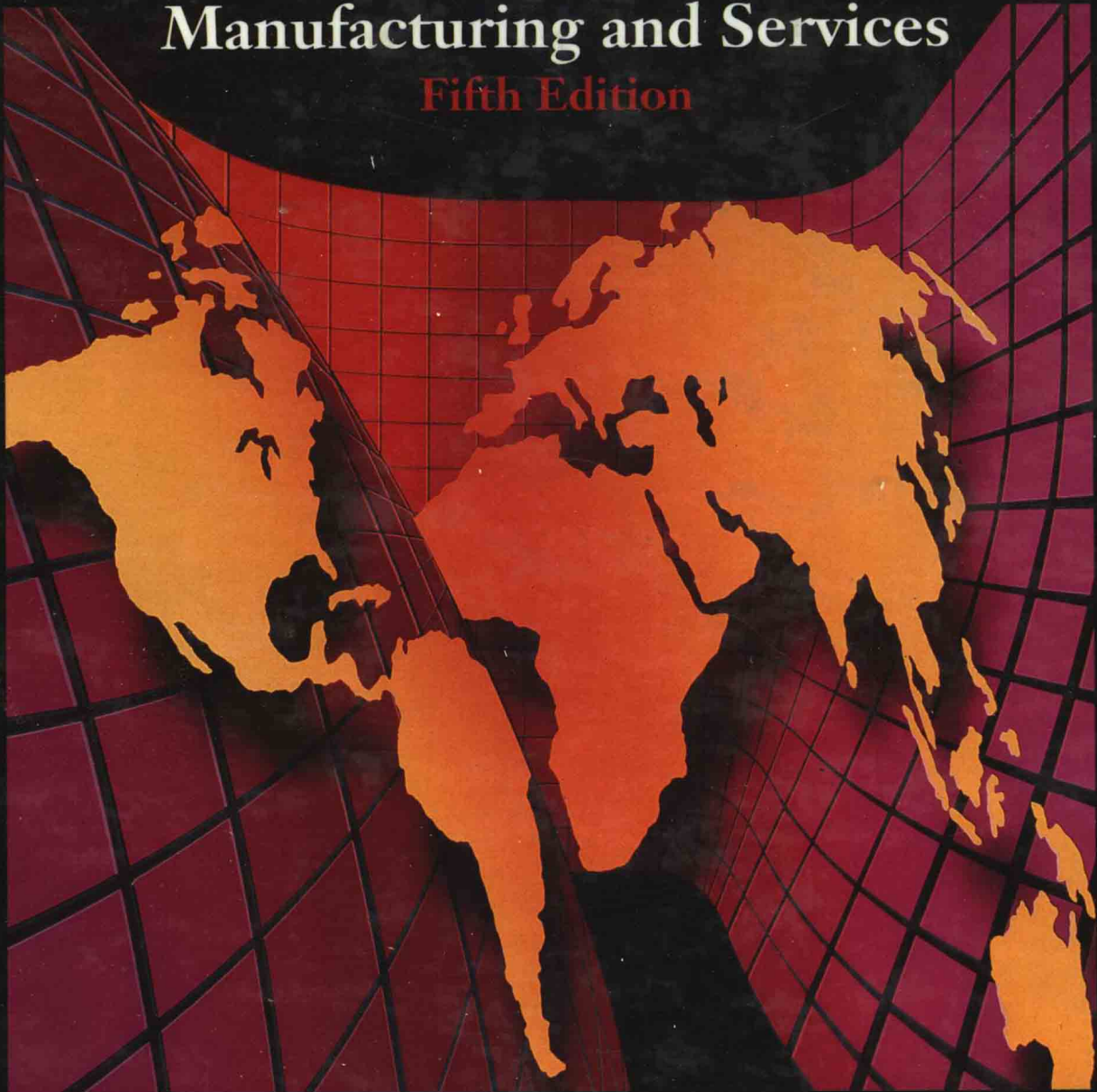


PRODUCTION AND OPERATIONS MANAGEMENT

Manufacturing and Services
Fifth Edition



JAMES B. DILWORTH

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Manufacturing and Services

FIFTH EDITION

James B. Dilworth

University of Alabama at Birmingham

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*Dedicated with love to Ginger,
Jimmy, Caroline, Jessica Leigh,
and Michael, and to the memory
of my father, my mother, and
Andrew*

