THE POCKET MBA:
CONCEPTS AND STRATEGIES

Delta Publishing Company

PREFACE

This course is a one-stop problem-solver for today's busy executive. It's a working guide to help you quickly pinpoint in the complex world of business.

- What to look for
- What to do
- What to watch out for
- How to do it

You'll find concepts, guidelines, and rules of thumb to help you conceptualize, analyze, and evaluate any business-related problem. Throughout, you'll find this course practical, quick, and useful.

Uses for this course are as varied as the topics presented.

Part I (Chapters 1, 2, 3, and 4) takes you through the world of business strategy, management, marketing, and legal environments of business. You will learn strategic analysis, various management techniques, production/operations management, the marketing process of planning and distribution, and how to price and promote products. These management and marketing techniques and processes have been presented in an extremely understandable and practical format to make them as useful as possible. The statutory and case law affecting business operations and decisions are also presented. Legal requirements must be known to protect the business entity.

Part II (Chapters 5, 6, and 7) covers the economic issues of interest to business managers because they have a significant impact upon corporate success or failure. Attention should be given to the changing economic environment as well as economic indices and statistics in making financial and investment decisions. Many companies are multinational so business managers must understand the opportunities and difficulties associated with international business and multinational finance. Some relevant issues of concern to business people are foreign exchange rates, currency risk management, political risk, and international sources of financing. Chapter 7 takes up the issue as to how information technology (IT) assists managers in business decisions. It covers the use of information systems in all phases of business and in all functional areas to analyze and solve business problems in the "real world."

This course has been designed in question-and-answer format in order to address the pertinent issues that come up during the course of business. The questions are typical of those asked by persons like yourself. The answers are clear, concise, and to the point. In short, this is a veritable cookbook of guidelines, illustrations, and "how-to's" for you, the modern decision maker.

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CHAPTER 1
BUSINESS STRATEGY AND OPERATIONS MANAGEMENT

Upon completion of this chapter, you will be able to

- Outline the key elements of a mission statement?
- Develop an organizational strategy using The Strength, Weaknesses, Opportunities and Threats (SWOT) analysis and describe Porter's competitive strategies.
- Summarize the types of management decisions and the steps to be followed in the decision-making process.
- List some useful management techniques and tools such as break-even and profit analysis, aggregate planning strategies, scheduling, and project management and control.

This chapter provides a discussion of strategic management and production and operations management (P/OM) including:

- Mission statement
- Strategic management
- Strength, Weaknesses, Opportunities and Threats (SWOT) analysis
- Management decision making
- Simulation
- Capacity management
- Location analysis
- Time-study procedures
- Aggregate planning schedules
- Inventory management
- Scheduling, including project scheduling

Strategy can be defined as a course of action or a plan, including the specification of resources required, to achieve a specific objective. All business organizations have objectives, but because of the dynamic nature of the organizations' environment, overall plans or strategies are needed to specify in broad terms just how the objectives of the organization can be achieved, given the uncertainty of the environment.

Strategic management is therefore concerned with deciding on a strategy and planning how that strategy is to be put into effect. As such, strategic management has general relevance in that strategic management is relevant for managers in all types of organizations, both profit seeking and non-profit organizations, state and private sector.

Production and operations management is a vital management activity in both manufacturing and service organizations. It is primarily concerned with the process of transforming organizational resource inputs into final organizational outputs. It is a comprehensive process that treats the organization as a system of interconnected functions. The major functions of P/OM incorporate design, planning, decision making, operations, and system controls.

1.1 THE ORGANIZATIONAL MISSION STATEMENT

What is the purpose of a mission statement?

A mission statement describes the basic operational intent of an organization. It takes a long-term perspective and states the reason for a firm's existence. It is a function is to provide guidance for its shareholders, customers, and employees about the organization's overall direction and rationale.

How is a mission statement developed?

A mission statement should be consistent with the organization's history, including past achievements, organizational culture, attributes, and basic policies. A new organization will take into consideration the history of the industry they are joining as well as the purpose they wish to serve. Successful mission statements emphasize areas where an organization has its greatest strengths and resources.

What are the key elements of a mission statement?

A mission statement must be:

- Meaningful for the organization's client or customer base. Organizations must be constantly aware of who their clientele is, and their requisite needs.
- Realistic and attainable. Unrealistic mission statements will cause the organization to fail.
- Stimulating and inspiring. A motivating mission statement will enhance employee creativity and commitment.
- Definitive and explicit. Unclear mission statements result in dispersed and unsuccessful organizational strategies.

Examples of a mission statement are as follows:

—Are you customer-focused? Walt-Mart’s mission is simple:
“We exist to provide value to our customers:’ The entire focus of the organization is on doing whatever they can to keep prices low and selection high.
--Are you employee focused? Hewlett Packard, on the other hand, focuses on respect and opportunity for HP people, including giving them an opportunity to share in the success of the organization.
—Are your products and services the focus of your competitive advantage? Who can forget

the classic Ford commercials that proclaimed that quality is job no. 1? At a time when the quality of American cars was in decline, Ford's efforts went a long way to putting quality back into the vocabulary of American car producers.
—Do you value taking risks? Sony focuses its efforts on being a pioneer—not just following others, but doing the "impossible." Their support for employee risk-taking has resulted in products that have changed the way we spend our time.

Once each of these companies established a core mission, that mission became the driver of all operations.

EXAMPLE 1.1

An independent power producer states that its mission consists of four central values:

1. Integrity: To act with integrity and honor its commitments.
2. Fairness: To treat fairly its employees, customers, suppliers, and the governments and communities in which it operates.
3. Fun: To create and maintain an atmosphere where employees can advance in their skills while enjoying their time at work.
4. Social Responsibility: To undertake projects that provide social benefits, such as lower costs to customers, a high degree of safety and reliability, increased employment, and a cleaner environment.

EXAMPLE 1.2

A rapidly growing petroleum company states that its mission is to create value by adding substantial oil and gas reserves while minimizing geological risk and leveraging staff expertise.

EXAMPLE 1.3

A company which introduced the first independent, electronic, product information database that uses the industry standard Universal Product Code (UPC) numbering system states that its mission is to provide quality electronic merchandise management services and technologies to the retail industry.

1.2 STRATEGY DEVELOPMENT PROCESS

What is the purpose of an organizational strategy?

The purpose of an organizational strategy is to achieve the goals of the mission statement. This is done by developing a logical plan for utilizing the organization's strengths and resources. An organizational strategy provides direction for the organization's activities and its human resources within the context of its mission statement's objectives.

What strategy must an organization develop to achieve its mission?

An organizational strategy must be developed for each functional area within its mission statement. The resulting strategies contain:

1. A clear purpose
2. Measurable expected outcomes
3. Fall-back plans in the event the primary strategy cannot be implemented
4. Costs and benefits

Developing an organizational strategy using The Strength, Weaknesses, Opportunities and Threats (SWOT) ***analysis.***

SWOT analysis is to combine the assessment of the environment with the analysis of the organization's internal resources and capabilities. The key objective is to arrive at strategic fit - the matching of strength to opportunities, the elimination or avoidance of threats, and the strengthening or avoidance of weaknesses.

Elements analyzed within the organization's environment consist of the following variables:

1. culture
2. demographics
3. economic technology
4. organizational publics
    (a) capital originators including shareholders, creditors, bankers, and underwriters
    (b) raw material and component providers
    (c) customers
    (d) human resources
    (e) competitive rivals
    (f) governmental and legal environment including regulators
    (g) special-interest lobbying groups

The SWOT analysis allows managers to develop a strategic plan by examining organizational strengths and weaknesses in terms of the opportunities and threats presented by its environmental elements. Subsequent strategies and tactical decisions can produce a competitive advantage.

What does strategic analysis seek?

Strategic analysis seeks to understand the strategic position of the organization. The analysis should encompass the environment, resources, objectives, expectations, and behaviors. Strategic choice concerns the formulation of possible courses of action, their evaluation and the choice between them. And strategic implementation is the planning of how the strategy can be put into effect. Implementation would affect all aspects of the organizational system.

More specifically, strategic analysis is concerned with the understanding of the strategic position of the organization, and will thus seek to analyze:

- The mission - what business are we in? Why it exists at all? What is the value system of the business?

- The goals - the specific relevance of the mission to the various stakeholders.
- The objectives - embodying the mission, quantifiable and used to measure actual performance against.
- The external environment - scanning of the environment for factors relevant to the organization's current and future activities.
- The internal appraisal or position audit - the current state of being in terms of resources, assets, facilities, and performance values.
- The corporate appraisal - evaluation of the strengths, weaknesses, opportunities and threats (SWOT) in relation to the internal and external factors.
- The gap analysis - identifying the gap between where we are, where we will be when extrapolated, and where we desire to be.

What do strategic management and control involve?

Strategic management is facilitated when managers think synergistically. Synergy occurs when the combination of formerly separate elements has a greater effect than the sum of their individual effects. Market synergy arises when products or services have positive complementary effects. Shopping malls reflect this type of synergy.

Strategic control measures may be categorized as concerning either external effectiveness or internal efficiency. Flexibility overlaps these categories. It relates to effectiveness and efficiency. Thus, an organization must be externally flexible in responding to changing customer needs and internally flexible in reordering its structural arrangements, retraining employees, etc.

How important is value chain analysis in the strategic planning process?

Value-chain analysis for assessing competitive advantage is an integral part of the strategic planning process. Value-chain analysis is a continuous process of gathering, evaluating, and communicating information for business decision making. A value chain depicts how customer value accumulates along a chain of activities that lead to an end product or service. A value change consists of the activities required to research and develop, design, produce, market, deliver, and support its product. Extended value-chain analysis expands the view of the parties involved to include those upstream (e.g., suppliers) and downstream (e.g., customers).

What are the three levels of planning? How are they related?

There are in general three levels of strategy: corporate strategy, business strategy and functional strategy. Corporate strategies define what business or businesses the firm is in or should be in and how integrated these businesses should be with one another; business strategies decide how each business attempts to achieve its mission within its chosen area of activity; and functional strategies governs how the different functions of the business (marketing, production, sales, finance, HRM, IT, etc.) support the corporate and business strategies.

These levels of strategies are matched by the three levels of planning: strategic planning, tactical planning, and operational planning.

Strategic planning decides on the objectives of the organization, on changes in these objectives, on the resources used to attain these objectives and on the policies that are to govern the acquisition, use and disposition of these resources. Tactical planning ensures that the resources are obtained and used effectively and efficiently in the accomplishment of the organization's objectives. Operational planning ensures that specific tasks are carried out effectively and efficiently.

What are Porter's generic competitive strategies?

Michael Porter proposes two "generic" competitive strategies for outperforming other corporations in a particular industry: lower cost and differentiation**. *Lower cost*** is the ability of a company or a business unit to design, produce, and market a comparable product more efficiently than its competitors. *Differentiation*, in contrast, is the ability to provide unique and superior value to the buyer in terms of product quality, special features, or after-sale service. These strategies are called generic because any type or size of business firm—and even not-for-profit organizations—can pursue them.

What are the objectives and goals?

Objectives are the end results of planned activity. They state what is to be accomplished by when and should be quantified if possible. The achievement of corporate objectives should result in fulfillment of the corporate mission. A community bank, for example, might set a one-year objective of earning a 10% rate of return on its investment portfolio.

The term *goal* is often confused with the term objective. In contrast to an objective, a goal is an open-ended statement of what one wishes to accomplish with no quantification of what is to be achieved and no time horizon for completion. *Note:* Effective goal setting requires a sufficient knowledge of employees' jobs. Employees must also understand how goal-oriented performance will be measured.

For example, a community bank's goal might be to increase its rate of return—a rather vague statement. Some of the areas in which a corporation might establish its goals and objectives are:

- Profitability (net profits);
- Efficiency (low costs, etc.);
- Growth (increase in total assets, sales, etc.);
- Shareholder wealth (dividends plus stock price appreciation);
- Utilization of resources (ROE or ROI);
- Reputation (being considered a "top" firm);
- Contributions to employees (employment security, wages);
- Contributions to society (taxes paid, participation in charities, providing a needed product or service);

- Market leadership (market share);
- Technological leadership (innovations, creativity);
- Survival (avoiding bankruptcy); and/or
- Personal needs of top management (using the firm for personal purposes, such as providing jobs for relatives).

The top management of most large, publicly traded U.S. corporations like to announce their long-term objectives for the company—partially because that will set challenging measurable goals to work toward and partially because they hope to impress shareholders and financial analysts. For example, Rubbermaid, Inc., a maker of housewares, toys, outdoor furniture, and office products, established the objective that its sales and earnings should increase by 15% annually. To emphasize the importance of developing new products in this highly competitive market, it also set the objective that 30% of its yearly revenue come from products launched in the past five years.

What is the role of the board in strategic management?

How does a board of directors fulfill strategic management's responsibilities? In terms of strategic management, a board of directors can do so by carrying out three basic tasks.

- *Monitor:* By acting through its committees, a board can stay abreast of developments both inside and outside the corporation. It can thus bring to management's attention developments that management might have overlooked. At a minimum, a board should carry out this task.
- *Evaluate and influence*: A board can examine management's proposals, decisions, and actions; agree or disagree with them; give advice and offer suggestions; and outline alternatives. More active boards do so in addition to monitoring management's activities.
- *Initiate and determine*: A board can delineate a corporation's mission and specify strategic options to its management. Only the most active boards take on this task in addition to the previous two.

1.3 MANAGERIAL DECISION MAKING

All managers have a shortage of knowledge, resources, and time. Working within these parameters, the management process culminates in decisions to implement various actions. Decision-making is the focal point of all organizational dynamics, and management effectiveness is judged on the basis of the quality of these decisions.

What is managerial decision making?

Managerial decisions are deliberate choices made from a range of alternatives. Before making the decision, the manager must evaluate each choice according to its projected outcomes in terms of the organization's resources as well as the amount of information and time available. Thus, every managerial decision is a best-effort compromise made in an environment of uncertainty.

What are the types of management decisions?

From a management perspective there are three types of decisions:

1. Long-term strategic decisions concerning the external environment of the organization.
2. Administrative decisions intended to order the functions of the organization in the most cost-effective way.
3. Operational decisions designed to maximize a firm's profitability through productive procedures.

What are the types of strategic decisions?

There are several types of strategic decisions in production and operations management (P/OM):

1. *Product or service strategies.* Management decisions regarding product line market strategies (including design, quality and cost) determine production cost parameters.
2. *Process strategy*. Management decisions regarding process methods are critical in determining technological and organizational production requirements. The process strategy decision is also crucial in determining capital and financial requirements.
3. *Research and Development (R&D) strategy.* R&D is critical for organizational survival in today's rapidly changing marketplace. The R&D strategy includes total resources being devoted to the effort, the type of research to be performed including pure vs. applied research, manufacturing vs. market research, and product development vs. process development.
4. *Location strategy.* Often the success or failure of a business, production, or service is determined by a location decision.
5. Inventory management strategy. It is essential to develop a strategy for coordinating production needs with raw material and component inventories. However, the inventory strategy is determined by whether the demand is dependent or independent of the demand for other components. If the demand for one product, such as air conditioners, is independent of another product, such as kitchen chairs, then an independent inventory management strategy is required. However, if the overall component demand is dependent on the demand for the product, then a Material Requirements Planning (MRP) strategy is needed. MRP is a component manufacturing planning method in which items required for a manufacturing process are indexed to overall product demand. With MRP it is not essential that all inventory items are available at all times, but only when they are required in the production process. Thus, under MRP, inventory needs are coordinated with production needs.

6. *Human resource planning and management strategy.* As a rule of thumb more than 75% of a firm's operating expense is for human resources. Therefore, adequate hiring, training, and utilization of human resources is a critical operational strategy for achieving success.

EXAMPLE 1.4

The management of an organization makes a strategic decision to develop a five-year marketing plan to achieve a competitive advantage through the introduction of a new service.

EXAMPLE 1.5

An automobile manufacturer makes a process strategy decision to offer a standard group of options on its automobiles in order to reduce the variation in its production needs and lower unit costs.

EXAMPLE 1.6

A computer chip manufacturer makes a strategy decision to increase R&D expenditures on an advanced CPU chip design enabling compatibility with multiple computer operating systems.

EXAMPLE 1.7

A firm makes a location strategy decision to conduct a nationwide survey of state industrial development agencies to evaluate where the company could receive the greatest financial and environmental location benefits.

EXAMPLE 1.8

A lawn mower and snow blower manufacturer makes an inventory management decision to use an MRP system to coordinate their need for lawn mower and snow blower components with seasonal manufacturing schedules.

EXAMPLE 1.9

A manufacturer makes a human resource strategy decision to give more responsibility to its employees by creating work teams to assemble entire products rather than components in the belief that it will obtain greater productivity because of job enrichment.

What are the types of administrative decisions?

1. Programmed decisions. Decisions typically made regarding highly routine situations where little discretion is required.
2. *Non programmed decisions*. Decisions made in unstructured situations where problem conceptualization and original thinking is required.

EXAMPLE 1.10

Management makes a programmed administrative decision to establish a vehicle maintenance schedule.

EXAMPLE 1.11

Management makes a non programmed administrative decision to implement an organizational downsizing plan to reduce duplication of services, decrease costs, and increase profitability.

What are the types of operational decisions?

1. *Quality*. Decision making regarding product and service quality is a vital operations responsibility necessitating comprehensive organizational support. Quality decisions are made in the design stage of the product or service plan and require the creation and maintenance of standards.
2. *Process.* Operational decisions are made regarding the design of the process used in the manufacturing or servicing of a final product. Process decisions normally are long range and cannot easily be reversed.
3. *Capacity*. Operational capacity decisions are concerned with the long-term capability of an organization to produce the required amount of output over time. Capacity planning determines not only the size of an organization's physical productive capability, but also its human resource needs.
4. *Inventory.* Inventory decisions are crucial in fulfilling management's inventory management strategy. The challenge for operations management is to create a balance in inventory between product demand, cost, and supply needs.
5. *Human Resources.* Human resources are an extremely important operational management responsibility. Organizations pay a major portion of their revenues to employees. Therefore, selection, hiring, training, termination, and general management of human resources are critical for the future of the organization.

EXAMPLE 1.12

The franchise management of a fast-food retail chain makes a determination concerning quality standards in terms of the content and temperature of the food when it is served to the customer. It implements a program to ensure the individual franchises meet the quality standards.

EXAMPLE 1.13

The management of a car-washing company makes a process decision to utilize a brushless car-washing facility that requires fewer workers, results in less damage to the car finish, and is more productive.

EXAMPLE 1.14

A seasonal manufacturer of lawn equipment makes a capacity operational decision to hire and train a second shift of employees during peak demand periods rather than increase overall plant capacity. This will make more productive use of existing capacity without increasing long-term overhead costs including plant maintenance and capital financing costs.

EXAMPLE 1.15

The franchise manager of a chain of job printers makes an operational decision to allow the individual store managers to buy their own printing supply inventory as long as they use the franchise's equipment.

EXAMPLE 1.16

A franchise manager makes a human resource operational decision to allow individual franchisees to hire, train, and supervise their own employees. Thus, the individual franchisee has the entire human resource operational responsibility.

What are the steps in the decision-making process?

Making good decisions is essential to the management process. As discussed, decisions are rational choices among a group of alternatives. Good decisions are the result of a sequential series of analytical steps:

1. Identify and delineate the problem. No management action can occur unless there is a need to resolve an issue. Additionally, when identifying a problem, it is necessary to assess the seriousness of the issue. Highly critical issues require more immediate attention and a greater demand on existing resources. Difficulties in identifying problems include:

   Perceptual errors. Often problems are not identified because of personal biases, which do not allow the individual to perceive that there is a problem needing attention. Preconceived notions of how something should be (as well as personal preferences) will interfere with the ability to identify a problem.

   Insufficient information. Insufficient research about a specific problem can lead to misleading and unwarranted conclusions regarding the true nature of the problem and its possible solution.

   - *Mistaking a symptom as the cause of the problem.* An apparent cause of a problem may just mask a systemic cause. Again, further research is essential to find the cause and nature of a problem.

2. *Establish decision priorities and goals*. Managers constantly deal with problems. However, all organizations have limited resources. They must assign priorities to problems in terms of their importance relative to the organization's goals. This process results in a matching of organizational resources with priorities and creates a management methodology for administering solutions to problems.

3. *Ascertain the cause of the problem.* In order to develop a solution to a problem, it is essential to understand its cause. This requires a systemic understanding of the dynamics of the situation that has caused the problem.

4. *Develop realistic alternatives.* It is important for the manager to develop a range of alternative realistic solutions. This means doing extensive research into the nature of the problem and discovering what alternatives would be a good fit.

5. *Weigh the best alternative.* This requires extensive evaluation and comparison using a cost benefit analysis. The alternative solutions are developed within the constraints of limited time and resources, and with a degree of uncertainty.

6. *Choose a solution.* After conducting extensive research, a decision will have to be made regarding an optimal solution. Managers operate within an environment of incomplete information, time deadlines, and limited resources. All solutions represent opportunity choices having limited outcome predictability. Therefore, managers must make decisions within a range of known alternatives having unknown outcomes.

7. *Implement the decision.* This requires developing human resources to carry out the decision. This mandates a high communication level between the manager and the human resource team.

8. *Follow up.* All decisions require constant monitoring. Changes will have to be made over time to ensure optimum results. This requires an effective organizational control and evaluation system for future organizational decisions

EXAMPLE 1.17

A word processing software manufacturer that has been very successful in the text-based operating system market is facing a crucial decision when the industry standard operating system is changed to a graphical user interface (GUI) system. The company's text-based word processor is extremely successful and has a large following. The commands used in the text-based word processor are difficult to learn, but once learned, it is a very versatile word processor.

If the word processor is converted to a graphical user interface, then a portion of the installed user base may be lost, and its competitive advantage based on powerful non-intuitive commands may also be compromised. However, failure to convert the word processor to a graphical user interface will mean losing its market share since the major competitors have already released GUI word processors.

After deciding to develop a GUI word processor, the company had to decide whether to do a fundamental rewrite of the program, which could take at least two years, or simply update it and make it GUI compatible. The company decides to release a GUI update to its word processing program with a fundamental GUI rewrite scheduled for a future date.

What is decision making under certainty and conflict?

Decision-making involves managing three major elements:

1. *Decision strategy.* A decision maker develops a plan affecting long-term organizational outcomes utilizing existing organizational resources.
2. *States of nature.* These are elements of the environment over which the manager has little or no control. States of nature include the weather, political environment, the economy, technological developments, etc. They can dramatically affect the outcomes of any decision strategy.

3. *Outcome*. This is the result of the interaction of the implementation of a decision strategy with the states of nature. Because of the many variables within the states of nature, outcomes can be extremely difficult to forecast.

Thus, outcomes of a decision strategy, O, the dependent variable, is a function of the interaction of the two independent variables, D, decision strategies and, S, the states of nature. Figure 1.1 shows a decision matrix. The rows are strategic choices a manager can make while the columns represent decision outcomes. An outcome O_{ij} is a function of a decision strategy D_i; and a state of nature S_j.

FIGURE 1.1 DECISION MATRIX

States of Nature

Strategies	S_1	S_2	S_X	S_X	S_X	S_j
D_1	O_{11}	O_{12}	*	*	*	O_{1j}
D_2	O_{21}	O_{22}	*	*	*	O_{2j}
D_x	*	*				*
D_x	*	*				*
D_j	O_{i1}	O_{i2}	*	*	*	O_{ij}

Mathematically this relationship can be expressed as:

$O_{ij} = f(D_i, S_j)$

What are decision trees and decision tables?

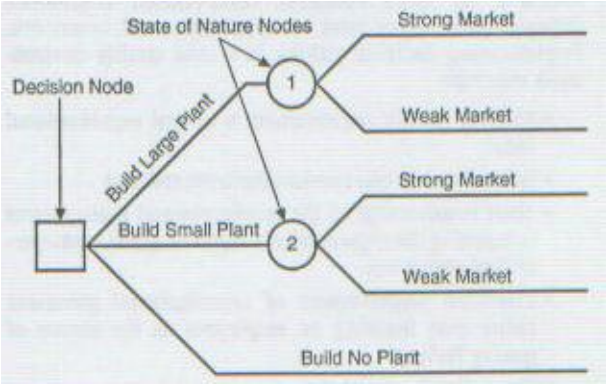
Developing a graphical display is an effective way of mapping the alternatives and probable events that can occur in a complex decision-making environment. Decision trees use symbols consisting of squares and circles. Branches of the decision tree that extend from a square depict an area where several choices can be made while a circle connotes a unique state of nature having certain outcomes.

A decision tree is analyzed in reverse order from right to left going back chronologically. Decision trees are normally accompanied by a payoff or decision table where all the alternatives are listed down the left side of the table with states of nature listed across the top of the table and payoffs stated in the main part of the table.

EXAMPLE 1.18

The Jackson Lawn Products Corporation is studying the possibility of manufacturing a new line of lawn mowers. Since the market for the new mowers is uncertain, the corporation must decide whether to construct a large or small plant, or do nothing. Figure 1.2 presents a decision tree depicting the Jackson Lawn Products decision choices.

FIGURE 1.2 JACKSON LAWN PRODUCTS CORPORATION DECISION TREE



A payoff or decision table can be developed to assist Jackson Lawn Products in determining what type of a lawn mower plant they should build. There is an outcome for each decision and state of nature that can be described in units of monetary value. The units of monetary value are also described as conditional values.

Exhibit 1.1 describes all of Jackson's decision alternatives in the left column of the exhibit, the states of nature across the top, and the payoffs (conditional values) in the main part of the exhibit. In the case of building a large plant, a strong market will produce a $250,000 net profit, whereas a weak market will result in a $125,000 net loss. If a small plant is built, a strong market will produce a $125,000 net profit with a $60,000 net loss in a weak market.

