

SOLUTIONS MANUAL TO ACCOMPANY **COST** **ACCOUNTING**

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Table of CONTENT

Part 1—Costs: Concepts and Objectives

1. Management, the Controller, and Cost Accounting	1
2. Cost Concepts and the Cost accounting Information System	13
3. Cost Behavior Analysis	25

Part 2—Cost Accumulation

4. Cost Systems and Cost Accumulation	61
5. Job Order Costing	80
6. Process Costing	102
7. The Cost of Quality and Accounting for Production Losses	145
8. Costing By-Products and Joint Products	178

Part 3—Planning and Control of Costs

9. Materials: Controlling, Costing, and Planning	203
10. Just-in-Time and Backflushing	228
11. Labor: Controlling and Accounting for Costs	245
12. Factory Overhead: Planned, Actual, and Applied	271
13. Factory Overhead: Departmentalization	288
14. Activity Accounting: Activity-Based Costing and Activity-Based Management	319

Part 4—Budgeting and Standard Costs

15. Budgeting: Profits, Sales, Costs, and Expenses	340
16. Budgeting: Capital Expenditures, Research and Development Expenditures, and Cash: PERT/Cost	385
17. Responsibility Accounting and Reporting	410
18. Standard Costing: Setting Standards and Analyzing Variances	443
19. Standard Costing: Incorporating Standards into the Accounting Records	488

Part 5—Analysis of Costs and Profits

20.	Direct Costing and Cost-Volume-Profit Analysis	513
21.	Differential Cost Analysis	543
22.	Planning for Capital Expenditures	588
23.	Economic Evaluation of Capital Expenditures	618
24.	Decision-Making under Uncertainty	652
25.	Profit Performance Measurements and Intracompany Transfer Pricing	688

CHAPTER 1

DISCUSSION QUESTIONS

- Q1-1. Planning is the development of a consistent set of actions, resources, and measurements by which the achievement of objectives can be assessed. Planning takes into account the interactions between the organization and its environment in whatever is to be done.

Control is the process by which managers assure that resources are obtained and used in an efficient and effective manner to carry out the plan and accomplish the organization's objectives. Control implies that performance measurements are reviewed to determine if corrective action is required.

Planning and control are interrelated. Control is carried out within the established planning framework and serves to evaluate conformance to the plan so that organizational objectives are achieved.

- Q1-2. Short-range plans usually deal with a period of a quarter or a year, while long-range plans usually cover three to five years. Short-range plans are detailed enough to permit preparation of a complete set of financial statements as of a future date, while long-range plans culminate in a very summarized set of expected results or a few quantified objectives, such as financial ratios.
- Q1-3. Long-range plans contain quantitative results, while strategic plans are the least quantifiable of all plans. Long-range plans usually extend three to five years into the future, while strategic plans may contemplate shorter or much longer periods. Long-range plans covering a three-to-five-year period would be prepared every three to five years, or might be systematically updated each year to maintain a complete plan, while strategic plans are formulated at irregular intervals by an essentially unsystematic process.
- Q1-4. Accountability is identical with responsibility accounting. Accountability deals with the discharge of an individual's responsibility to achieve assigned objectives within the costs and expenses allowed for the performance and agreed to by the individual.
- Q1-5. The controller does not control, but aids the control task of the managerial levels by issuing reports pointing out deviations from the predetermined course of action.
- Q1-6. The cost department keeps detailed records of materials, labor, factory overhead, and marketing and administrative expenses; analyzes these

costs; issues control reports; prepares cost studies for planning and decision making; and coordinates cost and budget data with other departments.

- Q1-7. For product research and design, the manufacturing departments need estimates of materials, labor, and machine process costs; for measuring and efficiency of scheduling, producing, and inspecting products, the departments need to know the costs incurred. The personnel department supplies employees' wage rates. The treasury department needs accounting, budgeting, and related reports in scheduling cash requirements. The marketing department needs cost information in setting prices. The public relations department needs information on prices, wages, profits, and dividends in order to inform the public. The legal department needs cost information for keeping many affairs of the company in conformity with the law.
- Q1-8. Modern techniques in communications give the controller and staff the means to transmit information in the form of results, analyses, and forecasts in a way never before possible. Profit opportunities or control actions have been delayed or missed entirely because timely information that might have improved the cost and profit position of the company was poorly communicated.
- Q1-9. The budget is an essential cost planning tool because it (a) supplies information and serves as a standard of performance for cost control by the supervisors responsible for cost; (b) provides an easy method for anticipating profits at an anticipated sales level; (c) helps in forecasting sales, costs, expenses, and profits for a period of one year or more in advance.
- Q1-10. These standards will not necessarily be able to prevent management fraud, but they do give internal accountants some guidance on how to proceed if they encounter a questionable practice.
- Q1-11. CASB standards: (a) enunciate a principle or principles to be followed; (b) establish practices to be applied; (c) specify criteria to be employed in selecting from alternative principles and practices in estimating, accumulating, and reporting contract costs. The standards are backed by the full force and effect of the law.

EXERCISES

- E1-1** The exercise requires two examples of the inseparability of planning and control. Three are listed here, and the third one gives two illustrations:

The most obvious example of the inseparability of planning and control is found in the definition of control: management's systematic effort to achieve objectives by comparing performance to plans and taking appropriate action to correct important differences. The definition shows that the specific results of planning are an essential input to the control phenomenon; there cannot be any such thing as a control effort without reference to some set of plans.

A second example of the inseparability of planning and control results from the fact that they are simultaneous. In practice, the implementation of the first steps of a plan, and any control action needed in those steps, are begun before all parts of planning are complete. Early results and the early findings of control activity can then be used in finalizing later parts of the same plan. An example is that a single annual budget is usually not completely finalized before customer orders begin to be received for that year, and consideration of the number of these actual customer orders may point to trends that need to be considered in finalizing the budget. Even actual financial results of the early weeks and months of the year can provide a basis for better establishing the budget for the later portion of the year.

The most elegant example of the inseparability of planning and control results from the fact that both planning and control are complex human activities, and almost all complex human activities are planned activities and also controlled activities. In other words, planning can be so complex that the planning effort is itself controlled (and planned), and control can be so complex that control activities are themselves planned (and controlled). Two illustrations of this are provided as follows:

- (1) A case in which planning is itself planned and controlled is when a complicated budget (plan) is to be prepared. To facilitate the creation of the budget, a detailed weekly schedule (another plan) is first agreed upon, showing which steps in the preparation of the budget are to be carried out during each week. Because it is desired that the creation of the budget not be allowed to fall far behind schedule, the responsible manager will exercise control by making comparisons between (a) the actual progress made on the budget each week and (b) the schedule. The manager will also take some corrective action if the difference between the schedule and the actual progress is considered important.
- (2) A case in which control is itself planned is when a manager decides what kinds of control reports will be used to compare actual results with plans in each future period of business operations. That decision, any efforts made to acquire a supply of preprinted report forms to be filled in each period, and any changes in the design of

E1-1 (Concluded)

the cost accounting system to capture and compile the needed information about actual results represent evidence that the future control activity is being planned.

E1-2

- (1) B
- (2) A
- (3) C
- (4) A
- (5) C
- (6) B — although the time frame involved in this kind of plan may be extremely long, there is nothing strategic about this kind of plan or decision. In fact, the plan and obligation to pay off the bonds when they come due is so routine that management would not consciously approach it as a decision.

E1-3

- (1) Paragraph (b) comes closest to describing the kind of control used in managing a business, although it is described in a nonbusiness setting. There is a plan formulated in advance, there is a measure of actual results, there is a decision maker who compares actual results with plans, there is a selection of a corrective action to bring results closer in line with the plan, and there is a foreshadowing of repeated periodic control activities (the remaining quizzes).

The fact that the measures of planning and actual performance are nonfinancial measures is not the governing consideration. Much planned and actual information used in controlling a business is non-financial, including some cost accounting information such as the number of units produced, the percentage of units that were defective, and the percentage of available machine time that was utilized.

- (2) Paragraph (a) is a perfect example of an engineering control, rather than the kind of control managers use in business. The simple device described, which is found in any home bathroom, is the kind of control device designed to monitor a physical condition, and so it is analogous to a thermostat or any of a variety of devices called "industrial controls." Of course, devices of this kind are used in manufacturing and other businesses, but they do not possess the essential attributes of control in the sense used in business and in cost accounting. The device achieves a continuous monitoring of the results, rather than a periodic comparison of results with plans. There is no human decision maker who selects a corrective action to be taken. A human decision maker is probably the salient attribute of control in managing a business that is missing in paragraph (a).

E1-3 (Concluded)

Paragraph (c) could be interpreted as an example of planning, but it lacks some essential ingredients of control (even though the word "control" is used in its last sentence). There is no periodic comparison of actual results with plans and no provision for modifying the treatment based on periodic results. For example, the contract requires five treatments each year, even if no weeds are visible. The actions taken are entirely preemptive.

Paragraph (d) refers to the concept of control that applies to police work and military science. It consists of being able to physically determine each event that occurs in some location and being able to prevent certain events from occurring. The potential use of coercive force, which is very clear in paragraph (d), is always present in achieving this kind of control. In paragraph (d), there is no indication that results were periodically compared with plans. A rule that says "Obtain the objective at any cost" is sometimes associated with these activities.

CASES

C1-1

- (1) Yes, Williams has an ethical responsibility to take action.
The IMA's *Standards of Ethical Conduct* states that management accountants "shall not commit acts contrary to these standards nor shall they condone the commission of such acts by others within their organizations."
- (2) (The requirement does not ask which standards have been violated, but, rather, which ones apply to Williams' situation.)
Management accountants have a responsibility to:
Competence: Perform their professional duties in accordance with relevant laws, regulations, and technical standards. (Dumping toxic wastes in a residential landfill is generally a violation of law.)
Confidentiality: Refrain from disclosing confidential information acquired in the course of their work except when authorized, unless legally obligated to do so (Williams may be legally obligated to take action and make certain disclosures.)
Integrity: Refrain from either actively or passively subverting the attainment of the organization's legitimate and ethical objectives. (Williams' avoidance of the issue would passively subvert attainment of ethical objectives.)
Communicate unfavorable as well as favorable information and professional judgments or opinions. (Williams is obligated to report his unfavorable findings to appropriate persons.)
Refrain from engaging in or supporting any activity that would discredit the profession. (Williams' silence would provide support to the dumping activity and, thus, could discredit the profession.)
Objectivity: Disclose fully all relevant information that could reasonably be expected to influence an intended user's understanding of the reports, comments, and recommendations presented. (Williams should disclose his findings to the appropriate persons.)
- (3) Alternative (a), to seek the advice of his immediate superior, is appropriate. This is the first step he is required to take, unless the superior is involved.
Alternative (b), communication of confidential information to persons outside the company, such as the local newspaper, is inappropriate unless there is a legal obligation to do so. If required by law, Williams should contact the proper authorities.
Alternative (c), contacting a member of the board of directors, would be inappropriate at this time. Williams should report the problem to successively higher levels within the company and turn to the board of directors only if the problem is not resolved at lower levels.

C1-1 (Concluded)

- (4) Williams should follow the company's established policies for resolving such issues, if such policies exist. If the issue is not resolved through existing policies, he should report the problem to successively higher levels within the company until it is resolved. (Williams is not required to report this action to his superior if his superior appears to be involved in the conflict. He is not to disclose the matter to persons outside the organization, unless required by law.) During these steps, Williams may clarify relevant concepts by confidential discussion with an objective advisor to obtain an understanding of possible courses of action. If the conflict is not resolved after exhausting all these courses of action, Williams may have no other recourse than to resign and submit an informative memorandum to an appropriate representative of the organization. Consultation with one's personal attorney is also appropriate.

C1-2

- (1) (The requirement does not ask which standards have been violated, but, rather, which ones apply to the CFO's behavior.)

Management accountants have a responsibility to:

Competence: Perform their professional duties in accordance with relevant laws, regulations, and technical standards. (The CFO has asked Deering to account for information in a way that is not in accordance with generally accepted accounting principles.)

Prepare complete and clear reports and recommendations after appropriate analyses of relevant and reliable information. (The CFO's restrictions on disclosure will result in incomplete reports.)

Confidentiality: Refrain from using or appearing to use confidential information acquired in the course of their work for unethical or illegal advantage, either personally or through third parties. (The CFO is attempting to use confidential information to protect the job security and bonuses of top management.)

Integrity: Avoid actual or apparent conflicts of interest and advise all appropriate parties of any potential conflict. (The CFO has failed to avoid a conflict of interest and has not informed the stockholders of the conflict.)

Refuse any gift, favor, or hospitality that would influence or would appear to influence their actions. (The CFO's bonus appears to be an influence on his actions.)

Refrain from either actively or passively subverting the attainment of the organization's legitimate and ethical objectives. (The CFO has subverted the attainment of the organization's legitimate objective, profit for stockholders, by pursuing, instead, the job security and bonuses of top management.)

Communicate unfavorable as well as favorable information and professional judgments or opinions. (The CFO is attempting to restrict disclosure of information about the acquisition.)

C1-2 (Continued)

Refrain from engaging in or supporting any activity that would discredit the profession. (The CFO's actions could discredit the profession.)

Objectivity: Communicate information fairly and objectively. (The CFO is attempting to unfairly control the information reported, resulting in a report that is not objective.)

Disclose fully all relevant information that could reasonably be expected to influence an intended user's understanding of the reports, comments, and recommendations presented. (The CFO is attempting to restrict disclosure of relevant information.)

- (2) (The requirement does not ask which standards have been violated, but, rather, which ones apply to Deerling's situation.)

Management accountants have a responsibility to:

Competence: Perform their professional duties in accordance with relevant laws, regulations, and technical standards. (Deerling is being asked to violate generally accepted accounting principles.)

Prepare complete and clear reports and recommendations after appropriate analyses of relevant and reliable information. (Deerling is being asked to prepare an incomplete report.)

Confidentiality: Refrain from using or appearing to use confidential information acquired in the course of their work for unethical or illegal advantage either personally or through third parties. (Deerling must not use the confidential information about the possible takeover to his own advantage or to that of the person(s) mounting the takeover attempt.)

Integrity: Refuse any gift, favor, or hospitality that would influence or would appear to influence their actions. (The last sentence of the case suggests that Deerling is considered a member of the top management group, so he may be eligible for a bonus.)

Refrain from either actively or passively subverting the attainment of the organization's legitimate and ethical objectives. (Deerling is being asked to subvert the attainment of the organization's legitimate objective, profit for stockholders, by pursuing instead the job security and bonuses of top management.)

Communicate unfavorable as well as favorable information and professional judgments or opinions. (Deerling is being asked to restrict disclosure of information about the acquisition.)

Refrain from engaging in or supporting any activity that would discredit the profession. (Deerling is being asked to take actions that could discredit the profession.)

Objectivity: Communicate information fairly and objectively. (Deerling is being asked to prepare a report that is not objective.)

Disclose fully all relevant information that could reasonably be expected to influence an intended user's understanding of the reports, comments, and recommendations presented. (Deerling is being asked to restrict disclosure of relevant information.)

C1-2 (Concluded)

- (3) If the company has established policies for dealing with such issues, Deerling should first follow these policies. If such policies do not exist, or if they are unsuccessful in resolving the problem, Deerling should present the problem to the chairman of the board. Deerling's immediate superior is involved, so he need not be informed of this action. If the matter remains unresolved, Deerling should report to the audit committee, the board of directors, and finally the majority owners. During these steps, Deerling may clarify relevant concepts by confidential discussion with an objective advisor to obtain an understanding of possible courses of action. If the conflict is not resolved after exhausting all these courses of action, Deerling may have no other recourse than to resign and submit an informative memorandum to an appropriate representative of the organization. Consultation with one's personal attorney is also appropriate.
- (4) The primary responsibility the company must fulfill before taking defensive actions is its fiduciary responsibility to stockholders. Other responsibilities include the effects that the takeover and defensive actions would have on creditors, bondholders, employees, customers, and the community. The company also has a responsibility to inform its external auditors and legal counsel to avoid putting them in a compromising position.

C1-3

- (1) (The requirement does not ask which standards have been violated, but, rather, which ones apply to Dixon's behavior.)

Management accountants have a responsibility to:

Competence: Maintain an appropriate level of professional competence by ongoing development of their knowledge and skills. (By systematically rejecting all minority applicants, Dixon is jeopardizing the level of competence among the staff.)

Perform their professional duties in accordance with relevant laws, regulations, and technical standards. (Equal opportunity in employment is required by law.)

Integrity: Avoid actual or apparent conflicts of interest and advise all appropriate parties of any potential conflict. (Dixon's prejudice is in conflict with the company's legal obligation to provide equal opportunity employment, and with the company's need for the most competent staff regardless of race.)

Refrain from either actively or passively subverting the attainment of the organization's legitimate and ethical objectives. (The company's objective of equal opportunity employment is being subverted by Dixon's prejudice.)

C1-3 (Concluded)

Refrain from engaging in or supporting any activity that would discredit the profession. (Such persistent, systematic discrimination in hiring could discredit the profession.)

- (2) (The requirement does not ask which standards have been violated, but rather, which ones apply to Foxworth's situation.) Because management accountants may not condone the commission of unethical acts by others within their organizations, all of the responsibilities listed in the solution to requirement (1) also apply to Foxworth's situation.

In addition, the following apply:

Management accountants have a responsibility to:

Confidentiality: Refrain from disclosing confidential information acquired in the course of their work except when authorized, unless legally obligated to do so. (Foxworth's suspicions about Dixon's behavior should not be disclosed inappropriately. See requirement (3)).

Objectivity: Communicate information fairly and objectively. (Foxworth is obligated to make objective hiring recommendations to Dixon, in spite of his belief that Dixon will be prejudiced in acting on them.)

- (3) Alternative (a), discussion with the director of personnel, who is one of Dixon's peers, is inappropriate at this time. If, however, Foxworth believes the director of personnel is an objective party, Foxworth may discuss the matter with the director, confidentially, to clarify the relevant concepts and to obtain an understanding of possible courses of action.

Alternative (b), informal discussion with a group of MAD senior management accountants, is inappropriate.

Alternative (c), private discussion with the CFO, Dixon's superior, is appropriate. Because Foxworth has already approached his immediate superior, Dixon, who is involved in the conflict, it is not necessary for Foxworth to inform him of this action.

- (4) Foxworth should follow the company's established policies for dealing with this type of conflict, if such policies exist. If policies do not exist, or if they are unsuccessful in resolving the conflict, Foxworth should discuss the issue with the CFO. If the matter remains unresolved, discussions with successively higher levels of management, including the audit committee and the board of directors, should follow. During these steps, Foxworth may discuss the matter confidentially with an objective advisor to clarify the relevant concepts and to obtain an understanding of possible courses of action. If the matter remains unresolved after exhausting all of these steps, Foxworth may have no recourse other than to resign and submit an informative memorandum to an appropriate representative of the company. Consultation with one's personal attorney is also appropriate.

C1-4

- (1) (The requirement does not ask for a list of responsibilities Rodriguez has violated, merely which of the fifteen responsibilities apply to his situation.)

Management accountants have a responsibility to :

Competence: Perform their professional duties in accordance with relevant laws, regulations, and technical standards. (The figures Rodriguez is being asked to prepare might amount to fraud in the loan application.)

Prepare complete and clear reports and recommendations after appropriate analyses of relevant and reliable information. (The reliability of the information is in doubt, and the fact that certain sales figures are or are not sufficient to justify the bank loan are not relevant to preparation of the budget.)

Integrity: Refrain from either actively or passively subverting the attainment of the organization's legitimate and ethical objectives. (There is a push to subvert legitimate objectives to the immediate need for a bank loan.)

Recognize and communicate professional limitations or other constraints that would preclude responsible judgement or successful performance of an activity. (Rodriguez has not expressed to Czeisla the conflict between his desire to be a team player and his ethical responsibilities.)

Communicate unfavorable as well as favorable information and professional judgements or opinions. (Rodriguez is being asked to report information that reflects so favorably on the company that it may not be justifiable.)

Refrain from engaging in or supporting any activity that would discredit the profession. (Preparing a deliberately misleading budget as part of a loan application could amount to obtaining money by fraud.)

Objectivity: Communicate information fairly and objectively. (Rodriguez feels pressured to abandon his objectivity in preparing the budget.)

Disclose fully all relevant information that could reasonably be expected to influence an intended user's understanding of the reports, comments, and recommendations presented. (A comparison of the new targeted sales figure with the actual sales of the corresponding periods of past years would be likely to influence the bank's understanding of just how large an increase in sales is being portrayed.)

- (2) Rodriguez could have clearly stated his concerns to Czeisla at each stage of the budget's creation and revision. He could have consulted with the marketing manager and production manager at every stage, rather than only upon receiving the initial budget data. He could present the budget, or a summary of it, in a comparative form to highlight the differences between each quarter's budget and the actual results of the corresponding quarter of the preceding year, and he could even

C1-4 (Concluded)

calculate the percentage increase being budgeted and compare it with actual percentage increases that were achieved annually in the past. He could have consulted with his staff superior at the headquarters of Northwestern (the parent company) — Czeisla is his line superior, according to the second sentence of the case.

- (3) In addition to his ethical responsibilities to CD, Rodriquez has ethical responsibilities to:
- (a) The banks
 - (b) The management accounting profession

C1-5

- (1) (The requirement does not ask for a list of responsibilities Jones has violated, merely which of the fifteen responsibilities apply to his situation.)

Management accountants have a responsibility to:

Confidentiality: Refrain from disclosing confidential information acquired in the course of their work except when authorized, unless legally obligated to do so. (If Jones accepts the consulting engagement with Crimson, it is likely she will be asked to disclose confidential SMI information about the desired computer system.)

Refrain from using or appearing to use confidential information acquired in the course of their work for unethical or illegal advantage either personally or through third parties. (The size of the consulting fee suggests Crimson is seeking to buy confidential information to help win the job.)

Integrity: Avoid actual or apparent conflicts of interest and advise all appropriate parties of any potential conflict. (The consulting job would constitute an apparent conflict of interest, and probably an actual one, because Jones has been named to the SMI committee that will evaluate and rank all the proposals, including Crimson's proposal, which she would have helped to write.)

Refrain from engaging in any activity that would prejudice their ability to carry out their duties ethically. (The consulting job with Crimson would prejudice Jones' ability to evaluate and rank the proposals for SMI, because one of the proposals would be Jones' own work.)

Refuse any gift, favor, or hospitality that would influence or would appear to influence their actions. (Regardless of whether the size of the consulting fee is construed as being a gift or favor, it is likely that other gifts, favors, or hospitality will be extended to Jones by Crimson during the course of the consulting engagement.)

Refrain from either actively or passively subverting the attainment of the organization's legitimate and ethical objectives. (SMI's legitimate objective of obtaining the best computer system at the best price would be subverted to Jones' personal need for money, as a result of Jones' disclosing crucial information for Crimson to include in its proposal, especially if Crimson might not deliver a system with the crucial attributes.)

C1-5 (Concluded)

Recognize and communicate professional limitations or other constraints that would preclude responsible judgment or successful performance of an activity. (Accepting the consulting job would preclude responsible judgment in evaluating and ranking the proposals for SMI; on the other hand, ethical limitations of Jones' employment at SMI would preclude successful performance of the consulting engagement for Crimson, especially if Crimson does expect her to reveal crucial information to help win the job—her ethical duty to SMI would prevent her from delivering what Crimson is paying for).

Refrain from engaging in or supporting any activity that would discredit the profession. (Selling confidential SMI information to a vendor would be a discreditable act.)

Objectivity: Communicate information fairly and objectively. (Jones would be unlikely to communicate objective evaluations of proposals if she had helped write one of them.)

Disclose fully all relevant information that could reasonably be expected to influence an intended user's understanding of the reports, comments, and recommendations presented. (Jones' role in writing the Crimson proposal would be relevant information in SMI's use of her evaluations of proposals.)

- (2) Jones might have disclosed, either orally or on her personal vita sheet or job application, the extent of her involvement on the SMI task force and the committee.
- (3) Jones could have first investigated all her career opportunities with firms that presented no potential conflict of interest of this kind, but for the sake of the argument, it is reasonable to assume she did exactly that before applying for a position at Crimson. Knowing that Crimson is a supplier of computer systems, Jones might have revised her personal vita sheet and the wording of her application for this one job interview to lessen the chances of Crimson's being tempted to pursue an unethical plan. (Of course, her involvement in SMI's upcoming purchase might have become known to Crimson anyway, or it might have been known to Crimson from other sources before her interview or even before her application for the position.)
- (4) In addition to her ethical responsibilities to SMI (and her financial responsibility to the hospital that provides treatment for her child), Jones has ethical responsibilities to:
 - (a) her family
 - (b) the management accounting profession
 - (c) Crimson

CHAPTER 2

DISCUSSION QUESTIONS

- Q2-1. (a) Cost is the current monetary value of economic resources given up or to be given up in obtaining goods and services. Economic resources may be given up by transferring cash or other property, issuing capital stock, performing services, or incurring liabilities.

Costs are classified as unexpired or expired. Unexpired costs are assets and apply to the production of future revenues. Examples of unexpired costs are inventories, prepaid expenses, plant and equipment, and investments. Expired costs, which most costs become eventually, are those that are not applicable to the production of future revenues and are deducted from current revenues or charged against retained earnings.

Expense in its broadest sense includes all expired costs; i.e., costs which do not have any potential future economic benefit. A more precise definition limits the use of the term "expense" to the expired costs arising from using or consuming goods and services in the process of obtaining revenues; e.g., cost of goods sold and marketing and administrative expenses.

- (b) (1) Cost of goods sold is an expired cost and may be referred to as an expense in the broad sense of the term. On the income statement, it is most often identified as a cost. Inventory held for sale which is destroyed by an abnormal casualty should be classified as a loss.

(2) Uncollectible accounts expense is usually classified as an expense. However, some authorities believe that it is more desirable to classify uncollectible accounts as a direct reduction of sales revenue (an offset to revenue). An uncollectible account which was not provided for in the annual adjustment, such as bankruptcy of a major debtor, may be classified as a loss.

(3) Depreciation expense for plant machinery is a component of factory overhead and represents the reclassification of a portion of the machinery cost to product cost (inventory). When the product is sold, the depreciation becomes a part of the cost of goods sold which is an expense. Depreciation of plant machinery during an unplanned and unproductive period of idleness, such as during a strike, should be classified as a loss. The term "expense"

should preferably be avoided when making reference to production costs.

(4) Organization costs are those costs that benefit the firm for its entire period of existence and are most appropriately classified as a noncurrent asset. When there is initial evidence that a firm's life is limited, the organization costs should be allocated over the firm's life as an expense or should be amortized as a loss when a going concern foresees termination. In practice, however, organization costs are often written off in the early years of a firm's existence.

(5) Spoiled goods resulting from normal manufacturing processing should be treated as a cost of the product manufactured. When the product is sold, the cost becomes an expense. Spoiled goods resulting from an abnormal occurrence should be classified as a loss.

- Q2-2. Cost objects are units for which an arrangement is made to accumulate and measure cost. They are important because of the need for multiple dimensions of data (e.g., by product, contract, or department) to accomplish the various purposes of cost accounting, including cost finding, planning, and control.

- Q2-3. (a) To classify costs as direct or indirect, the cost accountant must first know the answers to the questions "Directly traced to what?" and "Indirectly identified with what?" Otherwise, there is no way to assess the direct or indirect nature of a cost. It is the choice of a cost object that answers those two questions.

- (b) For example, the cost of a department's manager's salary cannot be classified as direct or indirect without selecting the cost object first. If the cost object is a product unit produced in the manager's department, then the salary is indirect. If the cost object is the department, the salary is direct.

- Q2-4. (a) The product unit, batch, or lot is the cost object. (Be careful about the lack of clarity of the term "the product" when it is not known whether it is intended to mean (a) a single unit, batch, or lot of a product, as opposed to (b) any large number of identical units. It could easily be taken to mean, say, product #321, as opposed to some other item in the company's catalog, and that could suggest the grand total of all identical pieces of #321 produced during

the entire product life cycle. The significance of this distinction is that some costs, such as product design, prototyping, and initial worker training, are direct costs with respect to the total of all units ever produced, but are indirect with respect to a single unit, batch, or lot.)

- (b) A disaggregation of overhead would be useful for any study of how to better manage costs, or of what causes costs to be incurred. Relatively few of the costs incurred in a factory are caused by the routine production of one more unit of one product.
 - (c) (1) A batch of identical units.
(2) The sum of all identical units ever produced.
(3) An activity or process carried out in production.
(4) A group or "cell" of machines and workers within a department.
(5) A department in which production occurs.
(6) A plant or other production facility.
(7) A strategic goal of the firm (e.g., improved quality).
- Q2-5. A cost system is a combination of procedures and records designed to provide the various types of information required in the conduct of the enterprise; including cost finding, planning, and control.
- Q2-6. A good information system requires the establishment of (a) long-range objectives; (b) an organization plan showing delegated responsibilities in detail; (c) detailed plans for future operations, both long- and short-term; and (d) procedures for implementing and controlling these plans.
- Q2-7. A chart of accounts is necessary to classify accounting data, so that the data may be uniformly recorded in journals and posted to the ledger accounts.
- Q2-8. Advantages of the electronic data processing system for record keeping are: speed, larger storage, single entry of multiple transactions, automatic control features, and flexibility in report formats.
- Q2-9. The following perceived weaknesses were mentioned in the text:
- (a) Traditional measures attempt to serve many purposes, and as a result they are not universally regarded as serving any one purpose ideally.
 - (b) Traditional measures are affected by accounting choices that are not always relevant to the purpose at hand; examples of these choices are cost flow assumptions and arbitrary fixed cost allocations.
 - (c) Traditional measures are calculated by systems that are usually slow to respond to changing conditions.
 - (d) Traditional measures of plant utilization can seem to encourage overutilization of capacity.
 - (e) Traditional measures of efficiency are often reported too late, are too aggregated, and are easy to misinterpret.
- Q2-10. Nonfinancial performance measures are based on simple counts or other physical data rather than allocated accounting data, they are unconnected to the general financial accounting system, and they are chosen to reflect one specific aspect of performance.
- Q2-11. Four examples of nonfinancial performance measures given in the text, and the aspects of performance they might be used to monitor, are
- (a) scrap weight as a percentage of total shipped weight; to monitor efficiency of a process, particularly efficiency of material usage
 - (b) processing time as a percentage of total time; to monitor cycle efficiency or inventory velocity
 - (c) distance moved by a unit while inside the plant; to monitor simplification of a process
 - (d) suggestions per year per employee; to monitor employee involvement
- Q2-12. The challenge posed by the increased interest in nonfinancial performance measures is to define the cost accountant's role broadly enough to include more measures that are not preceded by dollar signs and that are not tied to the financial accounting system.
- Q2-13. Costs are most commonly classified based on their relationship to
- (a) the product (a single batch, lot, or unit of the good or service);
 - (b) the volume of activity;
 - (c) the manufacturing departments, processes, cost centers, or other subdivisions;
 - (d) the accounting period;
 - (e) a proposed decision, action, or evaluation.
- Q2-14. Indirect materials are those materials needed for the completion of the product but whose consumption is either so small or so complex that their treatment as direct materials would not be feasible. For example, nails used to make the product are indirect materials.
- Q2-15. Indirect labor, in contrast to direct labor, is labor expended that does not affect the construction or the composition of the finished product. For example, the labor of custodians is indirect labor.
- Q2-16. (a) A service department is one that is not directly engaged in production, but renders a particular type of service for the benefit of other departments. Examples of service departments are receiving, storerooms, maintenance, timekeeping, payroll, and cafeteria.
- (b) Producing departments classify their share of service department expenses as indirect overhead expenses.

- Q2-17. (a) Capital expenditures are intended to benefit more than one accounting period. The expenditures should therefore be recorded by a charge to an asset account for allocation to the periods benefited.

Revenue expenditures benefit the operations of the current period only. They should be recorded by charges to the appropriate expense accounts.

- (b) If a capital expenditure is improperly classified as an expense, assets, retained earnings, and income for the period will be understated. In future periods, income will be overstated by any amount that would have been amortized had the expenditure been properly capitalized. Assets and retained earnings will be understated on future balance sheets by successively smaller amounts until the error has been fully counterbalanced.

If a revenue expenditure is improperly capitalized, assets, retained earnings, and income for the period will be overstated. Income will be understated in subsequent periods as the improperly capitalized item is charged to the operations of those periods. Assets and retained earnings will continue to be overstated in subsequent balance sheets by successively smaller

amounts until the improperly capitalized item has been completely written off.

- (c) The basic criterion for classifying outlays as revenue or capital expenditures is the period of benefit. The amount of detail necessary to maintain subsidiary records, the materiality of the expenditures, and the consistency with which various expenditures recur from period to period are other criteria generally considered in establishing a capitalization policy.

Firms frequently establish an arbitrary amount below which all expenditures are expensed, irrespective of their period of benefit. The level at which this amount is set is determined by its materiality in relation to the size of the firm. The objective of such a policy is to avoid the expense of maintaining excessively detailed subsidiary records. Expenditures for items that fall below the set amount but are material in the aggregate should be capitalized, if total expenditures for these items vary significantly from period to period. A capitalization policy that reasonably applies these criteria, although it disregards the period of benefit and is therefore lacking in theoretical justification, will not significantly misstate periodic income.

EXERCISES

- E2-1 (1) $\$6 + \$3 = \$9$ prime cost
 (2) $\$3 + \$1 = \$4$ variable conversion cost
 (3) $\$6 + \$3 + \$1 = \10 variable manufacturing cost
 (4) $\$1,000 \text{ fixed} + (\$10 \times 500) = \$6,000$

- E2-2 (1) $\$10 + \$15 + \$6 = \31 conversion cost
 (2) $\$32 + \$10 = \$42$ prime cost
 (3) $\$32 + \$10 + \$15 + \$3 = \$60$ variable cost
 (4) $((\$32 + \$10 + \$15 + \$6 + \$5) \times 12,000)$
 $+ (\$3 \times 8,000) = \$816,000 + \$24,000$
 $= \$840,000$ total cost incurred with 12,000
 units produced and 8,000 units sold

E2-3 First Method:

Sales ($\$19,950,000 \times 85\%$).....		\$16,957,500
Less: Variable costs ($\$11,571,000 \times 85\%$)...	\$9,835,350	
Fixed costs	<u>7,623,000</u>	<u>17,458,350</u>
Operating loss		<u>\$ (500,850)</u>

Second Method:

1st Step: $\frac{\text{Variable costs } \$11,571,000}{19A \text{ sales } \$19,950,000} = .58 \text{ variable cost ratio}$

2nd Step:

Sales ($\$19,950,000 \times 85\%$).....		\$16,957,500
Less: Variable costs ($\$16,957,500 \times .58$).....	\$9,835,350	
Fixed costs	<u>7,623,000</u>	<u>17,458,350</u>
Operating loss		<u>\$ (500,850)</u>

- E2-4 1. d
 2. b
 3. b
 4. a
 5. f
 6. e
 7. c
 8. f

E2-5 The cost of direct labor per computer is \$100,000, calculated as follows:

Total manufacturing cost.....	\$600,000	(given)
Less prime cost	<u>300,000</u>	(given)
Equals overhead cost	<u>\$300,000</u>	
Conversion cost.....	\$400,000	(given)
Less overhead cost	<u>300,000</u>	(calculated above)
Equals direct labor	<u>\$100,000</u>	

E2-6 The amount of factory overhead cost per blade is \$300, calculated as follows:

Total manufacturing cost.....	\$1,000	(given)
Less conversion cost.....	<u>400</u>	(given)
Equals direct material cost.....	<u>\$ 600</u>	
Direct labor cost = 1/6 of direct material cost = 1/6 x \$600 = \$100		
Conversion cost.....	\$400	(given)
Less direct labor cost.....	<u>100</u>	(calculated above)
Equals overhead cost	<u>\$300</u>	

E2-7 The direct labor cost per system is \$200, calculated as follows:

Total manufacturing costs	\$1,000	(given)
Less prime cost	<u>800</u>	(given)
Equals overhead cost	<u>\$ 200</u>	
Conversion cost.....	\$400	(given)
Less overhead cost	<u>200</u>	(calculated above)
Equals direct labor cost.....	<u>\$200</u>	

E2-8 The amount of factory overhead cost per machine is \$1,500, calculated as follows:

Total manufacturing cost.....	\$3,000	(given)
Less conversion cost.....	<u>2,000</u>	(given)
Equals direct material cost.....	<u>\$1,000</u>	

Direct labor cost = 1/2 of direct material cost
 = 1/2 x \$1,000 = \$500

Conversion cost.....	\$2,000	(given)
Less direct labor cost.....	<u>500</u>	(calculated above)
Equals overhead cost	<u>\$1,500</u>	

E2-9

- (1) The relevant cost objects are:
 - (a) An item of merchandise.
 - (b) The use of a bank credit card.
- (2) It implies that cash-paying customers are paying a part of the cost of the banks' fees for processing credit card transactions, because these fees are paid by the merchant who then recovers them in the form of slightly higher prices for all merchandise.
- (3) The competitive implications are that the prices paid by cash customers are too high to be competitive with the prices charged by merchants who deal only in cash, and the prices paid by customers using bank credit cards are too low to reflect all the costs of a credit sale.
- (4) The reason for not reducing all prices and charging extra for the use of a credit card is because of the psychological effect of an extra charge. To customers, it sounds like a penalty, as if the merchant wants to discourage the use of bank credit cards. A discount for cash customers has a positive connotation, even if prices marked on merchandise are higher to begin with. Raising all prices and offering a cash discount yields the same net revenue as leaving prices alone and charging extra for using a bank credit card, but the former method feels better to the customer than the latter.

