

# PRODUCTION TECHNOLOGY



**STANLEY A.  
KOMACEK**



# PRODUCTION TECHNOLOGY

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# PREFACE

Production technology is central to the way we live. Without the products made with manufacturing technology and the structures built with construction technology, our lifestyles would be very different. Modern production technology makes possible the buses, cars, and bicycles we use every day to go to school or to work. Telephones, televisions, radios, computers, even the paper that this book is printed on, would not exist without manufacturing technology. Homes, shopping malls, baseball stadiums, bridges, highways, even your school, would not exist without construction technology. Together, manufacturing and construction are the basic systems of production technology. Production technology affects almost every aspect of our lives and of people's lives around the world.

## Organization

Production is a complete technology composed of many parts. To make it easier for you to learn about the many aspects of production, this textbook includes 28 chapters. The chapters are grouped into six sections.

**Section One: Technology and Production.** This section introduces you to production and its relationship to people and the other technologies. You will read about the history of production, problem solving methods, careers in production, the organization and management of production technologies, and why manufacturing and construction are the two subsystems of production.

**Section Two: Production Materials.** This section covers the basic materials — natural and man-made — used in production technology. You will read about where materials come from, how raw materials are changed into production materials, the science of materials and the various classes of materials, including metals, woods, plastics, ceramics, and composites.

**Section Three: Production Tools and Machines.** This section gives you the basic information you need to use tools and machines to manufacture products and construct structures. You will be

introduced to the importance of using tools and machines safely and efficiently, see how six basic machines provide mechanical advantage to tool users, and learn about the various classes of production tools and machines, including measuring and layout tools, separating tools, forming tools, and combining tools. Also, you will learn how computers, robots, and lasers are being used to automate production tools and machines with processes like CAD, CAM, CNC, and other high-tech processes.

Sections One, Two, and Three give you the “basics” you need to work safely and efficiently in production technology. The next two sections are the heart of any production technology course; these deal with manufacturing and construction.

**Section Four: Manufacturing Systems.** This section covers the various types of manufacturing systems. It explains how several manufacturing departments work together to design, make, and sell products. You will learn about the entire process from product design and production engineering to mass production to advertising and selling products. Also, you will learn about the importance of money to manufacturing systems.

**Section Five: Construction Systems.** This section covers the various types of construction systems. It explains the process of designing, engineering, and constructing buildings and other structures. You will learn about the entire process, including architectural design and drawing; writing specifications and contracts; preparing the construction site; building foundations, floors, walls, and roofs; installing utilities; and finishing and landscaping. Also, you will learn about the heavy construction technologies used to build bridges, skyscrapers, highways, dams, and towers.

**Section Six: The Future of Production.** This section covers the environmental impacts of production, including scrap, waste, and pollution. You will read about the importance of recycling and pollution control. This section also covers the

possibility that production may someday be conducted in space on a permanent basis. The final chapter looks at a number of trends that may affect the future of production technology and society.

Near the end of the text are two very important sections. The first provides a number of plans for products and structures you and your classmates can produce. The other section provides several "design briefs" that pose problems that you may get the chance to solve. The production plans and design briefs will require you to use all the knowledge and skills you have gained by reading the textbook.

## Safety

Working in, and studying, production technology can be dangerous. You should not be afraid, but you should realize that you can be hurt when working with tools and machines. Near the beginning of the text is a special section on safety. Be sure to read that section carefully. Also, throughout the text there are many references to the importance of safety. Always follow all safety rules, and remember the ABC's of safety; Always Be Careful!

## Special Features

*Production Technology* uses a number of special features, including:

**Safety Guidelines.** A special safety section introduces the basic safety rules that every student should follow when working in a technology laboratory.

**Key Terms.** Listed at the beginning of each chapter, these important terms and phrases are highlighted within the text.

