# Chapter 9

# Production and Operations Management

## Learning Objectives

**LO 9-1** Describe the current state of U.S. manufacturing and what manufacturers have done to become more competitive.

**LO 9-2** Describe the evolution from production to operations management.

**LO 9-3** Identify various production processes and describe techniques that improve productivity, including computer-aided design and manufacturing, flexible manufacturing, lean manufacturing, mass customization, robotics, and 3D printing.

**LO 9-4** Describe operations management planning issues including facility location, facility layout, materials requirement planning, purchasing, just-in-time inventory control, and quality control.

**LO 9-5** Explain the use of PERT and Gantt charts to control manufacturing processes.

## Manufacturing and Services in Perspective

Manufacturing in the U.S.

* Since 1979, the number of U.S. workers employed by factories has steadily dropped.
* American factories can operate efficiently without large amounts of human labor.

The U.S. economy is no longer manufacturing-based.

* 80 percent of jobs are in the service sector.
* American factories can’t fill positions as engineers and computer experts flock to the tech industry.

## Manufacturers and Service Organizations Become More Competitive

* U.S. manufacturers must compete with China, Germany, South Korea, and India.
* How can U.S. businesses maintain a competitive edge?
* Keeping up with latest production techniques
* Focusing on customers
* Maintaining close relationships with suppliers
* Practicing continuous improvement

## From Production to Operations Management

**Production** — The creation of finished goods and services using the factors of production: land, labor, capital, entrepreneurship, and knowledge.

**Production management** — The term used to describe all the activities managers do to help firms create goods.

**Operations management** — A specialized area in management that converts or transforms resources (including human resources) into goods and services.

Operations management includes:

* Inventory management
* Quality control
* Production scheduling
* Follow-up services

## Operations Management in the Service Sector

* All about creating a good experience for those who use the service.
* In hotels, like Hilton, operations management includes smooth-running elevators, fine restaurants, comfortable beds, and a front desk that processes people quickly.

## Production Processes

**Form utility** — The value producers add to materials in the creation of finished goods and services.

Grove’s Basic Production Requirements

* To build and deliver products in response to the demands of the customer at the scheduled delivery time
* To provide an acceptable quality level
* To provide everything at the lowest possible cost

**Process manufacturing** — That part of the production process that physically or chemically changes materials.

**Assembly process** — That part of the production process that puts together components.

Production processes are either continuous or intermittent.

* **Continuous process** — Long production runs turn out finished goods over time.
* **Intermittent process** — The production run is short and the machines are changed frequently to make different products.

The Need to Improve Production Techniques and Cut Costs

* Developments making U.S. companies more competitive:
* Computer-aided design and manufacturing
* Flexible manufacturing
* Lean manufacturing
* Mass customization
* Robotics
* 3D printing

Computer-Aided Design and Manufacturing

* **Computer-aided design (CAD)** — The use of computers in the design of products.
* **Computer-aided manufacturing (CAM)** — The use of computers in the manufacturing of products.
* **Computer-integrated manufacturing (CIM)** — The uniting of computer-aided design with computer-aided manufacturing.
* CIM is expensive but it drastically reduces the time needed to program machines to make parts.

Flexible Manufacturing

* **Flexible manufacturing** — Designing machines to do multiple tasks so that they can produce a variety of products.
* Allen-Bradley uses flexible manufacturing to build motor starters.
* Machines and robots build, test, and package parts.

Lean Manufacturing

* **Lean manufacturing** — The production of goods using less of everything compared to mass production.
* Compared to others, lean companies:
* Take less human effort
* Take less manufacturing space
* Require less investment in tools
* Require less engineering time to develop a new product

Mass Customization

* **Mass customization** — Tailoring products to meet the needs of individual customers.
* More manufacturers are learning to customize.
* Mass customization exists in the service sector too.

Robotics

* The use of robotics allows manufacturing to continue 24 hours a day, seven days a week with great precision.
* Robotics have improved productivity while reducing the number of jobs for humans.
* Robots work in service businesses, such as hotels, as well.