E2-10

- (1) The relevant cost objects are:
 (a) A repair.
 (b) A pickup and delivery.
- (2) JTRS's repair prices include an allocation of the cost of picking up and delivering tractors, in addition to the cost of the repairs, administrative costs, marketing costs, and profit. Competitors' repair prices reflect only the cost of the repairs, administrative and marketing costs, and profit. Competitors should be able to price their repair services lower, because they do not have to reflect pickup and delivery costs in repair prices.

E2-11

(1)	Direct labor	\$
	Variable factory overhead	
	Fixed factory overhead	4
	Conversion cost	<u>\$11</u>
(2)	Direct material (lumber)	\$12
	Direct labor	2
	Prime cost	<u>\$14</u>
(3)	Direct material (lumber)	\$12
	Direct labor	2
	Variable factory overhead	5
	Variable manufacturing cost	<u>\$19</u>
(4)	Direct material (lumber)	\$12
	Direct labor	2
	Variable factory overhead	5
	Variable marketing	1
	Total variable cost	<u>\$20</u>

E2-11 (Concluded)

$$\begin{aligned}
 (5) \quad \text{Total cost} &= \text{total variable manufacturing cost} \\
 &\quad + \text{total variable marketing cost} \\
 &\quad + \text{total fixed cost} \\
 &= 2,000 \times (\$12 + \$2 + \$5) \\
 &\quad + 1,900 \times \$1 \\
 &\quad + 2,000^* \times (\$4 + \$3.50) \\
 &= \$38,000 + \$1,900 + \$15,000 \\
 &= \$54,900
 \end{aligned}$$

* The volume used here to calculate total fixed cost is the 2,000-unit volume level that was used originally to calculate the amounts of fixed costs per unit, as stated in the data given in the exercise. The 2,000-unit level of production stated in requirement (5) is not the reason that 2,000 is used here to calculate total fixed cost.

- (6) The data indicate the bookcases are made of lumber, and some examples of the indirect materials used in making wooden bookcases would be glue, sandpaper, and nails.
- (7) An estimate of costs referred to in the answer to requirement (6) would be included in the variable factory overhead of \$5 per unit.

E2-12 Factory overhead = $\frac{1}{3}$ x prime cost, so:

$$\begin{aligned}
 \text{Total manufacturing cost} &= \text{prime cost} + \text{factory overhead} \\
 &= \text{prime cost} + \left(\frac{1}{3} \times \text{prime cost}\right) \\
 &= \frac{4}{3} \times \text{prime cost};
 \end{aligned}$$

multiplying both sides by $\frac{3}{4}$ gives:

$$\begin{aligned}
 \frac{3}{4} \times \text{Total manufacturing cost} &= \frac{3}{4} \times \frac{4}{3} \times \text{prime cost} \\
 \frac{3}{4} \times \$20,000 &= 1 \times \text{prime cost} \\
 \$15,000 &= \text{prime cost.}
 \end{aligned}$$

Prime cost	\$15,000	
Less direct material cost	12,000	(given)
Direct labor cost	<u>\$ 3,000</u>	

CASES

C2-1

- (1) The percentage profit margin will be 82.5%, calculated as follows:

Revenues (\$2 x 4)		\$8.00
Cost of juice (\$.20 x 4)	\$.80	
Cost of one delivery	<u>.60</u>	<u>1.40</u>
Profit		<u>\$6.60</u>

Percentage profit margin = \$6.60 profit divided by \$8 revenue = 82.5%.

- (2) The percentage profit margin will be 60%, calculated as follows:

Revenues (\$2 x 1)		\$2.00
Cost of juice (\$.20 x 1)	\$.20	
Cost of one delivery	<u>.60</u>	<u>.80</u>
Profit		<u>\$1.20</u>

Percentage profit margin = \$1.20 profit divided by \$2 revenue = 60%.

- (3) The manager is treating the menu item as the cost object, for example, one glass of orange juice.
- (4) The refinement of the definition of cost object that would result in the planned profit margin is the use of two different kinds of cost object, the item and the delivery, which can be priced separately at \$.80 and \$2.40, respectively.

C2-1 (Concluded)

- (5) For an order consisting of four glasses of orange juice, the profit margin will be 75%, calculated as follows:

Revenues:	(\$.80 x 4)	\$3.20
	+ (\$2.40 x 1)	<u>2.40</u>
		\$5.60
Cost of juice (\$.20 x 4)	\$.80	
Cost of one delivery	<u>.60</u>	<u>1.40</u>
Profit		<u>\$4.20</u>

Percentage profit margin = \$4.20 profit divided by \$5.60 revenue = 75%.

For an order consisting of one glass of orange juice, the profit margin will also be 75%, calculated as follows:

Revenues:	(\$.80 x 1)	\$.80
	+ (\$2.40 x 1)	<u>2.40</u>
		\$3.20
Cost of juice	\$.20	
Cost of one delivery	<u>.60</u>	<u>.80</u>
Profit		<u>\$2.40</u>

Percentage profit margin = \$2.40 profit divided by \$3.20 revenue = 75%.

- (6) The food service manager's plan allocates the delivery costs over an arbitrarily selected number of items (two). This plan would result in higher-than-planned profit margin percentages on room service orders that contain more than two items, as demonstrated in the answer to requirement (1). Prices on these orders would be higher than those of a competitor who traces costs more carefully to cost objects and sets prices accordingly. The plan would also result in lower-than-planned profit margins on room service orders containing only one item, as demonstrated in the answer to requirement (2). Prices on these orders would be lower than what is needed to achieve the target profitability.

C2-2

- (1) The cost objects for which some amount of cost is identified in the case, and the amount of cost identified for each, are:
- (a) A new product variation, Zeggo (which means all units of Zeggo ever to be produced), \$250,000.
 - (b) A batch of Zeggo, \$1,000.
 - (c) A unit of Zeggo, $\$5 + \$10 = \$15$. (Notice the \$10 indirect cost amount includes all indirect production costs, so it must include the \$1 amount stated in the problem, along with an allocation or averaging of the \$1,000-per-batch setup costs, a share of the \$250,000 cost amount, and a share of any other indirect manufacturing costs. It would be double-counting to add the \$1 and arrive at a total of \$16 per unit.)
- (2) The other items mentioned in the case that could serve as cost objects, and a purpose each one could serve, are:
- (a) CCN Company, which is the relevant cost object when external financial statements are prepared.
 - (b) The assembly line on which Zeggo and other products are to be produced. This cost object would be relevant in a decision on whether to discontinue production of all the products produced on the particular line, or a decision to shut down the line and shift its production to other lines due to a reduction in customer orders.
- (3) The total cost expected to result from producing the first batch of 300 units of Zeggo is:
- | | | | |
|--|----|-----------------------|-------|
| Cost accounted for as direct cost of a unit..... | \$ | 5 | |
| Cost treated as indirect by the CCN system | | 1 | |
| | | <u>\$ 6</u> | |
| | | x 300 | units |
| | | <u>\$1,800</u> | |
| Add: setup cost | | 1,000 | |
| Total cost..... | | <u><u>\$2,800</u></u> | |
- (4) The cost expected to result from producing one more unit of Zeggo is \$5 + \$1 = \$6.
- (5) For the first batch of 300 units, the CCN cost accounting system will report a cost of:
 (\$5 direct cost + \$10 indirect cost allocation) x 300 units = \$15 x 300 = \$4,500

CHAPTER 3

DISCUSSION QUESTIONS

- Q3-1. The total dollar amount of a fixed cost is constant at different levels of activity within the relevant range, but fixed cost per unit of activity varies. In contrast, the total amount of a variable cost varies at different levels of activity, but the variable cost per unit remains constant within the relevant range. A semivariable cost contains both fixed and variable elements. Consequently, both total semivariable cost and semivariable cost per unit vary with changes in activity.
- Q3-2. The relevant range is the range of activity over which a fixed cost remains constant in total or a variable cost remains constant per unit of activity. The underlying assumptions about the relationship of the activity and the incurrence of cost change outside the relevant range of activity. Consequently, the amount of fixed cost or the variable cost rate must be recomputed for activity above or below the relevant range.
- Q3-3. The fixed and variable components of a semivariable cost should be segregated in order to plan, analyze, control, measure, and evaluate costs at different levels of activity. Separation of the fixed and variable components of semivariable cost is necessary to:
- (a) compute predetermined factory overhead rates and analyze variances;
 - (b) prepare flexible budgets and analyze variances;
 - (c) analyze direct cost and the contribution margin;
 - (d) determine the break-even point and analyze the effect of volume on cost and profit;
 - (e) compute differential cost and make comparative cost analyses;
 - (f) maximize short-run profits and minimize short-run costs;
 - (g) budget capital expenditures;
 - (h) analyze marketing profitability by territories, products, and customers.
- Q3-4. The obvious advantage to using managerial judgement to separate fixed and variable costs is expediency, i.e., it requires less time and is, therefore, less costly than the use of any of the three computational methods. The disadvantage is that the use of managerial judgement to separate fixed and variable costs often results in unreliable estimates of cost. Cost behavior is not always readily apparent from casual observation. As a consequence, managers often err in determining whether a cost is fixed or variable and frequently ignore the possibility that some costs are semivariable.
- Q3-5. The three computational methods available for separating the fixed and variable components of semivariable costs are: (1) the high and low points method; (2) the statistical scattergraph method; and (3) the method of least squares.
- Q3-6. The high and low points method has the advantage of being simple to compute, but it has the disadvantage of using only two data points in the computation, thereby resulting in a significant potential for bias and inaccuracy in cost estimates. The scattergraph has the advantage of using all of the available data, but it has the disadvantage of determining the fixed and variable components on the basis of a line drawn by visual inspection through a plot of the data, thereby resulting in bias and inaccuracy in cost estimates. The method of least squares has the advantage of accurately describing a line through all the available data, thereby resulting in unbiased estimates of the fixed and variable elements of cost, but it has the increased disadvantage of computational complexity.
- Q3-7. The \$200 in the equation, referred to as the y intercept, is an estimate of the fixed portion of indirect supplies cost. The \$4 in the equation, referred to as the slope of the regression equation, is an estimate of the variable cost associated with a unit change in machine hours. These estimates may not be perfectly accurate because they were derived from a sample of data that may not be entirely representative of the universe population, and because activities not included in the regression equation may have some influence on the cost being predicted.
- Q3-8. The coefficient of correlation, denoted r , is a measure of the extent to which two variables are related linearly. It is a measure of the covariation of the dependent and independent variables, and its sign indicates whether the independent variable has a positive or negative relationship to the dependent variable. The coefficient of determination is the square of the coefficient of correlation and is denoted r^2 . The coefficient of determination is a more easily interpreted measure of the covariation than is the coefficient of correlation, because it represents the percentage of variation in the dependent variable explained by the independent variable.
- Q3-9. The standard error of the estimate is defined as the standard deviation about the regression line. It is essentially a measure of the variability of the actual observations of the dependent variable from the points predicted on the regression line. A small value for the standard error of the estimate indicates a good fit. A standard error of zero would indicate a perfect fit, i.e., all actual observations would be on the regression line.

- Q3-10. Heteroscedasticity means that the distribution of observations around the regression line is not uniform for all values of the independent variable. If heteroscedasticity is present, the standard error of the estimate and confidence interval estimates, based on the standard error, are unreliable measures.
- Q3-11. Serial correlation means that rather than being random, the observations around the regression line are correlated with one another. If serial correlation is present, the standard error of the estimate and confidence interval estimates, based on the standard error, are unreliable measures.
- Q3-12. Multicollinearity means that two or more of the independent variables in a multiple regression analysis are correlated with one another. When the degree of multicollinearity is high, the relationship between one or more of the correlated independent variables and the dependent variable may be obscured. However, this circumstance would normally not affect the estimate of cost.

EXERCISES

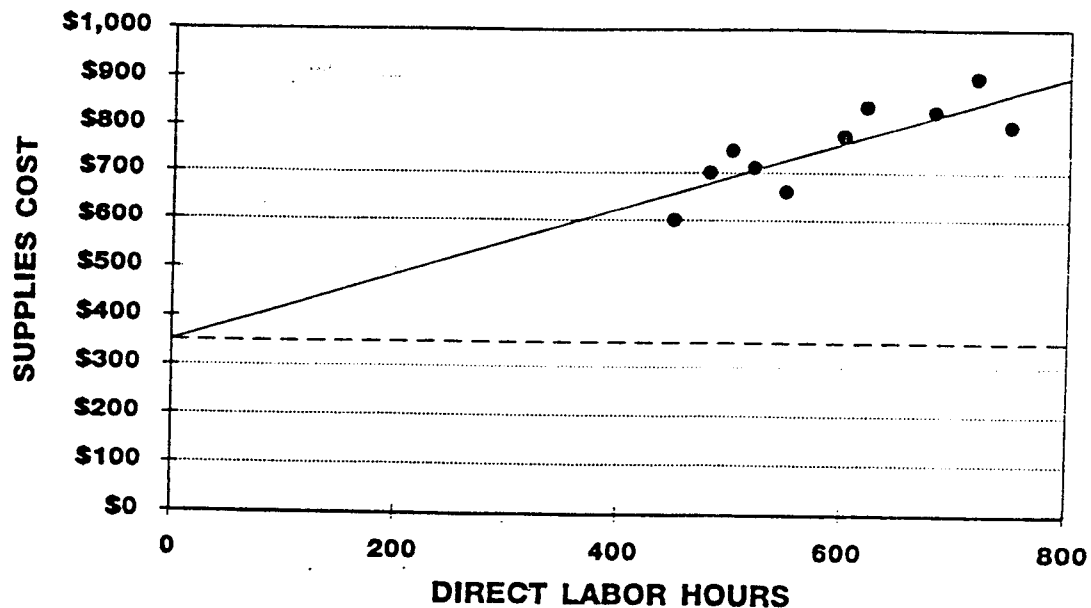
E3-1

	Activity Level	Cost
High	2,600 hours	\$1,300
Low	2,100	1,100
Difference	<u>500</u> hours	<u>\$ 200</u>

Variable rate: $\$200 \div 500 \text{ machine hours} = \$0.40 \text{ per machine hour}$

	High	Low
Total cost.....	\$1,300	\$1,100
Variable cost:		
$\$.40 \times 2,600 \text{ hours}$	1,040	
$\$.40 \times 2,100 \text{ hours}$		840
Fixed cost.....	<u>\$ 260</u>	<u>\$ 260</u>

E3-2



Average cost (\$7,575 total + 10 months).....	\$757.50
Fixed cost per month	<u>350.00</u>
Average total variable cost.....	<u>\$407.50</u>

$$\frac{\$407.50 \text{ average total variable cost}}{5,875 \text{ total direct labor hours} + 10 \text{ months}} = \$0.6936 \text{ variable cost per direct labor hour}$$

E3-3

$$b = \frac{\Sigma(x_i - \bar{x})(y_i - \bar{y})}{\Sigma(x_i - \bar{x})^2} = \frac{87,000}{1,450} = \$60$$

$$a = \bar{y} - b\bar{x} = \$10,000 - (\$60 \times 125) = \$2,500$$

Travel and entertainment expense for 200 sales calls would be:

$$y_i = a + bx_i = \$2,500 + (\$60 \times 200 \text{ calls}) = \$14,500$$

E3-4

	(1) y	(2) (y - \bar{y})	(3) x	(4) (x - \bar{x})	(5) (x - \bar{x}) ²	(6) (x - \bar{x})(y - \bar{y})
Month	Electricity Cost	Cost Deviation	Machine Hours	Activity Deviation	(4) Squared	(4) x (2)
January.....	\$ 1,600	100	2,790	190	36,100	19,000
February	1,510	10	2,680	80	6,400	800
March.....	1,500	0	2,600	0	0	0
April	1,450	(50)	2,500	(100)	10,000	5,000
May	1,460	(40)	2,510	(90)	8,100	3,600
June.....	1,520	20	2,610	10	100	200
July	1,570	70	2,750	150	22,500	10,500
August	1,530	30	2,700	100	10,000	3,000
September .	1,480	(20)	2,530	(70)	4,900	1,400
October.....	1,470	(30)	2,520	(80)	6,400	2,400
November ..	1,450	(50)	2,490	(110)	12,100	5,500
December ..	1,460	(40)	2,520	(80)	6,400	3,200
Total.....	<u>\$18,000</u>	<u>0</u>	<u>31,200</u>	<u>0</u>	<u>123,000</u>	<u>54,600</u>

$$\bar{y} = \Sigma y + n = \$18,000 + 12 = \$1,500$$

$$\bar{x} = \Sigma x + n = 31,200 + 12 = 2,600$$

$$\text{Variable rate (b)} = \frac{\Sigma(x - \bar{x})(y - \bar{y})}{\Sigma(x - \bar{x})^2} = \frac{\text{Column 6 total}}{\text{Column 5 total}} = \frac{54,600}{123,000} = \$0.44$$

$$\begin{aligned} \text{Fixed cost (a)} &= \bar{y} - b\bar{x} \\ &= \$1,500 - (\$0.44)(2,600) \\ &= \$356 \end{aligned}$$

E3-5

$$r = \frac{\Sigma(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\Sigma(x_i - \bar{x})^2 \Sigma(y_i - \bar{y})^2}} = \frac{1,564}{\sqrt{(850)(3,400)}} = .92$$

$$r^2 = (.92)^2 = .8464$$

E3-6

	(1) y Shipping Expense	(2) (y - \bar{y}) Expense Deviations	(3) x Sales Revenue	(4) (x - \bar{x}) Activity Deviations	(5) (x - \bar{x}) ² (4) Squared	(6) (x - \bar{x})(y - \bar{y}) (4) x (2)	(7) (y - \bar{y}) ² (2) Squared
Month							
January	\$ 560	(40)	\$ 26,500	(3,500)	12,250,000	140,000	1,600
February	600	0	30,000	0	0	0	0
March	600	0	29,000	(1,000)	1,000,000	0	0
April	580	(20)	28,000	(2,000)	4,000,000	40,000	400
May	570	(30)	27,000	(3,000)	9,000,000	90,000	900
June	550	(50)	25,500	(4,500)	20,250,000	225,000	2,500
July	590	(10)	30,000	0	0	0	100
August	610	10	33,000	3,000	9,000,000	30,000	100
September ..	650	50	35,000	5,000	25,000,000	250,000	2,500
October	620	20	32,000	2,000	4,000,000	40,000	400
November ..	630	30	30,500	500	250,000	15,000	900
December ..	640	40	33,500	3,500	12,250,000	140,000	1,600
Total	<u>\$7,200</u>	<u>0</u>	<u>\$360,000</u>	<u>0</u>	<u>97,000,000</u>	<u>970,000</u>	<u>11,000</u>

$$\bar{y} = \Sigma y + n = \$7,200 + 12 = \$600$$

$$\bar{x} = \Sigma x + n = \$360,000 + 12 = \$30,000$$

$$r = \frac{\Sigma(x - \bar{x})(y - \bar{y})}{\sqrt{\Sigma(x_i - \bar{x})^2 \Sigma(y_i - \bar{y})^2}} = \frac{970,000}{\sqrt{(97,000,000)(11,000)}} = .939$$

$$r^2 = (.939)^2 = .882$$

E3-7

(1)

$$r = \frac{\Sigma(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\Sigma(x_i - \bar{x})^2 \Sigma(y_i - \bar{y})^2}} = \frac{2,400}{\sqrt{(6,250)(1,000)}} = .96$$

$$r^2 = (.96)^2 = .9216$$

(2)

$$b = \frac{\Sigma(x_i - \bar{x})(y_i - \bar{y})}{\Sigma(x_i - \bar{x})^2} = \frac{2,400}{6,250} = \text{\$}.384 \text{ variable maintenance cost per machine hour}$$

(3)

$$\bar{y} = \Sigma y_i / n = \$50,000 / 10 = \$5,000$$

$$\bar{x} = \Sigma x_i / n = 40,000 / 10 = 4,000 \text{ hours}$$

Since $\bar{y} = a + b\bar{x}$, then:

$$a = \bar{y} - b\bar{x}$$

$$a = \$5,000 - (\text{\$}.384)(4,000)$$

$$a = \$5,000 - \$1,536$$

$$a = \$3,464$$

E3-8

(1)

For electricity cost and direct labor hours:

$$r = \frac{\Sigma(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\Sigma(x_i - \bar{x})^2 \Sigma(y_i - \bar{y})^2}} = \frac{5,700}{\sqrt{(28,500)(1,264)}} = \frac{5,700}{6,002} = .9497$$

$$r^2 = (.9497)^2 = .9019$$

(2)

For electricity cost and machine hours:

$$r = \frac{\Sigma(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\Sigma(x_i - \bar{x})^2 \Sigma(y_i - \bar{y})^2}} = \frac{7,000}{\sqrt{(50,000)(1,264)}} = \frac{7,000}{7,950} = .8805$$

$$r^2 = (.8805)^2 = .7753$$

(3)

In this case, direct labor hours should be chosen as the appropriate activity measure to be used in predicting electricity cost because the coefficient of determination ($r^2 = .9019$) is higher than that for machine hours ($r^2 = .7753$).

E3-8 (Concluded)

$$(4) \quad b = \frac{\Sigma(x_i - \bar{x})(y_i - \bar{y})}{\Sigma(x_i - \bar{x})^2} = \frac{5,700}{28,500} = \text{\$.20 variable electricity cost rate}$$

Since $\bar{y} = a + b\bar{x}$ and $\bar{y} = \Sigma y_i / n$ and $\bar{x} = \Sigma x_i / n$, then:

$$a = (\Sigma y_i / n) - b(\Sigma x_i / n)$$

$$a = (42,000 / 20) - (.20)(180,000 / 20)$$

$$a = 2,100 - (.20)(9,000)$$

$$a = 2,100 - 1,800 = \text{\$300 fixed electricity cost}$$

E3-9

	(1) x_i	(2) y_i Actual Utility Cost	(3) $(y'_i = a + bx_i)$ Predicted Utility Cost	(4) $(y_i - y'_i)$ Prediction Error (2) - (3)	(5) $(y_i - y'_i)^2$ (4) Squared
Month	Labor Hours				
January	2,650	\$ 3,600	\$ 3,650	(50)	\$ 2,500
February	3,000	4,000	4,000	0	0
March	2,900	4,000	3,900	100	10,000
April	2,800	3,800	3,800	0	0
May	2,700	3,700	3,700	0	0
June	2,550	3,500	3,550	(50)	2,500
July	3,000	3,900	4,000	(100)	10,000
August	3,300	4,100	4,300	(200)	40,000
September	3,500	4,500	4,500	0	0
October	3,200	4,200	4,200	0	0
November	3,050	4,300	4,050	250	62,500
December	3,350	4,400	4,350	50	2,500
Total	<u>36,000</u>	<u>\$48,000</u>	<u>\$48,000</u>	<u>0</u>	<u>\$130,000</u>

$$s' = \sqrt{\frac{\Sigma(y_i - y'_i)^2}{n - 2}} = \sqrt{\frac{\text{Column 5 total}}{12 - 2}} = \sqrt{\frac{\$130,000}{10}} = \$114.018$$

E3-10

$$s' = \sqrt{\frac{\sum (y_i - y'_i)^2}{n - 2}} = \sqrt{\frac{\$49,972}{15 - 2}} = \sqrt{3,844} = \$62$$

The 90 percent confidence interval estimate at the 1,500-hour level of activity would be:

$$y'_i \pm t_{90\%} s' \sqrt{1 + \frac{1}{n} + \frac{(x_i - \bar{x})^2}{\sum (x_i - \bar{x})^2}}$$

$$\$500 \pm (1.771)(\$62) \sqrt{1 + \frac{1}{15} + \frac{(1,500 - 1,300)^2}{150,000}}$$

$$\$500 \pm (1.771)(\$62) \sqrt{1.3333}$$

$$\$500 \pm (1.771)(\$62)(1.1547)$$

$$\$500 \pm \$126.79$$

PROBLEMS

P3-1

- (1) Coefficient of correlation and coefficient of determination between:
 (a) Travel expenses and the number of calls made:

	(1) <i>y</i> Travel Expense	(2) <i>(y - \bar{y})</i> Expense Deviations	(3) <i>x</i> Calls Made	(4) <i>(x - \bar{x})</i> Activity Deviations	(5) <i>(x - \bar{x})²</i> (4) Squared	(6) <i>(x - \bar{x})(y - \bar{y})</i> (4) x (2)	(7) <i>(y - \bar{y})²</i> (2) Squared
Month	Expense	Deviations	Made	Deviations	(4) Squared	(4) x (2)	(2) Squared
January.....	\$ 3,000	(200)	410	(30)	900	6,000	40,000
February.....	3,200	0	420	(20)	400	0	0
March.....	2,800	(400)	380	(60)	3,600	24,000	160,000
April.....	3,400	200	460	20	400	4,000	40,000
May.....	3,100	(100)	430	(10)	100	1,000	10,000
June.....	3,200	0	450	10	100	0	0
July.....	2,900	(300)	390	(50)	2,500	15,000	90,000
August.....	3,300	100	470	30	900	3,000	10,000
September.....	3,500	300	480	40	1,600	12,000	90,000
October.....	3,400	200	490	50	2,500	10,000	40,000
November.....	3,200	0	440	0	0	0	0
December.....	3,400	200	460	20	400	4,000	40,000
Total.....	<u>\$38,400</u>	<u>0</u>	<u>5,280</u>	<u>0</u>	<u>13,400</u>	<u>79,000</u>	<u>520,000</u>

$$r = \frac{\Sigma(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\Sigma(x_i - \bar{x})^2 \Sigma(y_i - \bar{y})^2}} = \frac{\text{Column 6 total}}{\sqrt{(\text{Column 5 total})(\text{Column 7 total})}}$$

$$r = \frac{79,000}{\sqrt{(13,400)(520,000)}} = \frac{79,000}{\sqrt{6,968,000,000}}$$

$$r = \frac{79,000}{83,475} = .9464$$

$$r^2 = .8957$$

P3-1 (Concluded)

(b) Travel expenses and orders received:

Month	(1) y Travel Expense	(2) (y - \bar{y}) Expense Deviations	(3) x Orders Received	(4) (x - \bar{x}) Activity Deviations	(5) (x - \bar{x}) ² (4) Squared	(6) (x - \bar{x})(y - \bar{y}) (4) x (2)	(7) (y - \bar{y}) ² (2) Squared
January.....	\$ 3,000	(200)	\$ 53,000	(13,000)	169,000,000	2,600,000	40,000
February	3,200	0	65,000	(1,000)	1,000,000	0	0
March	2,800	(400)	48,000	(18,000)	324,000,000	7,200,000	160,000
April	3,400	200	73,000	7,000	49,000,000	1,400,000	40,000
May	3,100	(100)	62,000	(4,000)	16,000,000	400,000	10,000
June.....	3,200	0	67,000	1,000	1,000,000	0	0
July	2,900	(300)	60,000	(6,000)	36,000,000	1,800,000	90,000
August	3,300	100	76,000	10,000	100,000,000	1,000,000	10,000
September..	3,500	300	82,000	16,000	256,000,000	4,800,000	90,000
October.....	3,400	200	62,000	(4,000)	16,000,000	(800,000)	40,000
November ..	3,200	0	64,000	(2,000)	4,000,000	0	0
December ..	3,400	200	80,000	14,000	196,000,000	2,800,000	40,000
Total	<u>\$38,400</u>	<u>0</u>	<u>\$792,000</u>	<u>0</u>	<u>1,168,000,000</u>	<u>21,200,000</u>	<u>520,000</u>

$$r = \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum (x_i - \bar{x})^2 \sum (y_i - \bar{y})^2}} = \frac{\text{Column 6 total}}{\sqrt{(\text{Column 5 total})(\text{Column 7 total})}}$$

$$= \frac{21,200,000}{\sqrt{(1,168,000,000)(520,000)}} = \frac{21,200,000}{\sqrt{607,360,000,000}}$$

$$= \frac{21,200,000}{24,644,675} = .8602$$

$$r^2 = .7399$$

- (2) Perfect direct correlation would be evidenced by a correlation coefficient of one. The coefficient of .9464 revealed in (1)(a) is closer to one than the coefficient of .8602 in (1)(b). This means that the variable portion of travel expense varies more directly with movements in the number of calls made than with the value of orders received. To explain this further, the relative coefficients of determination are obtained by squaring the coefficients of correlation and expressing the answer as a percentage in each case. The coefficients of determination are 89.57% for calls made and only 73.99% for orders received. This means that approximately 90% of the movements in the variable portion of travel expense are related to fluctuations in the number of calls made, and the remaining 10% of the movements are related to other factors.

P3-2

(1)	(1) y Supplies Cost	(2) (y - \bar{y}) Cost Deviations	(3) x Labor Hours	(4) (x - \bar{x}) Activity Deviations	(5) (x - \bar{x}) ² (4) Squared	(6) (x - \bar{x})(y - \bar{y}) (4) x (2)	(7) (y - \bar{y}) ² (2) Squared
Month							
January.....	\$ 1,505	5	5,000	0	0	0	25
February	1,395	(105)	4,600	(400)	160,000	42,000	11,025
March	1,565	65	5,160	160	25,600	10,400	4,225
April	1,515	15	5,100	100	10,000	1,500	225
May	1,445	(55)	4,830	(170)	28,900	9,350	3,025
June.....	1,415	(85)	4,750	(250)	62,500	21,250	7,225
July.....	1,465	(35)	4,900	(100)	10,000	3,500	1,225
August	1,505	5	5,080	80	6,400	400	25
September .	1,575	75	5,200	200	40,000	15,000	5,625
October.....	1,535	35	5,130	130	16,900	4,550	1,225
November ..	1,500	0	4,950	(50)	2,500	0	0
December ..	1,580	80	5,300	300	90,000	24,000	6,400
Total	<u>\$18,000</u>	<u>0</u>	<u>60,000</u>	<u>0</u>	<u>452,800</u>	<u>131,950</u>	<u>40,250</u>

$$\bar{y} = \Sigma y + n = \$18,000 + 12 = \$1,500$$

$$\bar{x} = \Sigma x + n = 60,000 + 12 = 5,000$$

$$r = \frac{\Sigma(x - \bar{x})(y - \bar{y})}{\sqrt{\Sigma(x - \bar{x})^2 \Sigma(y - \bar{y})^2}} = \frac{131,950}{\sqrt{(452,800)(40,250)}} = .977$$

$$r^2 = (.977)^2 = .955$$

P3-3

(1)	(1) y	(2) (y - \bar{y})	(3) x	(4) (x - \bar{x})	(5) (x - \bar{x}) ²	(6) (x - \bar{x})(y - \bar{y})	(7) (y - \bar{y}) ²
Month	Electricity Cost	Cost Deviations	Labor Hours	Activity Deviations	(4) Squared	(4) x (2)	(2) Squared
January.....	\$ 1,600	20	4,200	(30)	900	(600)	400
February	1,570	(10)	4,000	(230)	52,900	2,300	100
March	1,610	30	4,360	130	16,900	3,900	900
April	1,550	(30)	4,000	(230)	52,900	6,900	900
May	1,530	(50)	4,050	(180)	32,400	9,000	2,500
June	1,540	(40)	4,100	(130)	16,900	5,200	1,600
July	1,520	(60)	4,150	(80)	6,400	4,800	3,600
August	1,530	(50)	4,250	20	400	(1,000)	2,500
September .	1,580	0	4,150	(80)	6,400	0	0
October	1,650	70	4,500	270	72,900	18,900	4,900
November ..	1,660	80	4,600	370	136,900	29,600	6,400
December ..	1,620	40	4,400	170	28,900	6,800	1,600
Total	<u>\$18,960</u>	<u>0</u>	<u>50,760</u>	<u>0</u>	<u>424,800</u>	<u>85,800</u>	<u>25,400</u>

$$\bar{y} = \Sigma y + n = \$18,960 + 12 = \$1,580$$

$$\bar{x} = \Sigma x + n = 50,760 + 12 = 4,230$$

$$r = \frac{\Sigma(x - \bar{x})(y - \bar{y})}{\sqrt{\Sigma(x - \bar{x})^2 \Sigma(y - \bar{y})^2}} = \frac{85,800}{\sqrt{(424,800)(25,400)}} = .826$$

$$r^2 = (.826)^2 = .682$$

P3-3 (Concluded)

	(1) y Electricity Cost	(2) (y - \bar{y}) Cost Deviations	(3) x Machine Hours	(4) (x - \bar{x}) Activity Deviations	(5) (x - \bar{x}) ² (4) Squared	(6) (x - \bar{x})(y - \bar{y}) (4) x (2)	(7) (y - \bar{y}) ² (2) Squared
Month	Cost	Deviations	Hours	Deviations	(4) Squared	(4) x (2)	(2) Squared
January.....	\$ 1,800	20	2,300	0	0	0	400
February	1,570	(10)	2,150	(150)	22,500	1,500	100
March	1,610	30	2,400	100	10,000	3,000	900
April	1,550	(30)	2,250	(50)	2,500	1,500	900
May	1,530	(50)	2,160	(140)	19,600	7,000	2,500
June.....	1,540	(40)	2,240	(60)	3,600	2,400	1,600
July	1,520	(60)	2,180	(120)	14,400	7,200	3,600
August	1,530	(50)	2,170	(130)	16,900	6,500	2,500
September..	1,580	0	2,260	(40)	1,600	0	0
October.....	1,650	70	2,500	200	40,000	14,000	4,900
November ..	1,660	80	2,540	240	57,600	19,200	6,400
December ..	1,620	40	2,450	150	22,500	6,000	1,600
Total	<u>\$18,960</u>	<u>0</u>	<u>27,600</u>	<u>0</u>	<u>211,200</u>	<u>68,300</u>	<u>25,400</u>

$$\bar{y} = \Sigma y + n = \$18,960 + 12 = \$1,580$$

$$\bar{x} = \Sigma x + n = 27,600 + 12 = 2,300$$

$$r = \frac{\Sigma(x - \bar{x})(y - \bar{y})}{\sqrt{\Sigma(x - \bar{x})^2 \Sigma(y - \bar{y})^2}} = \frac{68,300}{\sqrt{(211,200)(25,400)}} = .933$$

$$r^2 = (.933)^2 = .870$$

- (2) Since the coefficient of determination for electricity cost and machine hours ($r^2 = .870$) is greater than the coefficient of determination for electricity cost and labor hours ($r^2 = .682$), machine hours should be used as the basis for estimating electricity cost. Machine hours explain more of the variance in electricity cost than do labor hours.