Production and Operations Management: Manufacturing and Services

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PREFACE

THE IMPORTANCE OF STUDYING OPERATIONS MANAGEMENT

As a primary business function, along with marketing and finance, the operations function plays a vital role in achieving a company's strategic plans. Since the operations function produces the goods and provides the services, it typically involves the greatest portion of the company's employees and is responsible for a large portion of the firm's capital assets. It has a major impact on quality and is often the visible face of the company with which the customer must deal. Customer service, product/service delivery, quality issues, and the effectiveness of many customer interactions are all operations activities.

In the face of increased international competition, U.S. firms have lost market share and have responded by working to improve both their operating efficiencies and the quality of their goods and services. With this renewed emphasis on operations, it has become increasingly important that students have an understanding of operations management's significance to the success of the companies where they will work.

Most business schools offer at least one course that provides students with a basic knowledge of the issues and methods involved in the production of goods and/or services. This book provides material for such a course, and it includes material on production of both goods and services because both are important segments of the economies in developed and developing nations.

In the United States, for example, manufacturing still contributes greatly to the GNP and services provide many of the jobs. An operations management course is an important opportunity for students to gain a basic understanding of issues in both manufacturing and services. If we are to prosper economically, managers must be knowledgeable regarding ways in which they can efficiently improve the internal and external service aspects of their business and the quality of their products. Knowledge of both manufacturing and services is valuable for students in various disciplines. For example, marketing majors may become involved in selling products of a manufacturer or in selling to manufacturers. Finance majors may work in banking and may make loans to manufacturers or service companies. Therefore I have tried to include a discussion of issues that operations face and have presented them in the contexts of manufacturing and services where it seemed appropriate.

SOME OF THE CHANGES IN PRODUCTION AND OPERATIONS MANAGEMENT, FIFTH EDITION

This book is based on much of the material in *Production and Operations Management*, Fourth Edition, which was published in 1989. The book retains the general order of presentation that was used in all four previous editions of *Production and Operations Management*. Part One introduces the operations function and discusses how operations (used as a singular noun for a single function) is related to the overall company strategy and presents some other preliminary concepts for further study of operations. Part Two then discusses planning and controlling the operations function so it effectively and efficiently serves customers in concert with the company's strategy. Following this, Part Three discusses how the operations function is designed to support this goal.

Parts Two and Three can be taught in either order from this book with little adaptation on the part of the instructor. Professors at some schools have indicated that they have a slight preference for teaching design before planning and control. A separate book, *Operations Management: Design, Planning, and Control for Manufacturing and Services*, was published in 1992 to serve the desires of these instructors.

In preparing this book I made several changes in response to suggestions from reviewers and other colleagues. I also kept in mind several major forces that are helping to reshape the field of operations management. I devoted a significant amount of time to integrating those forces into the text. The forces are outlined below:

- **GLOBALIZATION**—This book provides more recognition of the global extent of business, competition, the creation of goods and services, and the scope of operations.
- **TECHNOLOGY**—This book provides more discussion of the use of computers and other technology in operations. In addition, more problems have been added for which computer solutions are recommended.
- **SERVICES**—This book reflects the growing importance of services. It recognizes and integrates the applicability of many of the operations management issues and methods to service businesses as well as to manufacturing.
- **QUALITY**—More material on quality and continuous improvement has been added. There is a chapter on total quality management and a chapter on statistical quality control.