**Boxed Articles.** These are short stories of interesting or unusual information related to the chapter's subject.

**Photographs and Illustrations.** There are hundreds of color photos, illustrations, and line drawings that will help you understand the important parts of manufacturing.

**Summary.** The key points of each chapter are summarized.

**Discussion Questions.** These questions stress critical thinking and problem-solving skills.

**Chapter Activities.** Hands-on and/or minds-on activities are included in most chapters. Math and science concepts relating to each activity are presented.

**Product Plans.** There are numerous plans for products that you and your classmates can manufacture.

**Design Briefs.** Also included in this text are design briefs. A design brief is an activity that provides you with the basic information needed to make a product or structure. The design briefs let you apply the skills and knowledge you have developed by reading the textbook to a technological problem.

**Technology Student Association.** A special section describes the Technology Student Association and its manufacturing-related activities.

**Glossary.** A complete glossary of terms with definitions is included as an appendix to help you study.

## Acknowledgments

The author wishes to express his deep appreciation to the many people that contributed ideas, provided assistance, and helped make this textbook a usable resource for learners studying production technology. Three very important contributors were Mark Huth, Andy Horton, and Ann Lawson. The material they provided, through previously published textbooks, made this textbook a possibility. Thanks are also given to Richard T. Kreh, Sr., Larry Jeffus, and Paul E. Meyers for their work in supplying photographs for this textbook. Finally, thank you to Chris Worden, Chris Chien, and the other people at Delmar Publishers for transforming rough manuscript into a real textbook.

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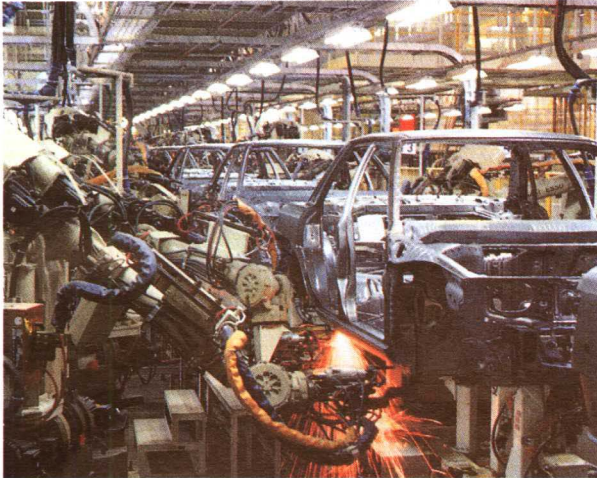
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# CONTENTS

Preface x

## SECTION ONE TECHNOLOGY AND PRODUCTION 1



(Courtesy of Toyota Motor Manufacturing, USA, Inc.)

### CHAPTER 1 ■ Introduction to Production Technology 2

What Is Technology? 2  
Production Technology 4  
Production and the Other Technologies 4  
Types of Manufacturing 5  
Types of Construction 5  
The History of Production 7  
The Impacts of Production 11  
Summary 12  
Discussion Questions 13  
Chapter Activities 13

### CHAPTER 2 ■ Problem Solving and Technology Systems 16

The Technology Problem Solving Method 17  
Technical Drawing 20  
Studying Systems of Technology 24  
Summary 25  
Discussion Questions 26  
Chapter Activities 26

### CHAPTER 3 ■ Careers in Production 31

Manufacturing— Several Departments, One Goal 32  
Construction Careers 36  
Considering a Job in Production 38  
Identifying and Hiring Workers 42  
Summary 44  
Discussion Questions 45  
Chapter Activities 45

### CHAPTER 4 ■ Ownership, Organization, and Management 49

Forms of Ownership 49  
Organizing a Corporation 52  
The Functions of Management 52  
Summary 55  
Discussion Questions 55  
Chapter Activities 56

## SECTION TWO PRODUCTION MATERIALS 59



(Courtesy of Amoco Corporation)

### CHAPTER 5 ■ Introduction to Production Materials 60

Renewable and Exhaustible Raw Material Resources 61  
Primary Manufacturing Processes 62