- (3) With machine hours as the basis for predicting electricity cost, the fixed cost and the variable cost rate can be determined by the method of least squares as follows:

$$\text{Variable rate } (b) = \frac{\Sigma(x - \bar{x})(y - \bar{y})}{\Sigma(x - \bar{x})^2} = \frac{\text{Column 6 total}}{\text{Column 5 total}} = \frac{68,300}{211,200} = \$.32339$$

$$\begin{aligned} \text{Fixed cost } (a) &= \bar{y} - b\bar{x} \\ &= \$1,580 - ($.32339)(2,300) \\ &= \$836.20 \end{aligned}$$

P3-4
(1)

	Maintenance Cost	Machine Hours
High	\$2,290	2,700
Low	2,000	2,000
Difference	<u>\$ 290</u>	<u>700</u>

Variable rate = \$290 ÷ 700 hours = \$.4142857 per machine hour

	High	Low
Total cost	\$2,290.00	\$2,000.00
Total variable cost	<u>1,118.57</u>	<u>828.57</u>
Average fixed cost	<u>\$1,171.43</u>	<u>\$1,171.43</u>

(2)	(1) y_i Maintenance Cost	(2) $(y_i - \bar{y})$ Cost Deviation	(3) x_i Machine Hours	(4) $(x_i - \bar{x})$ Activity Deviations	(5) $(x_i - \bar{x})^2$ (4) Squared	(6) $(x_i - \bar{x})(y_i - \bar{y})$ (4) x (2)	(7) $(y_i - \bar{y})^2$ (2) Squared
Month	Cost	Deviation	Hours	Deviations	(4) Squared	(4) x (2)	(2) Squared
January	\$ 2,200	40	2,500	100	10,000	4,000	1,600
February	2,130	(30)	2,350	(50)	2,500	1,500	900
March	2,000	(160)	2,000	(400)	160,000	64,000	25,600
April	2,170	10	2,400	0	0	0	100
May	2,050	(110)	2,100	(300)	90,000	33,000	12,100
June	2,220	60	2,600	200	40,000	12,000	3,600
July	2,150	(10)	2,450	50	2,500	(500)	100
August	2,250	90	2,550	150	22,500	13,500	8,100
September .	2,290	130	2,700	300	90,000	39,000	16,900
October	2,150	(10)	2,450	50	2,500	(500)	100
November ..	2,210	50	2,400	0	0	0	2,500
December ..	2,100	(60)	2,300	(100)	10,000	6,000	3,600
Total	<u>\$25,920</u>	<u>0</u>	<u>28,800</u>	<u>0</u>	<u>430,000</u>	<u>172,000</u>	<u>75,200</u>

$$\bar{y} = \Sigma y_i \div n = \$25,920 \div 12 = \$2,160$$

$$\bar{x} = \Sigma x_i \div n = 28,800 \div 12 = 2,400$$

$$b = \frac{\Sigma (x - \bar{x})(y - \bar{y})}{\Sigma (x - \bar{x})^2} = \frac{\text{Column 6 total}}{\text{Column 5 total}} = \frac{172,000}{430,000} = \$.40 \text{ variable cost rate}$$

Since $\bar{y} = a + b\bar{x}$, then:

$$a = \bar{y} - b\bar{x}$$

$$a = \$2,160 - ($.40)(2,400)$$

$$a = \$2,160 - \$960$$

$$a = \$1,200$$

P3-4 (Concluded)

$$(3) \quad r = \frac{\Sigma(x - \bar{x})(y - \bar{y})}{\sqrt{\Sigma(x_i - \bar{x})^2 \Sigma(y_i - \bar{y})^2}} = \frac{\text{Column 6 total}}{\sqrt{(\text{Column 5 total})(\text{Column 7 total})}}$$

$$r = \frac{172,000}{\sqrt{(430,000)(75,200)}} = \frac{172,000}{\sqrt{32,336,000,000}} = \frac{172,000}{179,822} = .9565$$

$$r^2 = (.9565)^2 = .91489$$

(4)	(1) x_i	(2) y_i Actual	(3) $(y'_i = a + bx_i)$ Predicted	(4) $(y_i - y'_i)$ Prediction	(5) $(y_i - y'_i)^2$
Month	Machine Hours	Maintenance Cost	Maintenance Cost	Error (2) - (3)	(4) Squared
January.....	2,500	\$ 2,200	\$ 2,200	\$ 0	\$ 0
February	2,350	2,130	2,140	(10)	100
March.....	2,000	2,000	2,000	0	0
April.....	2,400	2,170	2,160	10	100
May.....	2,100	2,050	2,040	10	100
June.....	2,600	2,220	2,240	(20)	400
July.....	2,450	2,150	2,180	(30)	900
August	2,550	2,250	2,220	30	900
September..	2,700	2,290	2,280	10	100
October.....	2,450	2,150	2,180	(30)	900
November ..	2,400	2,210	2,160	50	2,500
December ..	2,300	2,100	2,120	(20)	400
Total.....	<u>28,800</u>	<u>\$25,920</u>	<u>\$25,920</u>	<u>\$ 0</u>	<u>\$6,400</u>

$$s' = \sqrt{\frac{\Sigma(y_i - y'_i)^2}{n - 2}} = \sqrt{\frac{\text{Column 5 total}}{12 - 2}} = \sqrt{\frac{\$6,400}{10}} = \$25.29822$$

- (5) The 95% confidence interval for maintenance cost at the 2,500 machine hour level of activity is

$$y' \pm t_{95\%} s' \sqrt{1 + \frac{1}{n} + \frac{(x_i - \bar{x})^2}{\Sigma(x_i - \bar{x})^2}}$$

$$\$1,200 + (\$.40)(2,500) \pm (2.228)(25.29822) \sqrt{1 + \frac{1}{12} + \frac{(2,500 - 2,400)^2}{430,000}}$$

$$\$2,200 \pm \$59.29$$

P3-5

(1) (a) The method of least squares:

	(1) y_i	(2) $(y_i - \bar{y})$ Difference from Average of \$700	(3) x_i	(4) $(x_i - \bar{x})$ Difference From Average of 3,500	(5) $(x_i - \bar{x})^2$	(6) $(x_i - \bar{x})(y_i - \bar{y})$	(7) $(y_i - \bar{y})^2$
Month	Electricity Cost	Electricity Deviation	Guest Days	Guest Days	(4) Squared (000s omitted)	(4) x (2) (000s omitted)	(2) Squared (000s omitted)
January.....	\$ 400	\$(300)	1,000	(2,500)	6,250	\$ 750	\$ 90
February	500	(200)	1,500	(2,000)	4,000	400	40
March	500	(200)	2,500	(1,000)	1,000	200	40
April	700	0	3,000	(500)	250	0	0
May	600	(100)	2,500	(1,000)	1,000	100	10
June	800	100	4,500	1,000	1,000	100	10
July	1,000	300	6,500	3,000	9,000	900	90
August	900	200	6,000	2,500	6,250	500	40
September ..	900	200	5,500	2,000	4,000	400	40
October	700	0	3,000	(500)	250	0	0
November ..	600	(100)	2,500	(1,000)	1,000	100	10
December ..	800	100	3,500	0	0	0	10
Total	<u>\$8,400</u>	<u>0</u>	<u>42,000</u>	<u>0</u>	<u>34,000</u>	<u>\$3,450</u>	<u>\$380</u>

$$b = \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{\sum (x_i - \bar{x})^2} = \frac{\text{Column 6 total}}{\text{Column 5 total}} = \frac{\$3,450}{34,000} = \$0.1015 \text{ variable rate}$$

Since $\bar{y} = a + b\bar{x}$, then:

$$\$700 = a + (\$0.1015 \times 3,500)$$

$$a = \$700 - \$355$$

$$a = \$345 \text{ fixed cost per month}$$

P3-5 (Continued)

(b) The high and low points method:

	Electricity Cost	Guest Days
High.....	<u>\$1,000</u>	<u>6,500</u>
Low.....	<u>400</u>	<u>1,000</u>
Difference.....	<u>\$ 600</u>	<u>5,500</u>

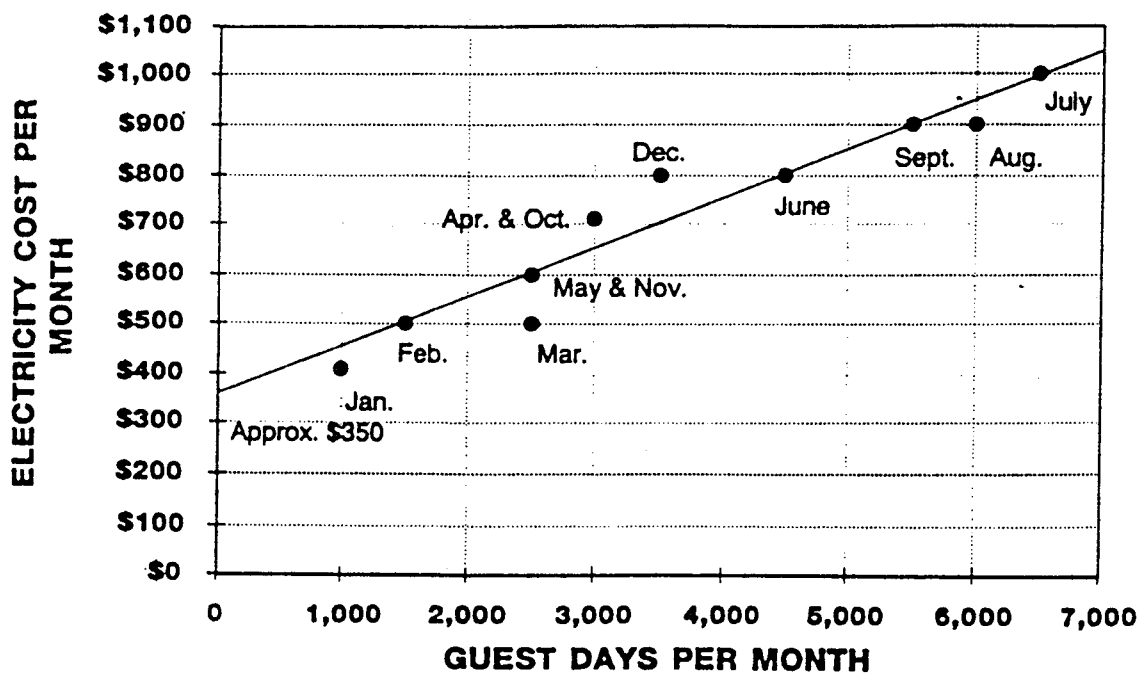
$$\text{Variable rate} = \frac{\$600}{5,500} = \$0.1091 \text{ per guest day}$$

$$\begin{aligned} \text{Fixed cost} &= \$1,000 - (6,500 \times \$0.1091) \\ &= \$1,000 - \$709 \\ &= \$291 \end{aligned}$$

OR

$$\begin{aligned} \text{Fixed cost} &= \$400 - (1,000 \times \$0.1091) \\ &= \$400 - \$109 \\ &= \$291 \end{aligned}$$

(c) A scattergraph with trend line fitted by inspection:

Fixed cost per month
determined by
inspection.....\$350

Average cost.....

\$700

Less fixed cost.....

350

Variable cost.....

\$350

$$\frac{\$350}{3,500 \text{ average guest days}} = \$0.10 \text{ variable cost per guest day}$$

P3-5 (Continued)

- (2) The coefficient of correlation (r) and the coefficient of determination (r^2), using data from the requirement (1)(a) answer:

$$\begin{aligned}
 r &= \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum (x_i - \bar{x})^2 \sum (y_i - \bar{y})^2}} = \frac{\text{Column 6 total}}{\sqrt{(\text{Column 5 total})(\text{Column 7 total})}} \\
 &= \frac{3,450,000}{\sqrt{(34,000,000)(380,000)}} = \frac{3,450,000}{\sqrt{12,920,000,000,000}} \\
 &= \frac{3,450,000}{3,594,440} = .9598 \\
 r^2 &= .9212
 \end{aligned}$$

- (3) The standard error of the estimate:

	(1) x_i	(2) y_i	(3) $(y'_i = a + bx_i)$	(4) $(y_i - y'_i)$	(5) $(y_i - y'_i)^2$ Prediction Error Squared
Month	Guest Days	Actual Electricity Cost	Predicted Electricity Cost	Prediction Error (2) - (3)	Squared (4) Squared
January	1,000	\$ 400	\$ 447	\$(47)	\$ 2,209
February	1,500	500	497	3	9
March	2,500	500	599	(99)	9,801
April	3,000	700	650	50	2,500
May	2,500	600	599	1	1
June	4,500	800	802	(2)	4
July	6,500	1,000	1,005	(5)	25
August	6,000	900	954	(54)	2,916
September ..	5,500	900	903	(3)	9
October	3,000	700	650	50	2,500
November ..	2,500	600	599	1	1
December ..	3,500	800	700	100	10,000
Total	42,000	\$8,400	\$8,405*	\$ (5)*	\$29,975

*rounding error

$$s' = \sqrt{\frac{\sum (y_i - y'_i)^2}{n - 2}} = \sqrt{\frac{\text{Column 5 total}}{12 - 2}} = \sqrt{\frac{\$29,975}{10}} = \sqrt{\$2,997.5} = \$54.75$$

P3-5 (Concluded)

- 4) The 90% confidence interval for electricity costs at 2,000 guest days would be:

$$y'_1 \pm t_{90\%} s' \sqrt{1 + \frac{1}{n} + \frac{(x_1 - \bar{x})^2}{\sum (x_i - \bar{x})^2}}$$

$$(\$345 + (\$.1015)(2,000)) \pm (1.812)(\$54.75) \sqrt{1 + \frac{1}{12} + \frac{(2,000 - 3,500)^2}{34,000,000}}$$

$$\begin{aligned} \$548 &\pm (1.812)(\$54.75)(1.072) \\ \$548 &\pm \$106.35 \end{aligned}$$

P3-6

- (1) (a) The high and low points method:

	<u>Cost</u>	<u>Activity</u>
High	\$500	2,400
Low	400	1,400
Difference	<u>\$100</u>	<u>1,000</u>

Variable rate = \$100 ÷ 1,000 Billets = \$.10

Fixed cost = \$500 - (\$.10 × 2,400 Billets) = \$260

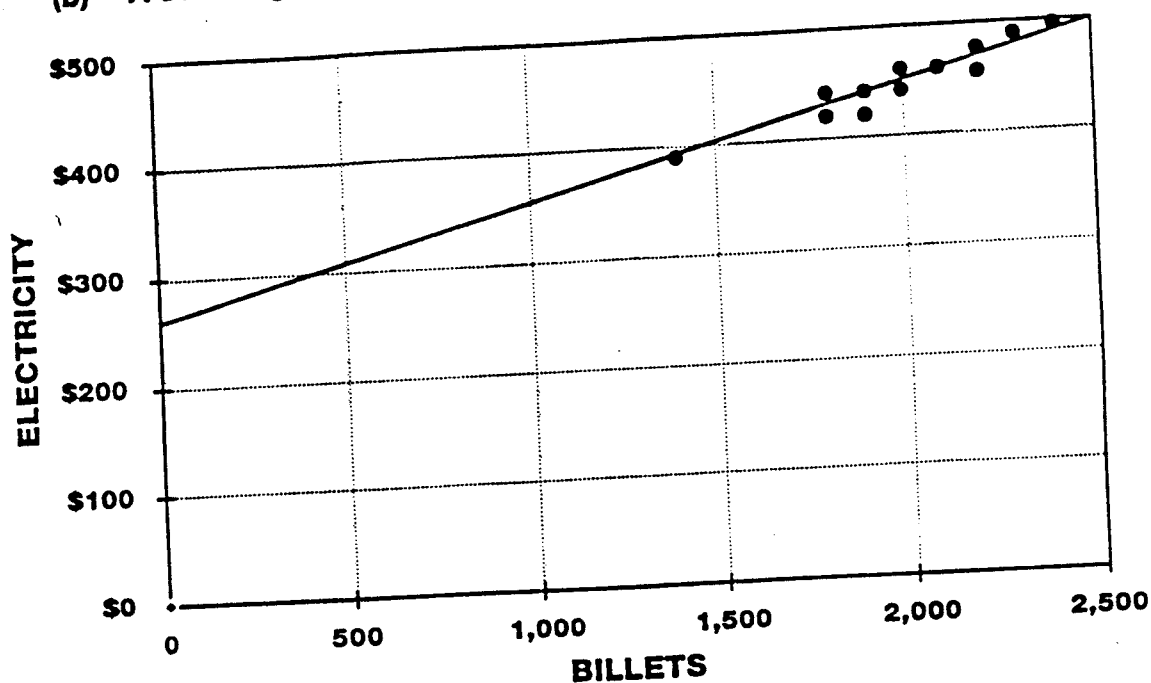
or

Fixed cost = \$400 - (\$.10 × 1,400 Billets) = \$260

Chapter 3

P3-6 (Continued)

(b) A scattergraph with a trend line fitted by inspection:



Fixed cost determined by inspection = \$260

Average cost = \$5,520 total cost ÷ 12 months = \$460

Average activity = 24,000 total Billets ÷ 12 months = 2,000

Variable cost = (\$460 average cost - \$260 fixed cost) ÷ 2,000 average activity = \$.10 per Billet

P3-6 (Continued)

(c)	(1) y Electricity Cost	(2) (y - \bar{y}) Cost Deviations	(3) x Number of Billets	(4) (x - \bar{x}) Activity Deviations	(5) (x - \bar{x}) ² (4) Squared	(6) (x - \bar{x})(y - \bar{y}) (4) x (2)	(7) (y - \bar{y}) ² (2) Squared
Month	Cost	Deviations	of Billets	Deviations	Squared	(4) x (2)	Squared
January	\$ 455	(5)	2,000	0	0	0	25
February	450	(10)	1,800	(200)	40,000	2,000	100
March	435	(25)	1,900	(100)	10,000	2,500	625
April	485	25	2,200	200	40,000	5,000	625
May	470	10	2,100	100	10,000	1,000	100
June	475	15	2,000	0	0	0	225
July	400	(60)	1,400	(600)	360,000	36,000	3,600
August	450	(10)	1,900	(100)	10,000	1,000	100
September ..	435	(25)	1,800	(200)	40,000	5,000	625
October	500	40	2,400	400	160,000	16,000	1,600
November ..	495	35	2,300	300	90,000	10,500	1,225
December ..	470	10	2,200	200	40,000	2,000	100
Total	<u>\$5,520</u>	<u>0</u>	<u>24,000</u>	<u>0</u>	<u>800,000</u>	<u>81,000</u>	<u>8,950</u>

$$\bar{y} = \Sigma y + n = \$5,520 + 12 = \$460$$

$$\bar{x} = \Sigma x + n = 24,000 + 12 = 2,000$$

$$\text{Variable rate (b)} = \frac{\Sigma(x - \bar{x})(y - \bar{y})}{\Sigma(x - \bar{x})^2} = \frac{\text{Column 6 total}}{\text{Column 5 total}} = \frac{81,000}{800,000} = \$0.10125$$

$$\begin{aligned} \text{Fixed cost (a)} &= \bar{y} - b\bar{x} \\ &= \$460 - (\$0.10125)(2,000) \\ &= \$257.50 \end{aligned}$$

- (2) The coefficient of correlation (r) and the coefficient of determination (r^2), using data from the answer in requirement (1)(c) follow:

$$\begin{aligned} r &= \frac{\Sigma(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\Sigma(x_i - \bar{x})^2 \Sigma(y_i - \bar{y})^2}} = \frac{81,000}{\sqrt{(800,000)(8,950)}} = .957 \\ r^2 &= (.957)^2 = .916 \end{aligned}$$

P3-6 (Concluded)

(3)

Month	(1) y Actual Electricity Cost	(2) x Number of Billets	(3) (y' = a + bx) Estimated Electricity Cost	(4) (y - y') (1) - (3)	(5) (y - y') ² (4) Squared
January.....	\$ 455	2,000	\$ 460	(5)	25
February	450	1,800	440	10	100
March.....	435	1,900	450	(15)	225
April	485	2,200	480	5	25
May	470	2,100	470	0	0
June.....	475	2,000	460	15	225
July	400	1,400	399	1	1
August	450	1,900	450	0	0
September	435	1,800	440	(5)	25
October.....	500	2,400	501	(1)	1
November ..	495	2,300	490	5	25
December ..	470	2,200	480	(10)	100
Total.....	<u>\$5,520</u>	<u>24,000</u>	<u>\$5,520</u>	<u>0</u>	<u>752</u>

$$s' = \sqrt{\frac{\sum (y - y')^2}{n - 2}} = \sqrt{\frac{\text{Column 5 total}}{12 - 2}} = \sqrt{\frac{\$752}{10}} = \$8.672$$

The 95% confidence interval level for electricity costs at the 2,200 Billets level of activity would be determined as follows:

$$a + bx \pm t_{95\%} s' \sqrt{1 + \frac{1}{n} + \frac{(x - \bar{x})^2}{\sum (x - \bar{x})^2}}$$

$$\$257.50 + (\$.10125)(2,200) \pm (2.228)(\$8.672) \sqrt{1 + \frac{1}{12} + \frac{(2,200 - 2,000)^2}{800,000}}$$

$$\$480.25 \pm (2.228)(\$8.672)(1.065)$$

$$\$480.25 \pm \$20.58$$

or between a low of \$459.67 and a high of \$500.83.

P3-7

(1)	(1) y_i	(2) $(y_i - \bar{y})$ Difference from Average of \$7,900	(3) x_i Direct Labor Hours	(4) $(x_i - \bar{x})$ Difference from Average of 1,800 Hours	(5) $(x_i - \bar{x})^2$ (4) Squared	(6) $(x_i - \bar{x})(y_i - \bar{y})$ (4) x (2)	(7) $(y_i - \bar{y})^2$ (2) Squared
Month	Factory Overhead Costs						
20A							
Jan.....	\$ 8,500	600	2,000	200	40,000	120,000	360,000
Feb.....	9,900	2,000	2,400	600	360,000	1,200,000	4,000,000
Mar.....	8,950	1,050	2,200	400	160,000	420,000	1,102,500
Apr.....	9,000	1,100	2,300	500	250,000	550,000	1,210,000
May.....	8,150	250	2,000	200	40,000	50,000	62,500
June.....	7,550	(350)	1,900	100	10,000	(35,000)	122,500
July.....	7,050	(850)	1,400	(400)	160,000	340,000	722,500
Aug.....	6,450	(1,450)	1,000	(800)	640,000	1,160,000	2,102,500
Sep.....	6,900	(1,000)	1,200	(600)	360,000	600,000	1,000,000
Oct.....	7,500	(400)	1,700	(100)	10,000	40,000	160,000
Nov.....	7,150	(750)	1,600	(200)	40,000	150,000	562,500
Dec.....	7,800	(100)	1,900	100	10,000	(10,000)	10,000
20B							
Jan.....	8,700	800	2,100	300	90,000	240,000	640,000
Feb.....	9,300	1,400	2,300	500	250,000	700,000	1,960,000
Mar.....	9,300	1,400	2,200	400	160,000	560,000	1,960,000
Apr.....	8,700	800	2,200	400	160,000	320,000	640,000
May.....	8,000	100	2,000	200	40,000	20,000	10,000
June.....	7,650	(250)	1,800	0	0	0	62,500
July.....	6,750	(1,150)	1,200	(600)	360,000	690,000	1,322,500
Aug.....	7,100	(800)	1,300	(500)	250,000	400,000	640,000
Sep.....	7,350	(550)	1,500	(300)	90,000	165,000	302,500
Oct.....	7,250	(650)	1,700	(100)	10,000	65,000	422,500
Nov.....	7,100	(800)	1,500	(300)	90,000	240,000	640,000
Dec.....	7,500	(400)	1,800	0	0	0	160,000
20C							
Jan.....	8,600	700	2,000	200	40,000	140,000	490,000
Feb.....	9,300	1,400	2,300	500	250,000	700,000	1,960,000
Mar.....	9,400	1,500	2,300	500	250,000	750,000	2,250,000
Apr.....	8,700	800	2,200	400	160,000	320,000	640,000
May.....	8,100	200	2,000	200	40,000	40,000	40,000
June.....	7,600	(300)	1,800	0	0	0	90,000
July.....	7,000	(900)	1,300	(500)	250,000	450,000	810,000
Aug.....	6,900	(1,000)	1,200	(600)	360,000	600,000	1,000,000
Sep.....	7,100	(800)	1,300	(500)	250,000	400,000	640,000
Oct.....	7,500	(400)	1,800	0	0	0	160,000
Nov.....	7,000	(900)	1,500	(300)	90,000	270,000	810,000
Dec.....	7,600	(300)	1,900	100	10,000	(30,000)	90,000
Total.....	<u>\$284,400</u>	<u>0</u>	<u>64,800</u>	<u>0</u>	<u>5,280,000</u>	<u>11,625,000</u>	<u>29,155,000</u>

P3-7 (Continued)

$$b = \frac{\Sigma(x_i - \bar{x})(y_i - \bar{y})}{\Sigma(x_i - \bar{x})^2} = \frac{\text{Column 6 total}}{\text{Column 5 total}} = \frac{11,625,000}{5,280,000} = \$2.20 \text{ variable cost rate}$$

Since $\bar{y} = a + b\bar{x}$ and $\bar{y} = \Sigma y_i / n$ and $\bar{x} = \Sigma x_i / n$, then:

$$(\$284,400 + 36) = a + (\$2.20)(64,800 + 36)$$

$$\$7,900 = a + \$3,960$$

$$a = \$3,940 \text{ fixed overhead cost}$$

- (2) The coefficient of correlation and the coefficient of determination, using data from the requirement (1) answer:

$$r = \frac{\Sigma(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\Sigma(x_i - \bar{x})^2 \Sigma(y_i - \bar{y})^2}} = \frac{\text{Column 6 total}}{\sqrt{(\text{Column 5 total})(\text{Column 7 total})}}$$

$$r = \frac{11,625,000}{\sqrt{(5,280,000)(29,155,000)}} = \frac{11,625,000}{\sqrt{153,938,400,000,000}} = \frac{11,625,000}{12,407,191} = .9370$$

$$r^2 = (.9370)^2 = .8780$$

P3-7 (Continued)

(3) The standard error of the estimate:

	(1) x_i	(2) y_i	(3) $(y_i = a + bx_i)$	(4) $(y_i - y_i)$	(5) $(y_i - y_i)^2$
Month	Direct Labor Hours	Actual Factory Overhead Costs	Predicted Factory Overhead Costs	Prediction Error (2) - (3)	Prediction Error Squared (4) Squared
20A					
January.....	2,000	\$ 8,500	\$ 8,340	\$ 160	\$ 25,600
February	2,400	9,900	9,220	680	462,400
March.....	2,200	8,950	8,780	170	28,900
April	2,300	9,000	9,000	0	0
May	2,000	8,150	8,340	(190)	36,100
June.....	1,900	7,550	8,120	(570)	324,900
July	1,400	7,050	7,020	30	900
August	1,000	6,450	6,140	310	96,100
September .	1,200	6,900	6,580	320	102,400
October.....	1,700	7,500	7,680	(180)	32,400
November ..	1,600	7,150	7,460	(310)	96,100
December ..	1,900	7,800	8,120	(320)	102,400
20B					
January.....	2,100	8,700	8,560	140	19,600
February	2,300	9,300	9,000	300	90,000
March.....	2,200	9,300	8,780	520	270,400
April	2,200	8,700	8,780	(80)	6,400
May	2,000	8,000	8,340	(340)	115,600
June.....	1,800	7,650	7,900	(250)	62,500
July	1,200	6,750	6,580	170	28,900
August	1,300	7,100	6,800	300	90,000
September .	1,500	7,350	7,240	110	12,100
October.....	1,700	7,250	7,680	(430)	184,900
November ..	1,500	7,100	7,240	(140)	19,600
December ..	1,800	7,500	7,900	(400)	160,000
20C					
January.....	2,000	8,600	8,340	260	67,600
February	2,300	9,300	9,000	300	90,000
March.....	2,300	9,400	9,000	400	160,000
April	2,200	8,700	8,780	(80)	6,400
May	2,000	8,100	8,340	(240)	57,600
June.....	1,800	7,600	7,900	(300)	90,000
July	1,300	7,000	6,800	200	40,000
August	1,200	6,900	6,580	320	102,400
September .	1,300	7,100	6,800	300	90,000
October.....	1,800	7,500	7,900	(400)	160,000
November ..	1,500	7,000	7,240	(240)	57,600
December ..	1,900	7,600	8,120	(520)	270,400
Total.....	<u>64,800</u>	<u>\$284,400</u>	<u>\$284,400</u>	<u>0</u>	<u>\$3,560,200</u>

P3-7 (Concluded)

$$s' = \sqrt{\frac{\sum (y_i - y'_i)^2}{n - 2}} = \sqrt{\frac{\text{Column 5 total}}{36 - 2}} = \sqrt{\frac{\$3,560,200}{34}} = \sqrt{\$104,712} = \$324$$

- (4) Since a large sample is used in this problem, $t_{95\%} = z_{95\%}$ and the confidence interval is:

$$\begin{aligned} y'_i &\pm z_{95\%} s' \\ (\$3,940 + (\$2.20)(2,200)) &\pm (1.960)(\$324) \\ \$8,780 &\pm \$635 \end{aligned}$$

P3-8

(1)	(1) y_i Maintenance Cost	(2) $(y_i - \bar{y})$ Cost Deviation	(3) x_i Labor Hours	(4) $(x_i - \bar{x})$ Activity Deviation	(5) $(x_i - \bar{x})^2$ (4) Squared	(6) $(x_i - \bar{x})(y_i - \bar{y})$ (4) x (2)	(7) $(y_i - \bar{y})^2$ (2) Squared
Months	Cost	Deviation	Hours	Deviation	Squared	(4) x (2)	Squared
Jan., 20A	\$ 1,195	(286)	950	(290)	84,100	82,940	81,796
Feb., 20A	1,116	(365)	1,024	(216)	46,656	78,840	133,225
Mar., 20A ...	1,390	(91)	1,109	(131)	17,161	11,921	8,281
Apr., 20A	1,449	(32)	1,148	(92)	8,464	2,944	1,024
May, 20A	1,618	137	1,313	73	5,329	10,001	18,769
June, 20A ..	1,325	44	1,261	21	441	924	1,936
July, 20A	1,687	206	1,552	312	97,344	64,272	42,436
Aug., 20A ...	1,650	169	1,372	132	17,424	22,308	28,561
Sep., 20A ...	1,595	114	1,366	126	15,876	14,364	12,996
Oct., 20A	1,675	194	1,455	215	46,225	41,710	37,636
Nov., 20A ...	1,405	(76)	1,221	(19)	361	1,444	5,776
Dec., 20A ...	1,251	(230)	1,150	(90)	8,100	20,700	52,900
Jan., 20B ...	950	(531)	999	(241)	58,081	127,971	281,961
Feb., 20B	1,175	(306)	1,022	(218)	47,524	66,708	93,636
Mar., 20B ...	1,425	(56)	1,220	(20)	400	1,120	3,136
Apr., 20B	1,506	25	1,283	43	1,849	1,075	625
May, 20B	1,608	127	1,339	99	9,801	12,573	16,129
June, 20B ..	1,653	172	1,250	10	100	1,720	29,584
July, 20B	1,675	194	1,440	200	40,000	38,800	37,636
Aug., 20B ...	1,724	243	1,290	50	2,500	12,150	59,049
Sep., 20B ...	1,626	145	1,335	95	9,025	13,775	21,025
Oct., 20B	1,575	94	1,164	(76)	5,776	(7,144)	8,836
Nov., 20B ...	1,653	172	1,373	133	17,689	22,876	29,584
Dec., 20B ...	1,418	(63)	1,124	(116)	13,456	7,308	3,969
Total	<u>\$35,544</u>	<u>0</u>	<u>29,760</u>	<u>0</u>	<u>553,682</u>	<u>651,300</u>	<u>1,010,506</u>

$$\bar{y} = \Sigma y_i + n = \$35,544 + 24 = \$1,481$$

$$\bar{x} = \Sigma x_i + n = 29,760 + 24 = 1,240$$

$$r = \frac{\Sigma (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\Sigma (x_i - \bar{x})^2 \Sigma (y_i - \bar{y})^2}} = \frac{\text{Column 6 total}}{\sqrt{(\text{Column 5 total})(\text{Column 7 total})}}$$

$$= \frac{651,300}{\sqrt{(553,682)(1,010,506)}} = \frac{651,300}{559,498,983,092} = \frac{651,300}{747,997} = .870725$$

$$r^2 = (.870725)^2 = .758162$$

Chapter 3

P3-8 (Continued)

Months	(1) y_i Maintenance Cost	(2) $(y_i - \bar{y})$ Cost Deviation	(3) x_i Machine Hours	(4) $(x_i - \bar{x})$ Activity Deviation	(5) $(x_i - \bar{x})^2$ (4) Squared	(6) $(x_i - \bar{x})(y_i - \bar{y})$ (4) x (2)	(7) $(y_i - \bar{y})^2$ (2) Squared
Jan., 20A....	\$ 1,195	(286)	809	(266)	70,756	76,076	81,796
Feb., 20A ...	1,116	(365)	744	(331)	109,561	120,815	133,225
Mar., 20A ...	1,390	(91)	987	(88)	7,744	8,008	8,281
Apr., 20A	1,449	(32)	987	(88)	7,744	2,816	1,024
May, 20A	1,618	137	1,186	111	12,321	15,207	18,769
June, 20A ..	1,525	44	1,154	79	6,241	3,476	1,936
July, 20A	1,687	206	1,291	216	46,656	44,496	42,436
Aug., 20A ...	1,650	169	1,238	163	26,569	27,547	28,561
Sep., 20A ...	1,595	114	1,186	111	12,321	12,654	12,996
Oct., 20A	1,675	194	1,246	171	29,241	33,174	37,636
Nov., 20A ...	1,405	(76)	997	(78)	6,084	5,928	5,776
Dec., 20A ...	1,251	(230)	841	(234)	54,756	53,820	52,900
Jan., 20B ...	950	(531)	502	(573)	328,329	304,263	281,961
Feb., 20B ...	1,175	(306)	733	(342)	116,964	104,652	93,636
Mar., 20B ...	1,425	(56)	1,090	15	225	(840)	3,136
Apr., 20B ...	1,506	25	1,135	60	3,600	1,500	625
May, 20B ...	1,608	127	1,174	99	9,801	12,573	16,129
June, 20B ..	1,653	172	1,246	171	29,241	29,412	29,584
July, 20B ...	1,675	194	1,264	189	35,721	36,666	37,636
Aug., 20B ...	1,724	243	1,323	248	61,504	60,264	59,049
Sep., 20B ...	1,626	145	1,230	155	24,025	22,475	21,025
Oct., 20B ...	1,575	94	1,165	90	8,100	8,460	8,836
Nov., 20B ...	1,653	172	1,237	162	26,244	27,864	29,584
Dec., 20B ...	1,418	(63)	1,035	(40)	1,600	2,520	3,969
Total	<u>\$35,544</u>	<u>0</u>	<u>25,800</u>	<u>0</u>	<u>1,035,348</u>	<u>1,013,826</u>	<u>1,010,506</u>

$$\bar{y} = \Sigma y_i + n = \$35,544 + 24 = \$1,481$$

$$\bar{x} = \Sigma x_i + n = 25,800 + 24 = 1,075$$

$$r = \frac{\Sigma (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\Sigma (x_i - \bar{x})^2 \Sigma (y_i - \bar{y})^2}} = \frac{\text{Column 6 total}}{\sqrt{(\text{Column 5 total})(\text{Column 7 total})}}$$

$$= \frac{1,013,826}{\sqrt{(1,035,348)(1,010,506)}} = \frac{1,013,826}{\sqrt{1,046,225,366,088}} = \frac{1,013,826}{1,022,852} = .991176$$

$$r^2 = (.991176)^2 = .982430$$

P3-8 (Continued)

- (2) The activity measure used to predict maintenance expense should be machine hours, which will result in the following cost estimates:

$$b = \frac{\Sigma(x - \bar{x})(y - \bar{y})}{\Sigma(x - \bar{x})^2} = \frac{\text{Column 6 total}}{\text{Column 5 total}} = \frac{1,013,826}{1,035,348} = \$0.979213 \text{ variable rate}$$

Since $\bar{y} = a + b\bar{x}$, then the estimated fixed cost is determined as follows:

$$a = \bar{y} - b\bar{x}$$

$$a = \$1,481 - (\$0.979213)(1,075)$$

$$a = \$1,481 - \$1,052.65$$

$$a = \$428.35$$

(3)	(1) x_i	(2) y_i Actual Maintenance Cost	(3) $(y_i' = a + bx_i)$ Predicted Maintenance Cost	(4) $(y_i - y_i')$ Prediction Error (2) - (3)	(5) $(y_i - y_i')^2$ (4) Squared
Months	Machine Hours				
Jan., 20A....	809	\$ 1,195	\$ 1,221	\$(26)	\$ 676
Feb., 20A ...	744	1,116	1,157	(41)	1,681
Mar., 20A ...	987	1,390	1,395	(5)	25
Apr., 20A ...	987	1,449	1,395	54	2,916
May, 20A ...	1,186	1,618	1,590	28	784
June, 20A ..	1,154	1,525	1,558	(33)	1,089
July, 20A....	1,291	1,687	1,693	(6)	36
Aug., 20A...	1,238	1,650	1,641	9	81
Sep., 20A...	1,186	1,585	1,590	5	25
Oct., 20A....	1,246	1,675	1,648	27	729
Nov., 20A...	997	1,405	1,405	0	0
Dec., 20A...	841	1,251	1,252	(1)	1
Jan., 20B ...	502	950	920	30	900
Feb., 20B...	733	1,175	1,146	29	841
Mar., 20B...	1,090	1,425	1,496	(71)	5,041
Apr., 20B....	1,135	1,506	1,540	(34)	1,156
May, 20B ...	1,174	1,608	1,578	30	900
June, 20B ..	1,246	1,653	1,648	5	25
July, 20B ...	1,264	1,675	1,666	9	81
Aug., 20B...	1,323	1,724	1,724	0	0
Sep., 20B ...	1,230	1,626	1,633	(7)	49
Oct., 20B ...	1,165	1,575	1,569	6	36
Nov., 20B...	1,237	1,653	1,640	13	169
Dec., 20B...	1,035	1,418	1,442	(24)	576
Total.....	25,800	\$35,544	\$35,547*	\$ (3)*	\$17,817

*rounding error

$$s' = \sqrt{\frac{\Sigma(y_i - y_i')^2}{n - 2}} = \sqrt{\frac{\text{Column 5 total}}{24 - 2}} = \sqrt{\frac{\$17,817}{22}} = \$28.458103$$

P3-8 (Concluded)

- (4) The 95% confidence interval for maintenance cost at the 1,100 machine hour level of activity is :

$$y' \pm t_{95\%} s' \sqrt{1 + \frac{1}{n} + \frac{(x_1 - \bar{x})^2}{\sum (x_i - \bar{x})^2}}$$

$$\begin{aligned} & \$428.35 + (\$.979213)(1,100) \pm (2.074)(28.458103) \sqrt{1 + \frac{1}{24} + \frac{(1,100 - 1,075)^2}{1,035,348}} \\ & \quad \quad \quad \$1,505.48 \pm \$80.26 \end{aligned}$$

CASES

C3-1

- (1) $W = a + bS$
 $= 5.062 + (.023)(1,200)$
 $= 5.062 + 27.6$
 $= 32.662$ or about 33 total workers
- | | |
|--|-----------|
| Total workers needed | 33 |
| Less permanent workers | <u>10</u> |
| Number of temporary workers needed | <u>23</u> |
- (2) Regression 2 appears to be better than Regression 1 because:
- (a) Data outside the relevant range have been excluded, thereby removing any bias.
 - (b) The standard error of the estimate (s) for Regression 2 is smaller than the standard error of the estimate for Regression 1 (.432 compared to 2.012).
 - (c) The coefficient of determination (r^2) is higher for Regression 2 than the coefficient of determination for Regression 1 (.998 compared to .962).
- (3) Jim Locter can use the regression in his planning for temporary workers if the following conditions exist:
- (a) The forecasted daily shipments are greater than 300 and do not deviate too much from the actual shipments.
 - (b) The amount of work to be done is dependent only on the number of shipments to be made and does not change from shipment to shipment.
 - (c) Worker productivity is expected to remain approximately the same as that experienced during the period used to develop the regression.
 - (d) A strong cause and effect relationship exists between the dependent variable and the independent variable.
 - (e) The time frame for a forecast is short-term.
- (4) The regression could be improved by the following:
- (a) Redeveloping the regression using the number of hours worked as the dependent variable.
 - (b) Performing another analysis if rush orders or deviations of actual orders from forecasts occur with any degree of regularity.
 - (c) Investigating the historical data used as a basis for the regression to determine if there are any further unusual circumstances that should be removed from the data set.
 - (d) Redoing the regression after a period of time, such as four to six months, to discover if there have been any changes in the relationship between the dependent and the independent variables.