EXHIBIT 1.1 DECISION TABLE WITH CONDITIONAL VALUES FOR JACKSON LAWN PRODUCTS CORP

Decision Alternatives	*States of Nature*	
	Strong Market	*Weak Market*
Build Large Plant	$250,000	-$125,000
Build Small Plant	$125,000	-$60,000
Build No Plant	$0	$0

What is decision making in a Total Quality Environment?

Total Quality Management evolved from W. Edwards Deming's 14 points, which was termed Total Quality Control. Decision making in a total quality environment essentially involves the elements of a continuous process focusing on three essential components: continuous improvement, assessment management, and teamwork.

Implementing decision-making in a total quality environment requires:

- Making quality improvement a central organizational focus.
- Extensive and continuous employee training.
- Total involvement of the employees and management concerning the organization's mission, goals, and operational objectives.
- Continual improvement of organizational processes rather than focusing on employees as the source of quality failures.
- Team decision-making.
- The recognition that the customer defines quality, and that a total quality decision objective is to meet or exceed customer satisfaction standards.

Decision-making in a TQM environment is a shared experience for all employees throughout the organization. Information is an organizational resource essential for making quality decisions. Increased quality leads to increased productivity, lower unit costs, and higher customer satisfaction.

EXAMPLE 1.19

A transmission manufacturing company was machining highly exacting parts to be used in automatic transmissions. The parts consisted of gears, bearings, and assorted spacers and shafts. The parts were engineered to be within the industry standard of + or - .003" of specifications. However, other manufacturers were able to produce the same transmissions at two-thirds of the price and achieve higher productivity and quality.

Management decided to make a 300% improvement in the tolerances of the parts by reducing them to + or .001" tolerance. The net result was there were fewer returns, lower unit costs, and higher overall customer satisfaction. Consequently, productivity and profits grew substantially.

1.4 SIMULATION MODELS

Management uses simulation techniques to replicate the characteristics and dynamics of a real system. Simulations enable management to test models of performance when it is too expensive, risky, or time consuming to do it with the real materials, workers, and/or equipment. Using simulation, a manager can test the effects of a decision in a wide variety of situations including time compression scenarios without disrupting an operational system. It allows the manager to evaluate alternative system designs when implementing a given operational strategy. Additionally, simulation permits the manager to evaluate the effects of interactions between individual system components and various when/if tactics.

The weaknesses of simulations are that they are syllogistic in that they can evaluate only the information built into the model. Therefore, variables not included or not capable of being included in the model cannot be evaluated. Another limitation for simulation is that it is typically designed for unique situations restricting transferability to other scenarios.

How is simulation implemented by management?

When implementing a simulation model, management is required to:

1. Delineate the problem.
2. Categorize the factors associated with the problem.
3. Develop an analytical model.
4. Construct strategic alternatives for testing.
5. Implement the simulation.
6. Analyze the outcomes of the simulation.
7. Apply the analysis to an operational system.

What is the Monte Carlo simulation?

When a scenario contains elements of chance, the Monte Carlo simulation can be used to estimate outcomes. The Monte Carlo simulation analyzes the probability distribution of variables in a problem and uses random sampling of the data. Using random sampling these probabilities are calculated to estimate a problem's solution.

The Monte Carlo simulation is developed through the following procedures:

1. Probability distributions for major elements of the problem are established. A critical feature of the Monte Carlo simulation is the generation of probability distributions. The probability distribution must correspond to the actual data as closely as possible in order for the simulation to be valid and reliable. A commonly accepted method for doing this is historical frequency.
2. Cumulative probability distributions are developed for each variable. After establishing a probability distribution for each variable in the model, the probabilities are sequentially totaled.
3. Random samples are established using the cumulative probability distributions to obtain specific element values for each observation. A random number table is often used to generate numbers for the sampling distribution.
4. Perform several simulation trials. The actual number of trials needed is determined by statistical tests of significance.

Monte Carlo simulations have a wide number of applications including estimating inventory demand on a time interval basis, times between machine failures, project scheduling times, and servicing schedules. Exhibit 1.2 presents a Random Number Table.

EXAMPLE 1.20

A computer memory chip manufacturer's records show the following failure rates of a particular memory chip when tested individually:

Memory Chip Failures

Failures	*Frequency of Failure in Hours*
2	10
5	20
6	30
8	40
2	50
1	60
Total Hours	210

Memory Chip Failures, Frequency of Failure, Failure Probability, Cumulative Probability, and Monte Carlo Numbers

Failures	Frequency of Failure in Hours	Probability (Frequency/Total Hours)	Cumulative Probability	Monte Carlo Numbers**
2	10	0.05	0.05	01-05
5	20	0.10	0.15	06-15
6	30	0.14	0.29	16-29
8	40	0.19	0.48	30-48
3	50	0.24	0.72	49-72
1	60	0.29	1.01*	73-00
Total Hours	210	1		

* Rounding error
**Derived from cumulative probability

Random numbers are then assigned, using a computer generated table of random numbers

EXHIBIT 1.2 RANDOM NUMBER TABLE

75	55	41	96	97	38	33	79	91	22	20	24
39	75	58	48	68	6	62	30	21	96	4	56
91	88	78	58	94	5	51	61	59	90	40	14
79	93	62	48	73	88	17	56	48	22	53	3
50	22	76	38	2	46	68	94	89	17	83	76
5	21	35	52	95	79	19	51	26	46	2	10
76	44	51	15	98	71	33	75	26	47	58	99
77	71	51	20	75	9	91	92	22	99	33	11
4	89	54	62	67	9	65	79	47	39	25	77
88	18	17	46	7	16	98	90	54	56	95	66

56	31	44	50	29	74	66	35	55	81	43	76
55	61	97	16	32	31	66	29	65	61	6	26
65	82	50	68	26	53	76	6	99	98	14	46
30	1	20	47	92	61	76	17	72	15	57	94
95	45	83	50	100	49	58	32	19	0	13	79
70	94	39	19	64	33	28	61	81	6	88	99
87	38	16	34	9	89	19	69	77	24	33	84
47	26	29	96	9	96	2	70	9	34	42	91
85	90	31	79	89	3	86	75	61	59	40	73
48	94	57	21	70	72	23	57	97	50	4	39

The next step is to simulate the memory chip failures. In this example, twenty simulations are run using random numbers from the first column of the random number table. The number of memory chip failures is derived from where the random number coincides with the Monte Carlo interval, as shown in Exhibit 1.3.

EXHIBIT 1.3 FAILURE RATES

Simulation	*Random Number*	*Simulated Failures*
1	75	1
2	39	8
3	91	1
4	79	1
5	50	3
6	5	2
7	76	1
8	77	1
9	4	2
10	88	1
11	56	3
12	55	3
13	65	3
14	30	8
15	95	1
16	70	3
17	87	1
18	47	8
19	85	1
20	48	8
Total Number of Failures		60
Average Failure Rate	60/20 =	3

A frequency distribution for the Hours and Failures of the simulation can now be tabulated, as shown in Exhibit 1.4.

EXHIBIT 1.4 SIMULATION FREQUENCY DISTRIBUTION

Hours	*Failures*	*Probability of Failure*
10	4	0.07
20	0	0
30	0	0
40	32	053
50	15	0.25
60	9	0.15
		1

In this simulation, the average failure rate for the memory chips is 3; however, the greatest number of failures occurs between 40 and 50 hours of operation. Assuming enough simulated iterations occurred, the simulated outcomes will represent real operations.

In this example, running more simulations could have changed the average failure rate for the memory chips. The expected failure rate for the memory chips can be calculated from the failure rates and their probabilities:

Expected failure rate = $\sum_{i=1}^{5}$ (probability of *i* units) x (failure rate of *i* units)

= (.05)(2) + (.10)(5) + (.14)(6) + (.19)(8) + (.24)(3) + (.29)(1)

= .1 + .5 + .84 + 1.52 + .72 + .29

= 3.97 failure rate

The expected failure rate for the memory chips is higher than the average for the sample simulation. Assuming more simulations were run, the average failure rate would more closely approximate the expected failure rate.

1.5 CAPACITY MANAGEMENT

Capacity is the total productive capability of a system during a unit of time. For a manufacturing facility, capacity is simply the maximum output that can be attained with the existing capital equipment during a period of time. Thus, an automobile manufacturer may

define its capacity as the number of cars that can be assembled in an hour, day, week, or month. Capacity is critically important for a productive organization because:

- It provides the output required to meet product demand.
- It directly impacts the cost and efficiency of productive capability.
- It is a major organizational investment.

What is design capacity?

Design capacity is the total achievable capacity under perfect conditions. Normally, perfect conditions are not achievable, and few organizations operate for any period of time at design capacity. Furthermore, operating at designed capacity can cause rapid wear and breakdowns. Operating at design capacity essentially means operating at the organization's productive limits.

What is effective capacity or utilization?

Effective capacity or utilization is a ratio between the expected capacity of a firm and its design capacity. It can be computed by the following formula:

$$\text{EFFECTIVE CAPACITY OR UTILIZATION} = \frac{\text{EXPECTED CAPACITY}}{\text{DESIGN CAPACITY}}$$

Effective capacity is affected by an organization's product mix, production scheduling, age of equipment, and maintenance standards.

EXAMPLE 1.21

A television manufacturing company has a design capacity of 50 televisions per hour, but due to intensive quality control standards, it normally produces only 40 televisions per hour. The effective capacity or utilization of the television manufacturing company is calculated in the following manner:

$$\text{EFFECTIVE CAPACITY OR UTILIZATION} = \frac{\text{EXPECTED CAPACITY}}{\text{DESIGN CAPACITY}}$$

$$\text{EFFECTIVE CAPACITY OR UTILIZATION} = \frac{40}{50} = 80\%$$

What is capacity efficiency?

Capacity efficiency is a ratio of production output to effective capacity. It is a measure of effective management in utilizing effective capacity. It is calculated using the following formula:

$$\text{EFFICIENCY} = \frac{\text{ACTUAL OUTPUT}}{\text{EFFECTIVE CAPACITY}}$$

EXAMPLE 1.22

The effective capacity of a candy manufacturing company is 1,000 units of candy per hour; however, it actually produces only 850 units per hour. The efficiency of the candy manufacturing company can be computed in the following manner:

$$\text{EFFICIENCY} = \frac{\text{ACTUAL OUTPUT}}{\text{EFFECTIVE CAPACITY}}$$

$$\text{EFFICIENCY} = \frac{850}{1{,}000} = 85\%$$

What is rated capacity?

Rated capacity is a determination of the maximum usable capacity of manufacturing capability. Rated capacity can never exceed design capacity. It is a product of design capacity times effective capacity times efficiency. The formula used to calculate rated capacity is:

Rated capacity = Design capacity x Effective capacity x Efficiency

EXAMPLE 1.23

A computer printer manufacturer has a manufacturing facility operating at an effective capacity of 80% with 85% efficiency. It has two assembly lines operating five days a week with two shifts a day. Each assembly line has a designed capacity of 40 printers per hour.

The rated capacity of the computer printer manufacturer is calculated by multiplying the design capacity times the effective capacity times the efficiency of the plant. To determine the design capacity, the two production lines have to be multiplied by the number of printers times the combined number of hours of production.

Design Capacity = 40 printers/hour x 2 assembly lines x 80 hours = 6,400 `

Rated capacity = Design capacity x Effective capacity x Efficiency

Rated capacity = 6,400 x 0.8 x 0.85 = 4,352 printers per week

What factors affect capacity?

Many factors affect an organization's productive capacity. Some are within management's control while others are not. Factors within management's control include the acquisition and supervision of land, physical resources, and the utilization of labor.

Management challenges affecting organizational capacity include personnel issues, technological maximization, and issues that are not directly controllable such as the impact of weather events, political issues, or war.

1.6 LOCATION ANALYSIS

Few decisions have more long-lasting and critical-cost implications than plant location. Costs affected by location decisions include:

- Transportation—the geographic location will determine how far products must be transported to markets.
- Energy—utility geographic service areas determine the respective energy costs for any particular location. These costs vary widely.
- Taxation—local and state tax rates vary widely. Location decisions have major taxation cost implications.
- Wages—wage levels vary widely depending on geographic regions. However, a location decision made solely on the basis of wage levels without considering labor productivity is counterproductive.
- Raw materials—certain industries are extremely dependent on the ready availability of specified raw materials such as wood or iron ore. Location analysis therefore must include the availability of these raw materials.

Note: One of the most important subjective factors in location analysis is the personal preference of the owners and managers. In fact, personal preference may well dominate as a factor in the location of single-plant enterprises. Multiplant enterprises are much more likely to be influenced primarily by objective and subjective economic factors.

Steps to be followed in a facility location decision are as follows:

- Define the location goals and associated factors.
- Identify the decision criteria: quantitative (e.g., cost) or qualitative (intangible)
- Choose a decision model (such as break-even, factor ratings, etc.)
- Select the location that best meets the criteria.

Location decisions need to be reviewed occasionally. They are not one-time decisions.

What is locational break-even and profit analysis?

Locational break-even analysis is an economic comparison of locational options based on a cost-volume examination. Location decisions can be compared in graph form using alternative production/sales volumes. In order to perform locational break-even analysis it is essential to:

1. Establish the fixed and variable costs for each location.
2. Graph the costs for each location where costs are on the Y axis and production/sales volume is on the X axis of the graph.
3. Determine which location has the lowest production/sales volume.

EXAMPLE 1.24

A washing machine manufacturer is analyzing three possible locations-Buffalo, New York; Toledo, Ohio; and Orlando, Florida - to build an additional manufacturing facility. Research analyses indicate the annual fixed costs for the sites are respectively $45,000; $60,000; and $95,000. The variable unit costs respectively are $235; $205; and $185. The anticipated selling price for the washing machines is $350. The company is seeking the most economical location for an expected volume of 5,000 units annually.

The total cost for each city at the expected volume of 5,000 units is calculated using the following formula:

Total cost = Fixed cost + Variable cost x Total volume

Buffalo:
Total cost = $45,000 + $235 x 5,000 = $1,220,000

Toledo:
Total cost = $60,000 + $205 x 5,000 = $1,085,000

Orlando:
Total cost = $95,000 + $185 x 5,000 = $1,020,000

Expected annual profits for each location can be calculated using the following formula:

Total revenue = (Selling price x 5,000) - Total cost (Fixed cost + Variable cost x total volume)

Buffalo:
$1,750,000 - $1,220,000 = $530,000

Toledo:
$1,750,000 - $1,085,000 = $665,000

Orlando:
$1,750,000 - $1,020,000 = $730,000

Assuming a maximum production of 5,000 units, Orlando provides the lowest cost location at $1,020,000 and the highest annual profit of $730,000.

Figure 1.3 shows the locational break-even analysis. At 500 units Buffalo and Toledo are both cheaper than Orlando. At 1,500 units Toledo is the cheapest location, but at 2,000 units of production Orlando becomes the cheapest. Therefore, the crossover points in the breakeven analysis are 500 and 1,500 units of production.

FIGURE 1.3 LOCATIONAL BREAK-EVEN ANALYSIS

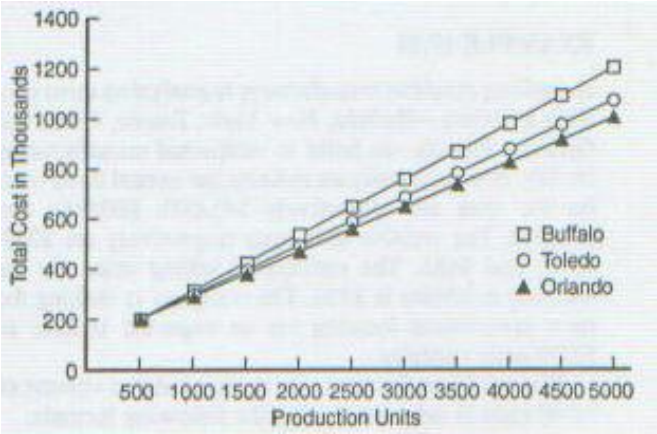
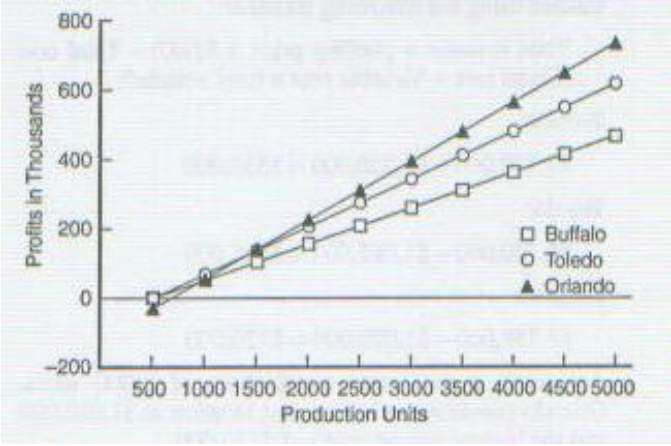


Figure 1.4 shows the location profit analysis. At 500 units both Buffalo and Toledo earn a profit of $12,500. A 1,000 units Toledo earns a profit of $85,000, while Buffalo and Orlando earn $70,000. At 1,500 units Buffalo shows a profit of $127 500, while Orlando shows a profit o $152,500 and Toledo's profit is $157,500. From 2,000 to 5,000 units Orlando is clearly more profitable than either Buffalo or Toledo. The crossover points are 500, 1,000 1,500 and 2,000 units for location profitability.

FIGURE 1.4 LOCATIONAL PROFIT ANALYSIS



Therefore, from both a cost analysis and profit analysis, Orlando at 2,000 units and over is the best locational choice.

What is the center of gravity location method?

The center of gravity location method relies on mathematical analysis for determining where a warehouse should be located to service a number of retail stores in disparate locations. The method considers three factors:

- Market location
- The volume of goods handled in these markets
- Shipping expenses to each location

In order to develop the center of gravity location method, each retail outlet has to be given coordinates within a map grid system where the geographical distances are correctly established.

The center of gravity is determined by using the following formula:

$$C_x = \frac{\Sigma i \, d_{ix} V_i}{\Sigma i \, W_i}$$

$$C_y = \frac{\Sigma i \, d_{iy} V_i}{\Sigma i \, W_i}$$

where

$C_x = x$ coordinate of the center of gravity
$C_y = y$ coordinate of the center of gravity
$d_{ix} = x$ coordinate of the center of gravity
$d_{iy} = y$ coordinate of the center of gravity
V_i = volume of goods moved to or from location i

In order to accurately reflect the true cost of distance on shipping, the center of gravity method evaluates the distance as well as the total volume actually being shipped to any respective location. The ideal location for a warehouse servicing several retail outlets is that which has the lowest weighted cost of distance and volume of units actually shipped.

EXAMPLE 1.25

Good Worth Hardware is a chain of six retail hardware stores being supplied by an outdated warehouse close to its first store. Stores are located in cities A, B, C, D, E, and F in Ohio, Pennsylvania, and New York.

The monthly volume of goods shipped to the respective stores is shown in Exhibit 1.5.

EXHIBIT 1.5 MONTHLY VOLUME OF GOODS SHIPPED TO STORES

Hardware Store Location	(d_{ix}, d_{iy})	Volume of Monthly Shipments
City A	(40,30)	600
City B	(100,90)	800
City C	(150,140)	900
City D	(165,180)	1,200
City E	(50.60)	850
City F	(110.120)	1,100

The company needs to find a more centralized location in which to locate a modern warehouse to supply all the hardware stores.

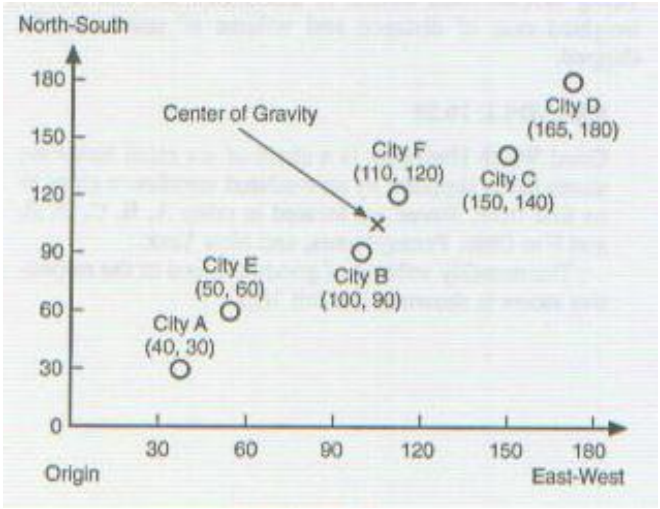
The data from the coordinate locations is then used in the formulas for coordinates x and y.

$$C_x = \frac{(40)(600) + (100)(800) + (150)(900) + (165)(1,200) + (50)(850) + (110)(1,100)}{600 + 800 + 900 + 1,200 + 850 + 1,100}$$

$$C_y = \frac{(30)(600) + (90)(800) + (140)(900) + (180)(1,200) + (60)(850) + (120)(1,100)}{600 + 800 + 900 + 1,200 + 850 + 1,100}$$

The center of gravity coordinate is shown in the coordinate locations in Figure 1.5.

FIGURE 1.5 COORDINATE LOCATIONS FOR HARDWARE STORES



1.7 TIME STUDIES

The classical approach to time studies was developed by Frederick W. Taylor in 1911, and is the accepted procedure for production analysis. A time study, also termed a stopwatch time study, is an analysis of a worker's performance against a time standard. Time studies are normally performed on short repetitive production types of tasks.

How is a time study performed?

There are several basic steps which must be followed in any time study:

1. Define the job to be analyzed.
2. Break the job into discrete tasks.
3. Measure the actual time required for each task.
4. Develop a statistically significant sample size of the task work cycles to be measured. Work measurement depends on sampling the work process. However, in order to counter inherent variability in the work samples, a sufficient representation of the sample universe must be selected. Therefore, it is essential to determine an adequate work cycle sample size. In order to do this, a preliminary analysis must be performed usually consisting of anywhere from 5 to 20 repetitive work cycles in order to determine variability.

The work sample size is dependent on three factors:

a. Observed variance in the work cycles.
b. How closely the sample will conform to the average work cycle (accuracy).
c. The desired statistical level of confidence.

The work cycle element having the greatest variability will determine the sample size needed to obtain an acceptable statistical level of confidence.

The typical statistical level of confidence expected is 95% with a reliability of t =5%. The following formula will determine required sample sizes:

$$N = \frac{nZ^2 [n\Sigma X^2 - (\Sigma X)^2]}{(n - 1)^{a2} (\Sigma X)^2}$$

where

n = initial sample size
X = cycle time
a = accuracy
Z = confidence level (Z = 1 for 68.3% confidence level, Z = 2 for 95.5% confidence level, and Z = 3 for 99.7% confidence level)

5. Calculate the average time required for each job element using the following formula:

$$\text{AVERAGE JOB ELEMENT TIME} = \frac{\text{SUM OF THE TIME NEEDED TO PERFORM EACH TASK}}{\text{NUMBER OF JOB CYCLES}}$$

6. Rate the performance of each worker (Performance Rating).

7. Calculate the normal time required for each job element using the following formula:

$$\text{Normal time} = (\text{average element time}) \times \frac{\text{Performance rating}}{100}$$

Here the observed time, normal time, for a particular employee is rated against the average job element time.

8. Determine allowances that may be permitted for a particular job task. This may take into consideration personal factors as well as unavoidable constraints encountered in the work situation. Allowances include all unavoidable delays, but rule out avoidable delays. An allowance factor represents time lost due to personal factors, shift adjustments, improper equipment, fatigue, and related issues. The performance rating is adjusted for any allowances.

9. Calculate the standard time. When calculating the standard time, three different types of time are actually utilized. Actual time is the time a particular employee actually takes to perform a particular job operation. Normal time is the time needed to complete an operation by an employee working at 100% efficiency having no delays. Standard time is the time needed to complete an operation by an employee working at 100% efficiency with unavoidable delays:

$$\text{Standard time} = \text{normal time} + \text{allowance time}$$

$$\text{Standard time} = \frac{\text{normal time}}{\text{1- allowance fraction}}$$

EXAMPLE 1.26
A work operation consisting of three procedures is observed using a stopwatch time procedure. The allowance for the work operation is 15% of mean time. It is necessary to determine the standard time for the operation and what the standard should be in hours per 1,500 units. The observed data are contained in Table 1.1:

TABLE 1.1 STOPWATCH TIME STUDY

Job Element	Performance (%)	1	2	3	4	5	6	7	8	9	10	Mean Time (sec)	Normal Time (sec)
1	85	10	4	9	8	5	6	8	6	8	8	7	6
2	90	11	9	12	12	14	11	10	9	11	13	11	10
3	105	8	9	9	7	8	6	10	7	8	9	8	9
													Total: 25

The standard time is 28.94 seconds/unit and the standard for 1500 units is 12.06 hr.

EXAMPLE 1.27

A manager wants to determine the required sample size for three different work cycle elements after having performed 12 sample observations. The manager is seeking a 95.5% statistical confidence level with an accuracy of ± 5%. Refer to Exhibit 1.6.