Several other key changes set this book apart from the fourth edition of *Production and Operations Management*. For example:

- Chapter 4 discusses the relationship between business planning, production planning, and master scheduling. New material has been added to the chapter on the scheduling of manufacturing to incorporate concepts from the theory of constraints and just-in-time manufacturing. The intent is to integrate these ideas into a discussion of the issue of scheduling, in addition to providing separate discussions of these concepts elsewhere.
- A new chapter on total quality management has been developed to complement the statistical quality control chapter.

- The final chapter is totally new and is devoted to emphasizing the trend to more global competition and the need for continuous improvement.






You will also find numerous other changes which I believe make the text more current, more useful, and more instructionally sound.

ORGANIZED FOR FLEXIBILITY

The material within each chapter is structured to provide flexibility. Generally, the first part of each chapter introduces a topic, discusses why it is important, and relates it to the field of operations management. The application of tools, methods, and techniques is generally discussed in the latter part of a chapter or in a chapter supplement. This structure enables a professor to teach a descriptive course by omitting, or not emphasizing, the latter parts of the chapters and the quantitative supplements and using mostly discussion questions and cases, instead of problems. For a more quantitative course, one may devote more class time to the tools and problems and let the students read the chapters' introductory discussion material outside of class.

PEDAGOGICALLY SOUND

The text also includes numerous pedagogical devices to facilitate student learning. These devices include:

1. Chapter outlines
2. Key terms
3. Numerous figures
4. Application boxes, indicated by the symbol  , to illustrate concepts with simplified example cases
5. Operations Management in Action boxes, indicated by the symbol  , to provide examples from actual companies
6. Value-added boxes, indicated by the symbol  , to describe how each element of the operations function can be used to add value for the customer.
7. Chapter summaries
8. Solved demonstration problems
9. Numerous, quality, end-of-chapter exercises and problems
10. Computer-based problems in selected chapters, indicated by the symbols  

All materials have been updated, the solved demonstration problems and end-of-chapter materials have been expanded in number, and the computer-based problems are new to this edition.

ANCILLARY MATERIALS

For the convenience of professors and students, a number of ancillary materials are available to supplement this book:

For the Instructor

- The **SOLUTIONS MANUAL** provides detailed solutions to all end-of-chapter questions and problems. It also contains suggested responses to discussion questions.
- The **INSTRUCTOR'S MANUAL AND TEST BANK** helps the instructor use the text effectively. It provides a wealth of supplementary information for enriching lectures such as, learning objectives, lecture outlines and notes, and transparency masters. Transparency masters include solutions to some demonstration problems not provided as transparency acetates and other visual aids to enhance lecture material. The *Instructor's Manual* includes over 1,000 test items and features a range of problems to test students' knowledge, as well as containing separate answer sections for test-making facility. The test items include true/false, multiple-choice, essay questions, and problems.
- The **COMPUTERIZED TEST BANK** also facilitates test construction. Called RHTest, it contains all questions from the Test File and is available for IBM PC/PC-XT or true compatibles. It is available in both 5 1/4 inch and 3 1/2 inch versions. A toll-free Customized Test Service is also available.
- The **TRANSPARENCY ACETATES**. Contact your local McGraw-Hill representative for information regarding our overhead transparency program.
- **REPORT CARD**. Contact your local McGraw-Hill representative for information regarding this instructor's grading software.
- **VIDEO CASSETTES**. Contact your local sales representative for information regarding our new Production/Operations Video Cassette Library.

For the Student

- A **STUDY GUIDE** by Larry Ettkin of the University of Tennessee at Chattanooga and myself may be purchased by students to enhance the information presented in the textbook. In addition to standard self-study features such as learning objectives, detailed chapter summaries, and true/false and multiple-choice questions, the guide provides further examples of solved problems (reinforcing this approach in the text) and unsolved problems (with solutions in an appendix) for students to maximize their learning.
- **MANAGING SERVICE: IMPROVING SERVICES THROUGH OPERATIONS MANAGEMENT** by D. Keith Denton of Southwest Missouri State provides the information needed to become more knowledgeable about how to manage services and also provides a source for handling "real-life" service situations. It can be assigned as an outside reading or it can be used as a game or simulation.