## vi ■ CONTENTS

Classification of Production Materials	64
Materials Science	64
Properties of Materials	65
Summary	70
Discussion Questions	70
Chapter Activities	70

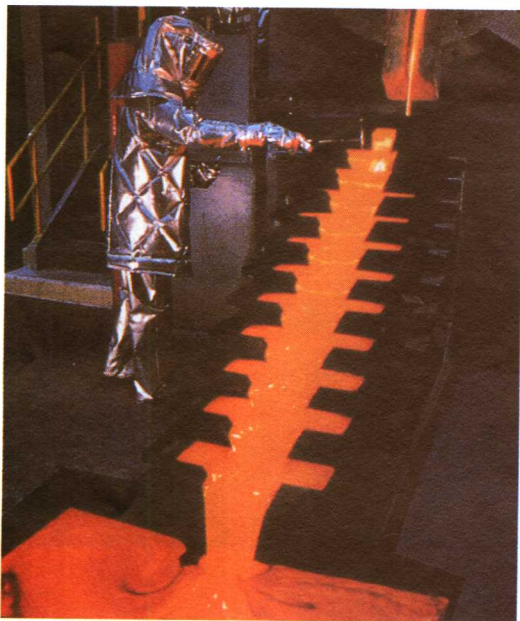
### CHAPTER 6 ■ Metal and Polymer Materials 75

Metal Materials	75
Polymer Materials	79
Summary	85
Discussion Questions	86
Chapter Activities	86

### CHAPTER 7 ■ Ceramic and Composite Materials 90

Ceramic Materials	90
Composite Materials	94
Summary	97
Discussion Questions	98
Chapter Activities	99

## SECTION THREE PRODUCTION TOOLS, MACHINES, AND PROCESSES 103



(Courtesy of FMC Gold Company)

### CHAPTER 8 ■ Introduction to Tools and Machines 104

Defining Tools and Machines	104
The Six Basic Machines	107

Classifying Tools and Machines	107
Measuring Tools	107
Layout Tools	108
Other Important Production Tools	112
Summary	113
Discussion Questions	114
Chapter Activities	114

### CHAPTER 9 ■ Separating Processes and Tools 117

Chip Removing Tools	117
Shearing Tools	126
Special Separating Tools	129
Summary	130
Discussion Questions	131
Chapter Activities	131

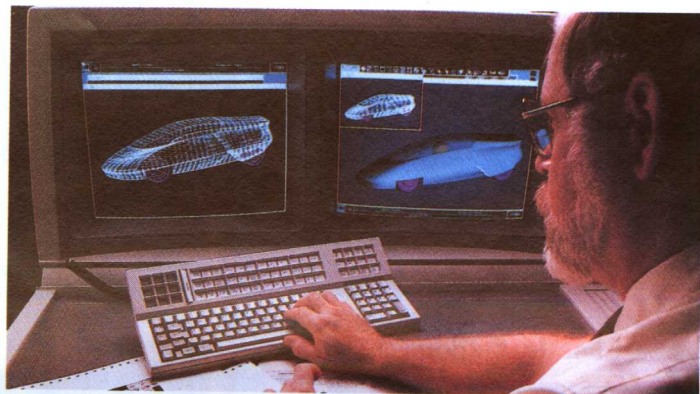
### CHAPTER 10 ■ Forming and Combining Processes and Tools 138

Forming	138
Combining	142
Summary	150
Discussion Questions	150
Chapter Activities	151

### CHAPTER 11 ■ Automating Tools: Computers, Robots, and Lasers 155

Computers: Multipurpose Machines for Production	155
Computers in Engineering	156
Computers in Manufacturing	157
Robots: Computer-Controlled Machines	160
Lasers in Manufacturing	161
Lasers in Construction	162
Summary	163
Discussion Questions	163
Chapter Activities	164