EXHIBIT 1.6 REQUIRED SAMPLE SIZE AT .005 LEVEL OF CONFIDENCE

Sample	Element 1		Element 2		Element 3	
Observation	X	X^2	X	X^2	X	X^2
1	8	64	12	144	7	49
2	7	49	13	169	6	36
3	10	100	14	196	9	81
4	9	81	16	256	8	64
5	6	36	18	324	9	81
6	8	64	15	225	7	49
7	9	81	16	256	9	81
8	10	100	17	289	8	64
9	9	81	14	196	7	49
10	9	81	15	225	8	64
11	7	49	16	256	7	49
12	8	64	14	196	9	81
Total	100	850	180	2,732	94	748

Z = 95.5% confidence level = 2

Element 1:

$$N = \frac{nZ^2 [n\Sigma X^2 - \Sigma (X)^2]}{(n - 1)a^2\Sigma (X)^2} = \frac{12(4)[\ 12(850) - 10{,}000]}{11(.0025)\ 10{,}000} = 34.91$$

Element 2:

$$N = \frac{12(4)[12(2{,}732) - 32{,}400]}{11(.0025)\ 32{,}400} = 20.69$$

Element 3:

$$N = \frac{12(4)[12(748) - 8{,}836]}{11(.0025)\ 8{,}836} = 27.66$$

Element I has the largest required sample size of 35. Therefore, the manager needs to make another 23 sample observations to complete the total sample size of 35.

1.8 WORK SAMPLING

Work sampling is a work measurement methodology that estimates the proportion of time an employee utilizes in performing assigned job tasks. The methodology uses random observations of actual worker activity and is dependent on the laws of probability. Since it does not require a formalized time study procedure conducted by qualified stopwatch analysts, it is less costly. The methodology requires that the manager simply determine whether an employee is actually working or is idle during any particular observation.

After all the observations have been completed, the percentage of working observations is computed from the total observations. The greater the number of observations, the more accurate the technique is.

How is work sampling used?

Work sampling is used for the following:

1. Ratio delay studies. Worker allowances are determined by calculating the percentage of time an employee spends on unavoidable delays.

2. Percent utilization of equipment. The technique is used to determine the actual utilization of machinery and other equipment.

3. Determining labor standards. The technique is useful in determining work standards for various tasks by rating the employee's performance.

4. Evaluating employee performance. A performance standard can be calculated utilizing the work sampling procedure and resulting standards.

How is work sampling performed?

1. *Sample observations*. Several sample observations are performed to act as the basis for developing a correct sample size based on the problem's parameters.

2. *Compute the actual sample size.* The sample size is dependent on the desired level of statistical confidence and accuracy. Normally, the acceptable level of confidence is 95% with an accuracy level of ± 5%. The following formula determines the actual sample size necessary for a work sampling procedure:

$$N = \frac{Z^2 (1 - p)}{a^2 p}$$

Where

p = estimate of time utilized in an activity

$1-p$ = estimate of time not utilized in an activity

a = accuracy level fraction

Z = confidence level (Z = 1 for 68.3% confidence level, Z= 2 for 95.5% confidence level, and Z= 3 for 99.7% confidence level)

A higher confidence level and a reduced accuracy level fraction will increase the required sample size. The 95% confidence level and ± 5% accuracy level establish that in 95 cases out of 100 the sampling activity will be accurate within ± 5% of the proportion of time utilized in an activity (p).

3. Prepare a random schedule of employee observations.
4. Observe and rate the employee's work performance.
5. Total the number of units produced and calculate the normal time per unit.
6. Compute the standard time per unit.

EXAMPLE 1.28

The supervisor of a large production organization wants to determine what the idle time is with a confidence level of 95.5% and an accuracy level of 5%. After performing a random sample of 75 observations, it is determined there is 20% idleness. Analyze the percentage of operational idleness.

The required sample size is determined by using the following formula:

Z = 95.5% confidence level = 2

$$N = \frac{Z^2 (1 - p)}{a^2 p} = \frac{4 (1- .80)}{0.0025(0.80)} = 400$$

Additional observations needed for sample = 400 - 75 = 325

For establishing labor standards, work samples are used in a similar manner to time studies. However, work samples, are more appropriate for operations having long production cycles, group service or production operations, and work using indirect labor. A determination is made as to whether the employee is busy or idle during the observation, a ratio is given to the employee, and the units produced are totaled in order to produce an average. Using this data, the normal time and standard time can be determined:

$$\text{Normal time} = \frac{\text{(Total study time) x (working time percent) x (performance rating)}}{\text{numbers of units produced}}$$

The standard time is the normal time plus allowance time:

$$\text{standard time} = \text{normal time} + \text{allowance time}$$

$$= \frac{\text{normal time}}{1 - \text{allowance time}}$$

EXAMPLE 1.29

A work sample study of a production operator was conducted over 60 hours (3,600 minutes) and disclosed the following data:

Number of pieces produced	580
Total number of observations	800
Total number of observations working	650
Average performance rating	95%

The total allowance given by the company for this operation is 15%. What is the standard time for each operation?

$$\text{Normal time} = \frac{\text{(Total study time) x (working time percent) x (performance rating)}}{\text{numbers of units produced}}$$

$$= \frac{(3600 \text{ min.})(0.8125)(.95)}{580} = 4.8 \text{ minutes/unit of production}$$

$$\text{Standard time} = \frac{\text{normal time}}{1 - \text{allowance time}}$$

$$= \frac{4.8}{1- .15} = 5.65 \text{ minutes/unit of production}$$

1.9 AGGREGATE PLANNING STRATEGIES

Planning is a primary management responsibility. Aggregate planning is concerned with organizing the quantity and timing of production over a medium period of time up to eight to ten months with undetermined demand. Specifically aggregate planning means combining all of an organization's resources into one aggregate production schedule for a predetermined intermediate time period. The objective of aggregate planning is to maximize resources while minimizing cost over the planning period.

The aggregate production plan is midway between short-range planning and long-range planning. Aggregate planning includes the following factors:

1. Work force size and composition

2. Demand forecasts and orders
3. Raw material planning
4. Plant capacity management
5. Utilizing outside subcontractors
6. Inventory management

Aggregate planning is the link between short-term scheduling and long-term capacity planning.

What are aggregate planning strategies?

There are three types of aggregate planning strategies:

Pure Strategy. In this strategy, only one production or supply factor is changed.
Mixed Strategy. This strategy simultaneously alters two or more production or supply factors or some combination.
Level Scheduling. This strategy has been adopted by the Japanese and it embodies maintaining constant monthly production schedules.

What aggregate planning strategies influence demand?

Aggregate planning can influence demand in the following ways:

1. *Pricing strategies.* Pricing can be used to increase or reduce demand. All things being equal, increasing prices reduces demand while lowering prices will increase demand.
2. *Advertising and promotion strategies.* Advertising and promotion are pure demand management strategies in that they can increase demand by making a product or service better known as well as positioning it for a particular market segment.
3. *Delayed deliveries or reserving orders.* Managing future delivery schedules is a strategy for managing orders when demand exceeds capacity. The net effect of delayed deliveries, or back ordering, and reservations is to shift demand to a later period of time, often to a more slack period, which provides a smoothing effect for overall demand. However, the negative is that a percentage of orders will be lost as consumers are unwilling or unable to wait the additional amount of time.
4. *Diversifying the product mix.* Product mix diversification is a method used to offset demand seasonality. For example, a lawn mower manufacturing company may diversify into snow removal equipment to offset the seasonality of the lawn mower industry.

What aggregate planning strategies influence supply?

Aggregate planning is also used to manage supply considerations by using the following strategies:

1. *Subcontracting.* Subcontracting is a method of increasing capacity without incurring large capital investment charges. It can turn the competitive advantage of other

corporations to the contracting organization's advantage. However, subcontracting can be costly, and also reveals part of the business to potential competitors.

2. *Overtime and idle time.* A direct short-term strategy for managing production capacity is to either increase or decrease the number of the work force. This strategy has the advantage of utilizing the currently existing work force. However, overtime is expensive and can produce job burnout if relied upon too extensively. On the other hand, enforcing idle time on the work force can result in resistance as well as a drop in morale.
3. *Hiring and laying off employees*. Hiring and laying off employees is a medium- to long-term strategy for increasing or decreasing capacity. Hiring employees usually involves the cost of training while laying off employees can incur severance charges. Laying off employees can also cause labor difficulties with unions and reduce morale
4. *Stockpiling inventory.* Accumulating inventory is a strategy for smoothing variances which may occur between demand and supply.
5. *Part-time employees.* Certain industries have seasonal requirements for lower skilled employees. Aggregate planning can be used to manage these seasonal requirements.

What is the charting method of aggregate planning?

Charting is a highly utilized trial-and-error aggregate planning method. It is relatively simple to use and is easily understood. Essentially, the charting approach uses a few variables in forecasting demand, applying current production capacity. While the charting method does not assure an accurate prediction, it is simple to implement requiring only minimal calculations. But trial and error method does not provide an optimal solution.

The charting method requires five steps to implement:

1. Calculate each period's demand.
2. Calculate each period's production capacity for regular time, overtime, and subcontracting.
3. Determine all labor costs including costs for hiring and layoffs as well as the cost of holding inventory.
4. Evaluate organizational employee and stock policies.
5. Create optional policies and evaluate their costs.

EXAMPLE 1.30

A Florida men's suit manufacturer has created expected demand forecasts for the period June-January, as shown in Table 1.2.

TABLE 1.2 EXPECTED DEMAND FOR MEN'S SUITS, PRODUCTION DAYS, AND DAILY DEMAND

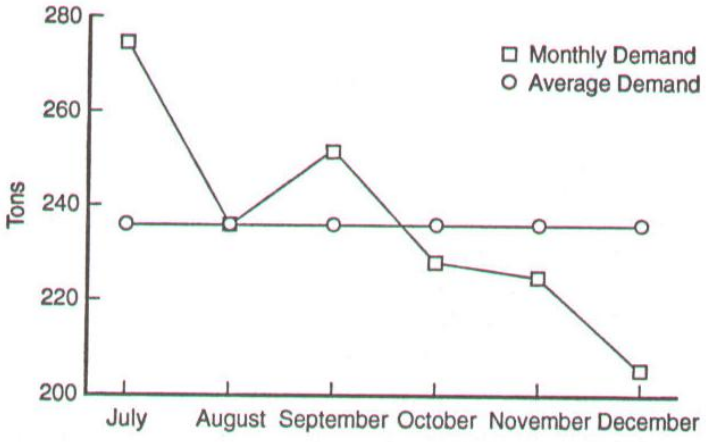
Month	*Expected Demand*	*Production Days*	*Daily Demand*
July	5,500	20	275
August	5,200	22	236

September	5,300	21	252
October	4,800	21	229
November	4,300	19	226
December	4,100	20	205
Average			237

The daily demand is calculated by dividing the total expected demand by the number of monthly working days:

$$\text{AVERAGE DEMAND} = \frac{\text{TOTAL EXPECTED DEMAND}}{\text{NUMBER OF PRODUCTION DAYS}}$$

FIGURE 1.6 MONTHLY AND AVERAGE MEN'S SUIT DEMAND



The graph in Figure 1.6 illustrates that there is a substantial variance between the monthly and average men's suit demand.

What are the costs of aggregate planning?

Aggregate planning is a systems methodology having major organizational impacts. Every strategy has associated costs and benefits. Increasing hiring means increasing training costs and incurring associated employment benefit costs. Increasing inventory increases carrying costs consisting of capital and storage costs, deterioration, and obsolescence. Using part-time employees involves the costs and risks of using improperly trained and inexperienced personnel as well as creating possible union conflicts. Using subcontractors has the cost of exposing an organization to potential competitors.

EXAMPLE 1.31

Using the data in example 1.30, it is possible to develop cost estimates for the men’s suit manufacturer. Basically, the manufacturer has three choices:

1. The manufacturer can meet expected monthly production fluctuations by varying the work force size, hiring and laying off employees as needed. In this scenario, an assumption is made that the men's suit manufacturer has a constant staff of 55 employees.
2. Another alternative is to maintain a constant work force of 51 employees and subcontract for additional expected demand.
3. A third alternative is to maintain a work force of 69 employees and store suits during the slack demand months.

Organizational Costs	
Inventory Holding Cost Per Unit Per Month	$3
Subcontracting Cost Per Unit	$25
Labor Hours Per Men's Suit	2
Layoff Cost Per Employee	$500
Hiring and Training Cost Per Employee	$650

THREE PLAN SUMMARY COSTS

Items	*Plan 1 Hiring & Lay Off*	*Plan 2 Subcontract*	*Plan 3 Store Inventory*
Hiring Costs	19,278		
Layoff Costs	2,000		
Inventory Holding Costs			14,244
Subcontractor Costs		102,700	
Total	21,278	102,700	14,244

In this example, the best production plan is plan 3 which maintains a work force of 69 employees and stores men's suit inventory during low demand months.

1.10 TRANSPORTATION METHOD

The objective of the transportation method is to limit shipment costs from several points of origin to several points of destination. Organizations having an origin and destination network must maximize effectiveness in order to limit costs while expediting the shipments. The transportation model is a special type of linear programming. It involves physical movement of goods from sources of supply to destinations. The objective function includes the transportation cost of each item from each source to each destination. The constraints are the output for each supply point and the demand by each destination.

How is the transportation method implemented?

The transportation method is implemented initially by determining point of origin predictive capacities, destination requirements, and shipment costs to the various destinations from the points of origin. The analysis is structured utilizing a matrix containing these factors.

PLAN 1

Month	*Required # of suits*	*Required Production Hours (Suits Required x 2)*	*Hours Available Per Employee per Month (# of days x 8)*	*Workers Required (Required Production Hours / Hours Available)*	*Workers Hired*	*Workers Laid Off*	*Hiring Cost (Workers Hired x $650)*	*Layoff Cost (Workers Laid Off x $500)*
July	5,500	11,000	160	69	14	0	8,938	
August	5,200	10,400	176	59	4	0	2,659	
September	5,300	10,600	168	63	8	0	5,262	
October	4,800	9,600	168	57	2	0	1,393	
November	4,300	8,600	152	57	2	0	1,026	
December	4,100	8,200	160	51		4		2,000
Total							19,278	2,000

PLAN 2

Month	*Required Number of Suits*	*Available Production Hours (no. of days ×8 × 51)*	*Suits Produced (Available Hours /2)*	*Suits Subcontracted*	*Subcontractor Cost (Tons Subcontracted × $25)*
July	5,500	8,160	4,080	1,420	35,500
August	5,200	8,976	4,488	712	17,800
September	5,300	8,568	4,284	1,016	25,400
October	4,800	8,568	4,284	516	12,900
November	4,300	7,752	3,876	424	10,600
December	4,100	8,160	4,080	20	500
Total					102,700

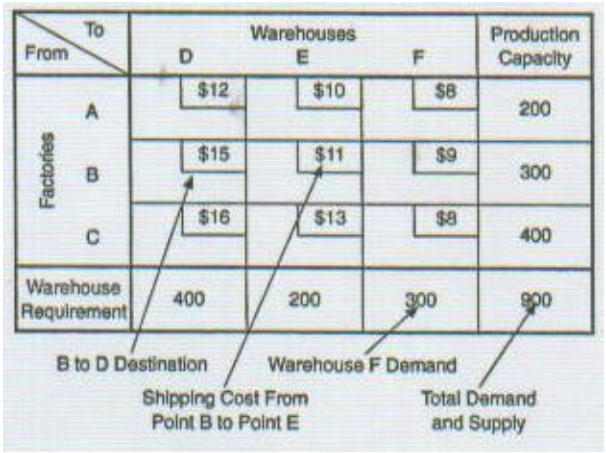
PLAN 3

Month	*Required Number of Suits*	*Available Production Hours (no. of days ×8 ×69)*	*Number of Suits Produced (Available Hours /2)*	*Ending Inventory of Suits*	*Inventory Holding Cost (Ending Inventory × $3)*
July	5,500	11,040	5,520	20	60
August	5,200	12,144	6,072	872	2,616
September	5,300	11,592	5,796	496	1,488
October	4,800	11,592	5,796	996	2,988
November	4,300	10,488	5,244	944	2,832
December	4,100	11,040	5,520	1,420	4,260
Total					14,244

EXAMPLE 1.32

A company manufactures furnaces in three different cities, A, B, and C located in various regions of the country. They are shipped to three different warehouses, D, B, and F also located in various regions of the country. Each manufacturing site has different capacities, and each warehouse has different requirements. A transportation matrix is developed to illustrate the data in Figure 1.7.

FIGURE 1.7 A TRANSPORTATION MATRIX



What is the Northwest corner rule?

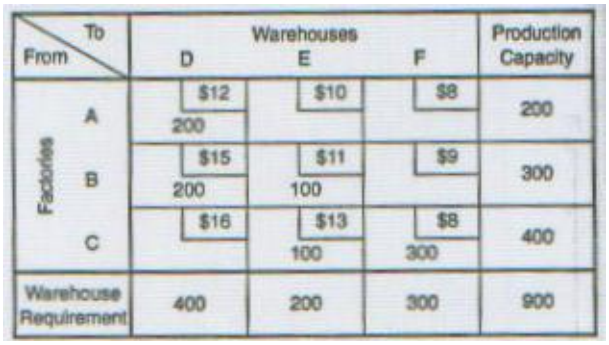
In the Northwest corner rule the maximum amount of a shipment is shipped from the upper left-hand corner (Northwest corner) of the matrix and distributed through the other cells going to the right and down throughout the matrix until all demands are met.

EXAMPLE 1.33

Develop an initial feasible transportation solution from the previous example as shown in Figure 1.8. The following shipments are assumed to have occurred:

1. 200 furnaces are shipped from A to D (this consumes A's production capacity)
2. 200 furnaces are shipped from B to D (this fulfills D's warehouse requirement)
3. 100 furnaces are shipped from B to E (this consumes B's production capacity)
4. 100 furnaces are shipped from C to E (this fulfills E's requirement)
5. 300 furnaces are shipped from C to F (this fulfills F's warehouse requirement and C's production capacity)

FIGURE 10.8 WAREHOUSES, DEMAND, AND SHIPPING COST



Using this information, furnace shipping costs are calculated for each respective destination, as shown in Table 1.3.

TABLE 1.3 RESPECTIVE FURNACE SHIPPING COSTS FOR EACH DESTINATION

Route	*Furnaces Shipped*	*Unit Cost*	*Total Cost*
From A to D	200	$12	$1,200
From B to D	200	$15	$3,000
From B to E	100	$11	$1,100
From C to E	100	$13	$1,300
From C to F	300	$8	$2,400
Total Cost			$9,000

This is an initial solution where all demands and capacities were utilized. However, this may not be the least expensive transportation solution for this set of variables since no consideration was given to limiting costs.

What is the stepping-stone method and how does it reach an optimum transportation solution?

The stepping-stone method is a technique for optimizing an initial transportation solution. The methodology calculates cost by testing each unused square in a transportation table. The following methodology is followed to calculate an optimal transportation solution:

1. Choose any unused square in a transportation table such as Figure 1.8.
2. Develop a closed horizontal and vertical path back to the original square through the squares that are being used. Unused squares are skipped in the process.
3. The first unused square is marked with a + sign and subsequent corner squares in the developed closed path are alternately marked with — and + signs.
4. An evaluation index is created by adding the unit cost figures in each square containing a plus sign and then subtracting the unit costs in each square containing a minus sign.
5. The methodology repeats all of these steps until an evaluation index is calculated for all the unused squares. An optimal solution is achieved when all the results are equal to or greater than zero. If a square evaluation is negative, cost reductions can be accomplished by transferring as many units as possible to that square.

EXAMPLE 1.34

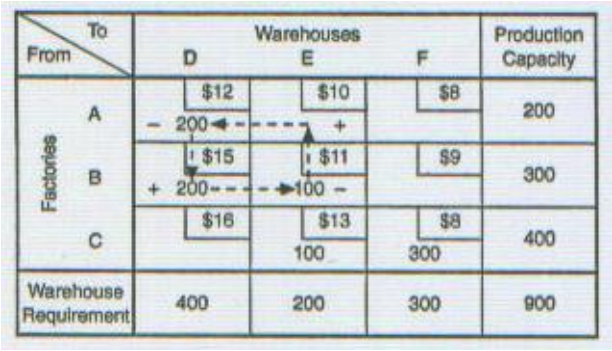
Using the transportation matrix for the furnace company, the stepping-stone method can be used to evaluate an optimal shipping route. Every empty cell must be tested using a closing pathway of engaged cells. In the stepping-stone method, the number of engaged squares has to equal the number of rows in the table plus the number of columns minus 1 (R + C - 1 = number of engaged cells). In the furnace example we have:

R + C - 1 = number of engaged cells
3 + 3 – 1 = 5

If there are fewer engaged cells than the stepping-stone rule calls for, there is a degeneracy, meaning it is not possible to trace a closed path for one or more unoccupied squares.

Shipping route A to E: starting’ in empty cell AE, a route is traced using only engaged squares. Thus, a route is traced from AE to AD to AB to BE and alternate + and — signs are placed in each square. This is shown in Figure 1.9.

FIGURE 1.9 SHIPPING ROUTE AE

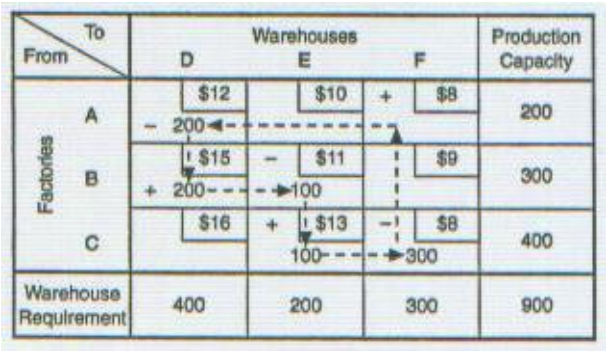


A shipping cost index for route AE is calculated using the shipment costs in the upper right-hand corner of each square:

$l0 -$12+$15-$11 =+$2

Thus, for route AE an additional cost of $2 would be incurred for each furnace shipped. Figure 1.10 shows shipping route AF.

FIGURE 1.10 SHIPPING ROUTE AF



The shipping cost index for shipping route AF is:

$8-$l2+$l5-$11 +$13-$8=+$5

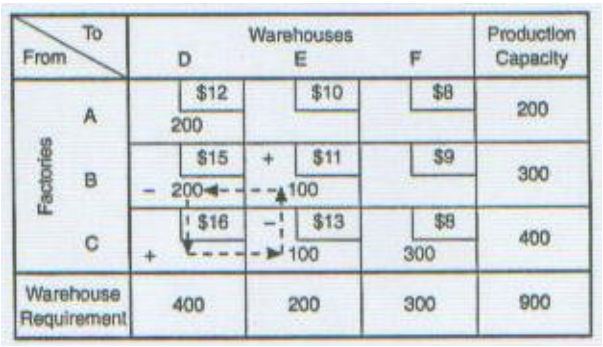
Using route AF will increase furnace shipping costs by $5 per unit.

Shipping route BF (not shown) would start in square BF going to square BE to square CE and back to square BF. The shipping cost index for shipping route BE is:

$9-$11+$13-$8=+$3

Using route BE will increase furnace shipping costs by $3 per unit. Figure 1.11 presents route CD.

FIGURE 1.11 SHIPPING ROUTE CD



The shipping cost index for route CD is:

$16 - $13 + $11 -$15 = -$1

Of the three routes, shipping route CD is the optimum since it would reduce the furnace shipping costs by $1 per unit.

The total amount that may be shipped on the optimum route is the smallest number in the squares having minus signs. Thus, in shipping route CD 100 furnaces, found in square CE, is the greatest amount that can be shipped. Using shipping route CD reduces furnace shipping costs by $100 (100 units x $1 = $100).

1.11 SCHEDULING

Scheduling is the management of organizational resources to achieve an orderly and uninterrupted workflow process. The basic objective of scheduling is to maintain high organizational productivity, low inventory levels, and high levels of customer satisfaction. Scheduling involves the use of time and the setting of priorities into operational rules. Scheduling is generally categorized into forward and backward scheduling.

What is forward scheduling?

Forward scheduling begins as soon as demand is known. This type of scheduling is generally used by custom fabricators and manufacturers who rely on individual customer orders. Normally, forward scheduling assumes a very short delivery date. It is essential that fabrication and manufacturing times be accurately estimated in order to develop reliable deadlines. This mandates the development of reliable estimates of fabrication and manufacturing capacities.

What is backward scheduling?

In backward scheduling, start and due dates as well as the required capacity for individual jobs are developed by calculating processing times and required capacities sequentially from the last job back to the first.

What is shop loading?

Shop loading is the apportioning of jobs to production centers. While the method determines which manufacturing centers receive specific jobs, it does not specify processing priorities. When job orders can be performed equally well by several manufacturing centers, a prioritizing of the manufacturing centers becomes necessary.

What are the two shop loading methods?

The two types of shop loading method are infinite loading and finite loading. Infinite loading does not consider capacity limitations when apportioning jobs to work centers, while finite loading apportions work to manufacturing centers consistent with their production capacities. Infinite loading monitors and measures production underloads and overloads and projects the timing sequence of their occurrence. The net result of infinite loading's monitoring and measuring of the production process results in a determination of capacity requirements. An overload occurs when a manufacturing center cannot finish scheduled jobs because of capacity constraints, whereas an underload occurs when a manufacturing center experiences periods of idleness because of insufficient job scheduling.

Since finite loading does not permit capacity overloads, it mandates job rescheduling based upon existing manufacturing capacities.

What are the advantages of finite and infinite loading?

All jobs must be prioritized before implementing finite loading. Since finite loading cannot exceed capacity, it should generate more realistic completion times. Those jobs
not having the highest priority are rescheduled for a later period of time.

Infinite loading's advantage is that it does not consider capacity. Therefore, it gives a more realistic assessment of what production capacity is really required to complete designated jobs. Using the capacity requirements that infinite loading provides allows management to more accurately schedule work among the available manufacturing centers.

How are Gantt charts useful in loading and scheduling?

The Gantt load chart depicts the apportioning of jobs to a production center. While many variations exist, normally the load chart is a table depicting the production center,
assigned jobs, hours required for the assigned jobs, and remaining capacity in hours arranged along horizontal and vertical lines.