Chapter 3

C3-2

- (1) The increase in y associated with a unit increase in x is 1.2. Therefore, a 500-unit increase in x will result in a 600-unit increase (1.2×500) in y (direct labor hours).
- (2)
 - (a) The equation may be unreliable if the correlation is spurious. The assumption is that there is a logical relationship between output and the use of electric power and direct labor.
 - (b) The equation may be reliable under the conditions at the time of the study, but if conditions change, the results may be unreliable.
 - (c) Data used were limited to a range of 500-2,000 units.
 - (d) It is assumed that a straight-line assumption is valid.
 - (e) The coefficient of correlation is a measure of the extent to which two variables are related linearly. It is a relative measure of goodness of fit. More of the variation in y is explained by the regression equation for direct labor hours than for electric power; that is, the equation for direct labor hours is a better fit than the equation for electric power.
 - (f) The standard error of the estimate is a measure of variation from the regression line. If the observations are normally distributed about the regression equation, the standard error can be interpreted in the same way as the standard deviation. The standard error is greater in the case of direct labor hours than in the case of electric power.

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C3-3

- (1) An advantage of Alternative A is that using time as an independent variable is a convenient way to take into consideration all possible factors that may be influencing the dependent variable during each period of time. A disadvantage of Alternative A is that there is no logical relationship between years and rental expense.

An advantage of Alternative B is that this method is logical because as revenues increase, the stores increase, and, thus, rental expense increases. A disadvantage of Alternative B is that an estimate of revenues is required.

An advantage of Alternative C is that the mathematical calculations are relatively easy and the method is easy to understand. A disadvantage of alternative C is that the arithmetic average is an oversimplification that does not recognize any relationship between variables.

C3-3 (Concluded)

- (2) Motorco Corporation should select Alternative B because the relationship between revenue and the rental expense is logical, the coefficient of correlation is high, and the standard error of the estimate is low.
- (3) A statistical technique is an appropriate method for estimating rental expense before Motorco actually contacts Alpha Auto Parts. A statistical technique attempts to measure the covariation between the variables that are presumed to have a cause and effect relationship, and such a relationship appears to exist in this situation. Of course, Motorco is assuming that any relationships that exist in the historical data will continue in the future without change. Management may want to adjust the variables for changes that it expects will occur, and Motorco may wish to introduce other quantitative variables.

C3-4

- (1) The phrase "regression provides a relational statement rather than a causal statement" means that regression analysis is used to determine a relationship, but not necessarily a cause-and-effect relationship. A specific value for a regression coefficient does not imply that the independent variable(s) causes a change in the dependent variable.
- (2) The meaning of each of the symbols in the basic formula for a regression equation follows:
 - y'_i = estimated value of the i th observation of the dependent variable.
 - a = the y -axis intercept or constant term (e.g., the fixed portion of a semivariable expense).
 - b = the regression coefficient corresponding to the independent variable x (e.g., the variable cost element associated with a one unit change in activity x).
 - x_i = the i th observation of the first independent variable.
 - c = the regression coefficient corresponding to the independent variable z (e.g., the variable cost element associated with a one unit change in activity z).
 - z_i = the i th observation of the second independent variable.
 - e_i = the error term associated with the i th observation.
- (3) Statistical factors used to test a regression equation for goodness of fit include:
 - (a) The coefficient of determination, r^2 , which indicates the portion of the variance in the dependent variable explained by the independent variables. A coefficient of determination approaching 1 indicates a good fit.

C3-4 (Concluded)

- (b) The standard error of the estimate which measures the dispersion of the observed points about the regression line. A standard error of the estimate approaching zero indicates a good fit.
- (4) (a) The term "linearity within a relevant range" means that in a specific situation, a straight-line relationship between the dependent variable and the independent variables can be assumed only within the range of historically observed values.
- (b) The term "constant variance (homoscedasticity)" means that the distribution of the observations about the regression line is uniform for all values of the independent variables within the observed range of values.
- (c) The term "serial correlation" refers to the lack of independence in a series of successive observations over time. The deviation of a value from the regression line should be unrelated to the deviation of any other point from this line.
- (d) The term "normality" means that the joint probability distribution of the variables is normally distributed (multivariate normal). The frequency of the observations should approximate a normal curve.
- (e) The term "multicollinearity" refers to the correlation of independent variables. When independent variables are highly correlated with each other, the relationship(s) between the independent variables may obscure the relationship between the independent variables(s) and the dependent variable.

C3-5

- (1) (a) $D = (2.455 + (.188)(1,500,000 + 100,000)) \times 10,000 \text{ units}$
 $= (2.455 + 2.82) \times 10,000 \text{ units}$
 $= 5.275 \times 10,000 \text{ units}$
 $= 52,750 \text{ units}$
- (b) $D = (2.491 + (.44)(12,000,000 + 1,000,000)) \times 10,000 \text{ units}$
 $= (2.491 + 5.28) \times 10,000 \text{ units}$
 $= 7.771 \times 10,000 \text{ units}$
 $= 77,710 \text{ units}$
- (2) The 50% confidence interval for demand is calculated as follows:
 $D = 104,160 \text{ units} \pm (.69)(.922 \times 10,000 \text{ units})$
 $= 104,160 \text{ units} \pm 6,361.8 \text{ units}$
 or between 97,798 units and 110,522 units.

C3-5 (Concluded)

- (3) Equation 4 is the best. The coefficient of correlation and the coefficient of determination are the highest of the four equations. The coefficient of determination indicates that 70.3% of the sample variance of automobile sales is explained by the regression. For predictive purposes, the standard error of the estimate at .922 is also the lowest of the four models, giving the tightest (smallest) physical confidence interval of any of the equations.**
- (4) Equation 3 assumes that factory rebates (R) are dependent on advertising funds (A). The results of the analysis show that factory rebates and advertising funds are almost totally independent and, therefore, cannot be used to predict each other. The results of Equation 3 lend credibility to the use of A and R in Equation 4. The independence of A and R reduces the possible negative aspects of collinearity.**

CHAPTER 4

DISCUSSION QUESTIONS

- Q4-1. The five parts are:
- (a) Direct materials section
 - (b) Direct labor section
 - (c) Factory overhead
 - (d) Work in process inventories
 - (e) Finished goods inventories
- Q4-2. The balance sheet is a statement of financial position; the income statement is a statement of activity. The income statement is complementary to the balance sheet, accounting in particular for the change in the proprietary equity as a result of operations during the year. In that respect, the income statement is essentially nothing more than a major section of the retained earnings account. Therefore, the revenue and expense accounts in the income statement have been termed "explanatory" accounts, explaining the ebb and flow of revenues and expenses that lead to the new income (or loss) and to the new retained earnings balance in the balance sheet.
- Q4-3. The ordinary balance sheet and income statement are intended to provide information as to financial position and results of operation of a business, in accordance with several assumptions that are made in preparing the statements. From the standpoint of the criticisms made, the most important of these assumptions are that cost less appropriate amortization of cost measures unexpired cost, and that a business may be assumed to be going to continue operations indefinitely into the future. Accounting statements are usually prepared on the theory that a sale or some other definite event is essential before revenue is recognized. Basically, the asset side of a balance sheet contains a presentation of the amounts of cost incurred, which can be presumed to benefit future periods. An income statement presents the amount of revenue recognized as having been realized during the period, less the portion of all costs incurred that does not appear to be fairly deferrable to future periods.

The income statement is primarily a measure of what has been earned, and not a measure of "earning power." For plant assets, the balance sheet is primarily a measure of accountability for expenditures, showing acquisition costs less costs allocated to past operations. This measure of accountability may be quite different from "true value."

To increase its usefulness as one element in judging earning power, the income statement is prepared with a distinction between operating and nonoperating items. For the same reason, certain items may be eliminated from the income

statement and shown in the statement of retained earnings. However, the effect of nonrecurring and nonoperating transactions is not entirely eliminated.

Information revealed by a series of income statements is more significant in judging earning power than information revealed by one income statement. The income of a business may follow or even exaggerate the ups and downs of the business cycle and, therefore, the income of any one year will not represent earning power.

Changes in law or local zoning ordinances may result in a marked change in the earning power of a business. Likewise, changes in public taste, development of new products, appearance of new competition, acquisition of subsidiaries, changes in management and the like, all may change earning power and yet not be clearly reflected, if reflected at all, in one income statement.

The accounting use of historical, rather than current, dollars in measuring depreciation and cost of goods sold may result in distorting any view of earning power obtained from a single income statement.

In regard to plant assets, it can be said that their value to a going concern is usually dependent upon the earning power of the business. Such a value is not necessarily the same as liquidation value, cost, cost less amortization, replacement value, or any other kind of value. The phrase "true value" has no definite connotation.

- Q4-4. *Actual* describes the way costs are measured, i.e., at actual historical amounts; *full absorption* describes which elements of cost are allocated to inventory accounts, i.e., all elements of manufacturing cost are fully allocated to inventories; *process* describes how cost information is accumulated, i.e., costs are accumulated for each process or department in the factory.
- Q4-5. Prime costing systems allocate only the prime costs, direct material and direct labor, to inventory accounts. Direct costing systems, also called variable costing systems, allocate the variable manufacturing costs, direct material, direct labor, and variable factory overhead to the inventory accounts. Absorption costing systems allocate to inventories part or all of fixed factory overhead, in addition to all variable manufacturing costs.
- Q4-6. Actual costing measures product costs at actual historical amounts, while standard costing measures product costs by using predetermined amounts of resources to be consumed and predetermined prices of those resources.

- Q4-7. Process costing accumulates costs for each process or department in the factory and maintains detailed records and calculations of the costs of work in process. Job order costing accumulates costs for each job, lot, batch, or contract and maintains detailed records and calculations of the costs of work in process. Backflush costing accumulates costs by working backwards through the available information after production is completed (i.e., at the end of the accounting period) and maintains no detailed records of the costs of work in process.
- Q4-8. Actual costing is more common than standard costing in defense-related industries, while standard costing is somewhat more common elsewhere.
- Q4-9. Super-full absorption or super absorption refers to the income tax requirement that some purchasing and storage costs be allocated to inventory accounts.
- Q4-10. Job order costing would be common in repair shops, building construction, and printing; and in service businesses such as medical, legal, architectural, construction engineering, accounting, and consulting firms, as mentioned in the text. Other examples include shipbuilding, bridge building, tool and die manufacturing, art and antique restoration, and contract research.
- Q4-11. As mentioned in the text, process costing would be common in the milling, brewing, chemical, and textile industries; in simple assembly operations; and in service businesses serving large numbers of customers simultaneously, such as airlines. Other examples include petroleum refining, basic food processing, and manufacture of low-cost consumer products such as toys, disposable pens, razors, and lighters.
- Q4-12. Aspects common to job order and process costing are:
- (a) They can be used by service organizations.
 - (b) They require considerable detail to calculate the cost of work in process.
 - (c) The work in process account in the general ledger is supported by subsidiary records.
- Q4-13. A blended costing method uses job order costing to accumulate some element(s) of cost and process costing to accumulate others.
- Q4-14. Flexible manufacturing systems consist of an integrated collection of automated production processes, automated materials movement, and computerized system controls to utilize facilities in efficiently manufacturing a highly flexible variety of products.
- Q4-15. The advantages of a flexible manufacturing system over the other systems include short (near-zero) setup times, the absence of a learning curve, lower lead times to shipment, lower direct labor cost per unit, lower direct labor cost in total, and lower work in process inventories.
- Q4-16. The initial cost of creating a flexible manufacturing system is much higher than that of other manufacturing systems.
- Q4-17. Manufacturing settings suited for backflush costing are distinguished by very fast processing speeds, which removes both the incentive and the opportunity to track the detailed costs of work in process.

EXERCISES

E4-1 Calculation of cost of goods sold (in thousands):

Total manufacturing cost	\$110
Add work in process inventory, beginning	80
	<u>\$190</u>
Less work in process inventory, ending	90
Cost of goods manufactured	\$100
Add finished goods inventory, beginning	150
Cost of goods available for sale	<u>\$250</u>
Less finished goods inventory, ending	60
Cost of goods sold	<u>\$190</u>

E4-2 Calculation of cost of goods sold (in thousands):

Direct materials used	\$ 90
Direct labor	60
Factory overhead	80
Total manufacturing cost	<u>\$230</u>
Add work in process inventory, beginning	250
	<u>\$480</u>
Less work in process inventory, ending	210
Cost of goods manufactured	\$270
Add finished goods inventory, beginning	340
Cost of goods available for sale	<u>\$610</u>
Less finished goods inventory, ending	270
Cost of goods sold	<u>\$340</u>

E4-4 (Concluded)**(2) Cost of goods manufactured:**

Stores, April 30	\$ 10,250
Purchases	105,000
	<u>\$115,250</u>
Less: Stores, May 31	12,700
Direct materials consumed	\$102,550
Direct labor used (4,250 x \$22)	93,500
Factory overhead	<u>77,390</u>
Total manufacturing cost	\$273,440
Add work in process, beginning inventory	<u>61,420</u>
	\$334,860
Less work in process, ending inventory	<u>52,800</u>
Cost of goods manufactured	<u><u>\$282,060</u></u>

(3) Ending balance of finished goods:

Finished goods, April 30	+	Cost of goods manufactured	-	Finished goods, May 31	=	Cost of goods sold
\$45,602	+	\$282,060	-	X	=	\$280,000
				X	=	\$ 47,662

Therefore, the finished goods ending balances is \$47,662.

E4-5	(a)	Materials	35,000	
		Accounts Payable		35,000
(b)		Work in Process	33,000	
		Factory Overhead Control	2,000	
		Materials		35,000
(c)		Payroll	40,000	
		Accrued Payroll		40,000
(d)		Accrued Payroll	40,000	
		Cash		40,000
(e)		Work in Process	32,000	
		Factory Overhead control	8,000	
		Payroll		40,000
(f)		Factory Overhead Control	4,000	
		Cash		4,000

E4-5 (Concluded)

(g)	Factory Overhead Control	18,000	
	Accounts Payable		18,000
(h)	Factory Overhead Control	4,130	
	Accumulated Depreciation.....		2,100
	Prepaid Expenses		780
	Accrued Property Taxes		1,250
(i)	Work in Process	36,130	
	Factory Overhead Control		36,130
(j)	Finished Goods.....	92,000	
	Work in Process		92,000
(k)	Accounts Receivable.....	80,000	
	Sales		80,000
	Cash	40,000	
	Accounts Receivable.....		40,000
	Cost of Goods Sold.....	60,000	
	Finished Goods		60,000

E4-6 (a)	Materials	13,500	
	Accounts Payable		13,500
(b)	Work in Process	17,500	
	Materials		17,500
(c)	Factory Overhead Control	1,800	
	Materials		1,800
(d)	Payroll	27,000	
	Accrued Payroll.....		27,000
	Work in Process	17,000	
	Factory Overhead Control	2,000	
	Marketing Expenses Control	5,000	
	Administrative Expenses Control	3,000	
	Payroll		27,000
(e)	Factory Overhead Control	2,508	
	Cash.....		2,508
(f)	Factory Overhead Control	8,500	
	Accounts Payable		8,500
(g)	Work in Process	14,808	
	Factory Overhead Control.....		14,808
(h)	Finished Goods.....	60,100	
	Work in Process		60,100

E4-6 (Concluded)

(i)	Accounts Receivable.....	80,000	
	Sales		80,000
	Cost of Goods Sold*	60,000	
	Finished Goods		60,000
	* $\$15,000 + \$60,100 - \$15,100 = \$60,000$		

E4-7

WALLACE INDUSTRIES
Cost of Goods Manufactured Statement
For May
(in thousands of dollars)

Direct materials:			
	Direct materials, April 30, 20A.....	\$ 28	
	Purchases	\$510	
	Freight in	15	525
	Direct materials available for use		\$553
	Less direct materials, May 31, 20A ...		23
	Direct materials consumed		\$ 530
	Direct labor.....		260
Factory overhead:			
	Indirect factory labor	\$ 90	
	Utilities (\$135 x 80%).....	108	
	Property tax	60	
	Insurance (\$20 x 60%)	12	
	Depreciation (\$20 + \$30).....	50	
	Total factory overhead.....		320
	Total manufacturing cost.....		\$1,110
	Add work in process, April 30, 20A...		150
			\$1,260
	Less work in process, May 31, 20A ...		210
	Cost of goods manufactured		<u>\$1,050</u>

E4-8

CINNABAR COMPANY
Statement of Cost of Goods Sold
For Year Ended December 31

Raw materials:			
Purchases	\$400,000		
Less discounts on raw materials purchased	<u>4,200</u>	\$395,800	
Less raw materials on hand, December 31, 20A		<u>24,000</u>	
Cost of raw materials consumed			\$371,800
Direct labor			180,000
Factory overhead:			
Factory maintenance		\$38,400	
Factory supplies used		22,400	
Power and heat—factory		19,400	
Insurance expense—factory building and equipment		4,800	
Depreciation—factory building and equipment		17,500	
Factory superintendence		100,000	
Indirect factory labor		<u>20,000</u>	
Total factory overhead			222,500
Total manufacturing costs			<u>\$774,300</u>
Add work in process, January 1, 20A			84,000
			<u>\$858,300</u>
Less work in process, December 31, 20A			<u>30,000</u>
Cost of goods manufactured			<u>\$828,300</u>
Add finished goods, January 1, 20A.			37,500
Cost of goods available for sale			<u>\$865,800</u>
Less finished goods, December 31, 20A			<u>70,000</u>
Cost of goods sold			<u><u>\$795,800</u></u>

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PROBLEMS

P4-1

(1)

BRIDGEWELL COMPANY
Cost of Goods Sold Statement
For Month Ended July 31
(in thousands)

Direct materials consumed	\$16
Direct labor	24
Factory overhead	20
Total manufacturing cost (a)	\$60
Add work in process inventory, July 1	15
	<u>\$75</u>
Less work in process inventory, July 31	25
Cost of goods manufactured	\$50
Add finished goods inventory, July 1 (b)	20
Cost of goods available for sale	\$70
Less finished goods inventory, July 31 (c)	15
Cost of goods sold	<u>\$55</u>

Calculations:

(a)	Cost of goods manufactured	\$50
	Add work in process, ending	25
		<u>\$75</u>
	Less work in process, beginning	15
	Equals total manufacturing cost	<u>\$60</u>
(b)	Cost of goods available for sale	\$70
	Less cost of goods manufactured	50
	Equals finished goods, beginning	<u>\$20</u>
(c)	Cost of goods available for sale	\$70
	Less cost of goods sold	55
	Equals finished goods, ending	<u>\$15</u>

P4-1 (Concluded)

(2)	(a)	Materials	25,000	
		Accounts Payable		25,000
(b)		Work in Process	16,000	
		Factory Overhead Control	2,000	
		Materials		18,000
(c)		Payroll (\$24,000 + \$5,000)	29,000	
		Accrued Payroll		29,000
(d)		Work in Process	24,000	
		Factory Overhead Control	5,000	
		Payroll		29,000
(e)		Finished Goods	50,000	
		Work in Process		50,000
(f)		Accounts Receivable	105,000	
		Sales (\$60,000 + (75% of \$60,000))		105,000
		Cost of Goods Sold	55,000	
		Finished Goods		55,000

Chapter 4

P4-2
(1)

SCOTTSBURG COMPANY
Cost of Goods Sold Statement
For Month Ended June 30
(in thousands)

Direct materials:			
Materials inventory, June 1		\$15	
Purchases		33	
Materials available for use		\$48	
Less: Indirect materials used	\$ 1		
Materials inventory, June 30	19	20	
Direct materials consumed			\$ 2
Direct labor (Note (a))			4
Factory overhead:			
Indirect materials	\$ 1		
Indirect labor (a)	7		
Depreciation	17		
Insurance	2		
General factory overhead	13		4
Total manufacturing cost (b)			\$11
Add work in process inventory, June 1			4
			\$15
Less work in process inventory, June 30			3
Cost of goods manufactured			\$12
Add finished goods inventory, June 1 (c)			7
Cost of goods available for sale			\$19
Less finished goods inventory, June 30 (d)			3
Cost of goods sold			\$15
Calculations:			
(a)	indirect labor + direct labor	= \$49	
	indirect labor + (indirect labor x 6)	= \$49	
	indirect labor x 7 = \$49		
	indirect labor = \$7		
	direct labor = 6 x \$7 = \$42		
(b)	Cost of goods manufactured	\$120	
	Add work in process, ending	30	
		\$150	
	Less work in process, beginning	40	
	Equals total manufacturing cost.	\$110	
(c)	Cost of goods available for sale	\$190	
	Less cost of goods manufactured	120	
	Equals finished goods, beginning	\$ 70	

P4-2 (Concluded)

(d)		Cost of goods available for sale	\$190	
		Less cost of goods sold.....	<u>155</u>	
		Equals finished goods, ending	<u>\$ 35</u>	
(2)	(a)	Materials	33,000	
		Accounts Payable		33,000
	(b)	Work in Process	28,000	
		Factory Overhead Control	1,000	
		Materials.....		29,000
	(c)	Payroll	49,000	
		Accrued Payroll.....		49,000
	(d)	Work in Process	42,000	
		Factory Overhead Control	7,000	
		Payroll.....		49,000
	(e)	Finished Goods.....	120,000	
		Work in Process		120,000
	(f)	Accounts Receivable	210,000	
		Sales (\$140,000 + (50% of \$140,000)) ...		210,000
		Cost of Goods Sold.....	155,000	
		Finished Goods		155,000

P4-3

(1)

MADEIRA COMPANY
Schedule of Cost of Goods Manufactured
For Month Ended March 31

Work in process, March 1		\$ 40,000
Production costs:		
Direct materials	\$104,000 **	
Direct labor	160,000 ***	
Factory overhead	80,000 ***	344,000
		<u>\$384,000</u>
Less work in process, March 31		36,000
Cost of goods manufactured.....		<u><u>\$348,000 *</u></u>

* Cost of goods sold (\$345,000) + ending finished goods inventory (\$105,000) – beginning finished goods inventory (\$102,000) = \$348,000.

** Purchases of materials during March (\$110,000) + beginning materials inventory (\$20,000) – ending materials inventory (\$26,000) = \$104,000.

*** Production costs for March (\$344,000) – direct materials (\$104,000) = direct labor and factory overhead (\$240,000).

Let x = direct labor
 1.5x = \$240,000
 x = \$160,000 direct labor
 .5x = \$80,000 factory overhead

(2)	Prime cost:	
	Direct materials (requirement (1))	\$104,000
	Direct labor (requirement (1))	160,000
		<u><u>\$264,000</u></u>
(3)	Conversion cost:	
	Direct labor (requirement (1))	\$160,000
	Factory overhead (requirement (1))	80,000
		<u><u>\$240,000</u></u>

P4-4

Company A:		
Sales		\$4,000,000
Cost of goods sold:		
Finished goods inventory, January 1.....	\$ 600,000	
Cost of goods manufactured.....	<u>3,800,000</u>	
Cost of goods available for sale.....	\$4,400,000	
Finished goods inventory, December 31	<u>1,200,000</u>	
Cost of goods sold		<u>3,200,000</u>
Gross profit (20% of sales).....		<u>\$ 800,000</u>

Company B:		
Cost of goods available for sale.....	\$1,510,000	
Less finished goods ending inventory.....	<u>210,000</u>	
Cost of goods sold	<u>\$1,300,000</u>	

Company C:		
Sales		\$ 429,000
Cost of goods sold:		
Cost of goods manufactured.....	\$ 340,000	
Add beginning finished goods inventory	<u>45,000</u>	
Cost of goods available for sale.....	\$ 385,000	
Less ending finished goods inventory....	<u>52,000</u>	
Cost of goods sold		<u>333,000</u>
Gross profit		<u>\$ 96,000</u>

P4-5

Finished Goods		Work in Process	
Beg.	34,000	Beg.	7,000
(4)	348,000	M	50,000
	380,000	L(2)	200,000
End. 30,000		FOH	100,000
			<u>357,000</u>
		End. 11,000	
Materials and Supplies		Accrued Payroll	
Beg.	20,000	(8)	259,000
	65,000	Beg.	13,000
(1)	50,000		55,000
	85,000		200,000
End. 15,000			<u>268,000</u>
		End. 9,000	

P4-5 (Concluded)

Accounts Receivable				Accounts Payable			
Beg.	54,000	(7)	532,000	(6)	77,000	Beg.	18,000
	500,000						65,000
	554,000						83,000
	End. 22,000						End. 6,000
Factory Overhead Control				Sales			
	20,000	(3)	100,000				500,000
	55,000						
	10,000						
	2,000						
	13,000						
	100,000						
Payroll				Cost of Goods Sold			
	55,000		55,000	(5)	350,000		
	200,000		200,000				
	255,000		255,000				

- (1) Materials issued to production, \$50,000
- (2) Direct labor, \$200,000
- (3) Total factory overhead, \$100,000
- (4) Cost of goods manufactured, \$346,000
- (5) Cost of goods sold, \$350,000
- (6) Payment of accounts payable, \$77,000
- (7) Collection of accounts receivable, \$532,000
- (8) Payment of payroll, \$259,000

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P4-6

Work in Process	84,000	84,000
Materials		
Cost of goods sold	\$140,000	
Add finished goods inventory increase ..	<u>17,000</u>	
Cost of goods manufactured.....	\$157,000	
Add work in process inventory increase	<u>2,000</u>	
Total manufacturing cost	\$159,000	
Less : Factory overhead.....	\$35,000	
Direct labor.....	<u>40,000</u>	
Materials used in manufacturing	<u>\$ 84,000</u>	
Materials	91,000	91,000
Accounts Payable		
Materials used in manufacturing		
(from above)	\$ 84,000	
Add materials inventory increase	<u>7,000</u>	
Materials purchased	<u>\$ 91,000</u>	
Payroll	40,000	40,000
Accrued Payroll.....		
Work in Process	40,000	40,000
Payroll		
Factory Overhead Control	35,000	35,000
Various Credits.....		
Work in Process	35,000	35,000
Factory Overhead Control		
Finished Goods (12,000 + 84,000 + 40,000 + 35,000 - 14,000)	157,000	157,000
Work in Process		
Cost of Goods Sold (28,000 + 157,000 - 45,000)	140,000	140,000
Finished Goods		

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P4-7

(1) and (2)

(a) Materials.....	92,000	
Accounts Payable.....		92,000
(b) Factory Overhead Control.....	26,530	
Accounts Payable.....		26,530
(c) Payroll.....	86,000	
Accrued Payroll		86,000
Work in Process.....	60,500	
Factory Overhead Control.....	12,500	
Marketing Expenses Control	8,000	
Administrative Expenses Control	5,000	
Payroll		86,000
Accrued Payroll (86,000 + 2,250).....	88,250	
Cash		88,250
(d) Work in Process.....	82,500	
Factory Overhead Control.....	8,300	
Materials		90,800
(e) Work in Process.....	47,330	
Factory Overhead Control		47,330
(f) Finished Goods.....	188,000	
Work in Process		188,000
(g) Accounts Receivable	241,150	
Sales.....		241,150
Cost of Goods Sold	185,500	
Finished Goods.....		185,500
(h) Cash	208,662	
Sales Discounts	4,258	
Accounts Receivable		212,920
(i) Marketing Expenses Control	18,000	
Administrative Expenses Control	12,000	
Accounts Payable.....		30,000
(j) Accounts Payable	104,000	
Cash		104,000

P4-7 (Continued)

Cash

1/1 Bal.	20,000	(c)	88,250
(h)	208,662	(i)	104,000
	228,662		192,250
	36,412		

Materials

1/1 Bal.	10,000	(d)	90,800
(a)	92,000		
	102,000		
	11,200		

Accounts Receivable

1/1 Bal.	25,000	(h)	212,920
(g)	241,150		
	266,150		
	53,230		

Machinery

1/1 Bal.	40,000
----------	--------

Finished Goods

1/1 Bal.	9,500	(g)	185,500
(f)	188,000		
	197,500		
	12,000		

Accumulated Depreciation

1/1 Bal.	10,000
----------	--------

Work in Process

1/1 Bal.	4,500	(f)	188,000
(c)	60,500		
(d)	82,500		
(e)	47,330		
	194,830		
	6,830		

Accounts Payable

(j)	104,000	1/1 Bal.	15,500
		(a)	92,000
		(b)	26,530
		(i)	30,000
			164,030
			60,030

Accrued Payroll

(c)	88,250	1/1 Bal.	2,250
		(c)	86,000

Retained Earnings

1/1 Bal.	21,250
----------	--------

Sales

(g)	241,150
-----	---------

Cost of Goods Sold

(g)	185,500
-----	---------

Sales Discounts

(h)	4,258
-----	-------

Payroll

(c)	86,000	(c)	86,000
-----	--------	-----	--------

P4-7 (Concluded)

Common Stock		Factory Overhead Control	
	1/1 Bal. 60,000	(b) 26,530	(e) 47,330
		(c) 12,500	
		(d) 8,300	
		47,330	
Administrative Expenses Control		Marketing Expenses Control	
(c) 5,000		(c) 8,000	
(i) 12,000		(i) 18,000	
17,000		26,000	

(3)

HOPKINS & WHITE COMPANY

Trial Balance

January 31

Cash.....	\$ 36,412	
Accounts Receivable.....	53,230	
Finished Goods	12,000	
Work in Process	6,830	
Materials	11,200	
Machinery	40,000	
Accounts Payable		\$ 60,030
Accumulated Depreciation.....		10,000
Common Stock.....		60,000
Retained Earnings.....		21,250
Sales		241,150
Sales Discounts	4,258	
Cost of Goods Sold	185,500	
Marketing Expenses Control.....	26,000	
Administrative Expenses Control.....	17,000	
	<u>\$392,430</u>	<u>\$392,430</u>

CHAPTER 5

DISCUSSION QUESTIONS

- Q5-1. The cost attached to a product is an amount assigned by the costing methods used—an amount controlled by the circumstances, assumptions, and limitations of the method under which it was compiled. Product costs are composites of historical outlay that have, perhaps, been modified by estimates or standards, by processes assigning or prorating expenditures to periods, or by tracing the direct costs and allocating the indirect costs to particular products so that the total period outlay is spread over the aggregate output. Despite these shortcomings, product costs are useful in costing inventories, comparing prices and total unit cost, measuring current profit or loss, and indicating the minimum cost below which a sales price cannot go in the long run. Some confusion will result at times in using cost information in making management decisions unless information relevant only to the decision is used.
- Q5-2. The primary objective in job order costing is to determine the cost of materials, labor, and factory overhead used to produce a specific order or contract. Cost estimates are made when the order is taken, and the job order procedures are designed to reveal costs as the order goes through production, thereby giving an opportunity to control costs.
- Q5-3. The type of cost accumulation method used by a company will be determined by the type of manufacturing operations performed. A manufacturing company should use process cost accumulation for product costing purposes when like units are continuously mass produced; when custom-made or unique goods are produced, job order costing would be more appropriate. Process costing is often used in industries such as chemicals, food processing, oil, mining, rubber, and electrical appliances. With a continuous mass production of like units, the center of attention is the individual process (usually a department).
- The unit costs by cost category as well as total unit cost for each process (department) are necessary for product costing purposes.
- Q5-4. A job order cost sheet is used:
- (a) to keep track of the direct materials and direct labor used on a job plus an appropriate share of factory overhead;
 - (b) to compare actual costs to estimated costs;
 - (c) as a subsidiary ledger for the work in process account.
- Q5-5. The work in process account is a control account in the general ledger, reflecting total costs assigned or applied to jobs. The individual job cost sheets form the work in process account's subsidiary ledger, indicating the direct materials, direct labor, and factory overhead charged to each job.
- Q5-6. Job order cost sheets serve a control function. Comparisons are made between estimates of job costs and costs actually accumulated for the job. In addition, cost control is enhanced by accumulating direct materials and labor as well as factory overhead costs by cost centers or departments, and by comparing the actual costs to cost center budgets.
- Q5-7. Actual factory overhead consists of the day-by-day costs that are actually experienced and incurred by the company. Applied factory overhead is the overhead charged to jobs based on the predetermined factory overhead rate. This rate is created by dividing total estimated overhead by total estimated number of units (or any other appropriate base). The difference between actual and applied factory overhead is the over- or underapplied factory overhead.
- Q5-8. The characteristic of a service business that makes likely the use of job order costing is that all jobs are not alike and cost information for each job is desired.