## SECTION FOUR MANUFACTURING SYSTEMS 169



**CHAPTER 12 ■ Manufacturing Enterprise 170**

- The Importance of Good Planning 171
- Ownership and Management 171
- Hiring Employees 172
- Engineering: Designing Products and Planning Production 172
- Processing Materials and Making Products 173
- Marketing 174
- Money and Manufacturing 174
- Impacts of Manufacturing 175
- Summary 176
- Discussion Questions 177

**CHAPTER 13 ■ Types of Manufacturing Systems 178**

- Is All Manufacturing the Same? 178
- Types of Manufacturing Systems 179
- Just-in-Time Manufacturing 183
- Choosing a Manufacturing System 184
- Summary 187
- Discussion Questions 187
- Chapter Activities 187

**CHAPTER 14 ■ Design Engineering 192**

- Research and Development 193
- Steps in the Product Design Process 193
- Summary 201
- Discussion Questions 203
- Chapter Activities 203

**CHAPTER 15 ■ Engineering Production 208**

- Methods Engineering 208
- Manufacturing Engineering Processes 212
- Quality Control Engineering 218
- Tooling Up: Preparing for Manufacturing 219
- Summary 219
- Discussion Questions 221
- Chapter Activities 221

**CHAPTER 16 ■ Marketing Processes 226**

- Market Research 226
- Product Planning 228
- Advertising 228
- Selling 230
- Product Service 231
- Summary 232
- Discussion Questions 232
- Chapter Activities 233

**CHAPTER 17 ■ Money and Manufacturing 237**

- The Finance Department 239
- Determining How Much Money Is Needed 239
- Obtaining Money 239
- Spending Money 240
- Creating Reports of Income and Expenses 247
- Summary 251
- Discussion Questions 252
- Chapter Activities 252

**SECTION FIVE CONSTRUCTION SYSTEMS 255**



(Courtesy of Pat Dineen/photo by Shirley Nelson)

**CHAPTER 18 ■ Architectural Design and Drawing 256**

- Design Considerations 256
- From Design to Drawings 257
- Architectural Working Drawings 259
- Structural and Civil Drawings 261
- Architectural Symbols and Abbreviations 263
- Computer-Aided Drafting (CAD) 263
- Scales 266
- Modeling 268
- Summary 268
- Discussion Questions 269
- Chapter Activities 269

**CHAPTER 19 ■ Specifications and Contracts 272**

- CAD, Computers, and Specification Writing 273
- Bids, Estimates, and Contracts 273



## **viii ■ CONTENTS**

Contractors and Subcontractors	274
Managing a Construction Project	274
Financing Construction Projects	278
Summary	278
Discussion Questions	279
Chapter Activities	279

### **CHAPTER 20 ■ The Substructure: Site Work and Foundations 283**

Building Codes and Plot Plans	283
Plot Plan and Energy Efficiency	284
Site Work	285
Foundation Design	288
Summary	295
Discussion Questions	296
Chapter Activities	296

### **CHAPTER 21 ■ Floor and Wall Systems 300**

Floor Systems	300
Floor Framing Design	301
Wall Systems	306
Bearing-Wall Construction versus Skeleton-Frame Construction	309
Summary	311
Discussion Questions	312
Chapter Activities	312

### **CHAPTER 22 ■ Roof Systems and Enclosing the Structure 316**

Roof Systems	316
Roof Design	317
Roof Covering	321
Enclosing the Structure	321
Cornice: Roof Trim	321
Exterior Doors	324
Windows	326
Exterior Wall Coverings	326
Summary	330
Discussion Questions	331
Chapter Activities	332

### **CHAPTER 23 ■ Utilities: Plumbing, Electrical, and Climate Control Systems 336**

Plumbing Systems	336
Electrical Systems	340
Climate Control Systems	342
Summary	348
Discussion Questions	349
Chapter Activities	349

