomplished by emphasizing operational problems rather than the solution techniques and by using examples to demonstrate the techniques.
4. **Liberal use of examples with solutions.** Each chapter includes examples of POM problems with complete solutions. These examples are solved step by step so that students can follow every detail of the solutions.
5. **End-of-chapter problems and cases.** A strength of the text is its problem sets and cases. The problems and cases are numerous, are about practical POM situations, and can be worked directly from the information in the chapters. The problems exhibit a progression of difficulty as one proceeds through a set.
6. **Graduated-learning process.** Chapters are presented in a framework particularly suitable for learning by students. Concepts and solved examples are presented within chapters, level of difficulty increases as one proceeds through the chapters, and answers to odd-numbered problems are provided as an appendix. This process builds understanding and confidence to the point that students should be able to test their ability to solve problems without the assistance of supplied solutions and answers.
7. **Liberal use of graphics in text.** Many charts, graphs, tables, and other visual tools are used in the text to demonstrate the concepts presented. Students continue to report the usefulness of these aids in understanding the concepts of the chapters.
8. **Use of second color to add emphasis.** A second color is used to emphasize organization, to accentuate content, and to aid understanding. Similarly,

second color and shading are used in the graphics to facilitate comprehension.

9. **Emphasis of POM in services.** Service operations receive considerable discussion in this edition. Operations strategy, process planning, automation, quality, and other topics are cast in the setting of transportation, retailing and wholesaling, banking, and other service industries.
10. **Balanced view of behavioral concepts.** Readers will immediately notice that behavioral concepts are intertwined with other issues as early as Chapter 1. As the text unfolds, these concepts are integrated with other content to form a balanced view of operations management.
11. **Japanese management approaches.** Japanese manufacturing strategy, personnel relations and practices, robotry, JIT, quality control, and other concepts are integrated throughout the text. The view is one of comparison and understanding, rather than one of directly adapting Japanese methods to U.S. production systems.
12. **Comprehensive set of supporting materials.** The text continues to offer a wide range of supporting materials:
  - The *Instructor's Manual and Transparency Masters* presents a comprehensive set of materials to assist instructors in teaching the course. It includes suggested course schedules, chapter teaching notes, sample exams, answers to end-of-chapter review and discussion questions, and transparency masters of figures not included in the text as well as of key figures from the text.
  - The *Instructor's Solutions Manual* consists of complete solutions for all of the problems and cases in the text. These are presented in large ORATOR type so that they can be used as transparency masters.
  - The *Test Bank* includes true/false, multiple-choice, and short-answer questions and problems with detailed solutions. A computerized version for use with IBM PC microcomputers is also available.
  - The *POM Computer Library* includes computer programs that are geared to novice computer users. This package is intended to remove some of the computational drudgery from problem solving of the number-intensive topics in the text. The package is thoroughly consistent with the text in sequence of topics, notation, terminology, and approach. The programs frequently refer to tables, figures, examples, and formulas in the text. Being totally prompted by the programs, students can use them to solve problems or cases as they proceed through the text. An information packet and a disk for IBM PC microcomputers are free to adopters of the text.

Our goal in this fourth edition has been to make the text even better. Toward this end, we have made the following changes to the previous editions:

1. **Emphasis on operations strategy.** Chapter 2, Operations Strategy, introduces the student to strategic issues early in the text. This chapter also motivates the study of POM by examining the forces at work today in our global economy and sets up Part II of the text, Strategic Planning in Operations. Chapter 2 combined with the chapters in Part II form a thorough treatment of the strategic issues and decisions in POM today.



2. **Emphasis on production processes.** Chapter 4, Production Processes, consolidates much of the information about production processing early in the text. Students are shown several classic types of production schemes and the strategic capabilities of each type are explained.
3. **Video plant tours.** Three classic types of manufacturing schemes are illustrated by plant tours of IBM, R. R. Donnelley, and Wal-Mart. Chapter 4 includes a written tour and each is accompanied by a video tour that helps bring the plant to life. These three videos are provided free to adopters.
4. **Advanced production technology.** Chapter 1 introduces students to robotics, automation, computer-integrated manufacturing, CAD/CAM, flexible manufacturing systems, bar-coding systems, and other high-tech production equipment. Chapter 2, Operations Strategy, discusses the strategic implications of high-tech manufacturing. Chapter 5, Production Technology, discusses automated work cells, flexible manufacturing systems, automated assembly systems, automation in services, and other state-of-the-art automation concepts. These methods are described and illustrated from the perspective of the operations manager and how they affect the strategic performance of operations.
5. **Industry Snapshots.** Special accounts of industry applications are featured in most chapters. These Industry Snapshots are visually highlighted to indicate their importance to the topics being discussed. Where possible in these narratives, the real names of companies and people and their actual situations are used to demonstrate to students the relevance of what we teach in POM courses.
6. **Placement of quantitative supplements in appendixes.** Quantitative topics such as linear programming and queuing theory had appeared as chapter supplements in earlier editions. Many of the users of the third edition suggested that these supplementary materials would be more easily located from other chapters if they were placed at the end of the text. Accordingly, in this fourth edition they are placed at the end of the text as appendixes. The quantitative topics remain thoroughly integrated with the application areas within the chapters.
7. **Refinement of problems and cases.** In a continuing effort to keep the problem sets current and effective, new problems have been added to this edition and several of the old ones have been removed. Some of the problems and their solutions that were removed from earlier editions have been placed in the *Instructor's Manual* for professors' use.
8. **More special problems and cases to be solved by computer.** Where appropriate, the end-of-chapter problems and cases are specially designed to be solved with the use of the computer. These problems and cases, which are formulated to be consistent with the expanded capabilities of the *POM Computer Library*, are identified by a computer symbol preceding the problem number or case title.
9. **More photos and full-color layouts.** As in the third edition, the fourth edition uses full-color photos to illustrate robotics, advanced manufacturing methods, and other POM concepts. Additionally, in the fourth edition, the photos are better integrated with other topics in Chapter 5, Production Technology.