EXERCISES

E5-1	Job 5575	
	Direct material	\$24,070
	Direct labor	22,832
	Applied overhead	10,024
	Total job cost	<u>\$56,926</u>

E5-2	Job 5576	
	Direct material	\$ 4,420
	Direct labor	2,600
	Applied overhead	2,000
	Cost to date.....	<u>\$ 9,020</u>

E5-3

(1)	The amount of direct labor in finished goods:	
	Finished goods	\$37,500
	Materials included in finished goods (\$15,500 - \$3,200)	12,300
	Direct labor and factory overhead in finished goods	<u>\$25,200</u>

$$\frac{\text{Factory overhead charged to work in process}}{\text{Direct labor charged to work in process}} = \frac{\$11,800}{\$14,750} = .8$$

Let X = direct labor in finished goods

1.8X = \$25,200 direct labor and factory overhead in finished goods

X = \$14,000 direct labor in finished goods

(2)	The amount of factory overhead in finished goods:	
	X = \$14,000	
	.8X = .8 (\$14,000)	
	.8X = \$11,200 factory overhead in finished goods	

E5-4

(1)	December materials used:	
	Materials inventory, December 1	\$ 9,000
	Materials purchased.....	\$84,000
	Freight-in.....	<u>1,500</u>
	Materials available	<u>\$94,500</u>
	Materials inventory, December 31	4,500
		<u>\$90,000</u>

E5-4 (Concluded)**(2) Work in process, December 31:**

	Per Unit	
Direct materials	\$2.40	
Direct labor .....	.80	
	\$3.20	x 2,000 units = \$6,400
Factory overhead		32 machine hrs. @ \$100 = 3,200
		<u>\$9,600</u>

(3) December cost of goods manufactured:

Materials used (direct) (requirement (1))	\$ 90,000
Direct labor	30,000
Factory overhead (600 machine hours @\$100).....	60,000
Total manufacturing cost	<u>\$180,000</u>
Add work in process, December 1:	
Direct Material, \$2.40 x 3,000	= \$7,200
Direct Labor, \$.80 x 3,000	= 2,400
Overhead, \$100 x 48 machine hours =	<u>4,800</u>
	14,400
	<u>\$194,400</u>
Less work in process, December 31 (requirement (2))	9,600
	<u>\$184,800</u>

(4) Finished goods, December 31:

Direct materials.....	\$ 5,000
Direct labor	3,000
Factory overhead (60 machine hours @\$100).....	6,000
	<u>\$ 14,000</u>

(5) December cost of goods sold:

Cost of goods manufactured (requirement (3)).....	\$184,800
Add finished goods, December 1	12,000
Cost of goods available for sale	<u>\$196,800</u>
Less finished goods, December 31 (requirement (4))	14,000
	<u>\$182,800</u>

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E5-5 Materials:

Beginning inventory	\$ 75	
Purchases	<u>336</u>	(1)
Materials available for use	\$411	
Less ending inventory	<u>85</u>	
Materials used.....		\$326
Direct labor $((\$686 - \$326) \div 1.6)$		225 (2)
Factory overhead $(\$225 \times .6)$		<u>135</u>
Total manufacturing cost		\$686
Add work in process, beginning inventory		<u>80</u>
		\$766
Less work in process, ending inventory		<u>30</u>
Cost of goods manufactured		\$736 (3)
Add finished goods, beginning inventory		<u>90</u>
Cost of goods available for sale		\$826
Less finished goods, ending inventory		<u>125</u>
Cost of goods sold		<u>\$701</u> (4)

E5-6

(1)	Materials	\$13,000
	Direct labor	15,000
	Factory overhead:	
	Molding $(1,000 \text{ DLH} \times \$2.70)$	2,700
	Decorating $(\$6,000 \times 35\%)$	<u>2,100</u>
	Estimated cost to produce	<u>\$32,800</u>
(2)	Materials	\$13,000
	Direct labor	<u>15,000</u>
	Estimated prime cost	<u>\$28,000</u>
(3)	Direct labor	\$15,000
	Factory overhead $(\$2,700 + \$2,100)$	<u>4,800</u>
	Estimated conversion cost	<u>\$19,800</u>
(4)	Estimated cost to produce (requirement (1))	\$32,800
	Markup $(\$32,800 \times 45\%)$	<u>14,760</u>
	Bid price	<u>\$47,560</u>

E5-7

(1)

WADSWORTH MACHINE WORKS
Job Order Cost Sheet—Job 909

Direct Materials			Direct Labor			Applied Factory Overhead			
Date Issued	Amount	Date (Week of)	Hours	Rate	Cost	Date (Week of)	Hours	Rate	Cost
9/14	\$ 600	9/20	90	\$8.20	\$ 558	9/20	10	\$80	\$800
9/20	331	9/26	70	7.30	511				
9/22	200								
	<u>\$1,131</u>				<u>\$1,069</u>				<u>\$800</u>

- (2) Sales price of Job 909, contracted a markup of 50% of cost:
- | | |
|--------------------------------|----------------|
| Direct materials..... | \$1,131 |
| Direct labor | 1,069 |
| Applied factory overhead | 800 |
| Total factory cost..... | <u>\$3,000</u> |
| Markup 50% of cost..... | 1,500 |
| Sales price | <u>\$4,500</u> |

E5-8

	<u>Debit</u>	<u>Credit</u>
(1) Work in Process (35,000 + 45,000 + 54,000).....	134,000	
Materials		134,000
(2) Work in Process (45,000 + 40,000 + 35,000).....	120,000	
Payroll		120,000
(3) Work in Process (36,000 + 32,000 + 28,000).....	96,000	
Factory Overhead Control		96,000
(4) Finished Goods (156,000 + 132,000).....	288,000	
Work in Process		288,000

E5-9	(a)	Materials	35,000	
		Accounts Payable		35,000
(b)		Work in Process	8,000	
		Factory Overhead Control	2,000	
		Materials		10,000
(c)		Payroll	9,400	
		Accrued Payroll		9,400
		Work in Process	7,600	
		Factory Overhead Control	1,800	
(d)		Payroll		9,400
		Factory Overhead Control	1,200	
		Accumulated Depreciation—Factory Equipment		1,200
(e)		Work in Process (1,830 x 66 2/3%)	1,220	
		Applied Factory Overhead		1,220
		Finished Goods (1,450 + 1,830 + 1,220)	4,500	
(f)		Work in Process		4,500
		Factory Overhead Control	1,250	
(g)		Accounts Payable		1,250
		Accounts Receivable	6,100	
		Sales		6,100
		Cost of Goods Sold	4,500	
		Finished Goods		4,500

E5-10

Materials				Work in Process			
Inv.	10,000	WIP	110,000	Inv.	30,000	FG	300,000
Purch.	138,000			Materials	110,000		
	148,000			Factory			
	38,000			overhead	90,000		
				Labor	180,000		
					410,000		
					110,000		
Finished Goods				Cost of Goods Sold			
Inv.	50,000	CGS	200,000	FG	200,000		
WIP	300,000						
	350,000						
	150,000						

E5-11

(1)	Work in Process	19,112.50	
	Materials		9,250.00
	Payroll		3,945.00
	Applied Factory Overhead		5,917.50
(2)	Finished Goods	19,112.50	
	Work in Process		19,112.50

PROBLEMS

P5-1

(1) Total cost of work put into process:		
Materials		\$ 60,000
Labor: Grinding (8,000 hrs. x \$5.60)		44,800
Machining (4,600 hrs. x \$6)		27,600
Factory overhead: Grinding (8,000 hrs. x \$6)		48,000
Machining (4,600 hrs. x \$8)		36,800
		<u>\$217,200</u>
(2) Cost of goods manufactured:		
Total cost of work put into process (from requirement (1))	\$217,200	
Work in Process, beginning inventory	15,000	
	<u>\$232,200</u>	
Work in process, ending inventory	17,600	
	<u>\$214,600</u>	
(3) Cost of goods sold:		
Cost of goods manufactured (from requirement (2))	\$214,600	
Finished goods, beginning inventory	22,000	
	<u>\$236,600</u>	
Finished goods, ending inventory	21,000	
	<u>\$215,600</u>	
(4) Conversion cost:		
Labor: Grinding (8,000 hrs. x \$5.60)	\$ 44,800	
Machining (4,600 hrs. x \$6)	27,600	
Factory overhead: Grinding (8,000 hrs. x \$6)	48,000	
Machining (4,600 hrs. x \$8)	36,800	
	<u>\$157,200</u>	
(5) Cost of materials purchased:		
Materials put into process	\$ 60,000	
Add materials, ending inventory	18,000	
	<u>\$ 78,000</u>	
Less materials, beginning inventory	20,000	
	<u>\$ 58,000</u>	

P5-2

(1)

Materials			
4/1	2,750	Indirect	
Purchases	11,500	Material	2,790
	14,250	Direct	
	1,755	Material	9,705 *
			12,495

* \$9,705 = \$2,450 + \$970 + \$6,285
(Job 207) (Job 204) (Jobs 202, 203, 205, & 206)

Work in process ending inventory consists of jobs 203 & 206:

	Job 203	Job 206	Total
Direct materials	(\$1,480 + \$ 555)	+ \$1,980	= \$ 4,015
Direct labor	(1,000 + 1,500)	+ 1,000	= 3,500
Applied overhead	(800 *+ 1,200)	+ 800	= 2,800
Total	(\$3,280 + \$3,255)	+ \$3,780	= <u>\$10,315</u>

* Applied overhead is 80% of direct labor cost.

(2)	Work in Process	4,850	
	Materials		1,250
	Payroll		2,000
	Applied Overhead		1,600
	Finished Goods (4,700 + 1,250 + 2,000 + 1,600) ..	9,550	
	Work in Process		9,550
	Cost of Goods Sold	9,550	
	Finished Goods		9,550
	Accounts Receivable	14,325	
	Sales		14,325

P5-2 (Concluded)

- (3) Cost of goods manufactured = cost of jobs finished in April.

Job 205:

Direct material	\$ 2,500	
Direct labor	2,100	(105 direct labor hours x \$20)
Applied overhead	1,680	(105 direct labor hours x \$16)
Total Job 205	<u>\$ 6,280</u>	
Job 202	9,550	(see requirement (2))
Job 204	6,930	
Job 207	5,870	
Total	<u>\$28,630</u>	

- (4) Actual overhead (1,375 + 2,500 + 2,700 + 2,790). \$ 9,365
- Applied overhead:
- | | | |
|--|------------|-----------------|
| Jobs 202, 203, 205, 206 (330* hours x \$16). | \$ 5,280 | |
| Job 207 | 1,520 | |
| Job 204 (\$1,760 - \$960) | <u>800</u> | |
| Total applied overhead | | <u>7,600</u> |
| Underapplied | | <u>\$ 1,765</u> |

* 100 + 75 + 105 + 50

- (5) Jobs 201, 202, and 205 were sold. Their costs are \$8,450 + \$9,550 + \$6,280 = \$24,280.
- | | |
|------------------------------|-----------------|
| Sales (\$24,280 x 1.5) | \$36,420 |
| Cost of goods sold | (24,280) |
| Underapplied overhead | <u>(1,765)</u> |
| Gross profit for April | <u>\$10,375</u> |

P5-3

Finished Goods			Work in Process		
Bal.	80,000	360,000	Bal.	20,000	(i) 320,000
(i)	320,000		(c)	150,000	
	400,000		(e)	80,000	
	40,000			100,000*	
				350,000	
				30,000	

* \$330,000 - \$80,000 = \$250,000 direct labor and factory overhead.
 Factory overhead is 150% of direct labor; therefore, direct labor is \$100,000

P5-3 (Concluded)

Materials			
Bal.	15,000	(e)	80,000
(b)	100,000		12,000
	115,000		92,000
	23,000		

Cost of Goods Sold	
	360,000

Factory Overhead Control			
(d)	60,000		
	12,000		
	75,000		
	147,000		

Applied Factory Overhead	
(c)	150,000

Accounts Payable			
(f)	102,000	Bal.	7,000
			100,000
			107,000
			5,000

Accrued Payroll			
(i)	172,000	Bal.	11,000
			175,000
			186,000
			14,000

Accounts Receivable			
Bal.	45,000	(h)	480,000
(a)	500,000		
	545,000		
	65,000		

Sales	
(a)	500,000**

** Cost of goods sold is 72% of sales (100% - 28%).

- (1) Materials purchased—\$100,000
- (2) Cost of goods sold—\$360,000
- (3) Finished goods ending inventory—\$40,000
- (4) Work in process ending inventory—\$30,000
- (5) Direct labor cost—\$100,000
- (6) Applied factory overhead—\$150,000
- (7) Over- or underapplied factory overhead—\$3,000 overapplied
- (8) Closed out to the cost of goods sold account

CGA-Canada (adapted). Reprint with permission.

P5-4

(1)

COLUMBUS COMPANY
Cost of Goods Sold Statement
For Month Ended October 31

Materials:		
Materials and supplies inventory, Oct. 1	\$40,700	
Purchases	<u>24,800</u>	
Materials and supplies available for use	\$65,500	
Less: Factory supplies used	\$ 3,950	
Materials and supplies inventory, Oct. 31	<u>31,750</u>	<u>35,700</u>
Materials consumed		\$29,800
Direct labor		18,600
Applied factory overhead		<u>27,450</u>
Total manufacturing cost		\$75,850
Add work in process inventory, Oct. 1		<u>4,070</u>
		\$79,920
Less work in process inventory, Oct 31		<u>4,440</u>
Cost of goods manufactured		\$75,480
Add finished goods inventory, Oct. 1		<u>9,800</u>
Cost of goods available for sale		\$85,280
Less finished goods inventory, Oct 31 (2,500 units x \$3.70)*		<u>9,250</u>
Cost of goods sold		<u><u>\$76,030</u></u>

***Calculations:**

Units in finished goods inventory, Oct. 1	2,800
Units manufactured	20,400
Units sold	<u>(20,700)</u>
Units in finished goods inventory, Oct. 31	<u><u>2,500</u></u>

$$\frac{\text{Cost of goods manufactured}}{\text{Units manufactured}} = \frac{\$75,480}{20,400} = \$3.70$$

P5-4 (Concluded)

(2)

COLUMBUS COMPANY
Income Statement
For Month Ended October 31

Sales				\$144,900
Less sales returns and allowances				<u>1,300</u>
Net sales				\$143,600
Less cost of goods sold.....				<u>76,030</u>
Gross profit				\$ 67,570
Less commercial expenses:				
Marketing expense.....	\$25,050			
Depreciation—building.....	30			
Depreciation—office equipment	<u>16</u>	\$25,096		
Administrative expense.....	\$19,700			
Depreciation—building.....	20			
Depreciation—office equipment	<u>24</u>	<u>19,744</u>		<u>44,840</u>
Income before income tax.....				<u><u>\$ 22,730</u></u>

(3)

Amount of over- or underapplied factory overhead:**Actual factory overhead:**

Factory overhead paid.....	\$20,100		
Indirect materials	3,950		
Depreciation—building.....	150		
Depreciation—machinery and equipment	800		
Indirect labor.....	<u>4,400</u>	\$29,400	
Applied factory overhead		<u>27,450</u>	
Underapplied factory overhead.....		<u><u>\$ 1,950</u></u>	

P5-5

(1) **MORRISVILLE CANNING COMPANY**
Balance sheet
December 31, 20B

<u>Assets</u>			
Current assets:			
Cash.....		\$19,000	
Accounts receivable.....		10,000	
Inventories:			
Finished goods	\$4,000		
Work in process	1,000		
Materials.....	<u>2,000</u>	7,000	
Prepaid expenses.....		<u>500</u>	
Total current assets.....			\$36,500
Property, plant, and equipment (net)			<u>26,000</u>
Total assets			<u>\$62,500</u>
<u>Liabilities</u>			
Current liabilities.....			\$17,500
<u>Stockholders' Equity</u>			
Common stock		\$30,000	
Retained earnings		<u>15,000</u>	
Total stockholders' equity			<u>45,000</u>
Total liabilities and stockholders' equity			<u>\$62,500</u>

P5-5 (Concluded)

(2) **MORRISVILLE CANNING COMPANY**
Income Statement
For Year Ended December 31, 20B

Sales.....		\$60,000
Cost of goods sold:		
Materials:		
Inventory, January 1	\$ 4,000	
Purchases.....	15,000	
Materials available for use	\$19,000	
Less inventory, December 31	2,000	
Materials consumed	\$17,000	
Direct labor	9,000	
Applied factory overhead.....	9,000	
Total manufacturing cost	\$35,000	
Add work in process inventory, January 1	2,000	
	\$37,000	
Less work in process inventory, December 31	1,000	
Cost of goods manufactured.....	\$36,000	
Add finished goods inventory, January 1	6,000	
Cost of goods available for sale.....	\$42,000	
Less finished goods inventory, December 31	4,000	
Cost of goods sold	\$38,000	
Add underapplied factory overhead.....	2,000	
Cost of goods sold—adjusted		40,000
Gross profit		\$20,000
Less commercial expenses:		
Marketing expense	\$ 6,000	
Administrative expense.....	9,000	15,000
Income before income tax.....		<u>\$ 5,000</u>

P5-6

(1) and (2)

TROPEZ INC.
Job Order Cost Sheets To Post Beginning Inventory Data
March 1, 19—

	<u>Job 621</u>	<u>Job 622</u>	<u>Job 623</u>
Materials	\$ 2,800	\$ 3,400	\$ 1,800
Labor	2,100	2,700	1,350
Factory Overhead	1,680	2,160	1,080
Total	\$ 6,580	\$ 8,260	\$ 4,230
(b) M	5,300	7,400	5,900
(c) M		(400)	
(f) L	6,420	8,160	6,320
(h) OH	5,136	6,528	5,056
Total	<u>\$23,436</u>	<u>\$29,948</u>	<u>\$21,506</u>
(j) Completed and transferred to warehouse		Completed and transferred to warehouse	Still in process

(2)	<u>Dr.</u>	<u>Cr.</u>
(a) Materials	22,000.00	
Accounts Payable		22,000.00
(b) Work in Process	18,600.00	
Factory Overhead Control	2,400.00	
Materials		21,000.00
(c) Materials	600.00	
Work in Process		400.00
Factory Overhead Control		200.00
(d) Accounts Payable	800.00	
Materials		800.00
(e) Payroll	38,000.00	
Accrued Payroll		38,000.00
(f) Work in Process	20,900.00	
Factory Overhead Control	7,600.00	
Marketing Expenses Control	5,700.00	
Administrative Expenses Control	3,800.00	
Payroll		38,000.00
(g) Factory Overhead Control	9,404.50	
Accounts Payable		7,154.50
Accumulated Depreciation—Factory Building & Equipment		2,000.00
Prepaid Insurance		250.00

P5-6 (Concluded)

	<u>Dr.</u>	<u>Cr.</u>
(h) Work in Process.....	16,720.00	
Factory Overhead Control (or Applied Factory Overhead)		16,720.00
(i) Finished Goods.....	53,384.00	
Work in Process		53,384.00
(j) Accounts Receivable	74,738.00 *	
Sales.....		74,738.00
Cost of Goods Sold	53,384.00	
Finished Goods.....		53,384.00
(k) Cash	69,450.00	
Accounts Receivable		69,450.00

* $(\$53,384 \times 40\%) + \$53,384 = \$74,738$

Materials				Work in Process			
3/1 Bal.	14,000	(b)	21,000	3/1 Bal.	19,070	(c)	400
(a)	22,000	(d)	800	(b)	18,600	(i)	53,384
(c)	600		21,800	(f)	20,900		53,784
	36,600			(h)	16,720		
	14,800				75,290		
					21,506		

Finished Goods			
3/1 Bal.	15,000	(j)	53,384
(i)	53,384		
	68,384		
	15,000		

(3)

TROPEZ INC.
Schedule of Inventories, March 31

Materials	\$14,800
Work in Process (Job 623).....	21,506
Finished Goods.....	15,000
Total	<u>\$51,306</u>

P5-7

(1) and (3)

Accounts Receivable	
(g)	117,500.00

Finished Goods	
3/1 Bal.	78,830.00
(g)	94,501.65
	173,331.65
	78,830.00

Work in Process	
3/1 Bal.	292,621.00
(c)	98,884.00
(d)	53,730.00
(f)	30,200.15
	475,435.15
	380,933.50

Cost of Goods Sold	
(g)	94,501.65

Factory Overhead Control	
(c)	12,480.00
(e)	28,461.87
	40,941.87

Various Credits	
(e)	28,461.87

Sales	
(g)	117,500.00

Materials	
3/1 Bal.	65,000.00
(a)	42,300.00
(b)	5,800.00*
	113,100.00
	59,370.00

Accounts Payable	
(a)	42,300.00
(b)	5,800.00
	48,100.00

Accrued Payroll	
(c)	111,364.00

Payroll	
(c)	111,364.00

Applied Factory Overhead	
(f)	30,200.15
(f)	30,200.15

Over- or Underapplied Factory Overhead	
(3)	10,741.72
3/1 Bal.	12,300.00
	1,558.28

*\$5,800 could also be posted directly to the work in process account, reducing entry (d) to \$47,930.

P5-7 (Concluded)

(2) The total cost of each job at the end of March:

	<u>Job 204</u>	<u>Job 205</u>	<u>Job 206</u>	<u>Job 207</u>	<u>Total</u>
Direct materials	\$15,230.00	\$ 40,450	\$ 60,875.00	\$16,640	
	9,480.00	11,320	10,490.00	5,800	\$170,285.00
Direct labor	21,430.00	55,240	43,860.00		
	26,844.00	22,750	28,920.00	20,370	219,414.00
Factory overhead ..	13,800.00	22,370	19,366.00		
	7,717.65 *	7,475	8,314.50	6,693	85,736.15
Total Cost.....	<u>\$94,501.65</u>	<u>\$159,605</u>	<u>\$171,825.50</u>	<u>\$49,503</u>	<u>\$475,435.15</u>

The balance in the work in process account
(Jobs 205, 206, and 207)..... \$380,933.50

* 3,355.5 hours x \$2.30 = \$7,717.65

P5-8

	<u>Dr.</u>	<u>Cr.</u>
(2)		
(a) Materials.....	114,520	
Accounts Payable.....		114,520
(b) Payroll.....	110,000	
Accrued Payroll.....		110,000
(c) Work in Process.....	78,000	
Factory Overhead Control.....	12,000	
Marketing and Administrative Expenses	20,000	
Payroll		110,000
(d) Work in Process.....	108,175	
Factory Overhead Control.....	7,520	
Materials		115,695
(e) Work in Process.....	42,750	
Applied Factory Overhead		42,750
(f) Cost of Goods Sold	190,350	
Work in Process		190,350

P5-8 (Continued)

(g) Cash	247,000	
Sales Discounts	13,000	
Accounts Receivable		260,000
(h) Marketing and Administrative Expenses	15,000	
Factory Overhead Control	24,680	
Cash		37,680
Accumulated Depreciation—Machinery		2,000
(i) Accounts Payable	85,000	
Cash		85,000
(j) Applied Factory Overhead	42,750	
Factory Overhead Control		42,750
Cost of Goods Sold	1,450	
Factory Overhead Control		1,450

(1) and (3)

GENERAL LEDGER

Cash				Materials			
1/1 Bal.	47,000	(h)	37,680	1/1 Bal.	22,000	(d)	115,695
(g)	247,000	(i)	85,000	(a)	114,520		
	294,000		122,680		136,520		
	171,320				20,825		
Accounts Receivable				Machinery			
1/1 Bal.	50,000	(g)	260,000	1/1 Bal.	45,300		
(f)	255,000						
	305,000						
	45,000						
Finished Goods				Accumulated Depreciation—Machinery			
1/1 Bal.	32,500					1/1 Bal.	10,000
						(h)	2,000
							12,000
Work in Process				Accounts Payable			
1/1 Bal.	7,500	(f)	190,350	(i)	85,000	1/1 Bal.	59,375
(c)	78,000					(a)	114,520
(d)	108,175						173,895
(e)	42,750						88,895
	236,425						
	46,075						

P5-8 (Continued)

Accrued Payroll	
	(b) 110,000
Payroll	
(b) 110,000	(c) 110,000
Retained Earnings	
	1/1 Bal. 34,925
Sales Discounts	
(g) 13,000	
Cost of Goods Sold	
(f) 190,350	
(j) 1,450	
	191,800
Common Stock	
	1/1 Bal. 100,000

Sales	
	(f) 255,000
Factory Overhead Control	
(c) 12,000	(j) 42,750
(d) 7,520	(i) 1,450
(h) 24,680	
	44,200
Applied Factory Overhead	
(j) 42,750	(e) 42,750
Marketing and Administrative Expenses	
(c) 20,000	
(h) 15,000	
	35,000

WORK IN PROCESS SUBSIDIARY LEDGER

Job 101	
1/1 Bal.-Mat. 2,500	(f) 88,350
1/1 Bal.-Lab. 2,000	
1/1 Bal.-OH 1,000	
(c) Labor 20,000	
(d) Materials 51,800	
(e) Overhead 11,250	
	88,350

Job 103	
(c) Labor 18,000	
(d) Materials 14,575	
(e) Overhead 13,500	
	46,075

Job 102	
1/1 Bal.-Mat. 600	(f) 102,000
1/1 Bal.-Lab. 1,000	
1/1 Bal.-OH 400	
(c) Labor 40,000	
(d) Materials 42,000	
(e) Overhead 18,000	
	102,000

P5-8 (Concluded)

(4)

MID-STATE COMPANY
Trial Balance
January 31

Cash	171,320	
Accounts Receivable	45,000	
Finished Goods	32,500	
Work in Process	46,075	
Materials	20,825	
Machinery	45,300	
Accumulated Depreciation—Machinery		12,000
Accounts Payable		88,895
Accrued Payroll		110,000
Common Stock		100,000
Retained Earnings		34,925
Marketing and Administrative Expenses	35,000	
Sales		255,000
Sales Discounts	13,000	
Cost of Goods Sold	191,800	
	<u>600,820</u>	<u>600,820</u>

(5)

MID-STATE COMPANY
Cost of Goods Sold Statement
For Month Ended January 31

Direct materials used	\$108,175
Direct labor	78,000
Applied factory overhead	42,750
Total manufacturing cost at normal	\$228,925
Add work in process inventory, January 1	7,500
	<u>\$236,425</u>
Less work in process inventory, January 31	46,075
Cost of goods sold	\$190,350
Add underapplied factory overhead	1,450
Cost of goods sold—adjusted	<u>\$191,800</u>

CHAPTER 6

DISCUSSION QUESTIONS

- Q6-1. The basic objective of process costing is to determine the costs of the products manufactured by the company. Determining the cost of the products manufactured is necessary in order to properly cost ending inventories for external reporting purposes (i.e., reporting to creditors and owners of the company, the SEC, and the IRS) and to evaluate the profitability of the manufacturing activity. In order to cost products, the costs must be determined for materials, labor, and factory overhead used to process each unit of product through each department.
- Q6-2. The products manufactured within a department (or cost center) during the period can be heterogeneous if job order costing is used, but must be homogeneous if process costing is used. In job order costing, products are accounted for in batches. The cost of each unit of product manufactured on a job is determined by dividing the total cost charged to the job by the number of units produced on the job. Since the manufacturing cost of each job is accounted for separately, accurate and useful product cost can be determined even when the products manufactured on different jobs are substantially different. By contrast, in process costing, all manufacturing costs are charged to the department, and the unit cost is determined by dividing the cost charged to the department by the number of units produced. As a consequence, the units of product manufactured within a department must be essentially alike in order for the cost allocated to each unit to be meaningful (i.e., to reasonably reflect the actual cost of the resources used to manufacture the product).
- Q6-3. (a) Process
(b) Process, unless significantly different models are manufactured
(c) Process
(d) Job order
(e) Process
(f) Process
(g) Job order
(h) Process, unless different fabrics are used for different models, in which case the conversion costs may be accounted for using process, but the materials using job order
- Q6-4. Three product flow formats are: sequential, parallel, and selective.
Sequential means that the product flows or is manufactured in an unchanging fixed set of operations, going from one department to the next.
Parallel means that certain operational phases take place simultaneously in other departments
- and the partially completed units or parts are brought together in subsequent departments.
Selective refers to the fact that a product does not necessarily move through every department. Depending upon the character or shape of the final product, different departments are engaged in completing the desired product.
- Q6-5. Materials Costs—In job order costing, materials requisitions are used and charges are made to jobs; in process costing, charges for materials issued to production are made to departments, with infrequent use of materials requisitions.
Labor Costs—Time tickets are used in job order costing to accumulate labor costs for each job; in process costing, labor costs are charged to departments, and, therefore, detailed time records are not necessary.
Factory Overhead—Job order costing requires the use of predetermined rates for charging overhead to jobs; in process costing, actual overhead may be used. (However, predetermined rates are often used in order to smooth overhead that is not incurred at the same rate as production activity to the products manufactured throughout the year.)
Summarizing Costs—A job order cost sheet is used to accumulate the costs of an order in job order costing; a cost of production report is used in process costing. In job order costing, costs are summarized on completion of the job; in process costing, costs charged to the department and costs accounted for are summarized in the cost of production report each month (or sometimes each week).
- Q6-6. Predetermined overhead rates can and should be used if the pattern of overhead cost incurrence does not follow the pattern of production activity. Some items of overhead are fixed and not responsive to changes in production activity. If production volume varies each month, then predetermined overhead rates should be used. Some items of overhead are incurred only at certain times during the year, but benefit production throughout the year (e.g., payroll taxes, insurance, property taxes, vacation pay, etc.). These items can be recorded as prepaid expenses and amortized uniformly to each month if actual overhead is charged to production. Alternatively, estimates of such costs can be included in the predetermined overhead rate, and the actual cost charged to overhead when incurred. The use of predetermined rates is often simpler than the allocation of actual costs because a single predetermined rate requires only one overhead charge to each department each month. In contrast, the capitalization and

- amortization of each item of actual overhead would require numerous charges each month.
- Q6-7. A cost of production report is an effective monthly (or weekly) summary of the cost of materials, labor, and overhead consumed by each department or cost center, along with a record of the quantity of products manufactured. It provides information necessary to cost products, prepare journal entries to record the transfer of costs between departments, and control costs.
- Q6-8. The sections commonly found in a cost of production report are: (a) a quantity schedule indicating the source and disposition of the units of product, (b) a cost charged to the department section, indicating the cost in total and per unit for the cost transferred in from the preceding department, as well as materials, labor and overhead charged to the department, and (c) a cost accounted for section indicating the amount of cost assigned to the units transferred out of the department, as well as the cost of ending inventory.
- Q6-9. Separate departmental cost of production reports are used to accumulate costs more accurately and to provide more detailed data for cost control purposes than a plant-wide cost of production report could provide. In some cases (e.g., a manufacturing plant that has a selective production flow for its products), a plant-wide cost of production report cannot be used.
- Q6-10. An equivalent unit of production is the amount of a resource (e.g., materials, labor, or overhead) that would be required to complete one unit of the product with respect to the cost element being considered. The total number of equivalent units, with respect to a particular element of cost, represents the number of units of the product that could have been completed with the resources used during the period.