A Gantt schedule chart is a graph used to analyze the progress of currently scheduled jobs. It is a visual method for surveying the actual progress of jobs in production.

What are the advantages and disadvantages of the Gantt loading and scheduling charts?

Gantt charts are a very popular management tool for assessing job loading for production centers as well as for analyzing actual job progress in the production centers. They are easy to develop and understand.

However, criticisms are that they are unsophisticated in the sense that no allowance is provided for uncontrollable production delays resulting from human error, unavoidable

technical failures, or material shortages. They also require continual adjustment as conditions change. Also, when there is more than one production center equally capable of processing job orders, the Gantt methodology does not provide the required sophistication to help management make decisions as to which should process particular jobs. Essentially, Gantt charts tend to be more useful in simply maintaining records regarding current operations.

EXAMPLE 1.35

It is necessary to chart the loading of ten jobs and calculate the remaining production hours available in three different production centers. A Gantt load chart, shown in Figure 1.12, Is prepared to demonstrate the loading of the jobs.

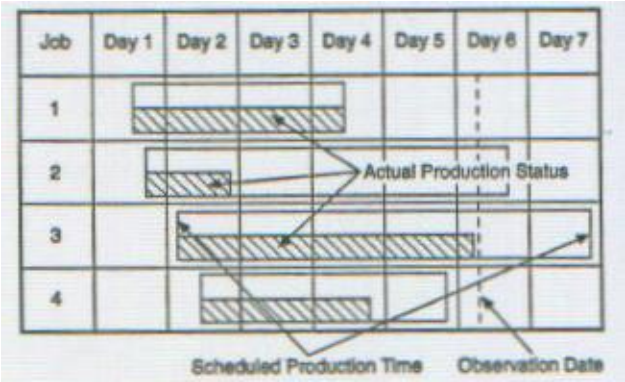
FIGURE 1.12 GANTT LOAD CHART

	Production Center					
Job	#1		#2		#3	
Number	Required	Available	Required	Available	Required	Available
1	7	70	2	50	3	60
2	3	63	4	48	6	57
3	6	60	5	44	4	51
4	4	54	3	39	7	47
5	9	50	7	36	8	40
6	2	41	6	29	4	32
7	4	39	4	23	8	28
8	7	35	8	19	5	20
9	3	28	4	11	7	15
10	4	25	5	7	2	8
Remaining Hours		21		2		6

EXAMPLE 1.36

Management needs to visualize the scheduling and production status of four different job orders, 1, 2, 3, and 4. A Gantt scheduling chart shown in Figure 1.13 displays the scheduling and production status of the four products.

FIGURE 1.13 GANTT SCHEDULING CHART



1.12 SEQUENCING

While the Gantt charts are useful for tracking job loading, they do not have the sophistication to help management determine what job order priorities should be. Sequencing is a process that determines the priorities job orders should have in the manufacturing process. Sequencing results in priority rules for job orders.

What are priority rules?

The basic function of priority rules is to provide direction for developing the sequence in which jobs should be performed. This assists management in ranking job loading decisions for manufacturing centers.

There are several priority rules which can be applied to job loading. The most widely used priority rules are:

DD—Due Date of a job. The job having the earliest due date has the highest priority.
FCFS—First Come, First Served. The first job reaching the production center is processed first.
LPT—Longest Processing Time. Jobs having the longest processing time have the highest priority.
PCO—Preferred Customer Order. A job from a preferred customer receives the highest priority.
SPT—Shortest Processing Time. The job having the shortest processing time has the highest priority.

EXAMPLE 1.37

Using the data contained in the table Job Processing Data, it is necessary to schedule orders according to the priority rules of Due Date (DD), First Come, First Served (FCFS), Longest Processing Time (LPT), Preferred Customer Order (PCO), and Shortest Processing Time (SPT).

Job Processing Data

Job	*Preferred Customer Status (1 = Highest)*	*Processing Time (days)*	*Due Date (days)*
A	3	7	9

B	4	4	6
C	2	2	4
D	5	8	10
E	1	3	5

PRIORITY RULES AND JOB SEQUENCING OUTCOMES

Priority Rules

Due Date	*First Come, First Served*	*Longest Processing Time*	*Preferred Customer Order*	*Shortest Processing Time*
C	A	D	E	C
E	B	A	B	E
B	C	B	A	B
A	D	E	C	A
D	E	C	D	D

What is the critical ratio method?

The critical ratio method assigns a priority that is a continually updated ratio between the time remaining until due date and the required job processing time. When used in conjunction with other jobs waiting to be processed, it is a relative measure of critical job order priority.

The critical ratio gives the highest priority to jobs that must be done to maintain a predetermined shipping schedule. Jobs that are falling behind a shipping schedule receive a ratio of less than 1, while a job receiving a critical ratio greater than 1 is ahead of schedule and is less critical. A job receiving a critical ratio score of 1.0 is precisely on schedule.

The critical ratio is calculated by dividing the remaining time until the date due by the remaining process time using the following formula:

$$\text{critical ratio} = \frac{\text{remaining time}}{\text{remaining process time}}$$

$$= \frac{\text{Due Date - Today's date}}{\text{days of remaining process time}}$$

EXAMPLE 1.38

On day 16, four jobs, A, B, C, and D, are on order for Ferguson's Kitchen Installation Service:

Jobs on Order

Job	*Due Date*	*Days of Remaining Process Time*

A	27	8
B	34	16
C	29	15
D	30	12

Using this data, the critical ratios and priority order are computed.

Critical Ratios and Priority

Job	*Critical Ratio*	*Priority*
A	(27—16)/8=1.38	4
B	(34—16)/16=1.13	3
C	(29—16)/15=.87	1
D	(30—16)114=1	2

Job C has a critical ratio less than one indicating it has fallen behind schedule. Therefore, it gets the highest priority. Job D is exactly on schedule, but jobs B and A have respectively higher critical ratios indicating they have some slack time. This gives them respectively lower priorities.

What Is Johnson's rule for scheduling N jobs in two production centers?

Johnson's rule provides an optimum prioritization based on minimum processing time when N jobs have to be sequentially processed in two production centers. The net result of utilizing Johnson's rule is a minimization of total idle time at a production center.

The procedure for using Johnson's rule is the following:

1. Show all the processing times for all orders at each respective processing site.
2. Find the job having the shortest processing time. If the job is at the first processing site, schedule it first; however, if it is at the second processing site, schedule it last.
3. Once the job is scheduled, it no longer receives further consideration.
4. The remaining jobs are scheduled using rules 2 and 3.

EXAMPLE 1.39

Five job orders must be sequentially processed through two processing centers. The orders need to be sequenced to achieve minimum idle time.

Processing Time for Jobs in Hours

Job	*Processing Center 1*	*Processing Center 2*
A	11	3
B	6	8
C	9	4
D	2	9
E	10	6

Now it is necessary to sequence the jobs starting with the smallest processing time. The smallest job is job D in Processing Center 1. Since it is in Processing Center 1, it is sequenced first and then eliminated from further consideration.

D				

The second smallest processing time is A in Processing Center 2. It is placed last, since it is at Processing Center 2, and eliminated from further consideration.

D				A

The next smallest processing time is job C in Processing Center 2. It is placed next to last.

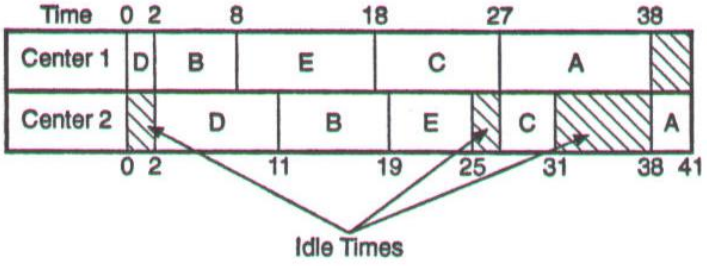
D			C	A

For the next smallest processing time, there is a tie in job B in Processing Center 1 and Job E in Processing Center 2. B is placed in the next highest sequence after job D and job E is placed directly after B.

D	B	E	C	A

The resulting sequential processing times are:

Processing Center 1	2	6	10	9	11
Processing Center 2	9	8	6	4	3



In Processing Center 2 the five jobs are completed in 41 hours, and there are 11 hours of idle time.

1.13 PROJECT MANAGEMENT TECHNIQUES: PERT AND CPM

What is PERT?

The Program Evaluation Review Technique (PERT) was originally developed for the U.S. Navy's Polaris submarine project. The primary purpose of PERT is to plan, schedule, and coordinate the sequential activities required in one time complex project. The PERT model develops a graphical depiction of the sequential activities required to complete a project. It then determines the total anticipated time needed for the project's completion. PERT is considered a network method of project scheduling since activities are depicted as arrows while intermediate goals, or events, are depicted as circles. There are four steps necessary in developing a PERT network project schedule:

1. A comprehensive project analysis is performed.
2. All of the required project activities are categorized according to their order of precedence.
3. A PERT chart is drawn where all the activities preceding an event are shown using a lettered arrow and events are numbered using circles.
4. Time and/or cost estimates are assigned to each activity.

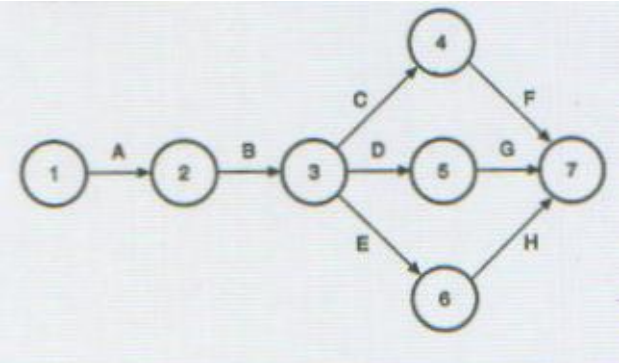
EXAMPLE 1.40

It is necessary for a manager to develop a PERT network using the following information listing activities and their respective predecessors.

Activity	*Preceding Activity*
A	--
B	--
C	B
D	B
E	B
F	C
G	D
H	E

A PERT chart is drawn as in Figure 1.14, where all the activities are lettered using arrows and the events are numbered using circles.

FIGURE 1.14 PERT NETWORK PROJECT SCHEDULE



Activities can also be designated by their beginning and ending events. For example:

Beginning Event	*Ending Event*	*Activity*
1	2	1-2
2	3	2-3
2	4	2-4
3	4	3-4
4	5	4-5
4	6	4-6
5	7	5-7

What is the critical path method (CPM)?

The critical path method was originally developed to schedule the startup and shutdown of major production plants. It is based on developing three activity time estimates for calculating project completion time with variances. The three time estimates are an optimistic time (*a*), pessimistic time (*b*), and most likely time (*m*).

What are the optimistic, pessimistic, and most likely times?

1. Optimistic time (*a*). This is an estimate of the least, or minimum, time an activity will take to complete.
2. Pessimistic time (*b*). This is an estimate of the most, or maximum, time an activity will take to complete.
3. Most Likely time (*m*). This is an estimate of the average or normal amount of time an activity would take assuming it were to be repeated several times.

In arriving at an expected time (t_e) for a given project activity, a beta probability distribution is employed in PERT. The three time estimates are combined and averaged to calculate a time estimate. Normally, in PERT applications the most likely time (*m*) is given a weight of 4 while the optimistic time (*a*) and pessimistic time (*b*) are each given a weight of 1. The variance (*v*) for each activity is also calculated:

$$t_e = \frac{a + 4m + b}{6}$$

and

$$v = \left[\frac{b - a}{6} \right]$$

The expected times (t_e) and variance (v) are calculated for each activity after the network for the PERT analysis is completed.

EXAMPLE 1.41

There are five activities in a project. It is necessary to compute the expected times and variances for the project:

Activity	*Optimistic Time(a)*	*Most Likely Time (m)*	*Pessimistic Time (b)*	*t* $\frac{a + 4m + b}{6}$	*V* $\frac{b - a}{6}$
1-2	5	7	9	7	0.67
1-3	1	3	5	3	0.67
2-4	2	3	4	3	0.33
3-4	4	6	8	6	0.67
3-5	3	7	9	6.67	1

What is critical path analysis?

Critical path analysis consists of analyzing the sequence of activities from the beginning event to the ending event. The critical path is the longest path through a network. It is critical because any increase in time for an activity on this path will delay the entire project. Moreover, any decrease in time for an activity not on the critical path will not shorten the project. To calculate the critical path, data must be obtained on the earliest start and finish times, the latest start and finish times, and the available slack time:

1. ES—Earliest activity start time. The time when all preceding activities are finished; the earliest an activity can commence.

2. LS—Latest activity start time. The time when all successor activities have to be finished without delaying the entire project. The latest activity start time is calculated by subtracting the expected time of the activity (t) from the latest finish time (LF) and then subsequently subtracting (t) for the slowest (longest (t) path(s).

3. EF—Earliest activity finish time. The earliest activity finish time equals the earliest activity start time (ES) of the activity plus expected time (t) for the activity.

4. LF—Latest finish time. The time when the project must be finished. The latest activity finish time equals the latest start time (LS) plus the expected time (t) of the activity.

5. S—Slack time. An activity's total slack is the difference between the latest and earliest activity start times (LS — ES) or the latest and earliest activity finish times (LF-EF). Slack is the free time associated with each activity. In other words, paths that are not critical have slack time. Slack represents unused resources that can be diverted to the critical path.

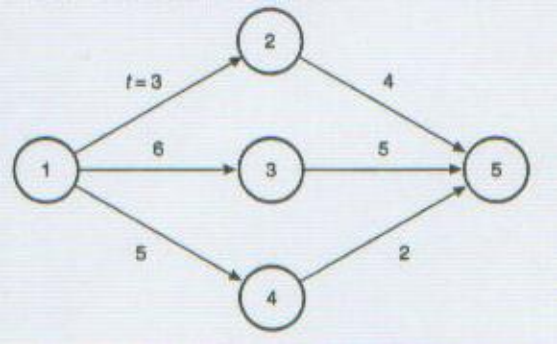
After calculating the preceding data for each activity, the overall project can be analyzed. This includes:

1. The critical path. The time it takes to finish all the project's activities without any slack time.

EXAMPLE 1.42

Using the PERT chart in Figure 1.15, calculate ES and EF for each activity.

FIGURE 1.15 PERT CHART



Now the earliest start (ES) and earliest activity finish times (EF) are determined. In order for an activity to begin, all of the preceding activities must be finished. EF is calculated by adding expected time (t_e) to ES for each activity.

Activity	*t*	*ES*	*EF (t + ES)*
1-2	3	0	3
1-3	6	0	6
1-4	5	0	5
2-5	4	3	7
3-5	5	6	11
4-5	2	5	7

The latest activity finish time (LF) of the project is 11 since the earliest activity finish time (EF) for activity 3-5 is 11.

In order to calculate a project's critical path, it is necessary to determine the latest start time (LS) by subtracting the expected time (t) of the activity from the latest finish time (LF). It is also necessary to determine the slack time for each activity by subtracting the earliest activity start time (ES) from the latest activity start time (LS).

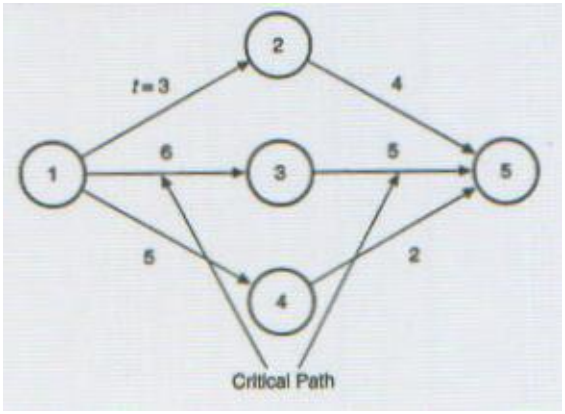
EXAMPLE 1.43

Using the above data, what is the project's slack time and critical path?

Activity	t_e	*ES*	*EF* (t_e + *ES*)	*LS*	*LF* (*LS* + t_e)	*S* (*LS* – *ES*)
1-2	3	0	3	4	7	4
1-3	6	0	6	0	6	0
1-4	5	0	5	4	9	4
2-5	4	3	7	7	11	4
3-5	5	6	11	6	11	0
4-5	2	5	7	9	11	4

The critical path is the activity with 0 slack time, or activity 3-5. The total completion time of the project is 11 since activity 3-5 is the longest path to completion. Figure 1.16 presents the critical path.

FIGURE 1.16 PERT CHART SHOWING CRITICAL PATH



Note: If the project duration (length of critical path) exceeds the allowable deadline, options include (1) changing the deadline or (2) "crashing" the project. Crashing means speeding up one or more activities along the critical path. This may involve shifting more resources (money) to those activities or perhaps outsourcing some of the work. The critical path method (CPM) model, also known as pert/cost, argues that most activities can be reduced in duration if extra resources (men, machines, money, and so on) are assigned to them. The cost for getting the job done may increase, but if other advantages outweigh this added cost, the job should be expedited or crashed. When making a cost/time trade-off, the first activity to be crashed (have its completion time accelerated) is one on the critical path. To select and activity on another path would not reduce the total time of completion. The activity chosen should be the one whose completion time can be accelerated at the lowest possible cost per unit of time saved.

CHAPTER 2
GENERAL MANAGEMENT

Upon completion of this chapter, you will be able to

- Outline the steps in the planning process.
- Demonstrate how the Just-in-Time (JIT) Inventory Management System works as compared to traditional inventory planning concepts.
- Define continuous improvement (CI).
- Discuss quality control, TQM, and quality costs.
- Compare the advantages and disadvantages of group decision making.
- What is brainstorming and how is it used?
- What functions do centralization and decentralization perform?
- What is the graphic rating scales performance evaluation method?
- What are behaviorally anchored rating scales (BARS)?
- List the types of common compensation method and discuss how successful they are

Management is a process that utilizes various functions and activities to help an organization accomplish its goals. Managers are charged with the responsibility of achieving the organization's goals by getting things done. Above all else, the management process is dependent on coordinating and motivating people in the organization to achieve high quality outcomes. The study of management involves theories, principles and concepts used in this process.

2.1 JUST IN-TIME (JIT) INVENTORY

Inventory is maintained to prevent production problems caused by the lack of supply of needed materials. Inventory activities are inherently nonvalue-adding. Nonvalue-adding activities are those that do not add utility to the product. Thus, a system, such as JIT, that simplifies production and reduces inventory and its attendant procedures (storage, handling, etc.) also reduces nonvalue-adding activities. *Note:* This system, however, increases the risk of the stockout costs because the inventory buffer is reduced or eliminated.

What is the cost of inventory?

Inventory entails many hidden and obvious costs. Among these are the costs of carrying, ordering, and storing supplies as well as the risks of obsolescence, spoilage, shrinkage, inadequate insurance, and undetected defects. Inventory costs can involve an enormous amount of money.

How does the Just-in-Time (JIT) Inventory Management System work?

The Just-in-Time Inventory Management System seeks to have the exact amount of production materials available when needed, without having shortages or excess inventory. In order to maintain this exacting performance specification, the methodology is designed to minimize system variances both inside and outside of the production process.

What are system variances and what causes them?

Basically, production system variances occur because of ineffective management practices and insufficient utilization and/or processing of production materials, i.e., waste. One bottleneck can be an ineffective procurement system, which includes purchasing, source, supply, and materials management.

Waste occurs because:

• Production results have unacceptable quality, quantity, or timeliness due to poor employee training, low quality production resources, or poor quality materials.
• Design specifications are faulty.
• Customer specifications are incomplete or unrealistic.

How does JIT minimize production variances?

JIT minimizes production variances in the following ways:

• Small lot sizes are used. Small lot sizes require smaller material inventory needs, and delivery times can be more reliably estimated and managed.
• The stages of the manufacturing process are carefully synchronized. This prevents unanticipated material demands.
• Inventory is used only when required instead of accumulating waiting for need. This is called an inventory "pull" strategy, as opposed to a "push" strategy.
• Smaller lot size produces a steadier inventory demand since maximum and minimum inventory levels are reduced. This can be demonstrated by calculating a mean inventory level:

$$\text{Maximum Inventory Level} = \frac{\text{Maximum Inventory} + \text{Minimum Inventory Level}}{2}$$

EXAMPLE 2.1

A manager wants to understand the Mean Inventory Levels in two different production departments. The first has large lot production of 5,000 units while the second only produces in small lot sizes of 200 units. The manager must calculate the mean inventory levels:

Mean Inventory
Level = Max.

Lot Size	Minimum Inventory	Maximum Inventory	Inventory + Min. Inventory/ 2
5,000	500	9,000	4,750
200	150	250	200
Difference			4,550

The large lot size has a mean inventory level of 4,750 while the small lot size has a mean inventory level of 200. The difference between the large and small lot sizes in Mean Inventory Levels is 4,550.

2.2 MATERIAL REQUIREMENTS PLANNING (MRP)

A Material Requirements Planning system provides a methodology for analyzing and forecasting material needs for the purpose of developing a schedule of the material necessary to complete production goals. MRP requires the existence of a production schedule, a bill of material, inventory and purchase records, and lead times for each production item. The MRP graphically demonstrates when inventory materials need to be ordered or when production on an item must begin so a particular item will meet the production schedule.

Normally, an MRP is computerized. It is a widely used inventory management system in companies involved in mass assembly.

EXAMPLE 2.2

A company produces a consumer item which consists of several components it also manufactures. Using these items, an MRP is constructed:

Gross material Requirements plan for 75 units of A

Component Deadline and Start Date	*Weeks* 1	2	3	4	5	6	7	8	*Lead Time*
A. Deadline Date								75	1 week
Start Date							75		
B. Deadline Date							150		3 weeks
Start Date				150					
C. Deadline Date							200		2 weeks
Start Date					200				
D. Deadline Date					350				1 week
Start Date				350					
E. Deadline Date					400				1 week
Start Date				400					

F. Deadline Date			550	1 week
Start Date		550		
G. Deadline Date		400		2 weeks
Start Date	400			
H. Deadline Date		500		2 weeks
Start Date	500			

In this gross material requirements example, in order to produce 75 units of A in week eight, their manufacture must begin in week seven. However, that requires that 150 components of B and 200 of C be available at that time. In turn, that means manufacture of components B and C must start at weeks 4 and 5, respectively. The MRP shows the start and deadline dates of the other required components in the manufacturing chain. Transforming these dates into an actual calendar allows managers to quickly view their progress in the manufacturing process.

How is an MRP adjusted when there is inventory on hand?

When there is inventory on hand, the MRP manufacturing schedule is adjusted to the actual net requirements to meet the production deadlines.

How does manufacturing resource planning (MRP II) differ from MRP?

Manufacturing Resource Planning (MRP II, or "closed loop" MRP) is an integrated information system that steps beyond first-generation MRP to synchronize all aspects (not just manufacturing) of the business. The MRP II system coordinates sales, purchasing, manufacturing, finance, and engineering by adopting a focal production plan and by using one unified database to plan and update in all systems. Manufacturing resources planning (MRPII) integrates such information as work force levels, inventory investment, and "what if" analyses.

2.3 PLANNING

What is planning?

Planning is a fundamental management process that influences an organization's mission, goals and objectives, and Management determines a future course of action. Planning is dynamic and continually responds to changes in the business environment. Rather than reacting to changes, planning allows the proactive control of future environmental variables. The planning process normally results in a management plan that can be widely distributed throughout the organization.

Why is planning essential?

Planning requires an organization to consider its future actions. The reality is that the organizational environment is becoming far more competitive and complex because of

increasing international competition and technological progress. While research and development expenditures are increasing, product life cycles are getting steadily shorter.
Planning is absolutely essential in order to develop an understanding of where an organization should be devoting its resources and energy. Without planning, proactive strategies and programs cannot be developed to secure the organization's future success. Planning allows the organization to develop a rational method for controlling and developing the future.

Who has the responsibility for planning?

The real question in planning authority is whether it is centralized or decentralized. Traditionally, the planning function was centralized as a staff management responsibility. The role of the centralized planner was to help shape the organization's mission, goals and objectives, and to develop management strategies for future actions. This was predicated on the advantage management traditionally had in accessing strategic information. It was only natural for planning to be positioned in a centralized management environment.

As the organizational environment has become more dynamic, with management information systems becoming more sophisticated and ubiquitous, information management capabilities have proliferated throughout all levels of an organization. Thus, the planning function has become integrated into the operational levels of organizations. This provides for a dynamic environment where the organization's mission, goals, and objectives are continuously being tested and shaped by those having the responsibility for operationalizing them.

What are the advantages of planning?

Planning makes it possible for an organization to:

• Achieve a coordinated system where all levels of the organization have input into operationalizing its mission, goals, and objectives.
• Control and manage the future consistent with the organization's capabilities and resources.
• Develop a sophisticated management information system so the organization can increase its information processing capability.
• Define organizational and performance objectives to achieve higher quality and productivity.
• Coordinate an overall management development effort throughout the organization.

What are the types of planning?

There are several ways of categorizing plans. Two methods are specificity and timeliness.

1. *Functionally specific plans.* These plans apply to individual organizational functions including human resource management, operations, financial, and marketing management.
2. *Time range of the plan.* The time range of a plan can correspond with the time parameters of objectives from short- and medium- to long-range.