Software

Software packages that can be used with this text are available from McGraw-Hill. They include two packages that require lotus or compatible spreadsheet software and two free-standing packages. Both of the Lotus template programs are available with extensive macro programs to perform operations management calculations. These templates run on IBM PC/PC-XT or true compatibles. They are available separately or packaged with the text.

- SPREADSHEET OPERATIONS MANAGER by Everette S. Gardner, Jr., of the University of Houston is Lotus template software. These templates are industrial-strength computational engines and are available in both 5 1/4 inch and 3 1/2 inch versions.
- PRODUCTION/OPERATIONS MANAGEMENT TOOLS FOR SPREADSHEETS by Sam L. Savage of the University of Chicago and Stanford University is Lotus template software that includes add-ins like WHAT'S BEST! The software focuses on improving students' model-building skills and is available in both 5 1/4 inch and 3 1/2 inch versions.
- SOFTWARE TOOLS FOR OPERATIONS MANAGEMENT by Willbann D. Terpening of Gonzaga University. The primary purpose of this software is to allow the student to explore many of the techniques in operations management more productively through the use of personal computers. It is available in both 5 1/4 inch and 3 1/2 inch versions for IBM PC/PC-XT or true compatibles.
- OM EXPERT by Hamid Noori of Wilfrid Laurier University is stand-alone software consisting of thirty-two separate programs grouped into twelve modules. The software has exceptional graphics capability, is easy to use, and is available in 3 1/2 inch and 5 1/4 inch formats for IBM PC AT and compatible equipment.

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James B. Dilworth

ABOUT THE AUTHOR

JAMES B. DILWORTH is Professor of Management at the University of Alabama at Birmingham. He received his B.S. at the University of Alabama and his M.S. at Oklahoma State University. Before obtaining his Ph.D. in Industrial Engineering and Management at Oklahoma State University, he worked for eight years in industry, first as an industrial engineer, and later as a manager of production control, an internal consultant, and a manager of the office of public systems. A specialist in production and operations management, Professor Dilworth has published many articles and is certified at the Fellow level by the American Production and Inventory Control Society. He is the author of *Production and Operations Management*, Fourth Edition (McGraw Hill, 1989) and *Production Observations from Japan* (American Production and Inventory Control Society, 1985) and is the editor of *Strategic and Tactical Issues in Just-in-Time Manufacturing* (Proceedings of the 1985 Conference of the Association for Manufacturing Excellence). Professor Dilworth received the Dean's Teaching Award for the 1984–85 academic year from the University of Alabama in Birmingham. In 1987, he prepared a research report for the Association for Manufacturing Excellence titled *Information Systems for JIT Manufacturing*.