EXERCISES

E6-1

(1)

	Cost from Preceding Department	Materials	Labor	Factory Overhead
Equivalent units transferred out	20,000	20,000	20,000	20,000
Equivalent units in ending inventory:				
Cost from preceding department (100% x 5,000)	5,000			
Materials (100% x 5,000)		5,000		
Labor (60% x 5,000)			3,000	
Factory overhead (40% x 5,000)				2,000
Total equivalent units	25,000	25,000	23,000	22,000

(2)

	Cost from Preceding Department	Materials	Labor	Factory Overhead
Cost in beginning inventory	0	0	0	0
Cost added during current period	\$40,000	\$15,000	\$ 9,200	\$15,400
Total cost to be accounted for	\$40,000	\$15,000	\$ 9,200	\$15,400
Divided by total equivalent units	25,000	25,000	23,000	22,000
Cost per equivalent unit	\$ 1.60	\$.60	\$.40	\$.70

E6-2

Work in Process—Department X	50,000	
Work in Process—Department Y	40,000	
Materials		90,000
Work in Process—Department X	80,000	
Work in Process—Department Y	70,000	
Payroll		150,000
Work in Process—Department X	180,000	
Work in Process—Department Y	70,000	
Factory Overhead		250,000
Work in Process—Department Y	310,000	
Work in Process—Department X		310,000
Finished Goods Inventory	476,000	
Work in Process—Department Y		476,000

E6-3

Tyndol Fabricators Inc.
Cutting and Forming Department
Cost of Production Report
For November

<u>Quantity Schedule</u>	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>	<u>Quantity</u>		
Beginning inventory.....				800		
Started in process this period				3,200		
				<u>4,000</u>		
Transferred to Assembling Department				3,400		
Ending inventory.....	75%	40%	25%	600		
				<u>4,000</u>		
<u>Cost Charged to Department</u>					<u>Total</u>	<u>Unit</u>
Beginning inventory:					<u>Cost</u>	<u>Units*</u>
Materials					\$ 17,923	
Labor					2,352	
Factory overhead					3,800	
Total cost in beginning inventory					<u>\$ 24,075</u>	
Cost added during current period:						
Materials					\$ 68,625	3,850
Labor					14,756	3,640
Factory overhead					29,996	3,550
Total cost added during current period.....					<u>\$113,377</u>	
Total cost charged to department					<u>\$137,452</u>	<u>\$36.70</u>
<u>Cost Accounted for as Follows</u>	<u>Units</u>	<u>% Complete</u>	<u>Unit Cost</u>			<u>Total Cost</u>
Transferred to Assembling Department	3,400	100%	\$36.70			\$124,780
Work in Process, ending inventory:						
Materials	600	75%	\$22.48	\$10,116		
Labor	600	40%	4.70	1,128		
Factory overhead	600	25%	9.52	1,428		12,672
Total cost accounted for						<u>\$137,452</u>

*Total number of equivalent units required in the cost accounted for section determined as follows:

	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>
Equivalent units transferred out.....	3,400	3,400	3,400
Equivalent units in ending inventory	450	240	150
Total equivalent units	<u>3,850</u>	<u>3,640</u>	<u>3,550</u>

** Total cost (i.e., the cost in beginning inventory plus the cost added during the current period) divided by the total number of equivalent units required in the cost accounted for section

E6-4

**Sonora Manufacturing Company
Molding Department
Cost of Production Report
For August**

<u>Quantity Schedule</u>	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>	<u>Quantity</u>		
Beginning inventory.....				1,000		
Started in process this period				9,000		
				<u>10,000</u>		
Transferred to Finishing Department				9,200		
Ending inventory.....	75%	25%	25%	800		
				<u>10,000</u>		
<u>Cost Charged to Department</u>						
Beginning inventory:						
Materials					Total	Unit
Labor.....					Cost	Cost**
Factory overhead						
Total cost in beginning inventory						
Cost added during current period:						
Materials						
Labor.....						
Factory overhead						
Total cost added during current period.....						
Total cost charged to department						
<u>Cost Accounted for as Follows</u>	<u>Units</u>	<u>% Complete</u>	<u>Unit Cost</u>			<u>Total Cost</u>
Transferred to Finishing Department	9,200	100%	\$8.50			\$78,200
Work in Process, ending inventory:						
Materials	800	75%	\$5.00	\$3,000		
Labor.....	800	25%	1.40	280		
Factory overhead	800	25%	2.10	420		3,700
Total cost accounted for						<u>\$81,900</u>

* Total number of equivalent units required in the cost accounted for section determined as follows:

	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>
Equivalent units transferred out....	9,200	9,200	9,200
Equivalent units in ending inventory	800	200	200
Total equivalent units	<u>9,800</u>	<u>9,400</u>	<u>9,400</u>

** Total cost (i.e., the cost in beginning inventory plus the cost added during the current period) divided by the total number of equivalent units required in the cost accounted for section

E6-5

**Hypertec Corporation
Forming Department
Cost of Production Report
For September**

<u>Quantity Schedule</u>	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>	<u>Quantity</u>		
Beginning inventory.....				1,400		
Received from Cutting Department...				4,600		
				<u>6,000</u>		
Transferred to Painting Department..				5,000		
Ending inventory.....	60%	30%	30%	1,000		
				<u>6,000</u>		
<u>Cost Charged to Department</u>					<u>Total Cost</u>	<u>Equivalent Units*</u>
Beginning inventory:						<u>Unit Cost**</u>
Cost from preceding department.....					\$ 21,120	
Materials					5,880	
Labor.....					2,614	
Factory overhead					5,228	
Total cost in beginning inventory					<u>\$ 34,842</u>	
Cost added during current period:						
Cost from preceding department.....					\$ 70,380	6,000
Materials					20,440	5,600
Labor.....					17,526	5,300
Factory overhead					35,052	5,300
Total cost added during current period.....					<u>\$143,398</u>	
Total cost charged to department.....					<u>\$178,240</u>	<u>\$31.35</u>
<u>Cost Accounted for as Follows</u>	<u>Units</u>	<u>% Complete</u>	<u>Unit Cost</u>			<u>Total Cost</u>
Transferred to Painting Department..	5,000	100%	\$31.35			\$156,750
Work in Process, ending inventory:						
Cost from preceding department	1,000	100%	\$15.25	\$15,250		
Materials	1,000	60%	4.70	2,820		
Labor.....	1,000	30%	3.80	1,140		
Factory overhead	1,000	30%	7.60	2,280		
Total cost accounted for						<u>21,490</u>
						<u>\$178,240</u>

- * Total number of equivalent units required in the cost accounted for section determined as follows:

	<u>Prior Dept. Cost</u>	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>
Equivalent units transferred out....	5,000	5,000	5,000	5,000
Equivalent units in ending inventory	1,000	600	300	300
Total equivalent units	<u>6,000</u>	<u>5,600</u>	<u>5,300</u>	<u>5,300</u>

- ** Total cost (i.e., the cost in beginning inventory plus the cost added during the current period) divided by the total number of equivalent units required in the cost accounted for section

E6-6

**Ramirez Corporation
Assembly Department
Cost of Production Report
For February**

<u>Quantity Schedule</u>	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>	<u>Quantity</u>
Beginning Inventory.....				400
Received from Cutting Department...				2,100
				<u>2,500</u>
Transferred to Finished Goods.....				2,000
Ending inventory.....	80%	60%	60%	500
				<u>2,500</u>

<u>Cost Charged to Department</u>	<u>Total Cost</u>	<u>Equivalent Units*</u>	<u>Unit Cost**</u>
Beginning Inventory:			
Cost from preceding department.....	\$ 12,590		
Materials	4,000		
Labor.....	1,200		
Factory overhead	2,400		
Total cost in beginning inventory	<u>\$ 20,190</u>		
Cost added during current period:			
Cost from preceding department.....	\$ 87,410	2,500	\$32.00
Materials	21,200	2,400	10.50
Labor.....	17,660	2,300	8.20
Factory overhead	35,320	2,300	16.40
Total cost added during current period.....	<u>\$141,590</u>		
Total cost charged to department	<u>\$161,780</u>		<u>\$67.10</u>

<u>Cost Accounted for as Follows</u>	<u>Units</u>	<u>% Complete</u>	<u>Unit Cost</u>	<u>Total Cost</u>
Transferred to Finished Goods.....	2,000	100%	\$67.10	\$134,200
Work in Process, ending inventory:				
Cost from preceding department	500	100%	\$32.00	\$16,000
Materials	500	80%	10.50	4,200
Labor.....	500	60%	8.20	2,460
Factory overhead	500	60%	16.40	4,920
				<u>27,580</u>
Total cost accounted for				<u>\$161,780</u>

* Total number of equivalent units required in the cost accounted for section determined as follows:

	<u>Prior Dept.</u>	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>
	<u>Cost</u>			
Equivalent units transferred out....	2,000	2,000	2,000	2,000
Equivalent units in ending inventory	500	400	300	300
Total equivalent units	<u>2,500</u>	<u>2,400</u>	<u>2,300</u>	<u>2,300</u>

** Total cost (i.e., the cost in beginning inventory plus the cost added during the current period) divided by the total number of equivalent units required in the cost accounted for section

E6-7

Zupton Manufacturing Corporation
Forming Department
Cost of Production Report
For June

<u>Quantity Schedule</u>	<u>Material A</u>	<u>Material B</u>	<u>Labor</u>	<u>Overhead</u>	<u>Quantity</u>
Beginning inventory.....					600
Received from Cutting Department...					3,900
					<u>4,500</u>
Transferred to Finishing Department					4,100
Ending inventory.....	100%	0%	30%	30%	<u>400</u>
					<u>4,500</u>
<u>Cost Charged to Department</u>			<u>Total Cost</u>	<u>Equivalent Units*</u>	<u>Unit Cost**</u>
Beginning inventory:					
Cost from preceding department.....			\$ 4,422		
Material A.....			2,805		
Material B.....			0		
Labor.....			1,250		
Factory overhead			<u>1,875</u>		
Total cost in beginning inventory			<u>\$ 10,352</u>		
Cost added during current period:					
Cost from preceding department.....			\$ 29,328	4,500	\$ 7.50
Material A.....			19,695	4,500	5.00
Material B			14,350	4,100	3.50
Labor.....			15,630	4,220	4.00
Factory overhead			<u>23,445</u>	4,220	<u>6.00</u>
Total cost added during current period.....			<u>\$102,448</u>		
Total cost charged to department.....			<u>\$112,800</u>		<u>\$26.00</u>
<u>Cost Accounted for as Follows</u>	<u>Units</u>	<u>% Complete</u>	<u>Unit Cost</u>		<u>Total Cost</u>
Transferred to Finishing Department	4,100	100%	\$26.00		\$106,600
Work in Process, ending inventory:					
Cost from preceding department	400	100%	\$7.50	\$3,000	
Material A	400	100%	5.00	2,000	
Material B	400	0%	3.50	0	
Labor.....	400	30%	4.00	480	
Factory overhead	400	30%	6.00	<u>720</u>	<u>6,200</u>
Total cost accounted for					<u>\$112,800</u>

* Total number of equivalent units required in the cost accounted for section determined as follows:

	<u>Prior Dept.</u>				
	<u>Cost</u>	<u>Material A</u>	<u>Material B</u>	<u>Labor</u>	<u>Overhead</u>
Equivalent units transferred out....	4,100	4,100	4,100	4,100	4,100
Equivalent units in ending inventory	400	400	0	120	120
Total equivalent units	<u>4,500</u>	<u>4,500</u>	<u>4,100</u>	<u>4,220</u>	<u>4,220</u>

** Total cost (i.e., the cost in beginning inventory plus the cost added during the current period) divided by the total number of equivalent units required in the cost accounted for section

E6-8

**Pop Cola Company
Carbonation Department
Cost of Production Report
For October**

<u>Quantity Schedule</u>	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>	<u>Quantity</u>
Beginning Inventory				1,000
Received from Syrup Department.....				2,000
Added to process in Carbonation Department				6,000
				<u>9,000</u>
Transferred to Bottling Department				7,800
Ending Inventory.....	100%	25%	25%	<u>1,200</u>
				<u>9,000</u>

<u>Cost Charged to Department</u>	<u>Total Cost</u>	<u>Equivalent Units*</u>	<u>Unit Cost**</u>
Beginning Inventory:			
Cost from preceding department.....	\$ 1,120		
Materials	190		
Labor	60		
Factory overhead	120		
Total cost in beginning inventory	<u>\$ 1,490</u>		
Cost added during current period:			
Cost from preceding department.....	\$ 9,680	9,000	\$1.20
Materials	1,610	9,000	.20
Labor	1,560	8,100	.20
Factory overhead	3,120	8,100	.40
Total cost added during current period.....	<u>\$15,970</u>		
Total cost charged to department.....	<u>\$17,460</u>		<u>\$2.00</u>

<u>Cost Accounted for as Follows</u>	<u>Units</u>	<u>% Complete</u>	<u>Unit Cost</u>	<u>Total Cost</u>
Transferred to Bottling Department..	7,800	100%	\$2.00	\$15,600
Work in Process, ending inventory:				
Cost from preceding department	1,200	100%	\$1.20	\$1,440
Materials	1,200	100%	.20	240
Labor	1,200	25%	.20	60
Factory overhead	1,200	25%	.40	120
				<u>1,860</u>
Total cost accounted for				<u>\$17,460</u>

* Total number of equivalent units required in the cost accounted for section determined as follows:

	<u>Prior Dept. Cost</u>	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>
Equivalent units transferred out ...	7,800	7,800	7,800	7,800
Equivalent units in ending inventory	1,200	1,200	300	300
Total equivalent units	<u>9,000</u>	<u>9,000</u>	<u>8,100</u>	<u>8,100</u>

** Total cost (i.e., the cost in beginning inventory plus the cost added during the current period) divided by the total number of equivalent units required in the cost accounted for section

E6-9

**Donegal Chemical Company
Blending Department
Cost of Production Report
For March**

<u>Quantity Schedule</u>	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>	<u>Quantity</u>
Beginning Inventory				5,000
Received from Refining Department.....				20,000
Added to process in Blending Department.....				5,000
				<u>30,000</u>
Transferred to Finishing Department				26,000
Ending Inventory	100%	80%	90%	4,000
				<u>30,000</u>
 <u>Cost Charged to Department</u>				
Beginning Inventory:		<u>Total Cost</u>	<u>Equivalent Units*</u>	<u>Unit Cost**</u>
Cost from preceding department.....		\$ 4,750		
Materials		2,375		
Labor		180		
Factory overhead		767		
Total cost in beginning inventory		<u>\$ 8,072</u>		
Cost added during current period:				
Cost from preceding department.....		\$25,250	30,000	\$1.00
Materials		12,825	30,000	.50
Labor		2,740	29,200	.10
Factory overhead		8,113	29,600	.30
Total cost added during current period.....		<u>\$48,728</u>		
Total cost charged to department		<u>\$56,800</u>		<u>\$1.90</u>
 <u>Cost Accounted for as Follows</u>				
	<u>Units</u>	<u>% Complete</u>	<u>Unit Cost</u>	<u>Total Cost</u>
Transferred to Finishing Department	26,000	100%	\$1.90	\$49,400
Work in Process, ending inventory:				
Cost from preceding department	4,000	100%	\$1.00	\$4,000
Materials	4,000	100%	.50	2,000
Labor	4,000	80%	.10	320
Factory overhead	4,000	90%	.30	1,080
Total cost accounted for				<u>\$56,800</u>

* Total number of equivalent units required in the cost accounted for section determined as follows:

	<u>Prior Dept. Cost</u>	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>
Equivalent units transferred out....	26,000	26,000	26,000	26,000
Equivalent units in ending inventory	4,000	4,000	3,200	3,600
Total equivalent units	<u>30,000</u>	<u>30,000</u>	<u>29,200</u>	<u>29,600</u>

** Total cost (i.e., the cost in beginning inventory plus the cost added during the current period) divided by the total number of equivalent units required in the cost accounted for section

E6-10 APPENDIX

**Brimhall Manufacturing Company
Cutting Department
Cost of Production Report
For July**

Quantity Schedule	Materials	Labor	Overhead	Quantity		
	60%	20%	20%	100		
Beginning inventory.....				900		
Started in process this period.....				<u>1,000</u>		
				850		
Transferred to Assembly Department				150		
Ending inventory.....	100%	50%	50%	<u>1,000</u>		
Cost Charged to Department			Total Cost	Equivalent Units*	Unit Cost**	
Beginning inventory:						
Materials			\$ 2,940			
Labor			390			
Factory overhead			585			
Total cost in beginning inventory			<u>\$ 3,915</u>			
Cost added during current period:						
Materials			\$46,530	940	\$49.50	
Labor			18,100	905	20.00	
Factory overhead			27,150	905	30.00	
Total cost added during current period.....			<u>\$91,780</u>			
Total cost charged to department			<u>\$95,695</u>			<u>\$99.50</u>
Cost Accounted for as Follows	Units	Current%	Unit Cost			Total Cost
Transferred to Assembly Department:						
Beginning inventory				\$3,915		
Cost to complete:						
Materials.....	100	40%	\$49.50	1,980		
Labor.....	100	80%	20.00	1,800		
Factory overhead	100	80%	30.00	<u>2,400</u>		\$ 9,895
Started and completed this period	750	100%	99.50			<u>74,625</u>
Total cost transferred to Assembly Department						\$84,520
Work in Process, ending inventory:						
Materials	150	100%	\$49.50	\$7,425		
Labor	150	50%	20.00	1,500		
Factory overhead	150	50%	30.00	<u>2,250</u>		11,175
Total cost accounted for						<u>\$95,695</u>

* Number of equivalent units of cost added during the current period determined as follows:

	Materials	Labor	Overhead
To complete beginning inventory ..	40	80	80
Started and completed this period	750	750	750
Ending inventory.....	150	75	75
Total equivalent units	<u>940</u>	<u>905</u>	<u>905</u>

** Cost added during the current period divided by the number of equivalent units of cost added during the current period

E6-11 APPENDIX

**Kandu Tool Company
Assembly Department
Cost of Production Report
For November**

<u>Quantity Schedule</u>	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>	<u>Quantity</u>
Beginning inventory.....	50%	40%	40%	1,200
Received from Cutting Department...				2,800
				<u>4,000</u>
Transferred to Finished Goods.....				3,000
Ending inventory.....	90%	80%	80%	1,000
				<u>4,000</u>

<u>Cost Charged to Department</u>	<u>Total Cost</u>	<u>Equivalent Units*</u>	<u>Unit Cost**</u>
Beginning inventory:			
Cost from preceding department.....	\$ 17,280		
Materials	5,550		
Labor.....	2,400		
Factory overhead	3,600		
Total cost in beginning inventory	<u>\$ 28,830</u>		
Cost added during current period:			
Cost from preceding department.....	\$ 40,600	2,800	\$14.50
Materials	30,890	3,300	9.30
Labor.....	16,932	3,320	5.10
Factory overhead	25 398	3,320	7.65
Total cost added during current period.....	<u>\$113,620</u>		
Total cost charged to department	<u>\$142,450</u>		<u>\$36.55</u>

E6-11 APPENDIX (Concluded)

<u>Cost Accounted for as Follows</u>	<u>Units</u>	<u>Current%</u>	<u>Unit Cost</u>		<u>Total Cost</u>
Transferred to Finished Goods:					
Beginning inventory				\$28,830	
Cost to complete:					
Materials	1,200	50%	\$ 9.30	5,580	
Labor	1,200	80%	5.10	3,672	
Factory overhead	1,200	80%	7.65	5,508	\$ 43,590
Started and completed this period	1,800	100%	36.55		65,790
Total cost transferred to Finished Goods					\$109,380
Work in Process, ending inventory:					
Cost from preceding department	1,000	100%	\$14.50	\$14,500	
Materials	1,000	90%	9.30	8,370	
Labor	1,000	80%	5.10	4,080	
Factory overhead	1,000	80%	7.65	6,120	33,070
Total cost accounted for					<u>\$142,450</u>

* Number of equivalent units of cost added during the current period determined as follows:

	Prior Dept.			
	<u>Cost</u>	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>
To complete beginning inventory ..	0	600	720	720
Started and completed this period	1,800	1,800	1,800	1,800
Ending inventory	1,000	900	800	800
Total equivalent units	<u>2,800</u>	<u>3,300</u>	<u>3,320</u>	<u>3,320</u>

** Cost added during the current period divided by the number of equivalent units of cost added during the current period

E6-12 APPENDIX

**Northeastern Chemical Corporation
Blending Department
Cost of Production Report
For May**

<u>Quantity Schedule</u>	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>	<u>Quantity</u>
Beginning inventory	100%	20%	40%	2,000
Received from Refining Department.....				5,000
Added to process in Blending Department....				5,000
				<u>12,000</u>
Transferred to Finished Goods				10,500
Ending inventory	100%	60%	80%	1,500
				<u>12,000</u>
<u>Cost Charged to Department</u>	<u>Total</u>		<u>Equivalent</u>	<u>Unit</u>
Beginning inventory:	<u>Cost</u>		<u>Units*</u>	<u>Cost**</u>
Cost from preceding department.....	\$ 2,480			
Materials	500			
Labor.....	150			
Factory overhead	800			
Total cost in beginning inventory	<u>\$ 3,710</u>			
Cost added during current period:				
Cost from preceding department.....	\$12,500		10,000	\$1.25
Materials	2,500		10,000	.25
Labor.....	3,300		11,000	.30
Factory overhead	7,630		10,900	.70
Total cost added during current period.....	<u>\$25,930</u>			
Total cost charged to department	<u>\$29,640</u>			<u>\$2.50</u>

E6-12 APPENDIX (Concluded)

<u>Cost Accounted for as Follows</u>	<u>Units</u>	<u>Current%</u>	<u>Unit Cost</u>		<u>Total Cost</u>
Transferred to Finished Goods:					
Beginning inventory				\$3,710	
Cost to complete:					
Materials	2,000	0%	\$.25	0	
Labor	2,000	80%	.30	480	
Factory overhead.....	2,000	60%	.70	840	\$ 5,030
Started and completed this period	8,500	100%	2.50		21,250
Total cost transferred to Finished Goods					\$26,280
Work in Process, ending inventory:					
Cost from preceding department	1,500	100%	\$1.25	\$1,875	
Materials	1,500	100%	.25	375	
Labor.....	1,500	60%	.30	270	
Factory overhead	1,500	80%	.70	840	3,360
Total cost accounted for					<u>\$29,640</u>

- Number of equivalent units of cost added during the current period determined as follows:

	<u>Prior Dept.</u>			
	<u>Cost</u>	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>
To complete beginning inventory ..	0	0	1,600	1,200
Started and completed this period	8,500	8,500	8,500	8,500
Ending inventory.....	1,500	1,500	900	1,200
Total equivalent units	<u>10,000</u>	<u>10,000</u>	<u>11,000</u>	<u>10,900</u>

- ** Cost added during the current period divided by the number of equivalent units of cost added during the current period

PROBLEMS

P6-1

(1)

**Modern Cabinet Company
Cutting Department
Cost of Production Report
For August**

<u>Quantity Schedule</u>	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>	<u>Quantity</u>		
Beginning inventory.....				200		
Started in process this period				800		
				<u>800</u>		
Transferred to Assembly Department				650		
Ending inventory	90%	80%	80%	150		
				<u>800</u>		
<u>Cost Charged to Department</u>			<u>Total</u>	<u>Equivalent</u>	<u>Unit</u>	
Beginning inventory:			<u>Cost</u>	<u>Units*</u>	<u>Cost**</u>	
Materials			\$ 5,385			
Labor			530			
Factory overhead			795			
Total cost in beginning inventory			<u>\$ 6,690</u>			
Cost added during current period:						
Materials			\$28,035	785	\$40.00	
Labor			8,350	740	12.00	
Factory overhead			12,525	740	18.00	
Total cost added during current period.....			<u>\$48,910</u>			
Total cost charged to department			<u>\$53,600</u>			<u>\$70.00</u>
<u>Cost Accounted for as Follows</u>	<u>Units</u>	<u>% Complete</u>	<u>Unit Cost</u>			<u>Total Cost</u>
Transferred to Assembly Department	650	100%	\$70.00			\$45,500
Work in Process, ending inventory:						
Materials	150	90%	\$40.00	\$5,400		
Labor	150	80%	12.00	1,080		
Factory overhead	150	80%	18.00	1,620		8,100
Total cost accounted for						<u>\$53,600</u>

* Total number of equivalent units required in the cost accounted for section determined as follows:

	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>
Equivalent units transferred out.....	650	650	650
Equivalent units in ending inventory.....	135	90	90
Total equivalent units	<u>785</u>	<u>740</u>	<u>740</u>

** Total cost (i.e., the cost in beginning inventory plus the cost added during the current period) divided by the total number of equivalent units required in the cost accounted for section

P6-1 (Continued)

**Modern Cabinet Company
Assembly Department
Cost of Production Report
For August**

<u>Quantity Schedule</u>	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>	<u>Quantity</u>		
Beginning Inventory.....				250		
Received from Cutting Department...				650		
				900		
Transferred to Finished Goods.....				800		
Ending Inventory.....	40%	20%	20%	100		
				900		
<u>Cost Charged to Department</u>			<u>Total Cost</u>	<u>Equivalent Units*</u>	<u>Unit Cost**</u>	
Beginning Inventory:						
Cost from preceding department.....			\$ 17,410			
Materials			3,451			
Labor			3,611			
Factory overhead			3,611			
Total cost in beginning inventory			\$ 28,083			
Cost added during current period:						
Cost from preceding department.....			\$ 45,500	900	\$ 69.90	
Materials			13,433	840	20.10	
Labor			20,989	820	30.00	
Factory overhead			20,989	820	30.00	
Total cost added during current period.....			\$100,911			
Total cost charged to department			\$128,994		\$150.00	

P6-1 (Concluded)

<u>Cost Accounted for as Follows</u>	<u>Units</u>	<u>% Complete</u>	<u>Unit Cost</u>		<u>Total Cost</u>
Transferred to Finished Goods	800	100%	\$150.00		\$120,000
Work in Process, ending inventory:					
Cost from preceding department	100	100%	\$ 69.90	\$6,990	
Materials	100	40%	20.10	804	
Labor	100	20%	30.00	600	
Factory overhead	100	20%	30.00	600	8,994
Total cost accounted for					<u>\$128,994</u>

- * Total number of equivalent units required in the cost accounted for section determined as follows:

	Prior Dept. <u>Cost</u>	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>
Equivalent units transferred out....	800	800	800	800
Equivalent units in ending inventory	100	40	20	20
Total equivalent units	<u>900</u>	<u>840</u>	<u>820</u>	<u>820</u>

- ** Total cost (i.e., the cost in beginning inventory plus the cost added during the current period) divided by the total number of equivalent units required in the cost accounted for section

(2)	Work in Process—Cutting Department.....	26,035	
	Work in Process—Assembly Department	13,433	
	Materials		39,468
	Work in Process—Cutting Department.....	8,350	
	Work in Process—Assembly Department	20,989	
	Payroll		29,339
	Work in Process—Cutting Department	12,525	
	Work in Process—Assembly Department	20,989	
	Applied Factory Overhead		33,514
	Work in Process—Assembly Department	45,500	
	Work in Process—Cutting Department.....		45,500
	Finished Goods Inventory.....	120,000	
	Work in Process—Assembly Department		120,000

P6-2

(1) **Rathbone Tool Corporation**
Casting Department
Cost of Production Report
For December

Quantity Schedule	Materials	Labor	Overhead	Quantity		
Beginning inventory.....				1,000		
Started in process this period				8,000		
				<u>9,000</u>		
Transferred to Finishing Department				7,500		
Ending inventory.....	100%	80%	80%	1,500		
				<u>9,000</u>		
Cost Charged to Department			Total Cost	Equivalent Units*		Unit Cost**
Beginning inventory:						
Materials			\$ 915			
Labor			60			
Factory overhead			90			
Total cost in beginning inventory			<u>\$ 1,065</u>			
Cost added during current period:						
Materials			\$17,085	9,000		\$2.00
Labor			4,290	8,700		.50
Factory overhead			6,435	8,700		.75
Total cost added during current period			<u>\$27,810</u>			
Total cost charged to department			<u>\$28,875</u>			<u>\$3.25</u>
Cost Accounted for as Follows	Units	% Complete	Unit Cost			Total Cost
Transferred to Finishing Department	7,500	100%	\$3.25			\$24,375
Work in Process, ending inventory:						
Materials	1,500	100%	\$2.00	3,000		
Labor	1,500	80%	.50	600		
Factory overhead	1,500	80%	.75	900		4,500
Total cost accounted for						<u>\$28,875</u>

* Total number of equivalent units required in the cost accounted for section determined as follows:

	Materials	Labor	Overhead
Equivalent units transferred out.....	7,500	7,500	7,500
Equivalent units in ending inventory.....	1,500	1,200	1,200
Total equivalent units	<u>9,000</u>	<u>8,700</u>	<u>8,700</u>

** Total cost (i.e., the cost in beginning inventory plus the cost added during the current period) divided by the total number of equivalent units required in the cost accounted for section

P6-2 (Continued)

**Rathbone Tool Corporation
Finishing Department
Cost of Production Report
For December**

<u>Quantity Schedule</u>	<u>Labor</u>	<u>Overhead</u>	<u>Quantity</u>
Beginning Inventory			1,500
Received from Casting Department.....			7,500
			<u>9,000</u>
Transferred to Finished Goods			7,000
Ending Inventory	40%	50%	2,000
			<u>9,000</u>
<u>Cost Charged to Department</u>	<u>Total Cost</u>	<u>Equivalent Units*</u>	<u>Unit Cost**</u>
Beginning Inventory:			
Cost from preceding department.....	\$ 4,785		
Labor	201		
Factory overhead	555		
Total cost in beginning inventory	<u>\$ 5,541</u>		
Cost added during current period:			
Cost from preceding department.....	\$24,375	9,000	\$3.24
Labor	2,139	7,800	.30
Factory overhead	3,125	8,000	.48
Total cost added during current period.....	<u>\$29,639</u>		
Total cost charged to department	<u>\$35,180</u>		<u>\$4.00</u>

P6-2 (Concluded)

<u>Cost Accounted for as Follows</u>	<u>Units</u>	<u>% Complete</u>	<u>Unit Cost</u>		<u>Total Cost</u>
Transferred to Finished Goods.....	7,000	100%	\$4.00		\$28,000
Work in Process, ending inventory:					
Cost from preceding department	2,000	100%	\$3.24	\$6,480	
Labor.....	2,000	40%	.30	240	
Factory overhead	2,000	50%	.45	450	7,180
Total cost accounted for					<u>\$35,180</u>

* Total number of equivalent units required in the cost accounted for section determined as follows:

	Prior Dept. <u>Cost</u>	<u>Labor</u>	<u>Overhead</u>
Equivalent units transferred out.....	7,000	7,000	7,000
Equivalent units in ending inventory.....	2,000	800	1,000
Total equivalent units	<u>9,000</u>	<u>7,800</u>	<u>8,000</u>

** Total cost (i.e., the cost in beginning inventory plus the cost added during the current period) divided by the total number of equivalent units required in the cost accounted for section

(2)	Work in Process—Casting Department	17,085	
	Materials		17,085
	Work in Process—Casting Department	4,290	
	Work in Process—Finishing Department.....	2,139	
	Payroll		6,429
	Work in Process—Casting Department	6,435	
	Work in Process—Finishing Department.....	3,125	
	Applied Factory Overhead		9,560
	Work in Process—Finishing Department.....	24,375	
	Work in Process—Casting Department		24,375
	Finished Goods Inventory.....	28,000	
	Work in Process—Finishing Department.....		28,000

P8-3

(1)

**Jetter Engine Corporation
Casting Department
Cost of Production Report
For February**

<u>Quantity Schedule</u>	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>	<u>Quantity</u>
Beginning inventory.....				500
Started in process this period				3,000
				<u>3,500</u>
Transferred to Assembly Department				2,700
Ending inventory.....	100%	80%	90%	800
				<u>3,500</u>
 <u>Cost Charged to Department</u>				
Beginning inventory:			<u>Total Cost</u>	<u>Equivalent Units*</u> <u>Unit Cost**</u>
Materials			\$ 10,925	
Labor			338	
Factory overhead			<u>2,839</u>	
Total cost in beginning inventory			\$ 14,102	
Cost added during current period:				
Materials			\$146,575	3,500 \$45.00
Labor			18,362	3,340 5.00
Factory overhead			<u>48,481</u>	3,420 15.00
Total cost added during current period			\$211,398	
Total cost charged to department			<u>\$225,500</u>	<u>\$65.00</u>
 <u>Cost Accounted for as Follows</u>				
	<u>Units</u>	<u>% Complete</u>	<u>Unit Cost</u>	<u>Total Cost</u>
Transferred to Assembly Department	2,700	100%	\$65.00	\$175,500
Work in Process, ending inventory:				
Materials	800	100%	\$45.00	\$36,000
Labor	800	80%	5.00	3,200
Factory overhead	800	90%	15.00	<u>10,800</u>
Total cost accounted for				<u>50,000</u>
				<u>\$225,500</u>

* Total number of equivalent units required in the cost accounted for section determined as follows:

	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>
Equivalent units transferred out.....	2,700	2,700	2,700
Equivalent units in ending inventory.....	800	640	720
Total equivalent units	<u>3,500</u>	<u>3,340</u>	<u>3,420</u>

** Total cost (i.e., the cost in beginning inventory plus the cost added during the current period) divided by the total number of equivalent units required in the cost accounted for section

P6-3 (Continued)

Jetter Engine Corporation
Assembly Department
Cost of Production Report
For February

<u>Quantity Schedule</u>	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>	<u>Quantity</u>
Beginning Inventory.....				1,000
Received from Casting Department ..				2,700
				<u>3,700</u>
Transferred to Finishing Department				2,900
Ending Inventory.....	70%	30%	30%	<u>800</u>
				<u>3,700</u>

<u>Cost Charged to Department</u>	<u>Total Cost</u>	<u>Equivalent Units*</u>	<u>Unit Cost**</u>
Beginning Inventory:			
Cost from preceding department.....	\$ 63,150		
Materials	40,258		
Labor	12,426		
Factory overhead	12,426		
Total cost in beginning inventory	<u>\$128,260</u>		
Cost added during current period:			
Cost from preceding department.....	\$175,500	3,700	\$ 64.50
Materials	116,480	3,460	45.30
Labor	44,408	3,140	18.10
Factory overhead	44,408	3,140	18.10
Total cost added during current period.....	<u>\$380,796</u>		
Total cost charged to department	<u>\$509,056</u>		<u>\$146.00</u>

<u>Cost Accounted for as Follows</u>	<u>Units</u>	<u>% Complete</u>	<u>Unit Cost</u>	<u>Total Cost</u>
Transferred to Finishing Department	2,900	100%	\$146.00	\$423,400
Work in Process, ending inventory				
Cost from preceding department	800	100%	\$ 64.50	\$51,600
Materials	800	70%	45.30	25,368
Labor.....	800	30%	18.10	4,344
Factory overhead	800	30%	18.10	4,344
Total cost accounted for				<u>85,656</u>
				<u>\$509,056</u>

* Total number of equivalent units required in the cost accounted for section determined as follows:

	<u>Prior Dept.</u>	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>
	<u>Cost</u>			
Equivalent units transferred out....	2,900	2,900	2,900	2,900
Equivalent units in ending inventory	800	560	240	240
Total equivalent units	<u>3,700</u>	<u>3,460</u>	<u>3,140</u>	<u>3,140</u>

** Total cost (i.e., the cost in beginning inventory plus the cost added during the current period) divided by the total number of equivalent units required in the cost accounted for section

P6-3 (Continued)

Jetter Engine Corporation
Finishing Department
Cost of Production Report
For February

<u>Quantity Schedule</u>	<u>Labor</u>	<u>Overhead</u>	<u>Quantity</u>		
Beginning Inventory.....			300		
Received from Assembly Department			2,900		
			<u>3,200</u>		
Transferred to Finished Goods			2,800		
Ending Inventory.....	50%	50%	400		
			<u>3,200</u>		
<u>Cost Charged to Department</u>		<u>Total Cost</u>	<u>Equivalent Units*</u>	<u>Unit Cost**</u>	
Beginning Inventory:					
Cost from preceding department.....		\$ 42,840			
Labor.....		2,760			
Factory overhead		4,140			
Total cost in beginning inventory		<u>\$ 49,740</u>			
Cost added during current period:					
Cost from preceding department.....		\$423,400	3,200	\$145.70	
Labor.....		12,240	3,000	5.00	
Factory overhead		18,360	3,000	7.50	
Total cost added during current period.....		<u>\$454,000</u>			
Total cost charged to department		<u>\$503,740</u>			<u>\$158.20</u>
<u>Cost Accounted for as Follows</u>	<u>Units</u>	<u>% Complete</u>	<u>Unit Cost</u>		<u>Total Cost</u>
Transferred to Finished Goods	2,800	100%	\$158.20		\$442,960
Work In Process, ending inventory:					
Cost from preceding department	400	100%	\$145.70	\$58,280	
Labor.....	400	50%	5.00	1,000	
Factory overhead	400	50%	7.50	1,500	60,780
Total cost accounted for					<u>\$503,740</u>

* Total number of equivalent units required in the cost accounted for section determined as follows:

	<u>Prior Dept.</u>		
	<u>Cost</u>	<u>Labor</u>	<u>Overhead</u>
Equivalent units transferred out.....	2,800	2,800	2,800
Equivalent units in ending inventory.....	400	200	200
Total equivalent units	<u>3,200</u>	<u>3,000</u>	<u>3,000</u>

** Total cost (i.e., the cost in beginning inventory plus the cost added during the current period) divided by the total number of equivalent units required in the cost accounted for section

P6-3 (Concluded)

(2)	Work in Process—Casting Department	146,575	
	Work in Process—Assembly Department	116,480	
	Materials		263,055
	Work in Process—Casting Department	16,362	
	Work in Process—Assembly Department	44,408	
	Work in Process—Finishing Department	12,240	
	Payroll		73,010
	Work in Process—Casting Department	48,461	
	Work in Process—Assembly Department	44,408	
	Work in Process—Finishing Department	18,360	
	Applied Factory Overhead		111,229
	Work in Process—Assembly Department	175,500	
	Work in Process—Casting Department		175,500
	Work in Process—Finishing Department	423,400	
	Work in Process—Assembly Department		423,400
	Finished Goods Inventory	442,960	
	Work in Process—Finishing Department		442,960

P6-4

(1)

**Persona Cologne Company
Blending Department
Cost of Production Report
For June**

<u>Quantity Schedule</u>	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>	<u>Quantity</u>
Beginning Inventory.....				1,000
Started in process this period				6,000
				<u>7,000</u>
Transferred to Finishing Department				6,400
Ending Inventory.....	60%	20%	25%	600
				<u>7,000</u>

<u>Cost Charged to Department</u>	<u>Total Cost</u>	<u>Equivalent Units*</u>	<u>Unit Cost**</u>
Beginning Inventory:			
Materials	\$ 19,820		
Labor	944		
Factory overhead	2,375		
Total cost in beginning inventory	<u>\$ 22,939</u>		
Cost added during current period:			
Materials	\$129,100	6,760	\$22.00
Labor	6,880	6,520	1.20
Factory overhead	29,065	6,550	4.80
Total cost added during current period.....	<u>\$165,045</u>		
Total cost charged to department	<u>\$187,984</u>		<u>\$28.00</u>

<u>Cost Accounted for as Follows</u>	<u>Units</u>	<u>% Complete</u>	<u>Unit Cost</u>	<u>Total Cost</u>
Transferred to Finishing Department	6,400	100%	\$28.00	\$179,200
Work in Process, ending inventory:				
Materials	600	60%	\$22.00	\$7,920
Labor	600	20%	1.20	144
Factory overhead	600	25%	4.80	720
Total cost accounted for				<u>8,784</u>
Total cost accounted for				<u>\$187,984</u>

* Total number of equivalent units required in the cost accounted for section determined as follows:

	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>
Equivalent units transferred out.....	6,400	6,400	6,400
Equivalent units in ending inventory.....	360	120	150
Total equivalent units	<u>6,760</u>	<u>6,520</u>	<u>6,550</u>