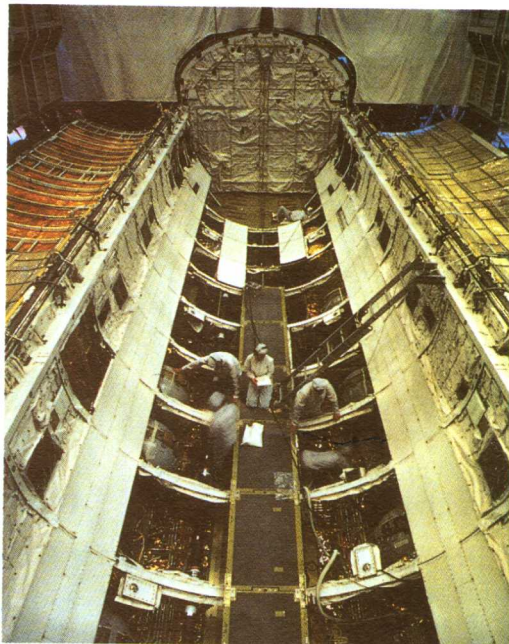
### **CHAPTER 24 ■ Completing the Structure: Finishing and Landscaping 352**

Ceilings	352
Walls	353
Floors	354
Molding	354
Cabinets and Countertops	355
Paints	356
Landscaping	359
Maintaining the Structure	361
Remodeling	361
Summary	362
Discussion Questions	363
Chapter Activities	363

### **CHAPTER 25 ■ Heavy Construction: Civil Construction and Industrial Construction 369**

Civil Construction	370
Industrial Construction	375
Summary	378
Discussion Questions	379
Chapter Activities	379

## **SECTION SIX PRODUCTION IN THE FUTURE 383**



(Courtesy of Lockheed Corporation/photo by Dick Luria)

### **CHAPTER 26 ■ Environmental Impacts: Scrap, Waste, and Pollution 384**

Scrap	385
Waste	385

Pollution	389
Summary	392
Discussion Questions	393
Chapter Activities	393
<b>CHAPTER 27 ■ Production in Space</b>	<b>397</b>
Manufacturing in Space	397
Constructing the Space Station	401
Building Large Antennas	402
Building in Orbit	402
Automated Beam Builder	404
New Materials	405
Summary	406
Discussion Questions	407
Chapter Activities	407
<b>CHAPTER 28 ■ Future of Production</b>	<b>409</b>
Exponential Rate of Growth	410
Trend #1: Decreased Use of Labor	412
Trend #2: Increased Use of Automation	412
Trend #3: Increased Global Competition	414
Trend #4: Decreased Demand for Unskilled/Semiskilled Labor	416
Trend #5: Increased Use of Natural Resources	416
Trend #6: Decreased Employment by Corporate Giants	417
Deciding Which Futures	417
Summary	418
Discussion Questions	419
Chapter Activities	419

**Appendix: Product Plans 421**

**Design Briefs 436**

**Technology Student Association 443**

**Glossary 446**

**Index 453**



# SECTION ONE

## TECHNOLOGY AND PRODUCTION



*(Courtesy of Toyota Motor Manufacturing, U.S.A., Inc.)*

- CHAPTER 1 ■ Introduction to Production Technology
- CHAPTER 2 ■ Problem Solving and Production Technology
- CHAPTER 3 ■ Careers in Production
- CHAPTER 4 ■ Ownership, Organization, and Management



# CHAPTER 1

## Introduction to Production Technology

### OBJECTIVES

After completing this chapter, you will be able to:

- Define and explain the differences between technology, production technology, manufacturing technology, and construction technology.
- Explain the relationship between production technology and the technologies of communication, transportation, and energy and power.
- Describe the two basic types of manufacturing technology.
- Describe the two basic types of construction technology.
- Summarize the history of production technology from earliest times to the age of automation.
- Identify various positive and negative impacts of production technology.