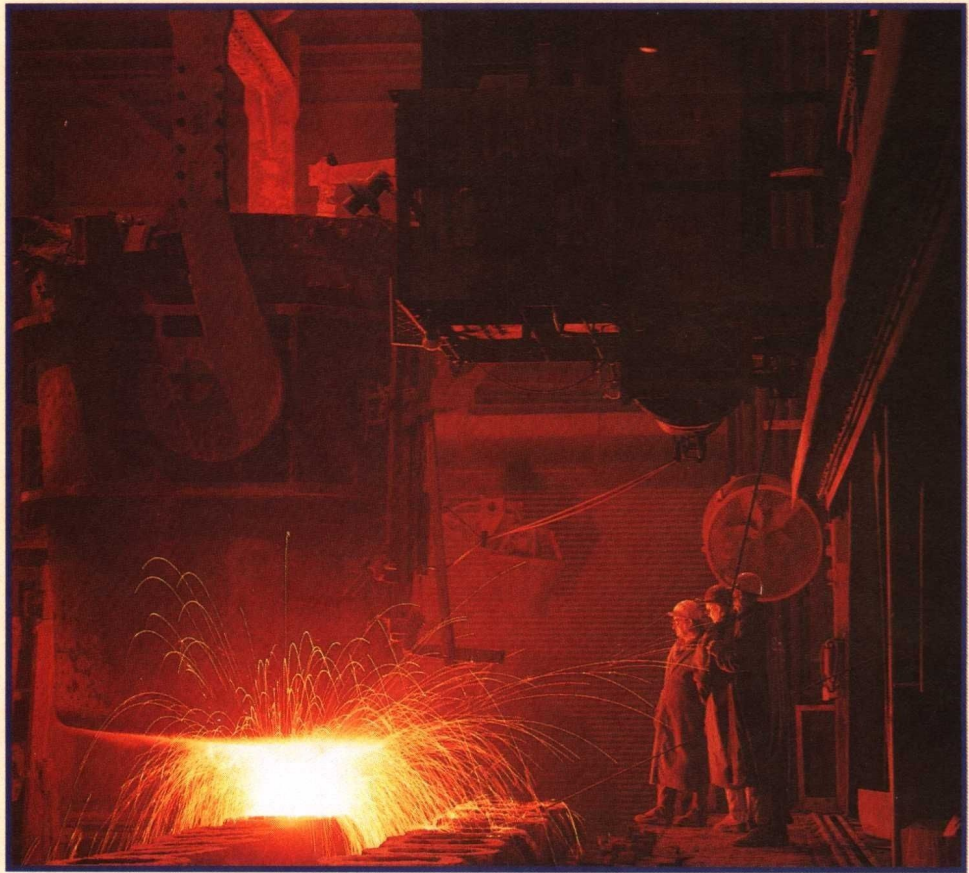
OPERATIONS CONTRIBUTE TO SOCIETY IN MANY WAYS

Numerous businesses work to transform inputs into goods and services that serve the needs of society. The operations function in these businesses performs some portion of a series of transformations to make knowledge and materials serve consumers. These photographs present some of the steps performed in various operations.

Plate 1. Steel companies add value for the customer by transforming a raw material, iron ore, into steel, an essential material for use in the manufacturing operations of industrialized nations.