Organizational plans are normally classified into several general categories which encompass a wide range of activities and functions:

• *Strategic Planning*. Strategic planning encompasses the broadest and most comprehensive type of planning. It includes the main purpose of the organization, its mission, as well as the organization's short-, intermediate- and long-range objectives, including the specific details of how the objectives and goals will be achieved. Strategic planning contains within it operational and tactical planning as well as standing and single-use plans.
• *Tactical Planning.* This type of planning is concerned with specific methods of implementing an overall strategic plan. If an organization, for example, would like to enter into a new market, tactical planning would be concerned with the types of products or services that might be necessary to do that.
• *Operational Planning.* Operational planning is very specific and is concerned with actual methods of operationalizing tactical plans which are designed to implement the overall strategic plan. For example, an operational plan might be concerned with managing a manufacturing process to produce a specific product that a tactical plan developed.
• *Single-use Plans*. Single-use plans have very specific time limits and purposes. Single-use plans are used to implement a program, product, project, or service. A single-use plan might, for example, be used for designing and implementing a specific manufacturing
process for the production of a particular product within a clearly defined time frame.
• *Standing Plans*. Standing plans are ongoing management plans for particular organizational policies.

What are the steps in the planning process?

Basically there are six steps in the planning process:

1. Survey the current organizational environment. Before a strategic plan can be established, management must conduct a thorough review of the organization's overall environment. This must include the firm's strengths and weaknesses, the competitive and regulatory environment, and current economic and market developments. This review will help the organization form a strategic plan; however, this must be coordinated with the organization's operational plan based on current cash flow, market performance, and overall capabilities.
2.Develop goals and objectives. The survey of the organization's current environment assists the organization in determining short-term objectives and future goals. Organizational objectives have different time spans depending on the nature of the objectives and the type of organization. Long-range plans can be for as long as 25 years. Short-term plans can last up to one year while intermediate-term plans can last from one to five years. All objectives must be met prior to achieving the organization's long-term goals. Complex organizations often have multiple objectives which create additional planning and budgeting challenges.

There are several types of organizational objectives:

-*Quality and productivity objectives*. Quality and productivity go hand-in-hand. Productivity is a ratio of the input of organizational resources to its output. An example is labor to units produced. However, without some standard of quality, there can be no productivity, while high quality increases productivity by decreasing imperfections and waste.
-*Marketing objectives.* Marketing objectives are the degree of success the organization is experiencing in achieving market, product, and service growth. Management also seeks to

evaluate an organization's overall market mix in order to determine where resources should be allocated.
-Profitability objectives. Profitability objectives include the total increase in profits relative to sales, and net assets. Numerous financial ratios are used to measure profitability. Profitability objectives are important to management for monitoring an organization's financial progress.

3. Create an organizational action plan. The net result of the planning process is the establishment of an organizational action plan designed to achieve short-term objectives and longer-term goals. An organizational action plan is derived from the careful definition and understanding of the organization's short-term objectives which are consistent and instrumental in achieving intermediate to longer-term objectives. After establishing a consensus with those having responsibility for carrying it out, the plan is transformed into a clearly written document. While the plan must encompass all of the short-, intermediate- and long-term objectives in order to achieve the organization's longer-term goals, it must also be flexible to permit adaptation to future changes in the organizational and external environment.
4. *Earmark resources*. In order to implement an action plan, a careful assessment of the quantity and nature of the necessary resources is required. A budget is developed for the purpose of allocating the required resources. The budget is based upon a priority analysis of each objective. It must be consistent with the organization action plan's short-, intermediate- and longer-term objectives. Budget allocations require constant monitoring to measure their success in achieving objectives.
5. *Execute the plan*. An organizational action plan will have no effect unless it is carried out. Organizational action plans are executed through the cooperation and teamwork of those within the organization. Management efforts must be coordinated while employees are oriented and trained in the plan's implementation.
6. *Manage the plan*. The management process involves constant feedback of information regarding the success of the plan in achieving its stated objectives. The use of a management information system would be extremely instrumental in managing the plan's implementation.

EXAMPLE 2.3

A beer brewery is planning to establish an organizational action plan. The company has several short-term objectives designed to achieve its long-term goal of increasing its overall market share.
• *Offset server liability*. One of the objectives of the company is to offset the server's legal liability when selling alcoholic beverages. The company creates a series of posters intended to be posted in establishments serving alcoholic beverages. Some posters illustrate the effects of drunk driving, and others urge the necessity of choosing a designated driver. The company also develops beer having a lower alcohol content.
• Offset the actions of the Mothers Against Drunk Driving (MADD) and other groups such as the Students Against Drunk Driving (SADD). The company decides to initiate a social responsibility campaign which emphasizes not consuming more than an individual's limit, and the need for responsible automobile driving.
• *Change the image of its products*. In addition to introducing a low-alcohol beer, it also introduces a low calorie "lite beer" including a non-alcohol product.

• *Develop a sales training program*. In order to achieve higher sales, the company develops a sales training program that emphasizes the importance of educating customers about the company's variety of beer products including low-alcohol and low-calorie beverages. It also seeks to demonstrate the company's commitment to social responsibility.

After creating a consensus regarding its organizational action plan, the brewery initiates a training program where its sales managers and representatives are trained in the significance of the newly developed plan. The company also develops a sophisticated management information system containing a large database where sales representatives can continuously update the database from remote locations using telecommunications.

Over time the company makes steady progress in increasing its market share while improving relations with MADD and SADD. The company has also achieved success in reducing the number of server liability cases as well as witnessing a reduction in driving-while-intoxicated convictions in its market area.

Finally, the company's market share, net profit, and stockholder equity show steady growth.

2.4 TOTAL QUALITY MANAGEMENT (TQM)

TQM is an extremely well-publicized organizational methodology. It is intended to involve all parts of the organization, beginning with total commitment from top management. It is a system-wide concept where all parts of the organization must function congruently in order for it to be functional. A major component of TQM is employee involvement, which management strongly encourages in every step of the decision-making process. This is accomplished by in-depth training and the delegation of extensive quality responsibility to operational employees.

TQM is the continuous pursuit of quality in every aspect of organizational activities through a philosophy of doing it right the first time, employee training and empowerment, promotion of teamwork, improvement of processes, and attention to satisfaction of customers, both internal and external.

What are the main components of TQM?

The following are some of the basic components of TQM:

• Organizations succeed through constant product and service development and innovation.
• Organizations must embrace a new management philosophy where traditional management views are rejected.
• Quality is achieved by design rather than by inspection.
• Purchasing must be made based on total cost. Short-term material savings could be disastrous if their quality is unacceptable.
• Production and service methods must be continuously improved. Single or occasional standard review and revision is unacceptable.
• Employees must receive training.
• Management needs to demonstrate leadership by teaching others what must be done on a continuous basis.

• A positive and personally rewarding organizational environment must be established for employees to be productive.
• Organizational communications must be open and free at all levels.
• Slogans and short-term employee objectives are not successful.
• Quotas are not successful motivators.
• Employees should be recognized and rewarded for the work they do.
• Continuous education and training programs should be made available to employees.
• A management program must be created to implement TQM or else it will never happen. Implementing TQM needs the active support of top management.

What is the role of quality in TQM?

Quality is a central focus in TQM. The concept of quality goes far beyond the acceptance of a standard minimum number of defects. It essentially means preventing defects from occurring in the first place. This concept has come to be known as "Zero Defects." However, TQM does not limit itself to zero defects in products. It also means providing superb service to develop loyal customers who are so impressed with the quality of the service and products delivered that they recommend the organization to others. TQM's operational definition of quality is nothing less than total customer satisfaction. This is achieved by meeting or exceeding the customer's expectations.

Quality itself is not a fixed objective. Rather it is a continuously evolving target. Organizations cannot be satisfied merely with achieving zero defects in a product or a high level of customer satisfaction. Continuous improvement is essential where previous quality levels are used as the basis for future improvements.

TQM promotes teamwork by modifying or eliminating traditional (and rigid) vertical hierarchies and instead forming flexible groups of specialists. Quality circles, cross-functional teams, and self-managed teams are typical formats. Teams are an excellent vehicle for encouraging the sharing of ideas and removing process improvement obstacles.

What is necessary to achieve continuous improvement?

Continuous improvement is dependent on continuously improving work methods where employees and customers have unlimited opportunities to express their points of view. This involves developing a dynamic, continually changing, flexible and broad, organizationally based quality planning process. This process would not only lead to new levels of quality performance, but also to new opportunities.

How does TQM compare with the traditional view of management?

TQM goes far beyond the traditional view of management where a defect standard was defined as acceptable. Table 2.1 compares the traditional management view with TQM.

TABLE 2.1 TRADITIONAL MANAGEMENT VIEW COMPARED WITH TQM

Traditional Management View	*TQM*
High quality is unaffordable. Low quality produces lower costs.	Low quality is unaffordable High quality produces lower costs.
A percentage standard of defects is acceptable.	Only zero defects are acceptable.
Defects are a function of employees.	Defects are a function of the system designed by management
Annual quality standards are established .	Continuously improve quality standards to maintain competitive advantages
Manage by using quotas and standards.	Eliminate quotas and standards.
Employees are a cost center.	Employees are a profit center.
Manage by fear.	Drive out fear.
Low costs create profits.	Loyal customers create profits.
Buy on the basis of price.	Buy on the basis of total costs.
Manage on the basis of profits.	Profits are historical and do not predict the future.

2.5 OTHER QUALITY CONTROL TECHNIQUES

What are the Baldrige National Quality Award Criteria?

In 1987 the Malcolm Baldrige National Quality Award (MBNQA) was created to recognize outstanding companies in quality management and control. The criteria specified in the MBNQA are leadership, information and analysis, strategic quality planning, human resource utilization, quality assurance, quality results, and customer satisfaction. Each company uses its own unique approach to winning the award. They define the management strategies and techniques required for each category.

The winning companies share certain characteristics:

• They dedicate themselves to changing former management practices in order to implement newer strategies often requiring radically different operational procedures.

• They display a singular resolve in committing the organization to the new strategy for the long term. They do not expect quick "fixes" will solve their problems.
Various innovative practices often emerge including outside partnering, human resource empowerment, and developing operational strategies to achieve new objectives and long-term goals.

What is the ISO 9000 standard?

ISO 9000 is the general name for the quality standard accepted throughout the European Economic Community. It was initially adopted in 1987. ISO is a series of documents on quality assurance published by the Geneva based International Standards Organization. The five documents outline standards for developing Total Quality Management and a Quality Improvement Process. ISO 9000 consists of guidelines for the selection and use of the quality systems contained in 9001-9003. ISO 9001 outlines a model for quality assurance in design, development, production, installation, and servicing. ISO 9002 outlines a model for quality assurance in production and installation. ISO 9003 outlines a model for quality assurance for finance inspection and testing. ISO 9004 is not a standard but contains guidelines for quality management and quality system elements.

Today, over fifty trading countries, including the United States, use the ISO 9000 standard. It is anticipated that certification in the ISO 9000 standard will be mandatory for firms involved in international trade. Companies doing business with many U.S. agencies are required to meet ISO 9000 standards.

What is Statistical Process Control (SPC)?

SPC is a widely used statistical variation measurement system which plots data graphs over time to illustrate upper and lower control limits for a particular process. The basic concept seeks to monitor excessive variations in a process. *Note:* statistical quality control and statistical process control can be grouped under prevention activities because they not only detect faulty work but also allow for adjustment of processes to avoid future defects.

What is special cause variation?

Special cause variations are those process variations caused by external influences. In order to use SPC effectively, management must undertake the demanding process of detecting and eliminating all special cause variations from a process. For example, a special cause variation may be electrical surges experienced from a power source causing manufacturing equipment failures. In order to eliminate this special cause, management installs a surge protector on the line.

What is common cause variation?

Common cause variations are random variations in a process. While management procedures can be developed to control common cause variation, its complete elimination is unrealistic. However, common cause that exceeds upper or lower control limits around a predetermined mean value must be carefully investigated by management.

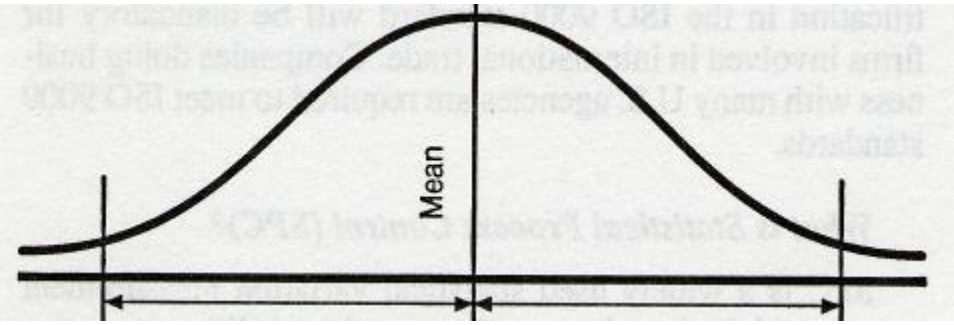
What is a stable system?

A stable system is a process operating within the tolerances of common cause variation. This can also be described as operating in statistical control. This does not mean there is no variation in the process; rather it is operating within the upper and lower control limits of common cause variation around a predetermined mean value.

How is SPC computed?

Standard deviation measures of a data sample mean are used to establish upper and lower process control limits. A process operating in statistical control should be within three standard deviation units from the mean. (See figure 2.1.)

FIGURE 2.1 PRODUCTION PROCESS VARIABILITY



3 standard deviations **3 standard deviations**

***99.7% confidence level**

What are statistical control charts?

Control charts are used to assist management in determining when excessive variation is occurring in a process. This is determined by setting upper control limits (UCL) and lower control limits (LCL) for a given data sample.

A method for determining upper and lower control limits for the percent defective in a large sample, a p-chart, is as follows:

$UCL = \bar{p} + z\sigma_\rho$

$LCL = \bar{p} - z\sigma_\rho$

Where

$\bar{p}$ = average defectives in a sample

z = number of standard deviations (3 = 99.7% confidence level)

σ_ρ = standard deviation of the sample population

n = sample size

σ_ρ is calculated by the following formula:

$$\sigma_p = \sqrt{\frac{\bar{p}\ (1-\bar{p})}{n}}$$

EXAMPLE 2.4

An automobile tire manufacturing company is seeking to develop a statistical process control chart of defective tires manufactured over a period of time. The manufacturer takes a weekly sample of 100 tires over a 20-week period.

Weekly sample	Number defected	Fraction defective	Weekly Sample	Number defected	Fraction defective
1	11	0.11	11	7	0.07
2	3	0.03	12	3	0.03
3	4	0.04	13	4	0.04
4	6	0.06	14	9	0.09
5	9	0.09	15	5	0.05
6	5	0.05	16	8	0.08
7	4	0.04	17	10	0.10
8	14	0.14	18	13	0.13
9	10	0.10	19	7	0.07
10	15	0.15	20	5	0.05
Total Defects				152	
Mean					0.076

$$\bar{\bar{p}} = \frac{\text{Total number of defects}}{\text{Total number of tires examined}}$$

$$= \frac{152}{(100 \times 20)} = .076$$

$$\sigma_p = \sqrt{\frac{(.076)(1-.076)}{(100)}} = 0.0265$$

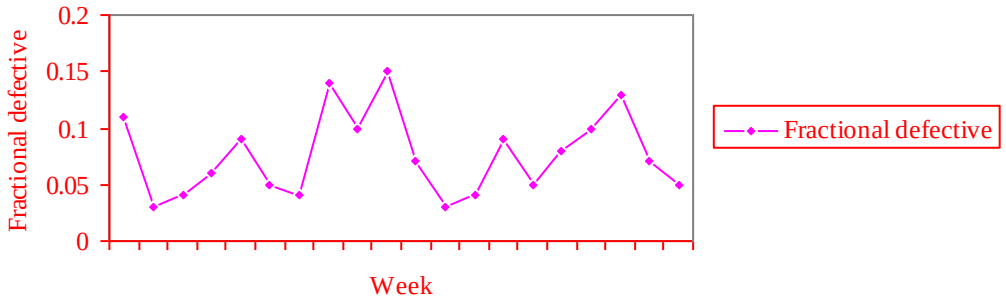
$UCL_p = \bar{\bar{p}} + z\sigma_p = .076 + 3(.0265) = .1555$

$LCL_p = \bar{\bar{p}} + z\sigma_p = .076 - 3(.0265) = .00^*$

* cannot have a negative LCL

When the process chart for the tire manufacturer is developed. it becomes apparent that no sample of defects exceeds the control limits, and it is therefore in statistical control. Only in week 10 does it approach the upper control limit with 15 defects. (See Figure 2.2.)

FIGURE 2.2 TIRE MANUFACTURER PROCESS (p) CHART



2.6 MANAGING QUALITY CONTROL

Quality control management is a crucial organizational responsibility. Now, as never before, organizations are vigorously competing on the basis of quality. ISO 9000 standards and global competition are pushing quality performance standards to ever higher levels. A major responsibility of quality control management is to develop procedures to locate quality bottlenecks and to ensure that products are made right the first time. *Note:* A traditional quality control process in manufacturing consists of mass inspection of goods only at the end of a production process. A major deficiency of the traditional control process is that it does not focus on improving the entire production process. The intent of quality control is to ensure that goods and services conform to the design specifications. Whether the focus is on feedforward, feedback, or concurrent control, the emphasis is on ensuring product or service conformity. For example, Dollar-unit sampling has been uniquely applied to auditing account balances. It is not used in statistical processing control.

How should a quality control program be designed?

Management should develop and implement a quality control program using these four steps:

1. Delineate product and service quality requirements. The quality interrelationship between products and services and market requirements has to be carefully established. Performing market surveys in appropriate market segments may be helpful in understanding the level of quality available and required by the marketplace. Management, however, has greater understanding of products and services than customers do, and this knowledge can be used for developing their full quality potential and competitive advantage.

2. *Develop quality standards.* Products and services should be designed to the highest quality standards available. Manufacturers who use computer aided design (CAD) and computer automated manufacturing (CAM) are able to achieve the highest technical

standards possible in achieving lasting quality. It is quantitatively cheaper to design quality prior to manufacturing or delivering a service than correcting flaws at the customer level where the costs escalate beyond control. Additionally, global competition demands the highest quality standards available.

3. *Develop a quality analysis program.* Management must develop a consistent and systematic program for insuring high quality. Not only does this mean selecting samples for a continual review process, but it also means constantly improving products and services to achieve ever improving quality standards.

4. *A total organizational commitment to quality must be established.* Management not only has the obligation of designing quality requirements and standards, but also has the responsibility to ensure a total organizational commitment to achieving them. This means developing an employee training program where all will gain the ability to perform to their highest potential.

For example, for a customer-service department, a criterion that requires all customer inquiries to be answered within 7 days of receipt permits accurate measurement of performance. The quantitative and specific nature of the appraisal using this standard avoids the vagueness, subjectivity, and personal bias that may afflict other forms of personal evaluations.

What is benchmarking and how is it useful?

Benchmarking is a process of comparing an organization's products or services against those considered to be the best in a particular industry or market segment. There are several types of benchmarking. Benchmarking typically involves the following steps:

(a) Identify those practices needing improvement.
(b) Identify a company that is the world leader in performing the process.
(c) Interview the managers of the company and analyze data obtained.

The benchmarking procedures that should be followed include the following:

• Identify a particular product, service, procedure, or function that could be improved
• Create a benchmarking team
• Target a particular organization or group of organizations having characteristics that would be most suitable for analysis
• Evaluate practices, procedures, and functions within a given market that are the most productive and then adapt and implement those that would be most useful to the target organization

What are quality circles (QC) and how are they used?

The purpose of QC is to allow a forum within an organization where those who are charged with the operational responsibilities interact with colleagues to improve the quality and

productivity of the workplace and organization. Most QC groups have ten or fewer members, and all are volunteers.

Normally, although their schedules are flexible, most quality circles meet weekly or monthly depending on the group's needs. The most successful QC groups consist of highly dedicated and disciplined members who strongly desire to improve the work methods and procedures followed in the organization. They seek to work together as a group to share their experience and abilities to solve common problems.

QC groups work best when they are integrated into an ongoing organizational quality control program having strong management support. QC programs are ongoing and seek to improve the overall organization through constant quality improvements.

The benefits of QC groups have been dramatic increases in organizational productivity and quality, increased job satisfaction, and lowered rates of absenteeism, job-related accidents, and turnover.

How do you classify quality costs?

Quality costs are costs that occur because poor quality may exist or actually does exist. These costs are significant in amount, often totaling 20 to 25 percent of sales. The subcategories of quality costs are prevention, appraisal, and failure costs. Prevention costs are those incurred to prevent defects. Amounts spent on quality training programs, researching customer needs, quality circles, and improved production equipment are considered in prevention costs. Expenditures made for prevention will minimize the costs that will be incurred for appraisal and failure. Appraisal costs are costs incurred for monitoring or inspection; these costs compensate for mistakes not eliminated through prevention. Failure costs may be internal (such as scrap and rework costs and reinspection) or external (such as product returns or recalls due to quality problems, warranty costs, and lost sales due to poor product performance). Quality cost reports can be used to point out the strengths and weaknesses of a quality system. Improvement teams can use them to describe the monetary benefits and ramifications of proposed changes.

2.7 QUALITY CONTROL TOOLS

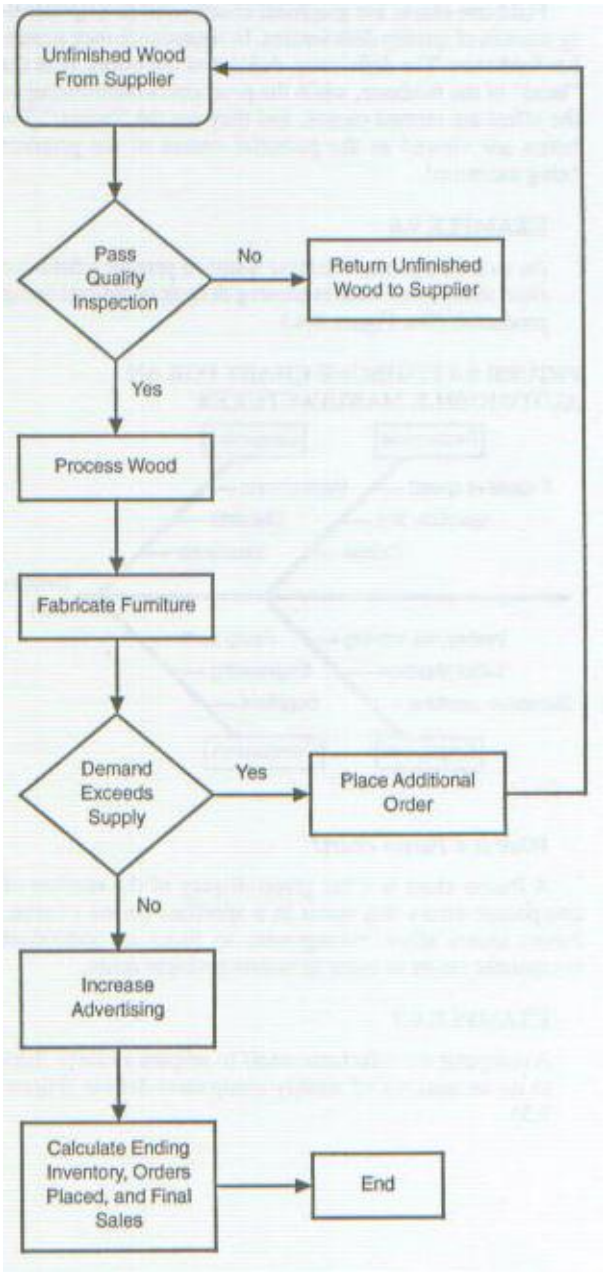
What is a flow chart and how is it used?

Flow charts are graphical depictions of a logical sequence of activities for a particular process. Management uses flow charts to understand the dynamics of an ongoing process. The objective analysis of the interrelationships of the parts of a process provided by a flow chart allow management to conceptualize alternative process configurations.

EXAMPLE 2.5

A furniture manufacturer wishes to draw a flow chart of the processes involved in the fabrication of its product from receiving the unfinished wood to final sales. (See Figure 2.3.)

FIGURE 2.3 FLOW CHART FOR A FURNITURE MANUFACTURER



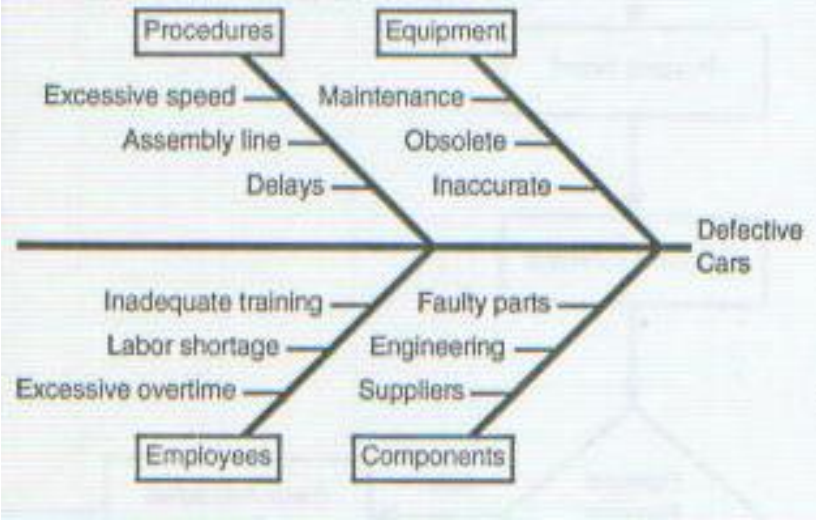
What are fishbone charts and how are they used?

Fishbone charts are graphical charts used to help identify sources of quality deficiencies. In appearance they resemble fishbones. The deficiency, defined as the effect, is at the "head" of the fishbone, while the procedures contributing to the effect are termed causes, and they are the "bones." The bones are viewed as the potential causes of the problem being examined.

EXAMPLE 2.6

An automobile manufacturer wants to prepare a fishbone chart to discover what is causing defects in the cars being produced. (See Figure 2.4.)