### KEY TERMS

Automation	Energy and power technology	Mass production
Bartering	Heavy construction	Production technology
Communication technology	Impact	Recycling
Computer	Industrial Revolution	Resources
Conservation	Innovations	Structures
Construction technology	Inventions	Technology
Cottage industry	Light construction	Transportation technology
Custom manufacturing	Manufacturing technology	

### What Is Technology?

Technology is all around us. It is part of our everyday lives. Without it our lives would be very different. Production is based on technology. What, then, is technology? Simply defined, **technology** is the use of tools, materials, and processes to meet human needs and wants. The food we eat has been grown, packaged, and shipped

to the store through technology. Your home was planned and built by people using tools, materials, and processes. The clothes we wear and the furniture we use were also made using technology.

Technology is used by people to increase their power to make or do something. If you had a board you wanted to cut in half, you would not





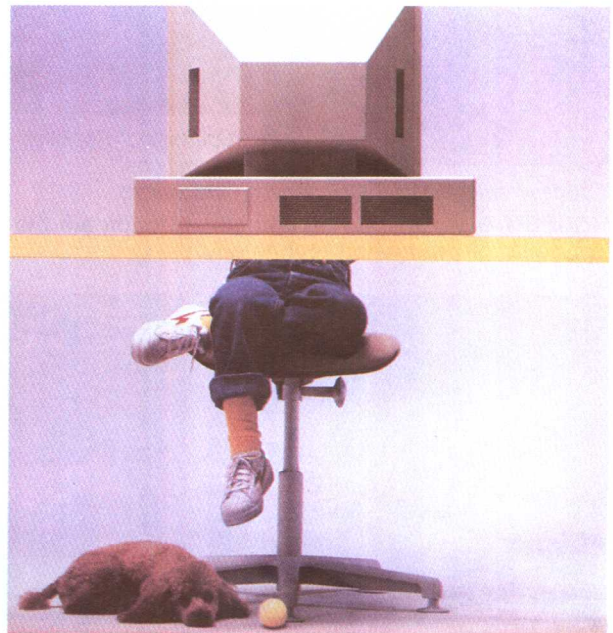
**FIGURE 1-1** Technology, like the computers shown here, needs humans to operate it. Technology includes tools, materials, and processes used to meet human needs and wants. (Courtesy of LTV Aircraft Products Group, Dallas, TX)

be able to do it with your bare hands. But with a tool of technology, a saw, your power to cut the board would be increased. If you wanted to get to the movies by a certain time and you had to walk, you would have to leave very early. With technology — a bicycle, automobile, or train — your power to get to the movies on time would be increased. Technology makes certain jobs and tasks easier to do.

Without people, technology would not exist. Technology requires people. People use their knowledge to apply tools, materials, and processes, Figure 1-1. Every day, we make decisions about how we will use the tools, materials, and processes of technology. These decisions include whether to write a letter or call on the telephone; whether to walk, ride a bike, or drive a car; and whether to buy a product or try to make it. Making decisions is a very important part of using technology.

Technology always causes change. Think of the changes in technology since your grandparents were children. Your parents have also seen many changes in technology during their lifetimes. Changes in technology can affect peo-

ple's lifestyles, their health, and how they work and learn, Figure 1-2. Technology also changes the natural environment. Water, air, and land are



**FIGURE 1-2** Changes in technology affect the way we learn today. (Courtesy of Eaton Corporation — Cleveland, OH)



affected by changes in technology. Because humans make the decisions about the use of technology, they can control the changes caused by technology. To make the best choices, we must know how technology works. This book is about one part of technology: production. Reading this book will help you learn how to make better decisions about the use of technology.

## Production Technology

**Production technology** is the study of how the products and structures (buildings) we use every day are made. Production technology is broken into two fields: manufacturing and construction, Figure 1-3. **Manufacturing technology** can be defined as the making of products in a factory.