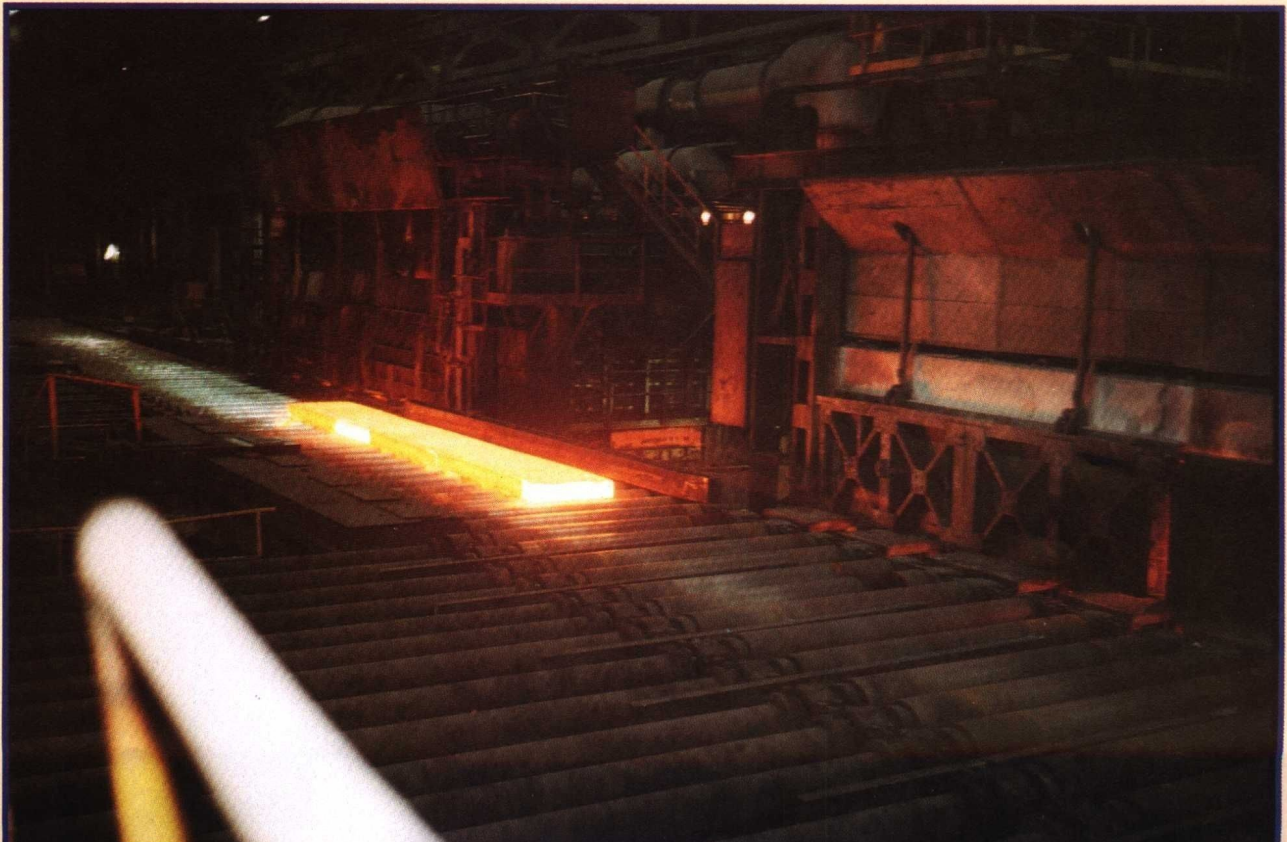
(a) At ARMCO in Kansas City, Missouri, ore is refined in a blast furnace as one of the initial steps in steelmaking.

(b) Refined steel is cast into ingots that are rolled into shapes convenient for use by other businesses.



(a)

(b)



(a)



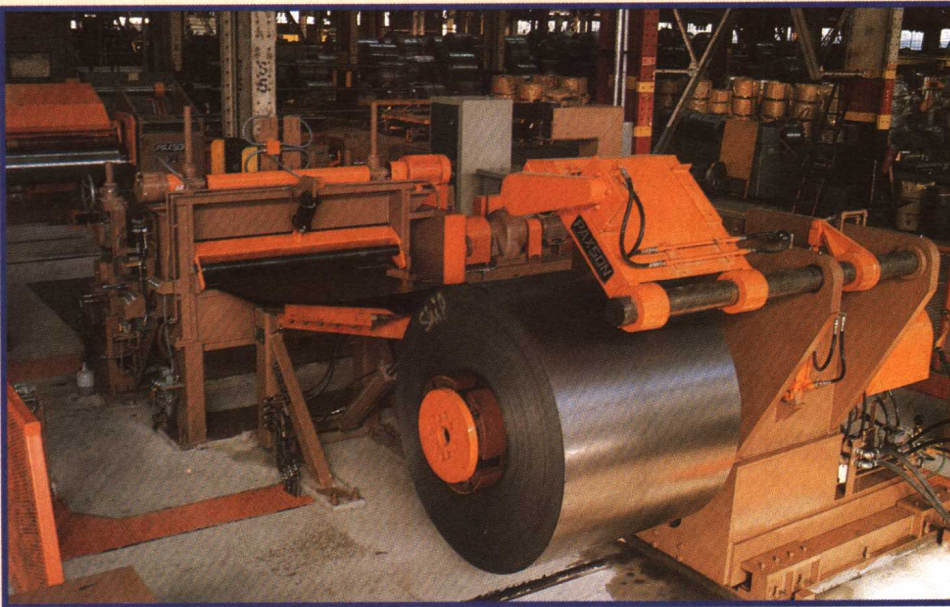
Plate 2. Various forms of steel become inputs into the manufacture of products which are an integral part of our everyday lives.