FIGURE 2.4 FISHBONE CHART FOR AN AUTOMOBILE MANUFACTURER



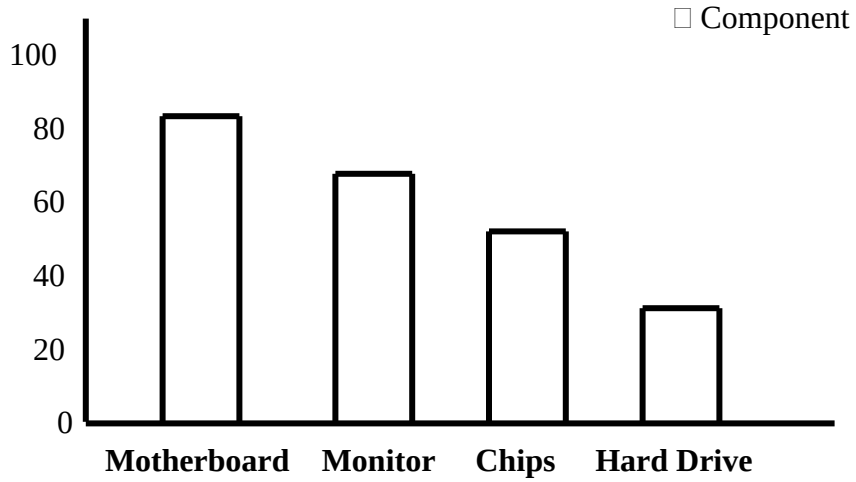
What is a Pareto chart?

A Pareto chart is a bar graph display of the number of component errors that occur in a specified period of time. Pareto charts allow management to focus on individual component errors in order to isolate problem areas.

EXAMPLE 2.7

A computer manufacturer wants to prepare a Pareto chart to do an analysis of weekly component defects (Figure 2.5)

FIGURE 2.5 WEEKLY COMPONENT DEFECTS



What is Pareto analysis?

PARETO ANALYSIS

Pareto analysis is used to differentiate between the vital few and the trivial many. It is based on the concept that about 80 percent of the problems come from 20 percent of the items.

We would expect to find a few vital sources that primarily contribute to costs, rather than the many trivial sources that contribute much less to costs. Quality costs are not uniformly distributed. Almost without exceptions, only a few of the sources account for the bulk of the costs. This "misdistribution" of quality costs is often referred to in quality diagnosis as a Pareto analysis.

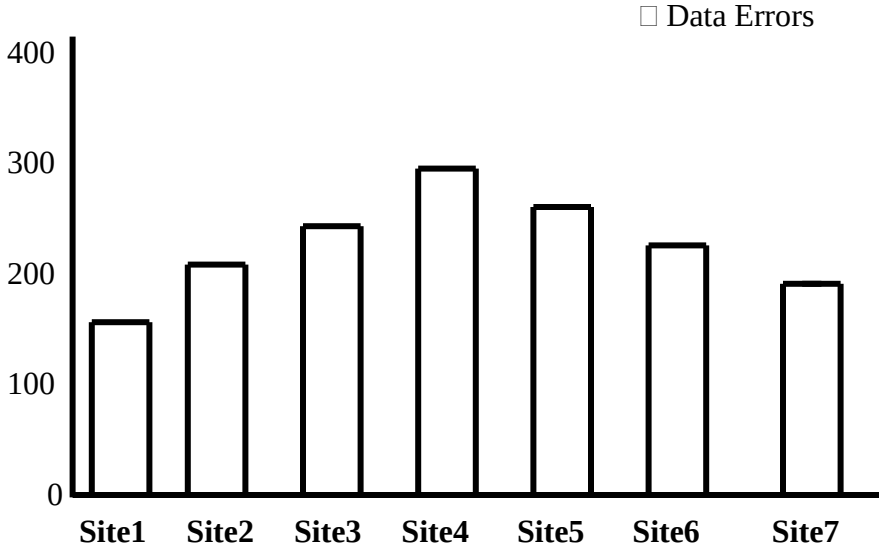
What is a histogram?

Histograms are bar graph displays of measurements of a particular component within a specified period of time. This allows management to observe the aspects of a particular component or process over time.

EXAMPLE 2.8

A firm wants to prepare a histogram in order to have a weekly breakdown of data errors at its various sites (Figure 2.6).

FIGURE 2.6 WEEKLY DATA ERRORS



2.8 GROUP DECISION MAKING

Group decision making involves the activities of two or more people working together to resolve a particular issue. The relative merits of group decision making versus individual decision making is a controversial issue. There is general agreement that group decision making is superior when nonprogrammed decisions are required; that is, when an unusual or unique set of events needs to be conceptualized involving several related elements of information.

What are the advantages and disadvantages of group decision making?

Advantages

1.Groups have greater knowledge and insight for evaluating group goals and objectives.

2. A group of organizational members brings broader knowledge for developing situational alternatives.

3. Groups bring greater knowledge and a wider breadth of experience for evaluating alternatives.

4. Groups bring more resources to bear when doing research for particular subjects of interest.

5. Those who participate in the forming of a group decision are highly motivated to implement resulting decisions. Consensus is a strong motivator.

6. Group decisions can be much more creative than individual decisions since many points of view are considered.

Disadvantages

1. Group decisions may result in the risky shift phenomenon where groups will take greater risks than individuals will. However, individual managers have the responsibility for implementing group decisions.

2. Group scheduling difficulties can result in long delays between meeting times.

3. Group decisions are very costly since they take much longer to develop than individual decisions.

4. "Group think" can develop where conformity to the general consensus is more important than individual expression of ideas.

5. Groups can be used as scapegoats for managers seeking to avoid responsibility for implementing group decisions.

6. Dominant personalities or supervising managers can result in group members being reluctant to express their points of view and conforming to one individual's point of view.

What is brainstorming and how is it used?

Brainstorming is a group decision-making technique operating under the rules that no one's idea should be criticized no matter how outrageous it may appear. The basic purpose of the

technique is to generate ideas and original thinking. Ideas generated through brainstorming can be discussed at a later period and may act as the genesis for new organizational policies.

What is the Delphi technique?

The Delphi technique is a process of soliciting ideas from a group of anonymous volunteers using a series of mailed questionnaires together with a summary of previous results. Using the summaries from earlier responses, the respondents are subsequently asked to further evaluate and focus their positions on the same range of issues. The basic concept is to reach a consensus among the respondents after at least two sets of questionnaires have been circulated. Normally, while many rounds of questionnaires can be circulated, after two responses a consensus begins to emerge.

What is the nominal group technique (NGT)?

In the nominal group technique a group of people initially discusses ideas in writing rather than having an open discussion. At a later point the group members individually express their ideas to a moderator who records them in full view, often using a flip chart.

After all of the ideas have been recorded, a vote is taken where they are prioritized. The rankings of the group members are then tallied to reach a final consensus on the relative priorities of the ideas discussed.

2.9 ORGANIZATIONAL STRUCTURE

Organizational structure consists of the methods used for disseminating power and authority throughout an organization. The rationale of an organization is that people work together more effectively than they do alone. This is the basis for synergy. However, an organization must be structured effectively to achieve synergy.

A traditional discussion in organizational theory is whether to centralize or decentralize an organizational structure.

What functions do centralization and decentralization perform?

The processes of centralization and decentralization determine who will have authority and power in an organization. In a centralized organization, authority and power are retained by just a few managers, whereas in a decentralized organization authority and power is disseminated to many managers through several levels.

Centralization allows high-level management to retain direct control over the organizational operations. Decentralization creates an environment where decisions are made by those having responsibility at the organization's operational level.

Centralization's advantage of direct control is offset by its distance from and possible misunderstanding of the organization's operations. This is particularly acute when the organization has geographically dispersed operations.

Decentralization's advantage of giving operational managers direct decision-making authority is offset by a lack of coordination at the organization's staff management levels. Some

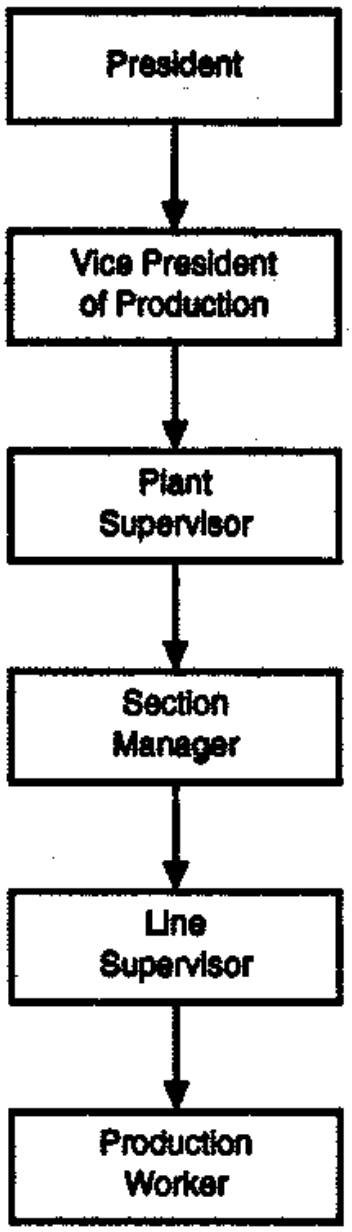
of these disadvantages can be offset through the implementation of a management information system which permits direct access to management staff levels.

In reality, organizations often are both centralized and decentralized in that certain functions, such as finance, are directed through a centralized management control system while other operational functions are decentralized. This permits an organization to have direct staff management control over certain designated functions, such as finance, while permitting flexible decentralized control where it is most functional.

What is the chain of command?

The chain of command is the line of authority that connects superior and subordinate positions in a hierarchical organization. Following the chain of command, subordinate positions must seek approval from the next immediately superior position prior to going to the next superior position for authorization. Similarly, superior positions must follow the chain of command going downward when passing instructions to lower levels of the organization (Figure 2.7). In flat organizations, the chain of command often has little relevance.

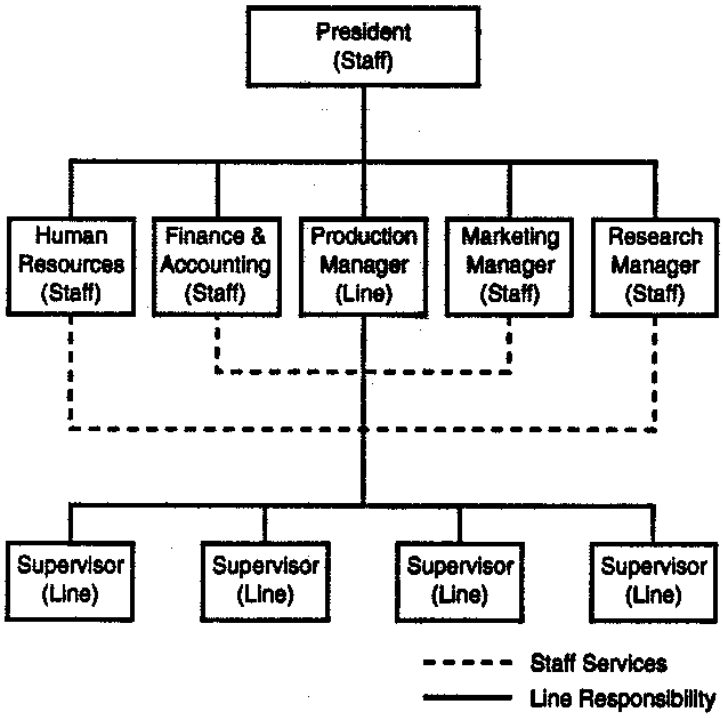
FIGURE 2.7 CHAIN OF COMMAND



What is the line and staff division of authority?

Line and staff is a concept first developed by the military. Respectively, line and staff describe the direct functional roles and advisory relationships existing in an organization. In modern terms, line functions are those that have direct operational responsibilities such as production or customer service. Staff responsibilities are essential management services provided to line functions. Staff responsibilities include human resource management, strategic planning, quality control, and marketing (Figure 2.8).

FIGURE 2.8 LINE AND STAFF MANAGEMENT



2.10 DEPARTMENTATION

Departmentation is a method of grouping organizational activities in order to achieve organizational objectives. A primary purpose of departmentation is to provide an organization similar specialized services or activities. For example, a marketing department normally consists of people primarily concerned with developing markets for particular products and services an organization may offer. It is not concerned with production, although it may interface from time-to-time with the production department in order to better understand products as well as the department's functional capabilities.

Departments are created to fulfill the following objectives:

- *Functional.* A functional department performs a specific role. Functional departments would include accounting and finance, human resources, marketing, production, research, and development.
- *Product.* A product department is created to build or complete a specific product. Job duties are highly functional in nature, and have the completion of a particular product as its end goal. General Motors, for example, has organized according to automobile product divisions.
- *Customer.* These are departments created to serve specific customer needs. For example, a

department store may have the following customer departmentation: babies, boys and girls, teens, ladies and men's wear, maternity, etc. Customer departmentation allows an organization to group its activities to best serve specific customer requirements.

- *Geographic.* National or international organizations have specific geographic needs. It is unrealistic to have one central management center for an organization having large nationwide and/or international operations. The communication and logistical needs are simply too great. Geographic departmentation can be used to manage specific regional needs. For example, an organization may have southern, western, eastern, and northern divisions or Asian, European, and Latin American divisions.

9.11 PERFORMANCE EVALUATION

Performance evaluation is the appraisal of employee performance using a systematic method of analysis. The essential process of performance evaluation is predicated on observation and judgmental analysis. The judgmental nature of performance evaluation precludes the possibility of completely eliminating subjective evaluations. Therefore, rigorously following an objective methodology is essential to have creditable evaluations.

What is the graphic rating scales performance evaluation method?

Graphic rating scales show a number of employee performance rating factors on which a supervisor indicates an evaluation. Rating factors include quantity and quality of work, attendance, timeliness, behavior attitudes, willingness to learn new techniques, and other factors that management feels are important. These factors arc then rated using an evaluation scale. In a five-point rating system, the highest rating is usually given a value of 5 while the lowest rating is given a rating of 1. All the points are added up to form a total for each employee.

EXAMPLE 2.9

A manager wants to create a graphic rating scale for the purpose of rating the employees in a production environment. To do this the manager creates a form having a series of performance categories with rating criteria which are to be used by the production supervisors for rating their employees.

GRAPHIC RATING SCALES

Employee Name: Dept:	Date:			
Rating Scale	Exceptional	Good	Average	Acceptable	Poor
Units of Work normally produced				
Work Quality				
Timeliness				
Attendance				
Work Attitude				
Cooperativeness				
Dependability				

What are behaviorally anchored rating scales (BARS)?

Behaviorally anchored rating scales are developed by rating specific job-related behaviors. Several scales can be developed covering various job-related behaviors, and BARS points can be given for various aspects of the job behavior. Figure 2.9 shows one area to be evaluated for a teacher:

FIGURE 2.9 BEHAVIORALLY ANCHORED RATING SCALES

Teaching Ability

(the ability to successfully interface with students and teach subject materials)

Above Average	___	4	Teacher is considered an expert in the field,
Outstanding teacher who	___	3.75	communicates well, and has strong student
is well rated by students.	___	3.5	acceptance. Teacher receives numerous
	X	3.25	student recommendations
	___	3	
Average Performance	___	2.75	This teacher can be relied upon to do a
Enthusiastic teacher who is	___	2.5	professional job and be well prepared.
very familiar with the material.	___	2.25	
	___	2	
	___	1.75	
	___	1.5	Teacher is not well prepared and has poor
Poor Performance	___	1.25	interaction with students. Frequent student
Teacher shows little	___	1	complaints.
professional interest.			

2.12 COMPENSATION

Compensation often is the largest organizational budgetary expense. It consists of the direct financial earnings an employee receives for work performed as well as associated employee benefits. Generally, direct financial earnings include one or more of the following: salary, commission, bonuses, and/or merit pay. Benefits, which can be an additional 40% of the total

compensation package, may include health, life and other forms of insurance, subsidized pension plans, compensated time including vacations, personal and/or sick leave, stock options, and subsidized services including cafeterias and recreational facilities.

Is there a relationship between compensation and performance?

The relationship between compensation and performance is controversial. Some research indicates a direct and positive relationship between the compensation levels and the quantity and quality of production. Others argue that tying compensation to performance destroys intrinsic motivation. It does seem fair to say that some behaviors can be more effectively motivated by compensation than others.

What common compensation methods exist and how successful are they?

Generally management seeks to fairly compensate its employees. However, it also expects comparable output for its compensatory policies. In the final analysis, employee productivity is necessary to generate the profits essential to form the basis of a compensation plan.

A basic type of salary compensation is a straight-time compensation plan while others provide employee incentives:

• *Flat rates*. Wage rates are based on an established pay scale for a specified job in a straight-time compensation plan. Flat rate plans do not recognize seniority, performance, or other individual differences. For example, an assembler on a particular job gets paid a flat rate of $7.00 per hour irrespective of experience. Flat rates are often found in unionized environments where the union does not wish to distinguish between individual capabilities. Flat rates prevent management from creating employee performance incentives.

• *Incentive plans*. The piece rate system and commission plans are types of individual incentive plans. In a piece rate system the employee works from an established pay level with additional stated levels of compensation being paid for production exceeding a base quota. The base production level is established after production research is completed.

The commission plan is usually associated with sales personnel. It is an established rate that is paid on the basis of sales. The greater the sales, the greater the commission. It is probably one of the oldest forms of incentive plans.

A gainsharing plan is an incentive plan that shares compensation, normally in the form of cash bonuses, with a group's members based on their performance. It is probably one of the most successful forms of employee incentive plans.

2.13 MOTIVATING PERFORMANCE THROUGH JOB DESIGN

Job design is essential for the organizational process. Job design not only structures the way work is done in the organization, but is also a critical factor in determining how an employee is motivated to perform useful work. There are several forms of job design.

What is job specialization?

Job specialization is the process of dividing work into smaller processes for the purpose of simplification. Job specialization, originally alluded to by Adam Smith, was fully developed by Frederick W Taylor in *Principles of Scientific Managemen*t (New York: Harper Bros., 1911) for the purpose of increasing production efficiencies. Job specialization makes work so simple that workers become interchangeable. The disadvantage is that the lack of challenge in simplified work processes oftentimes leads to boredom and subsequent accidents.

What is job rotation?

Job rotation is a form of job design where employees are systematically moved, or rotated, from one job to another. An objective of job rotation is to diminish the boredom and accidents often associated with job specialization. One advantage of job rotation is that employees have an opportunity to experience a cross section of jobs in the work place and thus become familiar with them all.

Nonetheless, when each individual job is specialized, the objective of avoiding the boredom and accidents associated with job specialization is unrealistic.

What is job enlargement?

Job enlargement simply consists of expanding the number of job responsibilities an individual has without increasing his or her authority to decide how the work is to be accomplished or what priorities work should receive. The rationale for job enlargement is it increases worker motivation; however, the only change is that the employee has more to do than before the job was enlarged. If the work consists of specialized tasks, the rationale for work enlargement has little inherent justification.

What is job enrichment?

The concept of job enrichment was developed by Frederick Herzberg in the late 1960s. The essential component of job enrichment is increasing the extent of control an employee has over the work for which he or she is responsible. The assumption in job enrichment is that the work itself is the motivator. The employee controls the type of work, work methods, and the degree of freedom or autonomy he or she has in making decisions regarding these work issues.

What is flextime?

Flextime is a method of developing work schedules that reflect worker preferences and needs. Using a range established by management, employees can determine at what hours they will begin and end the workday. Flextime is particularly useful for employees who must balance family and work responsibilities. It has proven to be popular, useful, and productive for employees and organizations.

What is the quality of work life?

The quality of work life is the personal significance the work environment has for individual employees. A high quality work life is personally fulfilling and has a high degree of significance. A low quality work life will produce worker alienation.
A positive quality of work life is associated with lower absenteeism and tardiness as well as higher productivity.

2.14 EFFECTIVE LEADERSHIP

Leadership is an extremely important concept in organizational dynamics. Basically, leadership consists of the manipulation of power. Power is the leader's ability to get others to do what the leader wants. The way power is managed distinguishes one leader from another.

What are the sources of leader power?

There are several sources of leader power:

• *Legitimate power*. Legitimate power is conferred by the organization itself, not by the person who occupies a particular position. For example, the role of bank president confers an ability on the person occupying the role to manage the overall affairs of the bank as well as to have a certain level of conferred status.
• *Reward power*. Managers have the ability to grant financial, status, and promotional rewards to the organization's human resources. This is an important management source of power.
• *Coercive power.* Coercive power is the ability of the manager to force others to carry out functions they would not otherwise perform because of the manager's ability to impose sanctions.
• *Expert power.* Expert power is derived from particular knowledge and expertise an individual has. For example, a computer expert is one who has demonstrated accumulated insight into the functioning of computer and is able to make computers perform as desired.
• *Information power*. Information power is derived from access to sources of information that others do not have. Thus, those having information power have the ability to gain particular organizational and competitive advantages.
• *Referent power*. Referent power is power derived from the esteem in which one is regarded by others. It there fore enables those having referent power to more effectively lead an organization.

What skills do leaders need?

Effective leadership depends on the exercise of several skills:

• *Flexibility*. Flexibility is an essential skill for managers. Not only is the environment of business extremely dynamic, the workplace itself consists of great cultural diversity which requires constant modification of this organizational culture.
• *Communication*. The understanding, processing, and transferring of information is a central management function. The ability to interface with others in the organizational and business environment requires excellent communication skills.

• *Human resource management.* Organizations consist of people. A critical management role is managing the organization's human resources. This consists of developing and managing training programs, organizations development strategies, counseling, and other skills.
• *Conceptualization.* The ability to understand the implications of information and strategic developments required for managers to succeed in a progressive, evolving technological and internationally competitive environment.

CHAPTER 3
MARKETING

Upon completion of this chapter, you will be able to

- State the role of products and services in marketing.
- Discuss the 4P's of the marketing mix.
- List the steps following in marketing research.
- Explain marketing strategies including channels, branding, new product development, and advertising.
- Compare and contrast services and products in terms of marketing strategies.

Marketing is an essential business function. It is the process of planning and distributing the exchange of products and services using the concepts of pricing and promotion. In this sense, marketing is not only an essential function, it is also a creative process.

3.1 THE DEFINITION OF MARKETING

The basic concept of marketing is based on the concept of an exchange of equal market values for the purpose of satisfying human needs or wants. This definition raises several additional questions.

What is an exchange?

A marketing exchange occurs when an individual gives something of value for a sought-after product or service. The vehicle most often used for an exchange transaction is money. Barter is another form of exchange which does not require the use of money. Rather, in a barter system, there is an exchange of property or services. An example is marketing consulting services given in exchange for the purchase of a computer system.

What is market value?

Market value is established by actual or potential buyers and sellers. A marketplace can either be centralized, such as a stock market, or decentralized, as in a national marketplace. In the decentralized marketplace, advertising and mass communication inform the buyers and sellers as to market values.

What is a need?

A need is an unfulfilled desire that an individual has which acts as a strong motivator. The individual seeks to fulfill a need. Needs include physical, social and psychological desires.

Marketing can create individual needs.

What is a want?

A want is the process of satisfying an unfulfilled need. Wants are culturally based in the sense that when an individual has a need for shoes, he/she will think of a particular brand name to satisfy the need. Individuals who have a need for a chocolate bar state they want a "Hershey Bar" when any brand chocolate bar will suffice. Wants and needs are often confused. Some computer manufacturers emphasize the speed and power of a computer, when many consumers only need a simple word processor to type a letter. Thus, computer manufacturers who bundle word processing software with the computer can emphasize its simplicity and usefulness for word processing, rather than its technological features, and gain market share.

What is the role of products and services in marketing?

Marketable products and services are used to satisfy the wants and needs of consumers in the marketplace. An individual having a need to appear successful may want to purchase expensive clothing or a luxury car to satisfy the need.

3.2 DEFINING THE MARKET

A market is a group of individuals and/or organizations wanting a particular product or service who have the financial ability to acquire it. This group of people and/or organizations is termed the target market. However, in order to be considered part of the market, the target group must be actively willing to purchase the product or service in question, and have the authority to do so. Otherwise, they are out of the market.

What is mass marketing?

Organizations using mass marketing essentially assume "one size fits all"; i.e., one particular product mix will satisfy everyone in a particular market, and it is not necessary to identify and service different aspects of the overall market. The example that is usually cited to illustrate mass marketing is Henry Ford's marketing of the Model T where he said people could have any color they wanted "as long as it is black." The rationale for mass marketing is that the greatest learning curve and economies of scale result in the lowest unit costs and prices. Increasingly, however, companies are moving away from mass marketing to target marketing.

What is target marketing?

Target marketing consists of breaking a total market into market segments representing smaller homogeneous markets. Once this analysis is performed, it is possible to identify those market segments which can be targeted for a particular product or service based on the conformity of their homogeneous characteristics to the product or service specifications. Using market segmentation, target marketing allows marketing managers to develop more effective marketing strategies.

What is the marketing mix?

The marketing mix consists of four variables-the four Ps-which a marketing manager can control: product (P_1), place (P_2), promotion (P_3), and price (P_4).

TABLE 3.1 THE MARKETING MIX

Product
Quality
Type of features
Brand name
Kind of packaging
Design type
Product-related services (service, warranties, maintenance policies)
Place
Number and type of marketing intermediaries
Market location
Warehouse location
Distribution methods
Promotion
Developing promotion budget
Creating the advertising message
Types of advertising media
Developing a sales force
Types of direct marketing
Methods of sales promotion
Price
Choose pricing objective
Estimate product demand
Calculate costs
Maximize product mix pricing
Competitive factors

• *Product.* The most basic element of the marketing mix is a company's product or service. The product component includes quality, features, brand name, types of packaging and design, and product-related services including maintenance and warranties.
• *Place.* Place concerns the processes management uses to make products and services available to the target market. This includes developing marketing intermediaries in order to provide the

product or service to market locations. The methods used to distribute products and services are also an essential place component.