10. **Study Guide.** The *Study Guide* provides chapter outlines and review questions and problems, including answers and solutions, to help students master the text material and prepare for exams.
11. **Expansion of the *POM Computer Library*.** The fourth edition includes many improvements to the computer package available for the IBM PC. The package is more visually appealing while retaining its ease of use, and it continues to include automatic file maintenance. The library has been refined to reflect many improvements to individual programs and also contains some new programs. A major improvement is the ability of the programs to edit data and to store data between use sessions. This allows students to interrupt sessions without losing data and to shift to other computers to print their output. This computer package is free to adopters of the text.
12. **Test Bank.** An expanded *Test Bank* by Ray Boykin, Marcus Najem, Kathryn Ritchie, Carl Salmonsén, and Toni Schreder of California State University — Chico, William Corney, University of Nevada, and Norman Gaither, includes more than 1,000 questions and problems with detailed solutions. Nile Leach, Colorado State University, checked all questions and problems for accuracy and consistency with the text.
13. **Computerized test bank.** The *Computerized Test Bank* includes all of the questions and problems in the *Test Bank* and is provided free to adopters of the text. The package is available in disk form for the IBM PC. With this package instructors can design their own comprehensive quizzes and examinations covering the concepts and issues presented in the text.
14. **Videotapes.** Several videotapes of factory and service operations are provided free to adopters of the text. These tapes are in VHS format and are intended to reinforce the materials in several topic areas of the text. The *Instructor's Manual* suggests how these tapes may be integrated with the text and with the other ancillary materials provided.

As with the previous editions, students should have completed courses in college algebra and introductory statistics as prerequisites to courses using this text. Although the mathematical and statistical concepts in the text are not complex, students with a basic background in these topics tend to perform better.

As this fourth edition is completed, numerous persons deserve special recognition for their contributions to the project:

1. My faculty colleagues, graduate students, and students at Texas A&M University who have participated in Bana 364, the POM core course. These persons not only made many suggestions for the improvements that are incorporated into this edition, but they also shared their thoughts and philosophies of teaching. A special mention goes to Bob Davis, Benito Flores, Rob Bregman, Ted Anthony, Joe Munn, and Greg Frazier.
2. My family and friends who have continued to provide me with moral support and encouragement. Lynda, my wife, is an especially important contributor to my work through her support and understanding. She has allowed me to spend countless hours in my office working on manuscripts rather than on other activities that she would have considered more fun.

3. The great editorial team at The Dryden Press. They continue to demonstrate that they are unparalleled in their ability to convert a rough manuscript into a finished POM textbook. For their suggestions, cooperation, congeniality, diligence, professionalism, and talent, I am truly thankful.
4. The many friends and associates who have contributed to both formal and informal reviews of the text manuscript. A special mention goes to those reviewers who were actively involved in the fourth edition project:
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To these and all of the other persons who have contributed to this work, I am grateful.

Norman Gaither



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## ABOUT THE AUTHOR

Norman Gaither is a professor in the Business Analysis and Research Department of Texas A&M University. He received his Ph.D. and M.B.A. from the University of Oklahoma and his B.S.I.E. from Oklahoma State University. He also taught at Northern Arizona University and the University of Oklahoma. Prior to teaching, Professor Gaither worked for eight years at Olin Corporation where he held the positions of chief industrial engineer, plant manager, and director of a multiplant operation and for three years at B.F. Goodrich Company as senior industrial engineer.

Professor Gaither's writings on a wide range of POM topics have appeared in *Management Science*, *Decision Sciences*, *International Journal of Production Research*, *Journal of Production and Inventory Management*, *Academy of Management Journal*, *Academy of Management Review*, *Simulation*, *Journal of Purchasing and Materials Management*, *Journal of Cost Analysis*, and *International Journal of Operations and Production Management*.

He serves on the editorial boards of the *Journal of Production and Inventory Management*, the journal of the American Production and Inventory Control Society, and the *International Journal of Production Research* and is an AACSB Federal Faculty Fellow. Professor Gaither has been actively involved in consulting for government agencies and major corporations, including Bell Telephone, Texas Instruments, Sector Research, and the U.S. Department of Commerce.

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