** Total cost (i.e., the cost in beginning inventory plus the cost added during the current period) divided by the total number of equivalent units required in the cost accounted for section

P6-4 (Continued)

Persona Cologne Company
Finishing Department
Cost of Production Report
For June

<u>Quantity Schedule</u>	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>	<u>Quantity</u>
Beginning inventory.....				1,400
Received from Blending Department.....				6,400
Added to process in Finishing Department				19,200
				<u>27,000</u>
Transferred to Finished Goods				26,000
Ending inventory.....	100%	70%	70%	1,000
				<u>27,000</u>

<u>Cost Charged to Department</u>	<u>Total Cost</u>	<u>Equivalent Units*</u>	<u>Unit Cost**</u>
Beginning inventory:			
Cost from preceding department.....	\$ 8,450		
Materials	1,395		
Labor	106		
Factory overhead	659		
Total cost in beginning inventory	<u>\$ 10,610</u>		
Cost added during current period:			
Cost from preceding department.....	\$179,200	27,000	\$6.95
Materials	25,605	27,000	1.00
Labor	19,919	26,700	.75
Factory overhead	60,751	26,700	2.30
Total cost added during current period	<u>\$285,475</u>		
Total cost charged to department	<u><u>\$296,085</u></u>		<u><u>\$11.00</u></u>

P6-4 (Concluded)

Cost Accounted for as Follows	Units	% Complete	Unit Cost	Total Cost
Transferred to Finished Goods	26,000	100%	\$11.00	\$286,000
Work in Process, ending inventory:				
Cost from preceding department	1,000	100%	\$ 6.95	\$6,950
Materials	1,000	100%	1.00	1,000
Labor	1,000	70%	.75	525
Factory overhead	1,000	70%	2.30	1,810
Total cost accounted for				<u>\$296,085</u>

- * Total number of equivalent units required in the cost accounted for section determined as follows:

	Prior Dept. Cost	Materials	Labor	Overhead
Equivalent units transferred out....	26,000	26,000	26,000	26,000
Equivalent units in ending inventory	1,000	1,000	700	700
Total equivalent units	<u>27,000</u>	<u>27,000</u>	<u>26,700</u>	<u>26,700</u>

- ** Total cost (i.e., the cost in beginning inventory plus the cost added during the current period) divided by the total number of equivalent units required in the cost accounted for section

(2)	Work in Process—Blending Department	129,100	
	Work in Process—Finishing Department	25,605	
	Materials		154,705
	Work in Process—Blending Department	6,880	
	Work in Process—Finishing Department	19,919	
	Payroll		26,799
	Work in Process—Blending Department	29,065	
	Work in Process—Finishing Department	60,751	
	Applied Factory Overhead		89,816
	Work in Process—Finishing Department	179,200	
	Work in Process—Blending Department		179,200
	Finished Goods Inventory	286,000	
	Work in Process—Finishing Department		286,000

P6-5

(1)

Hystest Chemical Corporation
Refining Department
Cost of Production Report
For March

<u>Quantity Schedule</u>	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>	<u>Quantity</u>
Beginning inventory				800
Started in process this period				7,200
				<u>8,000</u>
Transferred to Blending Department.....				7,000
Ending inventory.....	100%	75%	50%	1,000
				<u>8,000</u>

<u>Cost Charged to Department</u>	<u>Total Cost</u>	<u>Equivalent Units*</u>	<u>Unit Cost**</u>
Beginning inventory:			
Materials	\$ 728		
Labor	30		
Factory overhead	60		
Total cost in beginning inventory	<u>\$ 818</u>		
Cost added during current period:			
Materials	\$ 7,272	8,000	\$1.00
Labor	1,520	7,750	.20
Factory overhead	2,940	7,500	.40
Total cost added during current period	<u>\$11,732</u>		
Total cost charged to department	<u>\$12,550</u>		<u>\$1.60</u>

<u>Cost Accounted for as Follows</u>	<u>Units</u>	<u>% Complete</u>	<u>Unit Cost</u>		<u>Total Cost</u>
Transferred to Blending Department.	7,000	100%	\$1.60		\$11,200
Work in Process, ending inventory:					
Materials	1,000	100%	\$1.00	\$1,000	
Labor	1,000	75%	.20	150	
Factory overhead	1,000	50%	.40	200	1,350
Total cost accounted for					<u>\$12,550</u>

* Total number of equivalent units required in the cost accounted for section determined as follows:

	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>
Equivalent units transferred out.....	7,000	7,000	7,000
Equivalent units in ending inventory.....	1,000	750	500
Total equivalent units	<u>8,000</u>	<u>7,750</u>	<u>7,500</u>

** Total cost (i.e., the cost in beginning inventory plus the cost added during the current period) divided by the total number of equivalent units required in the cost accounted for section

P6-5 (Continued)

Hystest Chemical Corporation
Blending Department
Cost of Production Report
For March

<u>Quantity Schedule</u>	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>	<u>Quantity</u>
Beginning inventory				1,400
Received from Refining Department				7,000
Added to process in Blending Department.....				1,800
				<u>10,200</u>
Transferred to Finished Goods				9,200
Ending inventory.....	80%	40%	40%	<u>1,000</u>
				<u>10,200</u>
<u>Cost Charged to Department</u>		<u>Total</u>	<u>Equivalent</u>	<u>Unit</u>
Beginning inventory:		<u>Cost</u>	<u>Units*</u>	<u>Cost**</u>
Cost from preceding department.....		\$ 1,754		
Materials		620		
Labor.....		68		
Factory overhead		160		
Total cost in beginning inventory		<u>\$ 2,602</u>		
Cost added during current period:				
Cost from preceding department.....		\$11,200	10,200	\$1.27
Materials		4,380	10,000	.50
Labor.....		3,100	9,600	.33
Factory overhead		5,600	9,600	.60
Total cost added during current period		<u>\$24,280</u>		
Total cost charged to department		<u>\$26,882</u>		<u>\$2.70</u>

P6-5 (Concluded)

Cost Accounted for as Follows	Units	% Complete	Unit Cost		Total Cost
Transferred to Finished Goods	9,200	100%	\$2.70		\$24,840
Work in Process, ending inventory:					
Cost from preceding department	1,000	100%	\$1.27	\$1,270	
Materials	1,000	80%	.50	400	
Labor	1,000	40%	.33	132	
Factory overhead	1,000	40%	.60	240	2,042
Total cost accounted for					\$28,882

- * Total number of equivalent units required in the cost accounted for section determined as follows:

	Prior Dept. Cost	Materials	Labor	Overhead
Equivalent units transferred out....	9,200	9,200	9,200	9,200
Equivalent units in ending inventory	1,000	800	400	400
Total equivalent units	10,200	10,000	9,600	9,600

- ** Total cost (i.e., the cost in beginning inventory plus the cost added during the current period) divided by the total number of equivalent units required in the cost accounted for section

(2)	Work in Process—Refining Department	7,272	
	Work in Process—Blending Department	4,380	
	Materials		11,652
	Work in Process—Refining Department	1,520	
	Work in Process—Blending Department	3,100	
	Payroll		4,620
	Work in Process—Refining Department	2,940	
	Work in Process—Blending Department	5,600	
	Applied Factory Overhead		8,540
	Work in Process—Blending Department	11,200	
	Work in Process—Refining Department		11,200
	Finished Goods Inventory	24,840	
	Work in Process—Blending Department		24,840

P6-6 APPENDIX

(1) **Upton Manufacturing Company**
Cutting Department
Cost of Production Report
For October

<u>Quantity Schedule</u>	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>	<u>Quantity</u>	
Beginning inventory.....	90%	40%	20%	1,000	
Started in process this period				9,000	
				<u>10,000</u>	
Transferred to Assembly Department				8,500	
Ending inventory.....	100%	80%	100%	1,500	
				<u>10,000</u>	
Cost Charged to Department					
Beginning inventory:			<u>Total Cost</u>	<u>Equivalent Units*</u>	<u>Unit Cost**</u>
Materials			\$ 8,010		
Labor			1,750		
Factory overhead			790		
Total cost in beginning inventory			<u>\$ 10,550</u>		
Cost added during current period:					
Materials			\$ 81,900	9,100	\$ 9.00
Labor			18,600	9,300	2.00
Factory overhead			39,200	9,800	4.00
Total cost added during current period.....			<u>\$139,700</u>		
Total cost charged to department			<u>\$150,250</u>		<u>\$15.00</u>
Cost Accounted for as Follows					
	<u>Units</u>	<u>Current %</u>	<u>Unit Cost</u>		<u>Total Cost</u>
Transferred to Assembly Department:					
Beginning inventory				\$10,550	
Cost to complete:					
Materials.....	1,000	10%	\$ 9.00	900	
Labor.....	1,000	60%	2.00	1,200	
Factory overhead	1,000	80%	4.00	3,200	\$ 15,850
Started and completed this period	7,500	100%	15.00		<u>112,500</u>
Total cost transferred to Assembly Department					<u>\$128,350</u>
Work in Process, ending inventory:					
Materials	1,500	100%	\$ 9.00	\$13,500	
Labor.....	1,500	80%	2.00	2,400	
Factory overhead	1,500	100%	4.00	6,000	21,900
Total cost accounted for					<u>\$150,250</u>

P6-6 APPENDIX (Continued)

- Number of equivalent units of cost added during the current period determined as follows:

	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>
To complete beginning inventory.....	100	600	800
Started and completed this period	7,500	7,500	7,500
Ending inventory.....	1,500	1,200	1,500
Total equivalent units	<u>9,100</u>	<u>9,300</u>	<u>9,800</u>

- ** Cost added during the current period divided by the number of equivalent units of cost added during the current period

P6-6 APPENDIX (Continued)

Upton Manufacturing Company
Assembly Department
Cost of Production Report
For October

<u>Quantity Schedule</u>	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>	<u>Quantity</u>
Beginning Inventory.....	75%	60%	60%	2,000
Received from Cutting Department...				8,500
				<u>10,500</u>
Transferred to Finished Goods Inventory				9,500
Ending Inventory.....	60%	40%	40%	1,000
				<u>10,500</u>
 <u>Cost Charged to Department</u>				
<u>Beginning inventory:</u>			<u>Total Cost</u>	<u>Equivalent Units*</u> <u>Unit Cost**</u>
Cost from preceding department.....			\$ 4,000	
Materials			400	
Labor			800	
Factory overhead			1,800	
Total cost in beginning inventory			<u>\$ 6,800</u>	
<u>Cost added during current period:</u>				
Cost from preceding department.....			\$128,350	8,500 \$15.10
Materials			30,100	8,600 3.50
Labor			21,315	8,700 2.45
Factory overhead			30,015	8,700 3.45
Total cost added during current period.....			<u>\$209,780</u>	
Total cost charged to department			<u>\$216,580</u>	<u>\$24.50</u>
 <u>Cost Accounted for as Follows</u>				
	<u>Units</u>	<u>Current %</u>	<u>Unit Cost</u>	<u>Total Cost</u>
<u>Transferred to Finished Goods:</u>				
Beginning inventory				\$ 6,800
Cost to complete:				
Materials.....	2,000	25%	\$ 3.50	1,750
Labor.....	2,000	40%	2.45	1,960
Factory overhead	2,000	40%	3.45	2,760
				<u>\$ 13,270</u>
Started and completed this period	7,500	100%	24.50	183,750
Total cost transferred to Finished Goods				<u>\$197,020</u>
<u>Work in Process, ending inventory:</u>				
Cost from preceding department	1,000	100%	\$15.10	\$15,100
Materials	1,000	60%	3.50	2,100
Labor.....	1,000	40%	2.45	980
Factory overhead	1,000	40%	3.45	1,380
				<u>19,580</u>
Total cost accounted for				<u>\$216,580</u>

P6-6 APPENDIX (Concluded)

- Number of equivalent units of cost added during the current period determined as follows:

	Prior Dept. Cost	Materials	Labor	Overhead
To complete beginning inventory ..	0	500	800	800
Started and completed this period	7,500	7,500	7,500	7,500
Ending inventory.....	1,000	600	400	400
Total equivalent units	<u>8,500</u>	<u>8,600</u>	<u>8,700</u>	<u>8,700</u>

- ** Cost added during the current period divided by the number of equivalent units of cost added during the current period

(2)	Work in Process—Cutting Department.....	81,900	
	Work in Process—Assembly Department	30,100	
	Materials		112,000
	Work in Process—Cutting Department.....	18,600	
	Work in Process—Assembly Department	21,315	
	Payroll		39,915
	Work in Process—Cutting Department.....	39,200	
	Work in Process—Assembly Department	30,015	
	Applied Factory Overhead		69,215
	Work in Process—Assembly Department	128,350	
	Work in Process—Cutting Department.....		128,350
	Finished Goods Inventory.....	197,020	
	Work in Process—Assembly Department		197,020

P6-7 APPENDIX

(1) **Marston Manufacturing Company**
Fabricating Department
Cost of Production Report
For August

<u>Quantity Schedule</u>	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>	<u>Quantity</u>
Beginning Inventory.....	100%	40%	80%	400
Started in process this period				1,200
				<u>1,600</u>
Transferred to Finishing Department				1,100
Ending Inventory.....	100%	80%	90%	500
				<u>1,600</u>

<u>Cost Charged to Department</u>	<u>Total Cost</u>	<u>Equivalent Units*</u>	<u>Unit Cost**</u>
Beginning Inventory:			
Materials	\$ 29,280		
Labor	1,900		
Factory overhead	11,800		
Total cost in beginning inventory	<u>\$ 42,980</u>		
Cost added during current period:			
Materials	\$ 90,000	1,200	\$ 75.00
Labor	16,080	1,340	12.00
Factory overhead	46,740	1,230	38.00
Total cost added during current period.....	<u>\$152,820</u>		
Total cost charged to department	<u>\$195,800</u>		<u>\$125.00</u>

P6-7 APPENDIX (Continued)

<u>Cost Accounted for as Follows</u>	<u>Units</u>	<u>Current %</u>	<u>Unit Cost</u>		<u>Total Cost</u>
Transferred to Finishing Department:					
Beginning inventory				\$42,980	
Cost to complete:					
Materials.....	400	0%	\$ 75.00	0	
Labor.....	400	80%	12.00	2,880	
Factory overhead	400	20%	38.00	3,040	\$ 48,900
Started and completed this period	700	100%	125.00		87,500
Total cost transferred to Finishing Department					\$136,400
Work in Process, ending inventory:					
Materials.....	500	100%	\$ 75.00	\$37,500	
Labor.....	500	80%	12.00	4,800	
Factory overhead	500	90%	38.00	17,100	59,400
Total cost accounted for					<u>\$195,800</u>

* Number of equivalent units of cost added during the current period determined as follows:

	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>
To complete beginning inventory.....	0	240	80
Started and completed this period	700	700	700
Ending inventory	500	400	450
Total equivalent units	<u>1,200</u>	<u>1,340</u>	<u>1,230</u>

** Cost added during the current period divided by the number of equivalent units of cost added during the current period

P6-7 APPENDIX (Continued)

Marston Manufacturing Company
Finishing Department
Cost of Production Report
For August

<u>Quantity Schedule</u>	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>	<u>Quantity</u>
Beginning inventory.....	40%	20%	20%	600
Received from Fabricating Department				1,100
				<u>1,700</u>
Transferred to Finished Goods Inventory				1,300
Ending inventory.....	100%	60%	60%	400
				<u>1,700</u>

<u>Cost Charged to Department</u>	<u>Total Cost</u>	<u>Equivalent Units*</u>	<u>Unit Cost**</u>
Beginning inventory:			
Cost from preceding department.....	\$ 74,000		
Materials	230		
Labor	1,600		
Factory overhead	2,520		
Total cost in beginning inventory	<u>\$ 78,350</u>		
Cost added during current period:			
Cost from preceding department.....	\$136,400	1,100	\$124.00
Materials	2,920	1,460	2.00
Labor	19,880	1,420	14.00
Factory overhead	29,820	1,420	21.00
Total cost added during current period.....	<u>\$189,020</u>		
Total cost charged to department	<u>\$267,370</u>		<u>\$161.00</u>

<u>Cost Accounted for as Follows</u>	<u>Units</u>	<u>Current %</u>	<u>Unit Cost</u>	<u>Total Cost</u>
Transferred to Finished Goods:				
Beginning inventory				\$78,350
Cost to complete:				
Materials	600	60%	\$ 2.00	720
Labor	600	60%	14.00	6,720
Factory overhead	600	60%	21.00	10,080
Started and completed this period	700	100%	161.00	<u>112,700</u>
Total cost transferred to Finished Goods				<u>\$208,570</u>
Work in Process, ending inventory:				
Cost from preceding department	400	100%	\$124.00	\$49,600
Materials	400	100%	2.00	800
Labor	400	60%	14.00	3,360
Factory overhead	400	60%	21.00	5,040
Total cost accounted for				<u>\$267,370</u>

P6-7 APPENDIX (Concluded)

- * Number of equivalent units of cost added during the current period determined as follows:

	Prior Dept. Cost	Materials	Labor	Overhead
To complete beginning inventory ..	0	380	480	480
Started and completed this period	700	700	700	700
Ending inventory.....	400	400	240	240
Total equivalent units	<u>1,100</u>	<u>1,480</u>	<u>1,420</u>	<u>1,420</u>

- ** Cost added during the current period divided by the number of equivalent units of cost added during the current period

(2)	Work in Process—Fabricating Department	90,000	
	Work in Process—Finishing Department.....	2,920	
	Materials		92,920
	Work in Process—Fabricating Department	16,080	
	Work in Process—Finishing Department.....	19,880	
	Payroll		35,960
	Work in Process—Fabricating Department	46,740	
	Work in Process—Finishing Department.....	29,820	
	Applied Factory Overhead		76,560
	Work in Process—Finishing Department.....	136,400	
	Work in Process—Fabricating Department ..		136,400
	Finished Goods Inventory.....	208,570	
	Work in Process—Finishing Department		208,570

P6-8 APPENDIX

(1)

**Twonka Beverage Company
Mashing Department
Cost of Production Report
For September**

<u>Quantity Schedule</u>	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>	<u>Quantity</u>
Beginning Inventory.....	90%	60%	30%	600
Started in process this period				3,000
				<u>3,600</u>
Transferred to Blending Department.				3,100
Ending Inventory.....	60%	40%	20%	500
				<u>3,600</u>

<u>Cost Charged to Department</u>	<u>Total Cost</u>	<u>Equivalent Units*</u>	<u>Unit Cost**</u>
Beginning Inventory:			
Materials	\$ 1,088		
Labor	172		
Factory overhead	172		
Total cost in beginning inventory	<u>\$ 1,432</u>		
Cost added during current period:			
Materials	\$ 6,006	2,860	\$2.10
Labor	1,470	2,940	.50
Factory overhead	3,020	3,020	1.00
Total cost added during current period.....	<u>\$10,496</u>		
Total cost charged to department	<u>\$11,928</u>		<u>\$3.60</u>

P6-8 APPENDIX (Continued)

<u>Cost Accounted for as Follows</u>	<u>Units</u>	<u>Current %</u>	<u>Unit Cost</u>		<u>Total Cost</u>
Transferred to Blending Department:					
Beginning inventory				\$1,432	
Cost to complete:					
Materials	800	10%	\$2.10	126	
Labor	800	40%	.50	120	
Factory overhead	800	70%	1.00	420	\$ 2,098
Started and completed this period	2,500	100%	3.60		9,000
Total cost transferred to Blending Department					\$11,098
Work in Process, ending inventory:					
Materials	500	80%	\$2.10	\$ 830	
Labor	500	40%	.50	100	
Factory overhead	500	20%	1.00	100	830
Total cost accounted for					<u>\$11,928</u>

* Number of equivalent units of cost added during the current period determined as follows:

	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>
To complete beginning inventory	80	240	420
Started and completed this period	2,500	2,500	2,500
Ending inventory	300	200	100
Total equivalent units	<u>2,860</u>	<u>2,940</u>	<u>3,020</u>

** Cost added during the current period divided by the number of equivalent units of cost added during the current period

P6-8 APPENDIX (Continued)

Twonka Beverage Company
Blending Department
Cost of Production Report
For September

<u>Quantity Schedule</u>	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>	<u>Quantity</u>
Beginning inventory	50%	20%	20%	1,000
Received from Mashing Department				3,100
Added to process in Blending Department				3,100
				<u>7,200</u>
Transferred to Finished Goods Inventory				6,400
Ending inventory	100%	80%	80%	800
				<u>7,200</u>

<u>Cost Charged to Department</u>	<u>Total Cost</u>	<u>Equivalent Units*</u>	<u>Unit Cost**</u>
Beginning inventory:			
Cost from preceding department	\$ 1,770		
Materials	100		
Labor	55		
Factory overhead	74		
Total cost in beginning inventory	<u>\$ 1,999</u>		
Cost added during current period:			
Cost from preceding department	\$11,098	6,200	\$1.79
Materials	1,407	6,700	.21
Labor	2,004	6,680	.30
Factory overhead	2,672	6,680	.40
Total cost added during current period	<u>\$17,181</u>		
Total cost charged to department	<u>\$19,180</u>		<u>\$2.70</u>

<u>Cost Accounted for as Follows</u>	<u>Units</u>	<u>Current %</u>	<u>Unit Cost</u>		<u>Total Cost</u>
Transferred to Finished Goods:					
Beginning inventory				\$1,999	
Cost to complete:					
Materials	1,000	50%	\$.21	105	
Labor	1,000	80%	.30	240	
Factory overhead	1,000	80%	.40	320	\$ 2,664
Started and completed this period	5,400	100%	2.70		<u>14,580</u>
Total cost transferred to Finished Goods					<u>\$17,244</u>
Work in Process, ending inventory:					
Cost from preceding department	800	100%	\$1.79	\$1,432	
Materials	800	100%	.21	168	
Labor	800	80%	.30	144	
Factory overhead	800	80%	.40	192	1,936
Total cost accounted for					<u>\$19,180</u>

P6-8 APPENDIX (Concluded)

- * Number of equivalent units of cost added during the current period determined as follows:

	Prior Dept. Cost	Materials	Labor	Overhead
To complete beginning inventory ..	0	500	800	800
Started and completed this period	5,400	5,400	5,400	5,400
Ending inventory	800	800	480	480
Total equivalent units	<u>6,200</u>	<u>6,700</u>	<u>6,680</u>	<u>6,680</u>

- ** Cost added during the current period divided by the number of equivalent units of cost added during the current period

(2)	Work in Process—Mashing Department	6,006	
	Work in Process—Blending Department	1,407	
	Materials		7,413
	Work in Process—Mashing Department	1,470	
	Work in Process—Blending Department	2,004	
	Payroll		3,474
	Work in Process—Mashing Department	3,020	
	Work in Process—Blending Department	2,672	
	Applied Factory Overhead		5,692
	Work in Process—Blending Department	11,098	
	Work in Process—Mashing Department		11,098
	Finished Goods Inventory	17,244	
	Work in Process—Blending Department		17,244

CHAPTER 7

DISCUSSION QUESTIONS

Q7-1. Quality costs may be grouped into the following three classifications:

1. Prevention costs are the costs incurred to prevent product failure. They include the cost of designing high quality products and production systems, including the costs of implementing and maintaining such systems.
2. Appraisal costs are the costs incurred to detect product failure. They include the cost of inspecting and testing materials, inspecting products during production, and the cost of obtaining information from customers about product satisfaction.
3. Failure costs are the costs incurred when a product fails, and may occur internally or externally. Internal failure costs are those that occur during the manufacturing or production process (e.g., scrap, spoilage, and rework), and external failure costs are those that occur after the product has been sold (e.g., warranty repairs and replacements, sales refunds, handling customer complaints, and lost sales resulting from poor product quality).

Q7-2. TQM stands for total quality management, which is a company-wide approach to quality improvement in all processes and activities. TQM is a pervasive philosophy of doing business that applies to all functional areas of the company and to all personnel.

Q7-3. Five characteristics of TQM systems are:

1. The company's objective for all business activity is to serve its customers. The term "product" is extended to include services as well as goods, and "customer" includes internal users as well as those outside of the company who purchase the company's products. Each employee's activity is oriented to providing service to the customer.
2. Top management provides an active leadership role in the quality improvement movement.
3. All employees are actively involved in quality improvement. Employees are not only asked to contribute ideas, but also to find better ways of doing things. Involvement can be successful only when there is encouragement and an open and honest environment of trust.
4. The company has a system of identifying quality problems, developing solutions, and setting quality improvement objectives. This typically involves organizing employees from all ranks and from differ-

ent organizational units along with managers who have authority to take the necessary action to solve problems.

5. The company places a high value on its employees and provides continuous training, as well as recognition for achievement. Employees perform best when they are well trained, and they have the greatest capacity to contribute when they are highly educated.

Q7-4. The concept of continuous quality improvement differs from the concept of quality optimization in that continuous quality improvement is a dynamic process of change under the assumption that the ideal is not an absolute known value; whereas, quality optimization is a static approach to finding the best solution to a given set of fixed and known constraints.

Q7-5. The first problem with trying to inspect quality into the product is that it detects internal failures only after considerable cost has been incurred. The second problem is that the magnitude of the cost of the internal failures, detected by inspection, is rarely measured and typically ignored.

Q7-6. Companies should concentrate their efforts on preventing poor quality rather than on trying to inspect it into the process, because it will result in less total quality cost. The approach is founded on the belief that by increasing prevention costs, the cost of internal failures—such as scrap, spoilage, rework, and downtime—will decline by a larger amount than the increase in prevention costs.

Q7-7. Quality costs should be measured and reported to management in order to provide incentive and direction for improving quality. Large quality costs indicate large opportunities for improvement. Also, measurements provide a basis for monitoring the cost of quality and evaluating improvements.

Q7-8. Scrap includes (1) the filings and trimmings remaining after processing materials, (2) defective materials that cannot be used or returned to the vendor, and (3) broken parts resulting from employee errors or machine failures. Spoiled goods differ from scrap in that they are partially or fully completed units that are in some way defective and are not economically or physically correctable. Spoiled goods may be units of the product or component parts, and they may or may not have a salvage value. Rework is the process of correcting defective manufactured goods.

Q7-9. The cost of scrap, spoilage, and rework should not be ignored, because such costs are often

quite high and often result from internal failures that can be eliminated. Ignoring the cost of these internal failures sends a signal to managers that such costs are acceptable. Reporting such costs provides incentive for improvement, particularly if the costs are large.

- Q7-10. In order to know what to do with the cost, the accountant must know whether the spoilage or rework is caused by the customer or by an inter-

nal failure. If spoilage or rework is the result of a customer requirement, the unrecoverable cost should be charged to the job. On the other hand, if the spoilage or rework is the consequence of an internal failure, the unrecoverable cost should be removed from the job (i.e., charged to Factory Overhead Control) and reported to responsible management.

EXERCISES

E7-1

(1)	Accounts Receivable.....	1,800	
	Scrap Sales (or Other Income).....		1,800
(2)	Accounts Receivable.....	1,800	
	Cost of Goods Sold.....		1,800
(3)	Accounts Receivable.....	1,800	
	Factory Overhead Control		1,800
(4)	Accounts Receivable.....	1,800	
	Work in Process		1,800

E7-2	Spoiled Goods Inventory	120	
	Factory Overhead Control	152	
	Work in Process		272

E7-3 \$27,000 total job cost/1,000 chairs = \$27 cost per chair

	Spoiled Goods Inventory (\$9 x 100 chairs).....	900	
	Factory Overhead Control ((\$27 - \$9) x 100).....	1,800	
	Finished Goods Inventory (\$27 x 900 chairs)	24,300	
	Work in Process		27,000

E7-4	Spoiled goods Inventory (\$90 x 100 units).....	9,000	
	Cost of Goods Sold.....	95,000	
	Work in Process		104,000

E7-5	Factory Overhead Control	700	
	Materials (100 units x \$1.50).....		150
	Payroll (100 units x 1/4 hour x \$10 per hour)		250
	Applied Factory Overhead (100 x 1/4 hr x \$12 rate).....		300
	Finished Goods Inventory.....	6,800	
	Work in Process		6,800

E7-6	Work in Process	8,500	
	Materials (1,000 units x \$1)		1,000
	Payroll (1,000 units x 1/6 hour x \$15)		2,500
	Applied Factory Overhead (1,000 x 1/6 x \$30)		5,000
	Cost of Goods Sold	73,500	
	Work in Process (\$65,000 + \$8,500)		73,500
	Accounts Receivable (\$73,500 x 150%)	110,250	
	Sales		110,250

E7-7

(1)

**Manx Company
Forming Department
Cost of Production Report
For August**

<u>Quantity Schedule</u>	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>	<u>Quantity</u>		
Beginning inventory.....				1,000		
Started in process this period				9,000		
				<u>10,000</u>		
Transferred to Finishing Department				8,000		
Ending inventory.....	100%	75%	50%	1,500		
Spoiled in process.	100%	100%	100%	500		
				<u>10,000</u>		
<u>Cost Charged to Department</u>			<u>Total Cost</u>	<u>Equivalent Units*</u>	<u>Unit Cost**</u>	
Beginning inventory:						
Materials			\$ 1,260			
Labor.....			770			
Factory overhead			1,400			
Total cost in beginning inventory			<u>\$ 3,430</u>			
Cost added during current period:						
Materials			\$36,240	10,000		\$3.75
Labor.....			10,780	9,625		1.20
Factory overhead			21,725	9,250		2.50
Total cost added during current period.....			<u>\$68,745</u>			
Total cost charged to department.....			<u>\$72,175</u>			<u>\$7.45</u>
<u>Cost Accounted for as Follows</u>	<u>Units</u>	<u>% Complete</u>	<u>Unit Cost</u>		<u>Total Cost</u>	
Transferred to Finishing Department	8,000	100%	\$7.45		\$59,600	
Charge to Factory Overhead for spoilage:						
Materials.....	500	100%	\$3.75	\$1,875		
Labor.....	500	100%	1.20	600		
Factory overhead	500	100%	2.50	1,250	3,725	
Work in Process, ending inventory:						
Materials.....	1,500	100%	\$3.75	\$5,625		
Labor.....	1,500	75%	1.20	1,350		
Factory overhead	1,500	50%	2.50	1,875	8,850	
Total cost accounted for					<u>\$72,175</u>	

E7-7 (Concluded)

- * Total number of equivalent units required in the cost accounted for section determined as follows:

	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>
Equivalent units transferred out.....	8,000	8,000	8,000
Equivalent units in ending inventory.....	1,500	1,125	750
Equivalent units of spoilage.....	500	500	500
Total equivalent units	<u>10,000</u>	<u>9,625</u>	<u>9,250</u>

- ** Total cost (i.e., the cost in beginning inventory plus the cost added during the current period) divided by the total number of equivalent units required in the cost accounted for section

(2)	Work in Process—Finishing Department.....	59,600	
	Factory Overhead Control	3,725	
	Work in Process—Forming Department		63,325

E7-8

(1)

**Juniper Company
Finishing Department
Cost of Production Report
For July**

<u>Quantity Schedule</u>	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>	<u>Quantity</u>
Beginning inventory.....				500
Received from Cutting Department...				4,500
				<u>5,000</u>
Transferred to Finished Goods.....				3,800
Ending inventory.....	40%	20%	20%	800
Spoiled in process.....	100%	100%	100%	400
				<u>5,000</u>
 <u>Cost Charged to Department</u>				
Beginning inventory:			<u>Total Cost</u>	<u>Equivalent Units*</u> <u>Unit Cost**</u>
Cost from preceding department.....			\$ 5,500	
Materials			1,950	
Labor.....			1,180	
Factory overhead			1,770	
Total cost in beginning inventory			<u>\$ 10,400</u>	
Cost added during current period:				
Cost from preceding department.....			\$ 54,500	5,000 \$12.00
Materials			20,850	4,520 5.00
Labor.....			18,280	4,360 4.00
Factory overhead			24,390	4,360 6.00
Total cost added during current period.....			<u>\$115,800</u>	
Total cost charged to department			<u>\$126,200</u>	<u>\$27.00</u>
 <u>Cost Accounted for as Follows</u>				
	<u>Units</u>	<u>% Complete</u>	<u>Unit Cost</u>	<u>Total Cost</u>
Transferred to Finished Goods.....	3,800	100%	\$27.00	\$102,600
Transferred to Spoiled Goods Inventory at salvage value	400		\$10.00	4,000
Charge to Factory Overhead for spoilage:				
Cost of completed spoiled units	400	100%	\$27.00	\$10,800
Less salvage value of spoiled units	400		10.00	<u>4,000</u>
Work in Process, ending inventory:				
Cost from preceding department	800	100%	\$12.00	\$ 9,600
Materials	800	40%	5.00	1,600
Labor.....	800	20%	4.00	640
Factory overhead	800	20%	6.00	<u>960</u>
Total cost accounted for				<u>12,800</u>
				<u>\$126,200</u>

E7-8 (Concluded)

- * Total number of equivalent units required in the cost accounted for section determined as follows:

	<u>Prior Dept. Cost</u>	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>
Equivalent units transferred out....	3,800	3,800	3,800	3,800
Equivalent units in ending inventory	800	320	160	160
Equivalent units of spoilage.....	400	400	400	400
Total equivalent units	<u>5,000</u>	<u>4,520</u>	<u>4,360</u>	<u>4,360</u>

- ** Total cost (i.e., the cost in beginning inventory plus the cost added during the current period) divided by the total number of equivalent units required in the cost accounted for section

(2)	Finished Goods Inventory.....	102,600	
	Spoiled Goods Inventory	4,000	
	Factory Overhead Control	6,800	
	Work in Process—Finishing Department.....		113,400

E7-9

(1)

**Coastal Petroleum Inc.
Cracking Department
Cost of Production Report
For May**

<u>Quantity Schedule</u>	<u>Materials</u>	<u>Conversion Cost</u>	<u>Quantity</u>		
Beginning inventory.....			5,000		
Started in process this period			55,000		
			<u>60,000</u>		
Transferred to Refining Department			49,000		
Ending inventory.....	100%	70%	8,000		
Lost in process			<u>5,000</u>		
			<u>60,000</u>		
<u>Cost Charged to Department</u>		<u>Total Cost</u>	<u>Equivalent Units*</u>	<u>Unit Cost**</u>	
Beginning inventory:					
Materials		\$ 1,900			
Conversion cost		380			
Total cost in beginning inventory		<u>\$ 2,280</u>			
Cost added during current period:					
Materials		\$20,100	55,000	\$.40	
Conversion cost		7,820	53,200	.15	
Total cost added during current period.....		<u>\$27,720</u>			
Total cost charged to department		<u>\$29,980</u>			<u>\$.55</u>
<u>Cost Accounted for as Follows</u>	<u>Units</u>	<u>% Complete</u>	<u>Unit Cost</u>		<u>Total Cost</u>
Transferred to Refining Department	49,000	100%	\$.55		\$26,950
Work in Process, ending inventory:					
Materials	8,000	100%	.40	\$2,400	
Conversion cost	8,000	70%	.15	630	3,030
Total cost accounted for					<u>\$29,980</u>

* Total number of equivalent units required in the cost accounted for section determined as follows:

	<u>Materials</u>	<u>Conversion Cost</u>
Equivalent units transferred out....	49,000	49,000
Equivalent units in ending inventory	8,000	4,200
Total equivalent units	<u>55,000</u>	<u>53,200</u>

** Total cost (i.e., the cost in beginning inventory plus the cost added during the current period) divided by the total number of equivalent units required in the cost accounted for section

(2)	Work in Process—Refining Department	26,950	
	Work in Process—Cracking Department		26,950

E7-10 APPENDIX

(1)

**Sun Valve Company
Tooling Department
Cost of Production Report
For March**

<u>Quantity Schedule</u>	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>	<u>Quantity</u>
Beginning inventory.....	100%	70%	60%	2,000
Started this period.....				13,000
				<u>15,000</u>
Transferred to Finishing Department				7,000
Ending inventory.....	100%	50%	40%	3,000
Spoiled in process	100%	90%	90%	5,000
				<u>15,000</u>