• *Promotion.* Promotion involves the methods used to transmit product information to the target market. This involves creating and using advertising, choosing the appropriate media, developing a sales force, utilizing direct marketing where appropriate, and using other promotion methods.

• *Price*. Pricing is an important element of marketing a product or service. Management must choose pricing objectives which are consistent with the target market's expectations as well as the estimated product demand and the costs in producing the product or service. Competitive factors also play an important role in achieving product or service pricing.

The marketing mix management chooses at any particular moment, therefore, is a combination of these four Ps. The total marketing mix combinations available at any particular time are the product, place, promotion and pricing alternatives available to management. Thus, marketing mix combinations = (P_1 x P_2 x P_3 x P_4).

EXAMPLE 3.1

A toy manufacturer wants to determine its possible marketing mix combinations available at a particular time. It has the following possible product, place, promotion and price combinations respectively: 5, 10, 8, 7.

marketing mix combinations = (P_1 x P_2 x P_3 x P_4)
marketing mix combinations = (5 x 10 x 8 x 7) = 2800

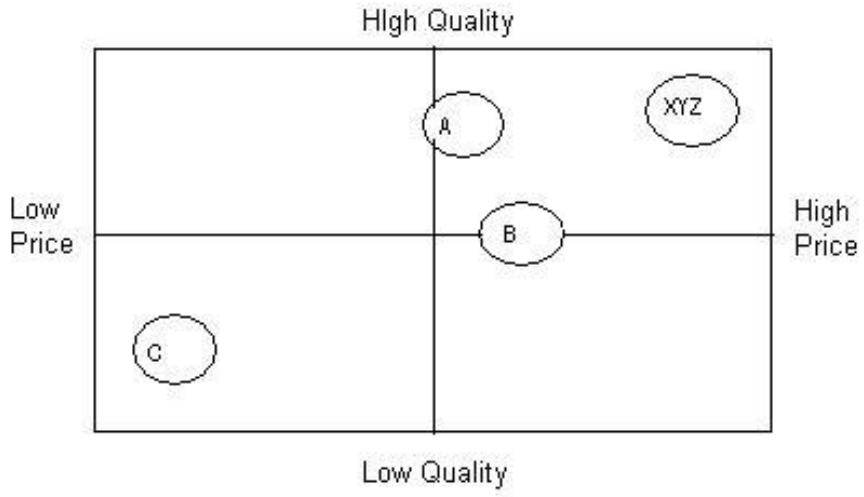
What is product positioning?

Product position is the perception consumers have regarding a market offering(s) relative to its competitors. Product positioning is the act of analyzing and managing consumer product position perceptions. Management develops product position maps to analyze how consumers position products relative to the competition. Product position maps can be developed prior to introducing a product or service or subsequent to introduction in order to obtain further market information.

EXAMPLE 3.2

XYZ Food Corporation is considering targeting the retail consumer food market by introducing packaged orange juice. The question the corporation must answer is whether to introduce a high-quality whole orange juice product packed fresh at the citrus grove, a lower quality concentrate also packed at the citrus grove, or a reprocessed concentrate packed locally. Company A has the high-quality whole orange juice medium price market, while company B has the medium-quality and price concentrate market while company C has the low-quality reprocessed concentrate low-price market. Corporation XYZ decides to offer a high-quality whole orange juice premium-priced orange juice product although there is room in the market to offer a low-quality reprocessed concentrate at a high price.

FIGURE 3.1 PRODUCT POSITIONING MAP FOR ORANGE JUICE



How is market demand determined?

Determining market demand is a critical management concern. Numerous variables ultimately determine market demand. These include demographics (such as age, sex composition, and per capita income of buyers), the state of the economy, past industry sales and others. Thus, market demand is dependent on the current environment. Three methods management can use to project current market demand are total market potential, total industry sales and market shares.

What is total market potential and how is it calculated?

Total market potential is a calculation of the potential market sales for an entire industry assuming a predetermined marketing effort under a given set of market conditions.

The formula for calculating total market potential is:

$$M = nap$$

where:

n = number of buyers in the particular product/ market assuming given market conditions

a = average quantity purchased by buyers

p = average unit price

EXAMPLE 3.3

Calculate the total market potential for ballpoint pens in the U.S. in any given year. Out of a population of approximately 250 million, it is necessary to calculate the estimated number of buyers of ballpoint pens. After researching the market, it is determined that the average age of ballpoint pen buyers range from ages 10 to 75. This eliminates approximately 55 million people from the pool. In addition, if another 30 million people are eliminated because they are institutionalized or are illiterate, then a total pool of potential buyers is (250 - 55 - 30) = 165 million. Additionally, market research tells us that annual per capita fountain pen purchases are 8, and that the average price is $1.50 per pen.

The total market potential for ballpoint pens is:

$M = nap$

M = (165,000,000 X 8 X $1.50)= $1,980,000,000

What is area market potential?

It is necessary for companies to choose the best marketing territories for their products and services. Being able to estimate the market potential of areas including cities and states is essential prior to committing a company's financial resources. The methods primarily used for this are the market-buildup method and the multiple factor method.

How are industry sales and market shares determined?

Trade associations normally provide gross industry sales data. By tracking its own sales against those of the entire industry, a firm can accurately determine its market share and whether it is increasing or decreasing. Additionally, marketing research firms monitor product-category sales in various retail outlets. This data allows a company to compare its own sales with both the overall industry and to particular competitors.

3.3 MANAGING THE MARKETING PROCESS

Marketing management involves marketing analysis, planning, implementing and controlling a marketing strategy. It is involved with product and service development as well as supervising basic marketing functions such as promotion, pricing and distribution.

What is marketing planning?

Marketing planning consists of making decisions about the overall direction of a marketing effort and is a function of effective marketing research. Areas that have to be planned include the company's marketing mix, the marketing budget and the priority allocations, distribution methods, brand names, and packaging.

A marketing plan should have a brief executive summary giving the plan's highlights and major conclusions. It should also discuss the current market, product, competitive and

distribution environment. All relevant variables and data are discussed with an analysis of how they impact the marketing plan. Analyses are provided of current opportunities, product market strengths and weaknesses, and of major issues needing attention. Financial and market objectives are also detailed. The marketing plan is used for developing an overall marketing strategy.

What is marketing strategy?

A marketing strategy is a comprehensive marketing methodology that is developed as a result of extensive marketing planning. A marketing strategy details the following factors: target markets, product line, product positioning, price, distribution channels, sales force, service procedures, advertising and promotion methodologies, product research and development expenditure targets, and marketing research.

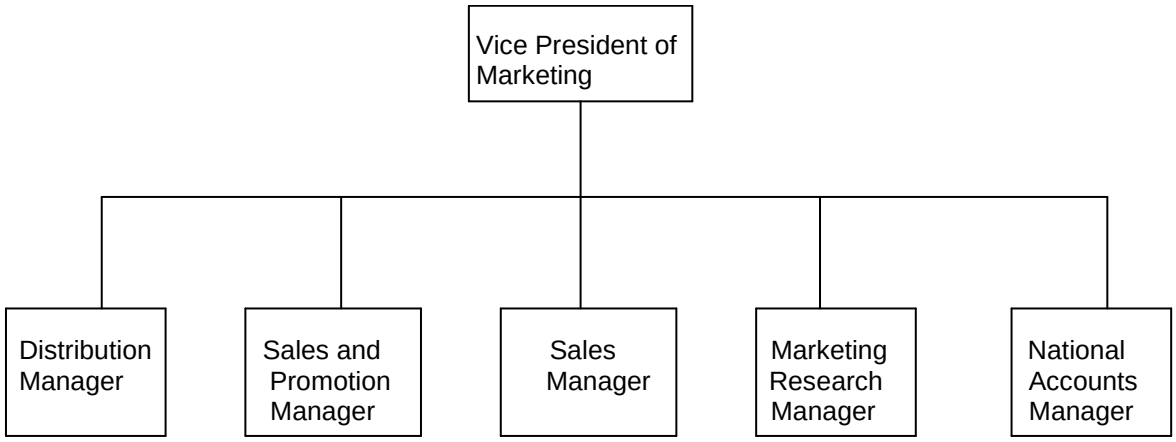
How are marketing departments organized?

Many types of marketing organizations currently exist. Companies often create various combinations of marketing organizations. The basic types of marketing organizations include the following: functional, geographical, product and brand management, and by markets.

What is a functional marketing organization?

A functional marketing organization consists of marketing personnel typically managed by a marketing vice president. It is the most widely used marketing organization. Since a functional marketing organization is not specialized, it is the simplest to manage. While this is a strength when a firm has relatively few products and services, it can also be a liability as a firm's market offerings become more diversified and specialized. Since a functional marketing organization has broad responsibilities, marketing personnel can compete with each other for specialized product or service resources. Figure 3.1 shows a typical functional marketing organization chart.

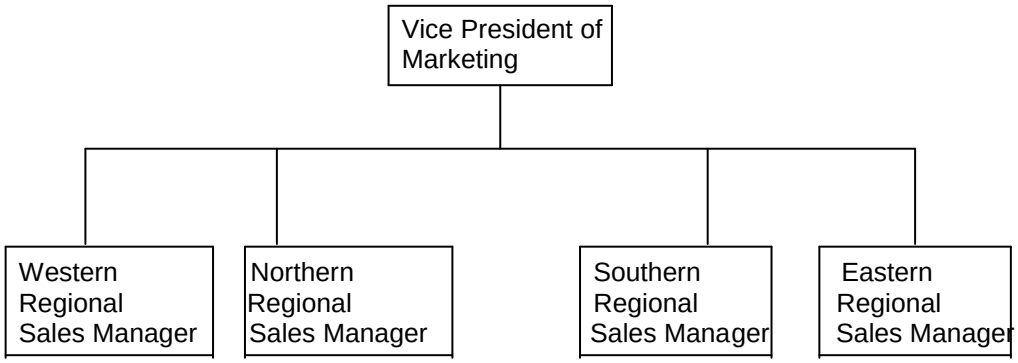
FIGURE 3.1 FUNCTIONAL MARKETING ORGANIZATION CHART



What is a geographical marketing organization?

National companies often find it is more effective having regional sales managers reporting to one national sales manager. The regional sales managers directly supervise a certain number of sales personnel. This facilitates regional market responses while freeing the national sales manager from excessive responsibility. Figure 3.2 shows a geographical marketing organization.

FIGURE 3.2 GEOGRAPHICAL MARKETING ORGANIZATION



What is a product and brand-directed marketing organization?

Product and brand-oriented marketing structures normally occur when organizations have experienced a large increase in products being offered to the market. Corporate management finds managing individual products and brands to be too time intensive and therefore choose individual managers who specialize in a particular product or brand. Product and brand organizations are essentially separate entities that interface with all elements of the larger organization. Thus, product and brand managers interface with the overall organization's production, promotion, advertising, legal, budgetary, research, purchasing and related functions.

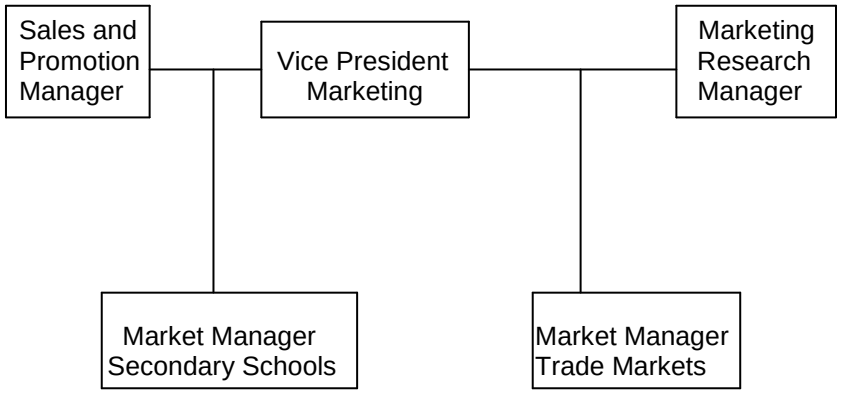
Product and brand managers become deeply knowledgeable about their product areas and can react quickly to market changes. However, product and brand management organizations often multiply to include even minor products. This imposes a large financial cost on the overall organization. Additionally, product and brand managers often compete with each other for organizational resources, creating a highly charged corporate environment.

What is a market organization?

Companies often deal with many different target markets. However, each target market has its own distinctive needs (example, some companies sell products or services to various industrial sectors as well as to federal, state and local governments). Often products are developed just for certain target markets (e.g., a book publisher will produce books for the primary, secondary, college and trade markets). When the market potential is great enough, companies often organize departments to coincide with those specific markets.

The market organization focuses attention on the marketing function. It allows for greater concentration of effort on the markets that are essential to the organization's success. Figure 3.3 shows a market organization for a publisher.

FIGURE 3.3 MARKET ORGANIZATION FOR A PUBLISHER



How are marketing plans implemented?

An organizational marketing plan has no values unless it is put into action. A close management interface with all aspects of the organization including production, promotion, marketing, research and design is essential to successfully implement the plan. Successful implementation requires creating a specific management plan to carry out elements of the marketing plan.

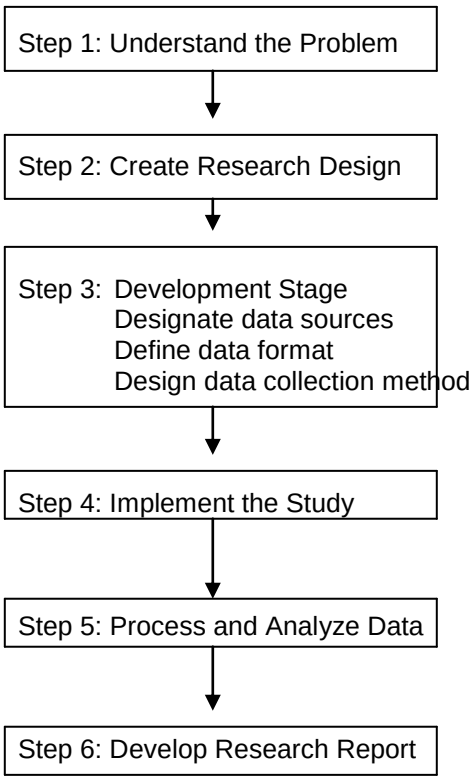
3.4 MARKET RESEARCH

Marketing research seeks to answer the question of what market needs exist, where they are located, what purchasing patterns exist, where they are located, and other factors such as its pattern of growth. Modern marketing research depends on the development of an extensive management information system normally having a large product and consumer database at its core. The research process is ongoing and data about products, manufacturers, customers and competitors is continually being collected and analyzed.

The market research process follows a series of steps which include understanding the

problem to be researched, creating a research design for the problem, designing data sources including designing the data collection methods, implementing the study, analyzing and processing the collected data, and developing the research report. Figure 3.4 illustrates the market research process.

FIGURE 3.4 MARKET RESEARCH PROCESS



Understanding the problem to be researched

A marketing manager, normally working with a marketing research group, must examine a problem carefully to understand its nature and complexity. A careful definition of the problem's parameters is crucial in developing the research project's goals.

There are various types of research problems. Some research is merely exploratory in nature which allows management to develop a clearer conceptualization of a problem. A more in-depth market study may be concerned with describing a particular problem in detail. A third type of research is interested in understanding the dynamics of a particular situation in terms of what causes it, or related issues, to occur. The objective of the research is the critical factor in determining the nature of the research design.

How is the research design created?

After developing an understanding of the problem to be researched, the next question to

be answered is what potential market value the research has when launching a new product.

EXAMPLE 3.4

Management seeks to determine the market value when launching similar products in a market segment to form the basis for a research budget. It can be determined that other product launches had an average annual profit of $35 million when market research was conducted and only $15 million without market research.

market research value = average profits with market research
- average profits without market research

market research value = $35 million
-$15 million
20 million

In this example it would be possible to justify a $20 million-dollar research budget.

Once a budget can be determined for the research project, it is then necessary to determine what types of data will be used. Two types of research data, primary and secondary, may be used in market research. Primary data such as census data collected by the government is original data which is either collected directly or is provided by a source who collects it directly. Secondary data is data reported on by a secondary source such as another market report or a periodical which provides results of primary data used in preparing the report. For the most part, market research uses primary data, although secondary data can be a useful theoretical source as well as validating results obtained from primary data collection studies.

In the development stage, how is marketing research data collected?

Marketing data is obtained using four basic research approaches: observational, focus group, survey and experimental.

• *Observational.* This is the most unstructured method of collecting data. The data collection method will depend on the context of the situation (for example, if one were to collect data regarding the cruise ship industry, one observational approach would be to book a cruise on one or several selected cruise ships and observe the activities on board, and the food being served, as well as to listen to passengers' before and after comments during embarkation and disembarkation).
• *Focus group.* In the focus-group methodology, a small group of selected individuals are invited to discuss a certain topic. In the cruise ship example, questions would be focused on the group's overall impressions regarding the cruise ship industry, with special attention given to particular cruise lines. Data obtained from a focus group session can be very useful when designing a more in-depth research study.

• *Survey research.* Surveys are the most commonly used form of marketing research. A survey is a systematic research tool used to obtain descriptive data. The three basic types of surveys are mail surveys to specified geographical areas, systematic telephone surveys within a calling area, and one-on-one personal interviews with a single individual or a group.
• *Experimental research.* This type of research has the most methodological accuracy. In experimental research, measures of the affects of variation in independent variables on the subject dependent variable are taken. This is done using as controlled an environment as possible either in a laboratory or field setting. An example of experimental research is testing the impact of various types of advertising on resulting sales. Different types of advertising can be used in different regional markets for the same product to determine if there is any measurable difference in resulting sales. However, controls for inherent regional differences must be predetermined.

How is a sampling plan developed?

A sampling plan is developed for the purpose of ensuring that the data collected is valid and reliable for the selected population. A sampling plan addresses three issues: the sampling unit, the sampling method, and the sample size.

• *Sampling unit*. This is a definition of a particular target population. If a company wants to sample opinions of people using a particular product, then it is necessary to define who that target population actually is.
• *Sampling method.* Researchers can use either a probability or non-probability sample of the target population. A probability sample is a statistical calculation of the sampling error of a target population. At the 1% level of confidence, there is a 99% probability of being a valid and reliable sample of the target population, while 1% would be inaccurate. In a non-probability sample, the researcher makes a judgment about what portion of a target population should be included in a sample.
• *Sample size.* Since it usually is impractical to sample opinions of an entire target population, it becomes necessary to develop a representative sample of the target population. Of course, the larger the sample, the more reliable and valid are the results. Sample sizes, either at the 5% or 1% level of confidence, are chosen according to the scope of the study, the resources available, and the criticality of the need for reliability.

How is the market research study implemented?

In the implementation stage, the researcher actually collects the required data. This is the most expensive and error-prone stage of the marketing research process. Data collection methods include mechanical means, computers including bar coding and interactive data input, questionnaires and interviewing. The major concern here is that data collection methods insure valid and reliable data.

How is the data processed and analyzed?

The data processing and analysis stage involves the processes of reviewing, categorizing, and analyzing. First the data must be reviewed for collection errors and omissions to insure that all areas have been completed accurately. Then the data has to be placed in categories where

similar data can be compared with each other. The analysis step is crucial for the study's final outcomes. Various statistical analysis methods are utilized for interpreting the results. This can involve using multivariate analysis and frequency distributions.

How is the research report developed?

Final reports should be succinctly written. Results should be interpreted and presented in an understandable format. Management requires report formats that are easily interpreted and conceptually coherent. The appropriate use of graphics can be helpful in explaining outcomes. Oral presentations by researchers often are used to further explain the study.

3.5 MARKET SEGMENTATION

Markets consist of buyers. Buyers have many different characteristics which are important in determining their willingness to purchase products and services. These differences are predicated on geography, demographics, buying power, occupation, education, and buying behavior. Markets can be divided into four clearly defined segments based on these characteristics: geographic, demographic, psychographic, and consumer behavior.

What is geographic segmentation?

Markets can be divided geographically by ZIP Codes, cities, states, regions, or countries. A company having a nationwide distribution system may detect differences in national demand depending on the region of the country. A particular product may sell better in certain regions than in others. The product may be sold, advertised and tailored only for certain designated geographic regions.

What is demographic segmentation?

Demographic segmentation uses various population measures including age, sex, income, nationality, education, and occupation as the basis for dividing people into specific markets. Demographic segmentation is easy to measure and is widely used.

• *Age.* This demographic variable is often used to divide markets (for example, a clothing department store divides departments chronologically: infants, girls, boys, young teens, young women and young men, ladies and men). For a clothing department store, demographic segmentation based on age works well. However, in other areas age may not be so effective, as everyone wants to be perceived as being young.
• *Sex*. Gender is a widely used method of demographic segmentation particularly in the clothing, hairdressing, health, hygiene and print markets. While gender is an easily measured demographic variable, market trends and applications may change quickly. The role of women is evolving rapidly in modern society. Automobile marketing, for one example, is now targeting the large numbers of female automobile owners using options and designs desired by women.
• *Occupation.* Market segmentation by occupations is also effective because of associated lifestyles (e.g., business people are targeted by the travel and clothing industries since they do more traveling and purchase more business clothing).

• *Education*. The level of education is an important demographic segmentation variable primarily because higher levels of education are associated with higher levels of income, and higher proportions of disposable income.
• *Nationality*. Nationality, racial and cultural groupings are important American demographic segmentation variables since the United States has such a diverse population. However, these variables can be difficult since it may be a mistake as well as a misrepresentation to believe that these demographic groupings all have the same desires and purchasing patterns.

What is psychographic segmentation?

Psychographic segmentation divides markets on the basis of social class, personality traits, and/or lifestyles.

• *Social class*. Dividing the population on the basis of social class primarily uses income as a determinant of the buying behavior and lifestyles people exhibit in the various groupings. Social class ranges from the lower class, to middle to the upper class. The classes can be further stratified into upper lower, upper middle and upper upper. Social class is a strong determinant of individual purchasing preferences in consumer goods as well as in services such as education, travel and tourism.
• *Personality traits.* This is a method of segmenting markets based on a perception of how differences in consumer personalities affect buying behavior. Products and services will be marketed in a manner which will appeal to these personality traits (for example, those who are considered more conservative are perceived as desiring products having darker colors and more reserved styles of dress). There is no clear evidence that personality trait market segmentation is successful in accurately identifying target markets and individual personalities.
• *Lifestyle.* A person's lifestyle can best be defined as how that person adapts to and interacts with the environment. Some people may be more artistic or entrepreneurial than others. Segmenting the market according to lifestyle attempts to identify common interests that a group of people has and to target this group for particular products and services (for example, those identified as having an adventurous lifestyle would be perceived as having a greater desire to go on a sailing vacation than to stay at a resort).
• *Consumer behavior*. An additional method of segmenting markets is based on consumer behavior relating to specified products and services. Categories included under consumer behavior would be the amount of usage of a particular product. Here consumers can be classified as heavy, moderate, or light users. Consumer profiles by usage category help determine the characteristics each group displays and how to appeal to them. It is also important to determine who does not use the product in order to determine whether a target marketing program would be justifiable.

Another market segment area of consumer behavior is brand loyalty. It is important to determine what the nature of consumer brand loyalty is for a specific product or service. By understanding which consumers are extremely loyal and which migrate, it may be possible to develop and implement strategies to increase or maintain consumer loyalty.

Still another method of segmenting consumer behavior is based on the benefits consumers seek by purchasing particular products and services. Some consumers may seek the speed of service associated with retail fast food. Others may seek hygienic qualities associated with certain consumable products such as toothpaste, household cleaners, paper tissues, etc.

After determining the benefits consumers actually seek from specified products, then the characteristics of the consumers must also be examined. Marketing strategies might be developed promoting new or expanded benefits to the consuming groups.

3.6 BRAND MARKETING DECISIONS

The objective of brand marketing is to increase consumer product or service awareness in order to generate increased and predictable demand leading to consumer willingness to buy and display loyalty. Brand marketing decisions involve a wide range of issues.

What is a brand?

A brand is a name, logo, sign or shape which singularly, or in combination, allow the consumer to differentiate the product or service from others in the marketplace.

What is a brand name?

A brand name is either a word or numbers in some combination which can be verbally expressed (for example, 3Com is a brand name).

What is a brand mark?

A brand mark is a symbol, graphic image, or shape, often used as a logo, which describes either a brand manufacturer or product.

What is brand loyalty?

Brand loyalty is repetitive consumer buying behavior resulting from consumer satisfaction with a particular brand.

What is brand recognition?

Brand recognition allows consumers to differentiate a branded product from other brands or those which are not branded.

What is brand acceptance?

At the minimum, marketers hope to generate brand acceptance where the consumer finds the brand meets their expectations. Therefore, they will purchase the product and not resist it.

What is brand preference?

Successful brand marketing causes brand preference where consumers prefer a particular brand over another.

What is brand insistence?

Extremely successful brand marketing may cause brand insistence where consumers insist on having one brand over another. True brand insistence is extremely difficult to generate.

What is brand rejection?

Brand rejection occurs when the consumer is familiar with a particular product but refuses to purchase it because of dissatisfaction with previous purchases. Brand rejection is extremely costly and difficult to reverse since the buyer's bias prevents him or her from considering any more purchases.

What is brand equity?

Brand equity is added value brought to a product by a brand name. This can be enhanced through the use of labels and logos. (Certain clothing and sports accessory manufacturers prominently display their name and/or logo on the product.) Brand equity often will allow the manufacturer to charge a premium price for its products.