(a) Thick steel beams are welded together to form the structural skeleton of a skyscraper.

(b) Steel is rolled into large coils of sheet metal ready for use in a further manufacturing process.

(c) At General Motors Corporation sheet metal is stamped into parts used in the production of automobiles.

(b)



(c)



Plate 3. The food industry processes the produce of farms and growers into forms convenient for the customer and readily available.

(a) At Pappas Tomato Processing in Cedarville, New Jersey, tomatoes are washed and graded.

(b) A later stage of food processing is cooking and canning.

(c) Canned and packaged goods are distributed and displayed in such a way as to assist the customer in making choices. A discriminating consumer compares products to obtain the greatest value, so continuous improvement must be an integral part of a manufacturer's competitive strategy.



(a)



(b)



(c)



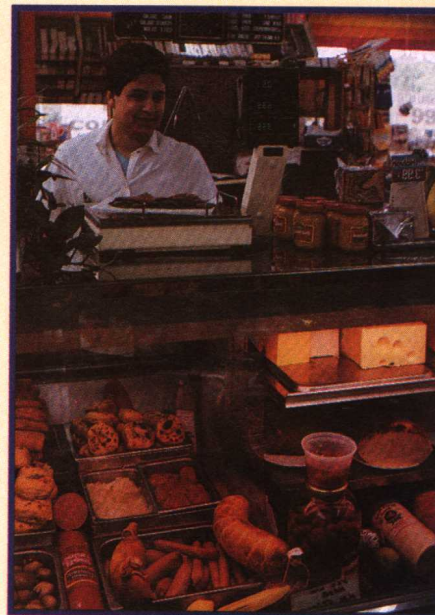
(a)

Plate 4. The meat sector of the food industry serves customers by preparing the kinds of products desired by the customer and distributing those products to convenient shopping locations.

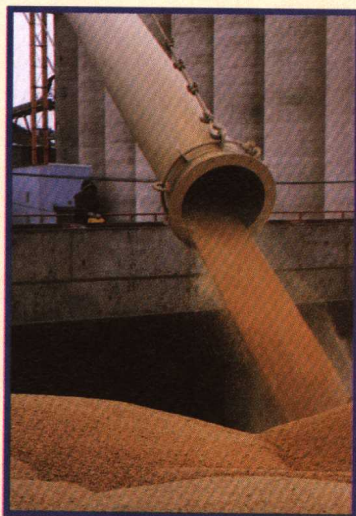
(a) One of the activities in meat preparation at the Monfort Beef Packaging plant in Greeley, Colorado is cutting.

(b) Meats and packaged goods prepared in a form convenient for retail customers to carry are distributed and then displayed by retailers in a way attractive to shoppers.

(b)



(a)



(b)