3D Printing and Additive Manufacturing

* Products are created one layer at a time by a nozzle.
* For now, 3D printing is typically used to make prototypes and molds.

Using Sensing, Measurement, and Process Control

* Sensors can detect the moment anything goes wrong.
* Nanomanufacturing allows manipulation of materials on a molecular or atomic scale.

## Operations Management Planning

Operations management planning helps solve problems like:

* Facility location
* Facility layout
* Materials requirement planning
* Purchasing
* Inventory control
* Quality control

Facility Location

* **Facility location** — The process of selecting a geographic location for a company’s operations.
* Rising numbers of online businesses means brick-and-mortar retailers must find great locations.

Facility Location for Manufacturers

* Considerations for moving facilities to a new location:
* Labor costs
* Availability of resources
* Access to transportation
* Proximity to suppliers and customers
* Crime rates
* Quality of life for employees
* Cost of living
* Need to train or retrain local workforce

Interfirm Operations Management

* Sometimes businesses outsource engineering, design, and manufacturing to other companies.
* Often these relationships are managed through the Internet.
* Many companies are developing Internet-focused strategies.

Facility Location in the Future

* Information technology gives firms increased flexibility in terms of location.
* **Telecommuting** — Working from home via computer and modem.

Facility Layout

* **Facility layout** — The physical arrangement of resources (including people) in the production process.
* Facility layout depends on the processes performed:
* Service: Help customers find products
* Manufacturing: Improve efficiency
* Facility layout options
* **Assembly line layout** — Workers do only a few tasks at a time.
* **Modular layout** — Teams of workers produce more complex units of the final product.
* **Fixed-position layout** — Allows workers to congregate around the product.
* **Process layout** — Similar equipment and functions are grouped together.

## Operations Management Planning

Materials Requirement Planning

* **Materials requirement planning (MRP)** — A computer-based operations management system that uses sales forecasts to make sure that needed parts and materials are available at the right time and place.
* **Enterprise resource planning (ERP)** — A newer version of MRP that combines the computerized functions of all the divisions and subsidiaries of the firm—such as finance, human resources, and order fulfillment—into a single integrated software program that uses a single database.

## Purchasing

* **Purchasing** — The function in a firm that searches for quality material resources, finds the best suppliers, and negotiates the best price for goods and services.
* The Internet has transformed purchasing.

## Just-in-Time Inventory Control

* **Just-in-time (JIT) inventory control** — A production process in which a minimum of inventory is kept on the premises and parts, supplies, and other needs are delivered just in time to go on the assembly line.
* To work effectively, the process requires excellent coordination with suppliers.

## Quality Control

* **Quality** — Consistently producing what the customer wants while reducing errors before and after delivery to the customer.
* **Six Sigma quality** — A quality measure that allows only 3.4 defects per million opportunities.
* **Statistical quality control (SQC)** — The process some managers use to continually monitor all phases of the production process to assure that quality is being built into the product from the beginning.
* **Statistical process control (SPC)** — The process of taking statistical samples of product components at each stage of the production process and plotting those results on a graph.
* Measuring quality along the production process reduces the need for quality control at the end.

## The Baldrige Awards

* Companies can apply for awards in these areas:
* Manufacturing
* Services
* Small businesses
* Nonprofit/government
* Education
* Health care

## ISO 9001 and ISO 14001 Standards

* The International Organization for Standardization (ISO) is a worldwide federation of national standards bodies.
* **ISO 9001** — The common name given to quality management and assurance standards.
* **ISO 14001** — A collection of the best practices for managing an organization’s impact on the environment.

## Control Procedures: PERT and Gantt Charts

**Program Evaluation and Review Technique (PERT)** — A method for analyzing the tasks involved in completing a given project, estimating the time needed to complete each task, and identifying the minimum time needed to complete the total project.

Steps Involved in PERT

* Analyzing and sequencing tasks
* Estimating the time needed to complete each task
* Drawing a PERT network illustrating the first two steps
* Identifying the critical path

**Critical path** — The sequence of tasks that takes the longest time to complete.

**Gantt chart** — Bar graph showing production managers what projects are being worked on and what stage they are in at any given time.