How is branding useful?

Branding is an overwhelming market force. It gives the seller numerous advantages:

• Brands divide products into identifiable classes providing the ability to accurately measure sales and provide follow-up.
• Brands provide a methodology for market segmentation.
• Brands can be legally protected and trademarked preventing competitors from usurping products and their respective market share.
• Brands encourage consumer familiarity and loyalty.
• Brands help to create a company image.

How are branding decisions made?

Normally, a firm makes branding decisions only after extensive debate, research and discussion. Occasionally, companies even offer a public contest to choose a brand name (for instance, Ford Motor Company offered a national contest when it sought a brand name for the car that later became known as the Edsel). Companies often use marketing research firms as well as more specialized brand name consultants to choose a brand name.

What is brand strategy?

Brand strategy is the marketing objective sought by giving or associating products or services with a particular brand. There are at least four brand strategies that a firm can pursue: corporate blanket brand, family blanket brand, product range brand, and new product brand.

• *Corporate blanket brand.* A corporate blanket brand occurs when a company uses its name as the primary identifier of its products. The products, such as breakfast cereals, are usually in just

one market and the corporation seeks corporate brand identification.
• *Family blanket brand*. Family blanket brand is used to cover a series of products in a variety of markets. One brand name covers them all.
• *Product range brand.* Product range brands are used to describe a series of products having clear links in one market. An example would be a variety of shampoos having the same brand name but formulated for differing hair conditions.
• *New product brand*. A new product brand is used when a firm introduces a new product in a totally different market that has no relationship to previous products the firm has on the market. If the firm expects the product will have a long product life cycle, and that it will generate sufficient profits to warrant a separate launch, a new product brand may be justified.

How do you measure the worth of a brand?

Corporate Branding, a U.S. consulting firm, measures the worth of a brand by tracking business people's perceptions of a company name—which for many businesses is its brand—and rating this as a percentage of its market capitalization. According to the survey, 3M, the large Minnesota-based manufacturer, owns the most valuable brand of any broad-based industrial company in the U.S. 3M has several thousand products, ranging from sticky tape for the home to specialist optical film for industry, sold by the company's 45 business divisions. The 2004 annual survey of 10,000 business people, gives the brand value attached to the 3M name as $7.3 billion. Tyco comes in the distant second as $4.8 billion. This shows that companies that put a lot of effort into building up their brands across a number of product divisions. They can also use a system of "multiple" brands to create a variety of messages for consumers and industrial buyers. Leveraging the value of brands across a company is where the magic in brand management happened.

3.7 SERVICE FIRM MARKETING STRATEGIES

As of 2005 over 70% of all U.S. employment was in the service producing sector. Additionally, services account for over 70% of the gross domestic product and will produce 90% of all new jobs in the next ten years.

What are the characteristics of the services industry?

• *Intangibility.* Marketing services are intangible since they cannot be seen, tasted, felt or sensed. Services are unknown until they are performed (for example, a woman seeking a new hairdo from the hairstylist does not know what it will be like until it is actually done). Because of the unknown nature of services, marketers must create an image of quality, reliability and value for the consumer.
• *Immediate production and consumption.* Services are consumed as fast as they are produced. A lawn service leaves a trimmed lawn as soon as it is finished. Therefore, developing a strong relationship with the consumer is critical for the marketer's success.
• *Perishability*. Services cannot be saved or stored. It is difficult for service firms to provide the ideal level of service at all times. During periods of peak demand, resources may be overtaxed, while during periods of low demand, resources are underutilized. Organizations providing mass transit often find that trains or buses are overloaded taking passengers to the urban area during

the morning rush while they are empty on the return ride.
• *Inconsistency*. There is no standard in services. The level of quality varies depending on who provides the service as well as when and where it is provided. Resume writers provide a wide variety of resumes depending on who is writing it, what their industry depth of knowledge is, how well they write and what level of interest they have in the consumer.

How is marketing performed for the service sector?

Marketing for the service sector is more complex than tangible products primarily because of the difficulty of defining quality service, and managing productivity.

• *Service market differentiation*. The greatest challenge for service marketers is differentiating between service providers. If consumers perceive that service providers have indistinguishable offerings, then price competition becomes the only differentiating feature. A method of differentiating services from the competition is to add innovative features. Thus, the marketer adds to the primary service package by offering a secondary service package (for instance, an automotive lubrication service provider adds a secondary service package of automotive manufacturer certification, speed of service, and a consumer comfort facility to distinguish its service from the traditional service station or automotive dealership).
• *Service productivity*. The service industry is experiencing a need to increase its productivity to remain competitive. However, the service industry is highly labor intensive. Increasing productivity, therefore, is extremely challenging. The following methods can be utilized in the service industry to increase productivity.

Better utilization of labor. Management can research and develop more effective service procedures. Employee skills can be upgraded through training to make their service activities more effective.

Trade off quality for quantity. In order to improve productivity, organizational procedures are developed whereby less time is spent per service unit. This may require changing the nature of the service as well as how services are delivered (e.g., using an automatic phone router which screens and routes phone calls).

Automate the provision of services. The implementation of technology often can reduce the need for labor while increasing consumer satisfaction (such as, installing a fax back system which immediately provides consumers with requested information).

Update current employees. Utilizing training and certification programs, It may be possible to upgrade lower paid employees to perform specified services performed by professional (for example, nurses are now performing many medical services previously performed by doctors).

Allow consumers to perform self-service. Increasingly consumers are substituting their own labor for procedures formerly performed by employees (as in, self-service gas stations).

How can service delivery differentiation be achieved?

Service delivery can be differentiated with the "3P's" of service marketing: people, physical environment and process. Having better trained and more competent people can be extremely important in the service delivery process itself. Improving the physical environment of the service delivery environment is also extremely important (for example, having a clean and

cheerful waiting room can be crucial in improving the overall image of an organization). Finally, improvements and innovations in the process can also make a critical difference in service market differentiation (e.g., the installation of bar code scanners in supermarket expedites the check-out process with improved accuracy while enabling management in maintain a real-time management information system).

3.8 PRODUCT LINE DECISIONS

A product line is a group of products related on the basis of similar customers, marketing methods or product characteristics. The range of product lines establishes a product mix. The two types of product lines are those having complementary and substitute products.

What are complementary products?

In a product line, complementary products are those designed to add to the original product. For example, a company producing computers would also manufacture other items such as a mouse, printers, and software.

What are substitute products?

Substitute products are those that appeal to the same basic market segment, but have different specific characteristics. For example, a soup company has a full line of soups including chicken, tomato, turkey, pea, etc. Each soup can easily be substituted for the other.

How long should a product line be?

Product line length is determined by the number of products supported in a particular product line. Companies seeking high market share and growth have longer product lines.

Profitability is also affected by product line length. A product line has too many products if adding to the line reduces profits, while it has too few if profits can be increased by adding products.

Increasing product length tends to increase associated costs including engineering, inventory, ordering and transportation costs. Companies having successful products often tend to increase product line length in order to increase profits. However, overextended product lines can cause diminishing returns.

Lines can be extended by stretching and filling.

What is product line stretching?

Product line stretching develops when a firm adds additional products to a product line. Product lines can be stretched downward, upward, or both.

What is downward product line stretching?

A company producing "high end" products, in the more expensive range of the market

segment, stretches downward by offering lower priced products in the market segment. Offering lower priced products will appeal to a wider range of consumers who may upgrade upon seeing the feature differences between the low and high end products. Using the "downward stretch" can be a competitive marketing strategy to challenge competitors either at the high or low end of the market segment.

What is upward product line stretching?

A company producing "low end" products, in the least expensive range of the market segment, stretches upward by offering higher priced products in the market segment. Companies may consider the "upward stretch" for a number of reasons. They may be well entrenched at the lower end of the market segment, but desire greater unit margins by moving upward in the market (for instance, the Japanese automotive companies implemented an "upward stretch" by successfully introducing luxury cars only after becoming well established in the lower end of the market with compact cars). The company may also be interested in experiencing a faster growth rate at the upper end of the market when those conditions exist.

What is two-way market stretching?

Two-way market stretching applies to companies in the middle of a market that want to expand their product line upward and downward. The basic objective is to become competitive in markets it did not previously serve by introducing products into those respective markets.

3.9 NEW-PRODUCT DEVELOPMENT AND MARKETING STRATEGIES

New-product development is essential for a company to remain competitive in today's rapidly changing markets. Marketing plays an important role in new-product development. Analyses of the selected market segments and the targeted consumer groups are performed, and decisions are made regarding the development of appropriate products. Yet, the introduction of new products is extremely risky. New product failures are estimated to be 80% of all new-product launches in certain markets. There are various levels of failure. A complete product failure is a dead loss and provides no cost recovery. Partial product failures allow the recovery of some variable and fixed costs, while a comparative product failure actually provides some profit, but is relatively less profitable when compared with other products.

Why is there such a high failure rate with new products?

New-product failures occur for a number of reasons:

• *New products may not have significant advantages.*
Certain markets may be saturated, and it is very difficult to develop truly innovative product ideas (e.g., the chocolate candy bar market is fairly well saturated, and it is difficult to improve upon the offerings already provided by the chocolate bar market leaders).
• *Divided markets.* Intense international competition is fragmenting markets into smaller segments. Focusing on smaller market segments increases the risks of failure.

• *Increasing product development costs.* As the technology becomes more complex, the cost of developing new products increases.
• *Shorter product life cycles and product development times*. Technological change is occurring at exponentially increasing rates that significantly reduces product life cycles as well as mandating shorter product development times. The risk of failure increases because of greater likelihood of product development mistakes and misjudgments. Shorter product life cycles also mean a shorter period of time in which to recoup product development costs.

What are the major stages in new product development?

• *Idea generation*. New-product ideas come from many sources. Customers are one of the best sources of new ideas (software companies rely extensively on their installed user base to provide feedback about how products should be improved). Consumers can be surveyed to identify needs and problems that are otherwise unknown to management. Competitors often introduce new product and service innovations which provide a rich area of product improvement. Employees who work closely with products can also provide significant insight into new product innovations and improvements. Brainstorming can be used by a marketing team where members give ideas in a free flow manner. In the final analysis, new-product ideas are the result of inspiration, imagination and deep experience.
• *Idea screening*. After numerous ideas have been generated, screening is utilized to evaluate the ideas in terms of practicality, cost, profit potential and strategic fit. Not only must new products have significant profit potential, but they must also be consistent with the firm's marketing plan and strategy. Most companies have product evaluation forms where the products are described and rated according to market potential. Subsequently, these forms are screened by a new-product organizational structure.
There are two significant risks in the idea screening stage. One risk is that a product is rejected because management underestimates its market and profit potential. The other risk is that a firm will approve a product not having good market potential or strategic fit because it received inadequate idea screening.
• *Concept development and testing*. If a product idea survives the idea screening stage, it is developed into a product concept. A product concept is an idea that is developed into an expression of the advantages offered by a new product or service and the target market to which it will be offered. This is termed a product category concept.

EXAMPLE 3.5

A company wants to develop a line of nutritional snacks. It then converts this product idea into several product concepts within the product category. One product concept consists of a candy made out of dried fruit. Another is an all natural cracker using dried fruit to add taste. A third product concept is a dried meat product made out of prepared soy beans.

• *Business analysis.* Having developed the product concept, a preliminary marketing strategy is then developed. This will enable management to evaluate the product concept's business potential. In order to do this, management must perform an extensive cost analysis on product development costs including research and design, marketing and production. Product demand

estimates are then combined with cost estimates to develop short- to intermediate-term profit estimates.

• *Product development*. Assuming the business analysis determines the product is worthwhile, it then goes to the product development stage where R&D develops a prototype. Normally, product development represents a substantial financial investment over an extended period of time. Additionally, product development must be sensitive to expressed consumer desires. The use of technology, particularly computer aided design and computer aided manufacturing (CAD/CAM), can help to shorten development time. When the prototype is actually developed, it must be subjected to rigorous functional testing to insure the product is viable, safe, and meets expectations. Assuming the product passes the functional testing stage of the product development process, it must then be subjected to consumer testing to determine whether or not the product would be appropriate for the target market.
• *Market testing*. The market testing process subjects the developed product to actual target market conditions. The product is packaged and branded and introduced using a controlled marketing program. The purpose of market testing is to determine consumer acceptance, the success of various marketing strategies, how large the market actually is, and how competitive it will be. There are several methods used in the market testing process:
• *Traditional test marketing*. In traditional test marketing, the product is introduced into a selected group of cities. When determining the test market strategy, management must determine in how many and in which cities the test marketing should be performed, the length of the test marketing process, and what factors should be evaluated. Traditional test marketing also allows a variety of promotional methods to be used to introduce the product in order to determine which method works most effectively. The negative side of the traditional test marketing process is that it is costly and time consuming.
• *Research firm test marketing.* The firm introducing a new product may decide to conduct test marketing by contracting with a research firm which directs market research in a group of commercial outlets. Various marketing strategies are carefully controlled and evaluated. Product sales are monitored using scanners and bar codes. Research firm test marketing is performed more quickly and cheaply than traditional test marketing.
• *Simulated test marketing*. In simulated test marketing, a selected group of shoppers is exposed to advertising for the new product as well as advertising for competitive products. They are then given a predetermined amount of money and allowed to shop in a simulated store carrying the new product as well as existing competitive products. Observations and measures are made of the products purchased, and the consumers are then asked why they purchased their chosen products. Follow-up questions are also asked of the selected consumers after a period of time has elapsed. Simulated test marketing can be conducted quickly and much more economically than either traditional test marketing or research firm test marketing.
• *Commercialization*. If the product successfully passes the market testing process, then the marketer is ready to implement a full commercial introduction. The firm now must make its greatest investment in the entire product development process. Manufacturing facilities have to be acquired, a promotional advertising program needs to be developed, sales personnel have to be employed and trained, and administrative support systems have to be put in place. Many activities have to be coordinated. Additionally, evaluations have to be performed concerning the timing, geographical selection of launch sites and the targeting of product launch prospects.

What is the product life cycle?

The product life cycle consists of the product development, introduction, growth, maturity, and decline stages. In the product development stage, the company incurs investment costs but makes no sales. In the introduction stage, sales are slow because the product is being introduced, profits and cash are negative, and investment in marketing is high. In the growth stage, profits are at their highest, although cash flow may because of high investment. In the maturity stage, sales decrease and profits level off or begin to decline. In the decline stage, sales and profits drop.

When is market-skimming pricing used?

Market-skimming pricing is used when a new product is introduced at the highest price possible given the benefits of the product. For market skimming to work, the product must appear to be worth its price, the costs of producing a small volume cannot be so high that they eliminate the advantage of charging more, and competitors cannot enter the market and undercut the price.

3.10 MARKETING CHANNEL DESIGN DECISIONS

Marketing channel (also termed channels of distribution) design decisions are critical for successful product distribution. Marketing channels consist of intermediaries who contribute to the product distribution process according to consumer demand. They consist of merchant middlemen, agent middlemen, and facilitators. Companies rely on market intermediaries because of their effectiveness in distributing products as well as their capitalization. A company's chosen channel members develop long-term relationships built on trust, and directly affect the marketing process including price. Marketing channels always have a producer and a final consumer.

Who are merchant middlemen?

Merchant middlemen consist of wholesalers and retailers who actually purchase the product and resell it. Wholesalers buy in large lots and sell in smaller quantities to retailers who in turn sell individual units to the consumer. Wholesalers and retailers assume the risk of ownership in return for a profit markup when selling the merchandise to others.

Who are agent middlemen?

Agent middlemen are sales intermediaries such as brokers, product representatives and sales representatives who seek others to purchase merchandise. They do not actually purchase any merchandise and are compensated on the basis of a percentage of sales and/or salary depending on whether they are independent business people or employees of companies wishing to sell products.

Who are facilitators?

Facilitators are intermediaries who directly assist in the distribution function without

taking title to the goods. They consist of a range of organizations including advertising agencies, financial lending organizations, shipping companies, and storage warehouses.

What is channel length?

Channel length describes the number of intermediary levels existing between the producer and the consumer. A direct, or zero, channel is one where there is a direct relationship between the producer and the consumer (e.g., a neighborhood bakery may be considered a direct channel since the retail consumer purchases the finished baked goods directly with no intermediaries). A one-level channel has one intermediary which is usually a retailer (e.g., a regional bakery goods operation utilizes local food stores to distribute the product to the consumer). A two-level channel has two intermediaries to distribute products to the consumer (e.g., a candy manufacturer sells the product to a wholesaler who in turn sells to the retailer). A three-level channel has three intermediaries normally consisting of an agent middleman who sells to a wholesaler who then sells to a retailer.

How are channels developed?

Developing channels of distribution requires many decisions. Channel distribution needs grow and develop as companies grow and markets change. Increased channel utilization increases costs which are passed on to the consumer. The design of channel development begins by studying the buying patterns of the target customers.

What are consumer buying patterns?

Consumer buying patterns affect a channel's characteristics and are classified in the following ways:

• *Units purchased.* Different customers have different purchasing needs. Commercial customers normally purchase larger lot sizes than do the household consumer. Channel modifications have to be made to meet these different needs.
• *Turnaround times*. Some industries, such as fast foods, use rapid turnaround times as an inherent part of the business, while other businesses may have longer turnaround times. Industries having customers needing rapid turnaround times require more direct channels of distribution than those with slower turnaround times.
• *Product assortment*. Industries, particularly retail, offering large product assortments have a need for deeper channels of distribution in order to provide product variety.
• *Services.* High levels of services, including repair, delivery, installation and others, require more intensive channel utilization.

How many intermediaries should be used in a channel?

Determining the number of intermediaries will affect the marketing of a product. Longer channels have more intermediaries and higher costs. On the other hand, intermediary expertise may be essential for successfully marketing a particular product. Thus, a manufacturer may try and limit the number of intermediaries in order to contain costs. The tradeoff in having fewer

intermediaries is limited distribution.

As manufacturers continue to penetrate markets, greater distribution is desired involving more intermediaries. While this will increase distribution, it will also increase costs while sacrificing some degree of marketing control. This may result in having the product incorrectly positioned.

Finally, not all intermediaries are the same. The marketer wants only those intermediaries who most effectively work with the company to distribute the product.

How do company characteristics affect channel development?

Generally, the companies having the largest array of retail products, particularly product consumables, have the least need for intermediaries. They are well-enough positioned in the market to deal directly with retail outlets. Smaller companies with smaller product lines have a greater need for the market distribution strengths of intermediaries.

How do product characteristics affect channel development?

Products that are perishable, time sensitive (such as fashions), heavy and bulky, or are highly unique in nature (such as those requiring specialized training) generally have short channels of distribution. On the other hand, standardized products often move through several intermediaries in the distribution process.

How are channel alternatives evaluated?

There are several issues in evaluating channel alternatives. One issue is choosing the most economically effective channel alternative. Companies must evaluate channel intermediaries based on those that have the largest level of sales per unit of selling cost. Other issues concern the extent to which marketing management control will be lost by including a sales agency or other sales broker in the marketing channel. A final variable is choosing a channel intermediary that will still allow the producer to maintain maximum marketing flexibility in fast moving markets.

What are the challenges in managing market channel intermediaries?

Several issues are important in channel management.

• *Choosing the most effective channel alternatives.* Management must determine what the characteristics are the most effective channel intermediaries. Having done this, management must develop strategies for attracting these channel intermediaries to the marketing channel.
• *Maximizing channel member effectiveness.* Management must motivate channel members to create the most cost-effective market distribution system for the company.
• *Evaluating the effectiveness of intermediaries.* Management must develop channel member evaluation systems. While seeking the cooperation of channel members, it is still essential to determine what profit standards must be used as the basis for evaluation.

3.11 DEVELOPING THE PROMOTION BUDGET

One of the most challenging marketing management functions is developing the company's promotion budget. Promotional advertising is extremely expensive, and establishing an acceptable figure is difficult at best. While companies use many different methods, we will describe four widely used methods:

• *Funds available method.* This is the simplest promotion budget allocation method. The marketing manager simply establishes the budget at the amount established by the company's management. It does not require any research and makes long-term planning impractical.
• *Percentage of current sales method*. This method is calculated from last year's or the current year's forecasted sales for various product or service categories. It can be justified in that the promotion budget will increase or decrease proportionally to sales and that it establishes linkage between the sales of a product or service category and the amount budgeted for its promotion. However, it encourages more spending during growth periods when less may be indicated, and spends less during periods of contraction when more may be appropriate.
• *Matching the competition.* A firm allocates an amount to its promotion budget that matches the competition's. This allows a product or service to maintain an amount of advertising equal to that of its competitors. It can also be justified by maintaining that this level of promotion represents an industry consensus. However, it assumes that other companies know the appropriate amount to allocate to the promotion budget when in fact there may be no justification for this assumption.
• *Objective and task method.* The promotion budget is established based on clear marketing goals, defined tasks needed to achieve the stated goals, and defined expenditure estimates. This method depends on estimating the promotional productivity of the resources allocated in each category. However, developing accurate estimates of the effectiveness of promotional expenditures is difficult at best.

3.12 THE PROMOTIONAL MIX

The promotional mix is the blending of five promotional areas of advertising, sales promotion, public relations, direct marketing and personal selling.

• *Advertising.* Advertising is any form of paid public and impersonal communication utilizing the mass media. The purpose of advertising is to emphasize the benefits and characteristics of products or services, often using special effects including graphics, color, sound, music, famous personalities, testimonials and related methods.
• *Sales promotion*. Sales promotions consist of various types of incentives including discounts, rebates, contests, etc., intended to induce a positive response from consumers. Although they are short-term in nature, promotions are designed to induce a rapid increase in sales.
• *Public relations*. Public relations is communication to an organization's public that extends beyond its immediate target market. The purpose of public relations is to create a positive image of the organization by providing and explaining information. One of the outcomes of public relations is the creation of publicity for all forms of the mass media. Publicity is advantageous since it normally appears as a news story and there is no cost to the organization.

• *Direct marketing.* Direct marketing consists of various types of marketing intended to solicit a direct consumer response. Forms of direct marketing include direct mail, telemarketing, and electronic marketing. Direct marketing is aimed at specific individuals in the target market rather than being broadly disseminated.
• *Personal selling.* Personal selling is the oldest and most successful form of sales promotion. Personal selling is contingent on developing personal long-term one-on-one relationships. Personal selling depends on the development of an organizational sales force.

3.13 ADVERTISING

Advertising is any form of paid non-personal communication of messages designed to promote products and services to target markets utilizing the mass media.

What are the objectives of advertising?

The objectives of advertising are to educate, convince, and remind target markets.

• *Educate.* Educational advertising is essential in the early stages of product or service introduction. Education advertising informs the target consumer about the advantages of a particular product or service and how it can be useful.
• *Convince.* In competitive markets it becomes essential to convince consumers about why one product or service is more advantageous than another in terms of features, services, price, or status.
• *Remind*. In mature markets it is necessary to continuously remind consumers to use a particular brand or service. It is also useful for overcoming buyer's remorse, and consumer second thoughts about a purchase, by reminding them of the strengths of a particular product or service.

How is the advertising message developed?

Developing advertising is a creative process. The basic purpose of an advertising message is to stress the positive aspects of a product or service. This is done by collecting and analyzing consumer responses and consumer data. Several advertising variations should be developed and tested; however, the reality is that the costs for doing this are prohibitive.

Nonetheless, an advertisement serves several functions. First, it catches the consumer's attention by using a catchy introduction or headline. Here is where effective headlines make a difference. Once the advertisement has the consumer's attention, the copy should make its message clear.

Which media should be chosen?

The major media markets include newspapers, television, radio, direct response, magazines and outdoor media which include billboards, buildings, buses, and other outside advertising space. The marketing manager seeks to have the best fit between the media and the target market. The basic objective is get the maximum impact for each advertising dollar. This is based on the effectiveness of the ad and the audience size provided by the media for the products

and services. Impact can be given a numerical value to rate the specific exposures in a particular medium. Additionally, outcomes have to be continuously evaluated to determine if effectiveness is changing over time.

Other variables include the media's effectiveness in targeting specific geographic areas. The reach of the media is the number of consumers who are exposed to the advertising, while the frequency is the number of times the audience is exposed to the advertising message. The total number of exposures can be calculated as follows:

Total Number of Exposures (E) = Reach (R) x Frequency (F)

The total number of exposures is known as the gross rating points (GRP) which is used as a measure for rating the media. This figure is usually calculated for an estimate of the percent of the target market that specific media actually reaches.

EXAMPLE 3.6

A marketing manager wants to know what the gross rating points will be for a television ad when its reach is 75% of the target market with an average frequency of 5.

GRP =75 x 5
GRP = 375

What is the cost-per-thousand media index?

The cost-per-thousand index is a method of evaluating the cost effectiveness of the media based on its reach in thousands and the cost of an exposure. The formula for calculating the cost-per-thousand index is:

$$\text{Cost Per Thousand (CPM)} = \frac{\text{Exposure Cost} \times 1000}{\text{Reach}}$$

EXAMPLE 3.7

A marketing manager wants to compare the CPM for a 30-second advertisement of instant decaffeinated coffee in two different nonprime TV network shows serving the same target market.

Network Show A has 3,825,000 viewers who regularly drink decaffeinated coffee and charges $45,500 for the advertisement. Network Show B has 2,785,000 viewers who regularly drink decaffeinated coffee and charges $37,500 for the advertisement.

$$\text{Network Show A CPM} = \frac{\$45{,}500 \times 1000}{3{,}825{,}000} = \$11.90$$

$$\text{Network Show B CPM} = \frac{\$37.500 \times 1000}{2{,}785{,}000} = \$13.46$$