(Courtesy of Rockwell International Corporation)



(Courtesy of Ford Motor Company)

**FIGURE 1-3 Manufacturing and construction are the two fields of production technology.**

Furniture, automobiles, clothing, and airplanes are examples of products made with manufacturing technology. **Construction technology** can be defined as the building of **structures** that cannot be moved. Buildings, roads, bridges, and pipelines are examples of structures built with construction technology. Manufacturing and construction are both production technologies because they both produce (make) a product. The products of manufacturing and construction are made to meet human needs and wants. We need shelters to live in — construction technology provides homes and apartments. We need furniture and clothing — manufacturing technology provides them.

## Production and the Other Technologies

Production technology is related to all the other technologies. The other major technologies are communication, transportation, and energy and power, Figure 1-4. **Communication technology** is the study of sending and receiving information. Radios, televisions, cameras, and computers are examples of communication technology. **Transportation technology** moves people and things using vehicles like buses, trucks, cars, airplanes, and even the space shuttle. **Energy and power technology** is the base of all the other technologies. Energy and power provides the muscle needed to communicate information, transport things, construct structures, and manufacture products.

The space shuttle is a good example of how production and the other technologies are related,



**Energy and power** (Courtesy of New York Power Authority)



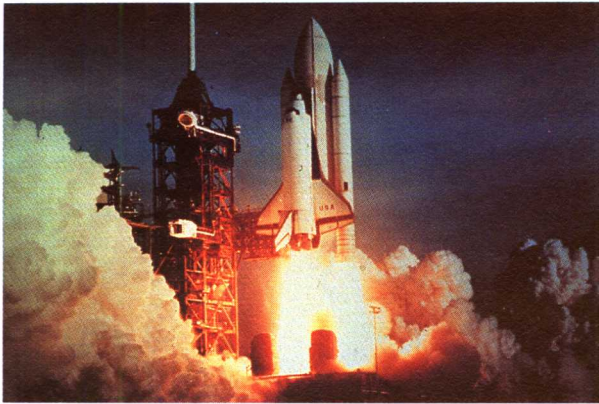
**Transportation** (Courtesy of Aluminum Association, Inc.)



**Communication** (Courtesy of Contel Corporation)

**FIGURE 1-4 Production technology is related to communication, transportation, and energy and power technologies.**





**FIGURE 1-5** To get the space shuttle off the ground, it takes all the technologies working together. (Courtesy of NASA)

Figure 1-5. The shuttle itself is a large product that was manufactured in a factory. The tower and launch pad from which the space shuttle lifts off was constructed. The shuttle has very complex communication devices that the astronauts use to send information back to earth when they are in space. The space shuttle itself is an example of a transportation technology. Its job is to transport satellites and astronauts into space. Finally, energy and power is needed to get the heavy space shuttle off the launch pad and into space. Almost anything you can think of, from a package of chewing gum to the space shuttle, uses all of the major technologies.

## Types of Manufacturing

There are two basic types of manufacturing: custom and mass. **Custom manufacturing** involves one person making one product by hand. All the parts on the product are made by the worker. Today, very few products are made by custom manufacturing. The products that are custom manufactured today include one-of-a-kind products like the space shuttle. Most products today are mass produced. **Mass production** involves making a large number (a mass) of the same product, Figure 1-6. A group of people work together to mass produce the product. Each person in the group is given one small job to do in mass production.

## Types of Construction

There are also two basic types of construction: light and heavy. **Light construction** is the



**FIGURE 1-6** Today, most products are mass produced; that is, large numbers of the same product are made. (Photo by Kenneth A. Deitcher, M.D.)



**FIGURE 1-7** Light construction refers to houses and other small buildings. (Courtesy of the California Redwood Association)

building of homes and other small buildings, Figure 1-7. These may be single-family homes, small apartment buildings, offices, stores, and so on. Larger structures are not included in this group because the tools and materials used are different from those used in light construction. **Heavy construction** includes the building of roads, bridges, tunnels, and factories. This type