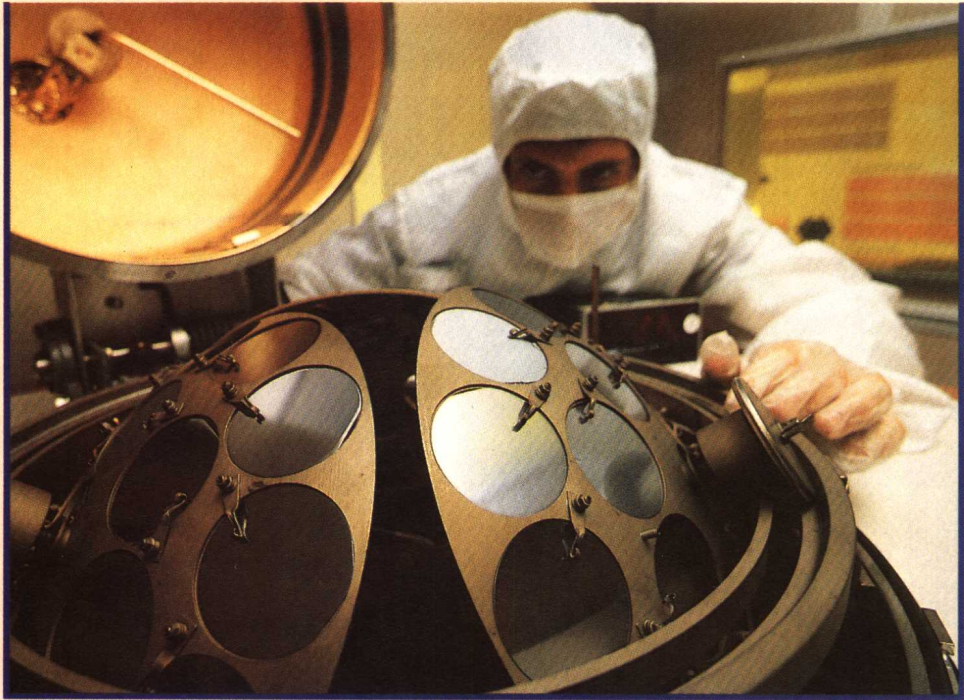
Plate 5. Grain is transformed into a variety of products that are staples in the daily diet of millions of people.

(a) Grain is loaded ready for processing into flour and refined cereals.

(b) Flour is then used in the preparation of baked goods which consumers expect to be of consistently good quality and readily available.

Plate 6. Intense competition in the electronics industry causes companies in this business to strive to improve their value ratios by constant attention to innovation, quality, productivity, and dependability.

(a) Basic electronic components are fabricated from high-purity raw materials in a clean-room work area.



(a)

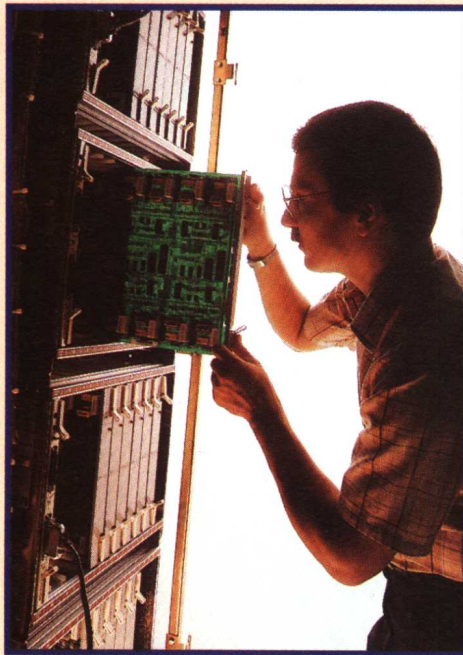


(b)

(b) Components are then assembled on circuit boards to create functional circuits.

(c) Large circuit boards are used in the assembly of mainframe computers.

(d) At COMPAQ Computer Corporation in Houston, Texas lap-top computers, designed to meet customer demand for more advanced computers and information systems, are assembled.



(c)



(d)



(a)



(b)



(c)



(d)

Plate 7. Companies such as airlines, shipping lines, and railroads add value for the customer by changing the location of people and materials.

(a) A Federal Express van conveniently picks up a package at a sender's location.

(b) Packages are quickly transported to the Federal Express hub facility.

(c) At the Memphis, Tennessee central hub packages are sorted and loaded onto a vehicle for delivery to the appropriate destinations.

(d) Finally, the package is presented to the receiver. Value has been added by virtue not only of the relocation of the package but also by the speed of that relocation.