<u>Cost Charged to Department</u>	<u>Total Cost</u>	<u>Equivalent Units*</u>	<u>Unit Cost**</u>
Beginning inventory:			
Materials	\$ 1,800		
Labor	290		
Factory overhead	950		
Total cost in beginning inventory	<u>\$ 2,840</u>		
Cost added during current period:			
Materials	\$ 9,750	13,000	\$.75
Labor	2,320	11,800	.20
Factory overhead	9,200	11,500	.80
Total cost added during current period.....	<u>\$21,270</u>		
Total cost charged to department	<u>\$24,110</u>		<u>\$1.75</u>

<u>Cost Accounted for as Follows</u>	<u>Units</u>	<u>Current %</u>	<u>Unit Cost</u>	<u>Total Cost</u>
Transferred to Finishing Department:				
From beginning inventory				\$2,840
Cost to complete this period:				
Materials.....	2,000	0%	\$.75	0
Labor.....	2,000	30%	.20	120
Factory overhead	2,000	40%	.80	840
Started and completed this period	5,000	100%	\$1.75	8,750
Total cost transferred to Finishing Department				<u>\$12,350</u>
Charge to Factory Overhead for spoilage:				
Materials	5,000	100%	\$.75	\$3,750
Labor.....	5,000	90%	.20	900
Factory overhead	5,000	90%	.80	3,800
Work in Process, ending inventory:				
Materials	3,000	100%	\$.75	\$2,250
Labor.....	3,000	50%	.20	300
Factory overhead	3,000	40%	.80	980
Total cost accounted for				<u>\$24,110</u>

E7-10 APPENDIX (Concluded)

- * Number of equivalent units of cost added during the current period determined as follows:

	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>
To complete beginning inventory.....	C	800	800
Started and completed this period	5,000	5,000	5,000
Ending inventory	3,000	1,500	1,200
Spoiled units	5,000	4,500	4,500
Total equivalent units	<u>13,000</u>	<u>11,800</u>	<u>11,500</u>

- ** Cost added during the current period divided by the number of equivalent units of cost added during the current period

(2)	Work in Process—Finishing Department.....	12,350	
	Factory Overhead Control	8,250	
	Work in Process—Tooling Department.....		20,600

E7-11 APPENDIX**(1)**

**Plastico Furniture Company
Finishing Department
Cost of Production Report
For September**

<u>Quantity Schedule</u>	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>	<u>Quantity</u>
Beginning Inventory.....	80%	40%	40%	1,200
Received from Fabricating Department				6,000
				<u>7,200</u>
Transferred to Finished Goods.....				5,000
Ending inventory.....	100%	80%	80%	1,500
Spilled in process.....	100%	100%	100%	700
				<u>7,200</u>

<u>Cost Charged to Department</u>	<u>Total Cost</u>	<u>Equivalent Units*</u>	<u>Unit Cost**</u>
Beginning inventory:			
Cost from preceding department.....	\$ 14,160		
Materials	1,210		
Labor.....	1,300		
Factory overhead	3,250		
Total cost in beginning inventory	<u>\$ 19,920</u>		
Cost added during current period:			
Cost from preceding department.....	\$ 72,000	6,000	\$12.00
Materials	6,240	6,240	1.00
Labor.....	12,240	6,120	2.00
Factory overhead	30,600	6,120	5.00
Total cost added during current period.....	<u>\$121,080</u>		
Total cost charged to department	<u>\$141,000</u>		<u>\$20.00</u>

E7-11 APPENDIX (Concluded)

<u>Cost Accounted for as Follows</u>	<u>Units</u>	<u>Current %</u>	<u>Unit Cost</u>		<u>Total Cost</u>
Transferred to Finished Goods:					
From beginning inventory				\$19,920	
Cost to complete this period:					
Materials.....	1,200	20%	\$ 1.00	240	
Labor.....	1,200	60%	2.00	1,440	
Factory overhead	1,200	60%	5.00	3,600	\$ 25,200
Started and completed this period	3,800	100%	\$20.00		76,000
Total cost transferred to Finishing Department					\$101,200
Transferred to Spoiled Goods Inventory					
at salvage value	700		\$12.00		8,400
Charge to Factory Overhead for spoilage:					
Cost of completed spoiled units	700	100%	\$20.00	\$14,000	
Less salvage value of spoiled units	700		12.00	8,400	5,600
Work in Process, ending inventory:					
Cost from preceding department	1,500	100%	\$12.00	\$18,000	
Materials.....	1,500	100%	1.00	1,500	
Labor.....	1,500	60%	2.00	1,800	
Factory overhead	1,500	60%	5.00	4,500	25,800
Total cost accounted for					<u>\$141,000</u>

* Number of equivalent units of cost added during the current period determined as follows:

	<u>Prior Dept. Cost</u>	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>
To complete beginning inventory ..	0	240	720	720
Started and completed this period	3,800	3,800	3,800	3,800
Ending inventory.....	1,500	1,500	900	900
Spoiled units.....	700	700	700	700
Total equivalent units	<u>6,000</u>	<u>6,240</u>	<u>6,120</u>	<u>6,120</u>

** Cost added during the current period divided by the number of equivalent units of cost added during the current period

(2)	Finished Goods Inventory.....	101,200	
	Spoiled Goods Inventory	8,400	
	Factory Overhead Control	5,600	
	Work in Process—Finishing Department.....		115,200

E7-12 APPENDIX

(1)

**Local Pop Inc.
Cooking Department
Cost of Production Report
For December**

<u>Quantity Schedule</u>	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>	<u>Quantity</u>
Beginning inventory.....	75%	25%	25%	10,000
Received from Mixing Department....				40,000
				50,000
Transferred to Bottling Department..				37,000
Ending inventory.....	100%	75%	75%	8,000
Lost in process				5,000
				50,000

<u>Cost Charged to Department</u>	<u>Total Cost</u>	<u>Equivalent Units*</u>	<u>Unit Cost**</u>
Beginning inventory:			
Cost from preceding department.....	\$ 2,920		
Materials	305		
Labor.....	140		
Factory overhead	210		
Total cost in beginning inventory	\$ 3,575		
Cost added during current period:			
Cost from preceding department.....	\$10,850	35,000	\$.31
Materials	1,500	37,500	.04
Labor.....	2,430	40,500	.06
Factory overhead	3,645	40,500	.09
Total cost added during current period.....	\$18,425		
Total cost charged to department	\$22,000		\$.50

<u>Cost Accounted for as Follows</u>	<u>Units</u>	<u>Current %</u>	<u>Unit Cost</u>	<u>Total Cost</u>
Transferred to Bottling Department:				
From beginning inventory				\$3,575
Cost to complete this period:				
Materials.....	10,000	25%	\$.04	100
Labor.....	10,000	75%	.06	450
Factory overhead	10,000	75%	.09	675
Started and completed this period	27,000	100%	\$.50	13,500
Total cost transferred to Finishing Department				\$18,300
Work in Process, ending inventory:				
Cost from preceding department	8,000	100%	\$.31	\$2,480
Materials	8,000	100%	.04	320
Labor.....	8,000	75%	.06	360
Factory overhead	8,000	75%	.09	540
Total cost accounted for				3,700
				\$22,000

E7-12 APPENDIX (Concluded)

* Number of equivalent units of cost added during the current period determined as follows:

	Prior Dept. Cost	Materials	Labor	Overhead
To complete beginning inventory ..	0	2,500	7,500	7,500
Started and completed this period	27,000	27,000	27,000	27,000
Ending inventory.....	8,000	8,000	6,000	6,000
Total equivalent units	<u>35,000</u>	<u>37,500</u>	<u>40,500</u>	<u>40,500</u>

** Cost added during the current period divided by the number of equivalent units of cost added during the current period

(2)	Work in Process—Bottling Department.....	18,300	
	Work in Process—Cooking Department		18,300

PROBLEMS

P7-1

(1)	Spoiled Goods Inventory (200 units x \$2.25)	450	
	Factory Overhead Control	1,350	
	Work in Process		1,800
(2)	Accounts Receivable (\$550 + \$450)	1,000	
	Scrap Sales		550
	Spoiled Goods Inventory		450

P7-2

- (1) $\frac{\$90,000 \text{ total job cost}}{5,000 \text{ units on job}} = \18 per unit

	Spoiled Goods Inventory (200 units x \$15 salvage)	3,000	
	Factory Overhead Control	600	
	Work in Process (200 units x \$18 cost)		3,600
	Cost of Goods Sold.....	86,400	
	Work in Process (\$90,000 - \$3,600)		86,400
	Accounts Receivable (\$86,400 x 140%)	120,960	
	Sales.....		120,960
(2)	Spoiled Goods Inventory (200 units x \$15 salvage)	3,000	
	Work in Process		3,000
	Cost of Goods Sold.....	87,000	
	Work in Process (\$90,000 - \$3,000)		87,000
	Accounts Receivable (\$87,000 x 140%)	121,800	
	Sales.....		121,800

P7-3

(1)	Factory Overhead Control	2,200	
	Materials (100 units x \$4)		400
	Payroll (100 units x 1/2 hr x \$12 rate)		600
	Applied Factory Overhead (100 x 1/2 hr x \$24 rate)		1,200
	Cost of Goods Sold	200,000	
	Work in Process		200,000
	Accounts Receivable (\$200,000 x 150%)	300,000	
	Sales		300,000
(2)	Work in Process	2,200	
	Materials (100 units x \$4)		400
	Payroll (100 units x 1/2 hour x \$12 rate)		600
	Applied Factory Overhead (100 x 1/2 hr x \$24 rate)		1,200
	Cost of Goods Sold	202,200	
	Work in Process (\$200,000 + \$2,200)		202,200
	Accounts Receivable (\$202,200 x 150%)	303,300	
	Sales		303,300

P7-4 (1)

**Overstreet Company
Cutting Department
Cost of Production Report
For April**

<u>Quantity Schedule</u>	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>	<u>Quantity</u>	
Beginning inventory.....				5,000	
Started in process this period				20,000	
				<u>25,000</u>	
Transferred to Assembling Department				18,000	
Ending inventory.....	100%	60%	60%	4,000	
Spoiled in process	100%	90%	90%	3,000	
				<u>25,000</u>	
<u>Cost Charged to Department</u>			<u>Total</u>	<u>Equivalent</u>	<u>Unit</u>
Beginning inventory:			<u>Cost</u>	<u>Units*</u>	<u>Cost**</u>
Materials			\$ 1,280		
Labor.....			789		
Factory overhead			1,789		
Total cost in beginning inventory			<u>\$ 3,838</u>		
Cost added during current period:					
Materials			\$36,240	25,000	\$1.50
Labor.....			10,761	23,100	.50
Factory overhead			21,311	23,100	1.00
Total cost added during current period.....			<u>\$68,312</u>		
Total cost charged to department			<u>\$72,150</u>		<u>\$3.00</u>
<u>Cost Accounted for as Follows</u>	<u>Units</u>	<u>%Complete</u>	<u>Unit Cost</u>		<u>Total Cost</u>
Transferred to Assembling Department	18,000	100%	\$3.00		\$54,000
Charge to Factory Overhead for spoilage:					
Materials	3,000	100%	\$1.50	\$4,500	
Labor.....	3,000	90%	.50	1,350	
Factory overhead	3,000	90%	1.00	2,700	8,550
Work in Process, ending inventory:					
Materials	4,000	100%	\$1.50	\$6,000	
Labor.....	4,000	60%	.50	1,200	
Factory overhead	4,000	60%	1.00	2,400	9,600
Total cost accounted for					<u>\$72,150</u>

* Total number of equivalent units required in the cost accounted for section determined as follows:

	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>
Equivalent units transferred out.....	18,000	18,000	18,000
Equivalent units in ending inventory.....	4,000	2,400	2,400
Equivalent units of spoilage.....	3,000	2,700	2,700
Total equivalent units	<u>25,000</u>	<u>23,100</u>	<u>23,100</u>

** Total cost (i.e., the cost in beginning inventory plus the cost added during the current period) divided by the total number of equivalent units required in the cost accounted for section

P7-4 (Continued)

**Overstreet Company
Assembling Department
Cost of Production Report
For April**

<u>Quantity Schedule</u>	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>	<u>Quantity</u>		
Beginning Inventory.....				4,000		
Received from Cutting Department...				18,000		
				<u>22,000</u>		
Transferred to Finished Goods Inventory				17,000		
Ending Inventory.....	80%	20%	20%	4,000		
Spilled in process	100%	100%	100%	1,000		
				<u>22,000</u>		
<u>Cost Charged to Department</u>			<u>Total</u>	<u>Equivalent</u>	<u>Unit</u>	
Beginning Inventory:			<u>Cost</u>	<u>Units*</u>	<u>Cost**</u>	
Cost from preceding department.....			\$ 10,900			
Materials			38,028			
Labor.....			3,358			
Factory overhead			5,034			
Total cost in beginning inventory			<u>\$ 57,318</u>			
Cost added during current period:						
Cost from preceding department.....			\$ 54,000	22,000	\$ 2.95	
Materials			164,432	21,200	9.55	
Labor.....			15,444	18,800	1.00	
Factory overhead			23,168	18,800	1.50	
Total cost added during current period.....			<u>\$257,042</u>			
Total cost charged to department			<u>\$314,360</u>			<u>\$15.00</u>
<u>Cost Accounted for as Follows</u>	<u>Units</u>	<u>% Complete</u>	<u>Unit Cost</u>			<u>Total Cost</u>
Transferred to Finished Goods.....	17,000	100%	\$15.00			\$255,000
Transferred to Spilled Goods Inventory at salvage value	1,000		\$ 5.00			5,000
Charge to Factory Overhead for spoilage:						
Cost of completed spoiled units	1,000	100%	\$15.00	\$15,000		
Less salvage value of spoiled units	1,000		5.00	5,000		10,000
Work in Process, ending inventory:						
Cost from preceding department	4,000	100%	\$ 2.95	\$11,800		
Materials	4,000	80%	9.55	30,560		
Labor.....	4,000	20%	1.00	800		
Factory overhead.	4,000	20%	1.50	1,200		44,360
Total cost accounted for						<u>\$314,360</u>

P7-4 (Concluded)

- Total number of equivalent units required in the cost accounted for section determined as follows:

	<u>Prior Dept. Cost</u>	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>
Equivalent units transferred out....	17,000	17,000	17,000	17,000
Equivalent units in ending inventory	4,000	3,200	800	800
Equivalent units of spoilage.....	1,000	1,000	1,000	1,000
Total equivalent units	<u>22,000</u>	<u>21,200</u>	<u>18,800</u>	<u>18,800</u>

- ** Total cost (i.e., the cost in beginning inventory plus the cost added during the current period) divided by the total number of equivalent units required in the cost accounted for section

(2)	Work in Process—Assembling Department.....	54,000	
	Factory Overhead Control	8,550	
	Work in Process—Cutting Department.....		62,550
	Finished Goods Inventory.....	255,000	
	Spoiled Goods Inventory	5,000	
	Factory Overhead Control	10,000	
	Work in Process—Assembling Department..		270,000

P7-5

(1)

**Hometown Brewery Company
Mixing and Brewing Department
Cost of Production Report
For January**

<u>Quantity Schedule</u>	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>	<u>Quantity</u>	
Beginning inventory.....				4,000	
Started in process this period				36,000	
				<u>40,000</u>	
Transferred to Canning Department				28,000	
Ending inventory.....	100%	40%	40%	6,000	
Lost in process				6,000	
				<u>40,000</u>	
 <u>Cost Charged to Department</u>					
Beginning inventory:			<u>Total Cost</u>	<u>Equivalent Units*</u>	<u>Unit Cost**</u>
Materials			\$ 600		
Labor			88		
Factory overhead			128		
Total cost in beginning inventory			<u>\$ 816</u>		
 Cost added during current period:					
Materials			\$4,840	34,000	\$.16
Labor			824	30,400	.03
Factory overhead			1,088	30,400	.04
Total cost added during current period.....			<u>\$6,752</u>		
Total cost charged to department			<u>\$7,568</u>		<u>\$.23</u>
 <u>Cost Accounted for as Follows</u>					
	<u>Units</u>	<u>% Complete</u>	<u>Unit Cost</u>		<u>Total Cost</u>
Transferred to Canning Department	28,000	100%	\$.23		\$6,440
Work in Process, ending inventory:					
Materials	6,000	100%	\$.16	\$960	
Labor.....	6,000	40%	.03	72	
Factory overhead	6,000	40%	.04	96	1,128
Total cost accounted for					<u>\$7,568</u>

* Total number of equivalent units required in the cost accounted for section determined as follows:

	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>
Equivalent units transferred out.....	28,000	28,000	28,000
Equivalent units in ending inventory.....	6,000	2,400	2,400
Total equivalent units	<u>34,000</u>	<u>30,400</u>	<u>30,400</u>

** Total cost (i.e., the cost in beginning inventory plus the cost added during the current period) divided by the total number of equivalent units required in the cost accounted for section

P7-5 (Continued)

**Hometown Brewery Company
Canning Department
Cost of Production Report
For January**

<u>Quantity Schedule</u>	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>	<u>Quantity</u>	
Beginning inventory				2,000	
Received from Mixing and Brewing Department.....				28,000	
				<u>30,000</u>	
Transferred to Finished Goods Inventory				25,000	
Ending inventory.....	100%	50%	50%	1,000	
Spoiled in process	100%	80%	80%	4,000	
				<u>30,000</u>	
 <u>Cost Charged to Department</u>					
Beginning inventory:			<u>Total Cost</u>	<u>Equivalent Units*</u>	<u>Unit Cost**</u>
Cost from preceding department.....			\$ 550		
Materials			190		
Labor			75		
Factory overhead			150		
Total cost in beginning inventory			<u>\$ 965</u>		
Cost added during current period:					
Cost from preceding department.....			\$ 6,440	30,000	\$.233
Materials			1,520	30,000	.057
Labor			786	28,700	.030
Factory overhead			1,572	28,700	.060
Total cost added during current period.....			<u>\$10,318</u>		
Total cost charged to department			<u><u>\$11,283</u></u>		<u><u>\$.380</u></u>
 <u>Cost Accounted for as Follows</u>					
	<u>Units</u>	<u>% Complete</u>	<u>Unit Cost</u>		<u>Total Cost</u>
Transferred to Finished Goods Inventory	25,000	100%	\$.380		\$ 9,500
Charge to Factory Overhead for spoilage:					
Cost from preceding department	4,000	100%	\$.233	\$932	
Materials	4,000	100%	.057	228	
Labor.....	4,000	80%	.030	96	
Factory overhead	4,000	80%	.060	192	1,448
Work in Process, ending inventory:					
Cost from preceding department	1,000	100%	\$.233	\$233	
Materials	1,000	100%	.057	57	
Labor.....	1,000	50%	.030	15	
Factory overhead	1,000	50%	.060	30	335
Total cost accounted for					<u><u>\$11,283</u></u>

P7-5 (Concluded)

- * Total number of equivalent units required in the cost accounted for section determined as follows:

	Prior Dept. Cost	Materials	Labor	Overhead
Equivalent units transferred out....	25,000	25,000	25,000	25,000
Equivalent units in ending inventory	1,000	1,000	500	500
Equivalent units of spoilage.....	4,000	4,000	3,200	3,200
Total equivalent units	<u>30,000</u>	<u>30,000</u>	<u>28,700</u>	<u>28,700</u>

- ** Total cost (i.e., the cost in beginning inventory plus the cost added during the current period) divided by the total number of equivalent units required in the cost accounted for section

(2)	Work in Process—Canning Department	6,440	
	Work in Process—Mixing and Brewing Department		6,440
	Finished Goods Inventory.....	9,500	
	Factory Overhead Control	1,448	
	Work in Process—Canning Department		10,948

P7-6 APPENDIX

(1)

**Handy Tool Company
Fabricating Department
Cost of Production Report
For April**

<u>Quantity Schedule</u>	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>	<u>Quantity</u>		
Beginning inventory.....	100%	70%	70%	2,000		
Started this period.....				9,000		
				<u>11,000</u>		
Transferred to Finishing Department				9,000		
Ending inventory.....	100%	40%	40%	1,500		
Spilled in process	100%	60%	60%	500		
				<u>11,000</u>		
<u>Cost Charged to Department</u>			<u>Total</u>	<u>Equivalent</u>	<u>Unit</u>	
Beginning inventory:			<u>Cost</u>	<u>Units*</u>	<u>Cost**</u>	
Materials			\$ 1,900			
Labor			340			
Factory overhead			1,020			
Total cost in beginning inventory			<u>\$ 3,260</u>			
Cost added during current period:						
Materials			\$ 9,180	9,000	\$1.02	
Labor			2,125	8,500	.25	
Factory overhead			6,375	8,500	.75	
Total cost added during current period			<u>\$17,680</u>			
Total cost charged to department			<u>\$20,940</u>		<u>\$2.02</u>	

P7-6 APPENDIX (Continued)

<u>Cost Accounted for as Follows</u>	<u>Units</u>	<u>Current %</u>	<u>Unit Cost</u>		<u>Total Cost</u>
Transferred to Finishing Department:					
From beginning inventory				\$3,280	
Cost to complete this period:					
Labor.....	2,000	30%	\$.25	150	
Factory overhead	2,000	30%	.75	450	\$ 3,880
Started and completed this period	7,000	100%	\$2.02		14,140
Total cost transferred to Finishing Department					\$18,000
Charge to Factory Overhead for spoilage:					
Materials	500	100%	\$1.02	\$ 510	
Labor.....	500	60%	.25	75	
Factory overhead	500	60%	.75	225	810
Work in Process, ending inventory:					
Materials	1,500	100%	\$1.02	\$1,530	
Labor.....	1,500	40%	.25	150	
Factory overhead	1,500	40%	.75	450	2,130
Total cost accounted for					<u>\$20,940</u>

* Number of equivalent units of cost added during the current period determined as follows:

	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>
To complete beginning inventory.....	0	600	600
Started and completed this period	7,000	7,000	7,000
Ending inventory	1,500	600	600
Spoiled units	500	300	300
Total equivalent units	<u>9,000</u>	<u>8,500</u>	<u>8,500</u>

** Cost added during the current period divided by the number of equivalent units of cost added during the current period

P7-6 APPENDIX (Continued)

**Handy Tool Company
Finishing Department
Cost of Production Report
For April**

<u>Quantity Schedule</u>	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>	<u>Quantity</u>	
Beginning inventory.....	100%	40%	40%	3,000	
Received from Fabricating Department				9,000	
				<u>12,000</u>	
Transferred to Finished Goods.....				9,900	
Ending inventory.....	100%	25%	25%	2,000	
Spolied in process.....	100%	100%	100%	100	
				<u>12,000</u>	
 <u>Cost Charged to Department</u>					
Beginning inventory:			<u>Total Cost</u>	<u>Equivalent Units*</u>	<u>Unit Cost**</u>
Cost from preceding department.....			\$ 6,100		
Materials			3,500		
Labor			520		
Factory overhead			780		
Total cost in beginning inventory			<u>\$10,900</u>		
Cost added during current period:					
Cost from preceding department.....			\$18,000	9,000	\$2.00
Materials			10,800	9,000	1.20
Labor			3,720	9,300	.40
Factory overhead			5,580	9,300	.60
Total cost added during current period.....			<u>\$38,100</u>		
Total cost charged to department			<u>\$49,000</u>		<u>\$4.20</u>

P7-6 APPENDIX (Concluded)

<u>Cost Accounted for as Follows</u>	<u>Units</u>	<u>Current %</u>	<u>Unit Cost</u>		<u>Total Cost</u>
Transferred to Finished Goods:					
From beginning inventory				\$10,900	
Cost to complete this period:					
Labor.....	3,000	60%	\$.40	720	
Factory overhead.....	3,000	60%	.60	1,080	\$12,700
Started and completed this period	6,900	100%	\$4.20		28,980
Total cost transferred to Finished Goods					\$41,680
Transferred to Spoiled Goods Inventory					
at salvage value	100		\$1.00		100
Charge to Factory Overhead for spoilage:					
Cost of completed spoiled units	100	100%	\$4.20	\$ 420	
Less salvage value of spoiled units	100		1.00	100	320
Work in Process, ending inventory:					
Cost from preceding department	2,000	100%	\$2.00	\$ 4,000	
Materials	2,000	100%	1.20	2,400	
Labor.....	2,000	25%	.40	200	
Factory overhead	2,000	25%	.60	300	6,900
Total cost accounted for					<u>\$49,000</u>

* Number of equivalent units of cost added during the current period determined as follows:

	<u>Prior Dept. Cost</u>	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>
To complete beginning inventory ..	0	0	1,800	1,800
Started and completed this period	6,900	6,900	6,900	6,900
Ending inventory	2,000	2,000	500	500
Spoiled units.....	100	100	100	100
Total equivalent units	<u>9,000</u>	<u>9,000</u>	<u>9,300</u>	<u>9,300</u>

** Cost added during the current period divided by the number of equivalent units of cost added during the current period

(2)	Work in Process—Finishing Department.....	18,000	
	Factory Overhead Control	810	
	Work in Process—Fabricating Department ..		18,810
	Finished Goods Inventory.....	41,680	
	Spoiled Goods Inventory	100	
	Factory Overhead Control	320	
	Work in Process—Finishing Department.....		42,100

P7-7 APPENDIX**(1)**

**XXX Chemical Company
Distillation Department
Cost of Production Report
For June**

<u>Quantity Schedule</u>	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>	<u>Quantity</u>		
Beginning inventory.....	100%	20%	20%	4,000		
Started this period.....				16,000		
				<u>20,000</u>		
Transferred to Refining Department .				14,000		
Ending inventory.....	100%	80%	80%	2,000		
Lost in process				4,000		
				<u>20,000</u>		
<u>Cost Charged to Department</u>				<u>Total</u>	<u>Equivalent</u>	<u>Unit</u>
Beginning inventory:				<u>Cost</u>	<u>Units*</u>	<u>Cost**</u>
Materials				\$ 3,824		
Labor				96		
Factory overhead				480		
Total cost in beginning inventory				<u>\$ 4,200</u>		
Cost added during current period:						
Materials				\$10,800	12,000	\$.90
Labor				1,480	14,800	.10
Factory overhead				7,400	14,800	.50
Total cost added during current period.....				<u>\$19,680</u>		
Total cost charged to department.....				<u>\$23,880</u>		<u>\$1.50</u>

P7-7 APPENDIX (Continued)

<u>Cost Accounted for as Follows</u>	<u>Units</u>	<u>Current %</u>	<u>Unit Cost</u>		<u>Total Cost</u>
Transferred to Refining Department:					
From beginning inventory				\$4,200	
Cost to complete this period:					
Labor.....	4,000	80%	\$.10	320	
Factory overhead	4,000	80%	.50	1,600	\$ 6,120
Started and completed this period	10,000	100%	\$1.50		15,000
Total cost transferred to Refining Department					\$21,120
Work in Process, ending inventory:					
Materials	2,000	100%	\$.90	\$1,800	
Labor.....	2,000	80%	.10	160	
Factory overhead	2,000	80%	.50	800	2,760
Total cost accounted for					<u><u>\$23,880</u></u>

* Number of equivalent units of cost added during the current period determined as follows:

	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>
To complete beginning inventory.....	0	3,200	3,200
Started and completed this period	10,000	10,000	10,000
Ending inventory.....	2,000	1,600	1,600
Total equivalent units	<u><u>12,000</u></u>	<u><u>14,800</u></u>	<u><u>14,800</u></u>

** Cost added during the current period divided by the number of equivalent units of cost added during the current period

P7-7 APPENDIX (Continued)

XXX Chemical Company
Refining Department
Cost of Production Report
For June

<u>Quantity Schedule</u>	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>	<u>Quantity</u>
Beginning inventory.....	100%	50%	50%	2,000
Received from Distillation Department				14,000
				<u>16,000</u>
Transferred to Finished Goods Inventory				12,000
Ending inventory.....	100%	30%	30%	2,000
Lost in process				2,000
				<u>16,000</u>

<u>Cost Charged to Department</u>	<u>Total Cost</u>	<u>Equivalent Units*</u>	<u>Unit Cost**</u>
Beginning inventory:			
Cost from preceding department.....	\$ 3,500		
Materials	240		
Labor	160		
Factory overhead	900		
Total cost in beginning inventory	<u>\$ 4,800</u>		
Cost added during current period:			
Cost from preceding department.....	\$21,120	12,000	\$1.76
Materials	1,440	12,000	.12
Labor	1,740	11,600	.15
Factory overhead	10,440	11,600	.90
Total cost added during current period.....	<u>\$34,740</u>		
Total cost charged to department	<u>\$39,540</u>		<u>\$2.93</u>

<u>Cost Accounted for as Follows</u>	<u>Units</u>	<u>Current %</u>	<u>Unit Cost</u>	<u>Total Cost</u>
Transferred to Finished Goods:				
From beginning inventory				\$4,800
Cost to complete this period:				
Labor.....	2,000	50%	\$.15	150
Factory overhead	2,000	50%	.90	900
Started and completed this period	10,000	100%	\$2.93	<u>29,300</u>
Total cost transferred to Finished Goods				<u>\$35,150</u>
Work in Process, ending inventory:				
Cost from preceding department	2,000	100%	\$1.76	\$3,520
Materials	2,000	100%	.12	240
Labor.....	2,000	30%	.15	90
Factory overhead	2,000	30%	.90	540
Total cost accounted for				<u>\$39,540</u>

P7-7 APPENDIX (Concluded)

- * Number of equivalent units of cost added during the current period determined as follows:

	Prior Dept. Cost	Materials	Labor	Overhead
To complete beginning inventory ..	0	0	1,000	1,000
Started and completed this period	10,000	10,000	10,000	10,000
Ending inventory	2,000	2,000	600	600
Total equivalent units	<u>12,000</u>	<u>12,000</u>	<u>11,600</u>	<u>11,600</u>

- ** Cost added during the current period divided by the number of equivalent units of cost added during the current period

(2)	Work in Process—Refining Department	21,120	
	Work in Process—Distillation Department ...		21,120
	Finished Goods Inventory	35,150	
	Work in Process—Refining Department		35,150

CASES

C7-1 Although improvement in product quality was clearly a stated goal at Star Disk Corporation, the company's reward structure suggests otherwise. Employees cannot be expected to put quality first if rewards are dispensed for achieving objectives that are often in conflict with quality improvement (i.e., short-run production volume goals). The quality improvement effort seems to have been focused solely on manufacturing activity, and the approach taken seems to have been to improve quality by inspecting it into the product. Such an approach is inadequate, because it waits too late in the process (i.e., after costs have been incurred in manufacturing defective products, instead of before) and focuses on only one piece of the problem rather than the whole problem.

In order to turn the problem around, top management must become actively involved. The reward structure should be changed to ensure compatibility with quality goals. Quality teams that include employees from all business functions (product design as well as manufacturing) and all levels (labor as well as management) should be created to help identify quality problems and find ways to solve the identified problems. Top management should actively participate in these teams in order to emphasize the importance of quality, coordinate efforts between organization units, and provide direction. Employees are more likely to become motivated when they understand the importance of quality, and top management participation and leadership underscore that importance. In addition, all employees must refocus their efforts on serving their respective customers. The data presented in the case suggest that managers from the different departments put all their attention on meeting production volume goals rather than on meeting the needs of their customers (i.e., the department receiving their output).

Although product inspection should be continued, emphasis should be shifted to preventing poor quality rather than detecting it. Prevention should start with product design and extend throughout the entire manufacturing process. Some things to be considered include:

- (a) reducing the number of parts required in the product;
- (b) using higher quality materials;
- (c) using standardized parts;
- (d) using well-known production technologies where possible;
- (e) minimizing retoolings;
- (f) increasing employee training;
- (g) reorganizing the manufacturing facility from production departments to manufacturing cells to promote teamwork and decrease inventory costs;
- (h) upgrading or modifying machinery;
- (i) installing a statistical process control system to monitor production quality and reduce production variability.

C7-1 (Concluded)

A few of the biggest and most urgent problems should be identified and tackled. In order to achieve results, effort should be concentrated on a few costly problems that can be solved. Tackling too many problems results in dispersed efforts and little observable accomplishment. Improving quality takes time and never ends. The company and its employees need some successes to build confidence and create the momentum needed to turn the quality problem around.

- C7-2** Product cost may be increasing as a result of an increasing amount of scrap, spoilage, and rework. Since the costs of these internal failures are not measured, management cannot evaluate the significance of the problem. In addition, since these costs are not measured, employees have no incentive to reduce or eliminate them. Treating scrap, spoilage, and rework as a normal production cost encourages such waste. As a consequence, overall costs rise. The company's cost accountants should develop a system of determining the cost of scrap, spoilage, and rework; implement the system (i.e., begin measuring such costs); and report these costs to responsible managers. If the cost of scrap, spoilage, and rework is high, management should initiate a quality improvement program that concentrates on preventing these internal failures. This may involve organizing employee quality teams to identify problems and develop solutions, locating new vendors to obtain higher quality materials, redesigning products to improve quality, modifying or upgrading manufacturing machinery, training or retraining employees, and/or reorganizing the production processes.

CHAPTER 8

DISCUSSION QUESTIONS

Q8-1. Joint products represent two or more products separated in the course of the same processing operation, with each product having such relative value that no one product can be designated as a major product.

A by-product is relatively minor in terms of total value and is derived incidentally from the production or manufacture of one or more major products.

Q8-2. Revenue from the sale of by-products may be listed as other income, additional sales revenue, a deduction from the cost of goods sold of the main product, or as a deduction from the cost of production of the main product.

Q8-3. Yes, when by-product revenue is deducted from the total production cost of the main product, the unit cost of the main product is reduced; consequently, the cost of the ending inventory changes also.

Q8-4. The replacement cost method can be used in such cases. In this method, the by-products that go into making other units are valued at the cost the company would have to pay if it were to go out on the market and purchase such materials.

Q8-5. (a) The treatment described for by-products may be justified when, relative to main products, the revenue generated by the by-product is insignificant; when no clearly defined basis of identifying by-product costs exist; or when the cost of more refined accounting would be disproportionate to the benefits received.

(b) The treatment described has several shortcomings. All gross profit is ascribed to major products and is incorrect as a measure of total gross profit, since the inventories of by-products that may be unsold at the end of the period will have a zero value. Failure to assign values to by-products may well mean they are not recognized as inventories at all. This, in turn, could lead to their waste, theft, or other mishandling. If by-products are sold irregularly and inventories are allowed to accumulate, both a material understatement of inventories and a distortion of reported net income of successive periods may result.

Q8-6. Yes, some of the initial manufacturing costs, additional manufacturing costs (when by-products are further processed after separation), and perhaps even marketing and administrative expenses may be charged to the by-products.

Q8-7. Methods for allocating the total joint production cost to joint products are:

(a) Allocate the joint cost on the basis of the relative market value of the joint products.

(b) Allocate the joint cost by using an average unit cost obtained by dividing the total joint manufacturing cost by the total number of units produced.

(c) Allocate the joint cost on the basis of weight factors such as size, difficulty of manufacture, or amount of materials used.

(d) Allocate the joint cost on the basis of some unit of measurement such as pounds, tons, or gallons. If the joint products are not measured in the same way, they must be converted to a denominator that is common to all the units produced.

Q8-8. The market value method considers the revenue-producing ability of the joint products by assuming that each should be valued according to its cost absorption ability. Resulting inventory costs are in harmony with revenue producing ability and, if the combined joint products are profitable, the market value method avoids allocating more cost to a product than its revenue; thus achieving a neutral effect. However, this method may be difficult to apply if the market value at the split-off point is not known.

The average unit cost method, while simple to apply when units are measured in like terms, fails to consider the heterogeneous nature of the individual products.

Q8-9. Joint costs must be allocated to joint products when there is inventory to be costed.

Q8-10. Not exactly. A new manufacturer would do well to consult the Internal Revenue Service about the methods to be used, so that an IRS agent can make a decision before the tax return is prepared. In other cases, where an allocation method has been applied consistently from year to year, to apply for a ruling would not be good strategy.

Q8-11. The method used in calculating unit costs produces the same unit cost for all grades of lumber sold. The owner is then led to believe that the same costs in the same ratio are attributable to the low as well as the high grade number.

It must also be recognized that because of the inherent nature of the materials and the milling process, it is not possible to eliminate low grade number. Thus, the profitability of the operation can be viewed best by considering the aggregate of revenue and costs of both the high and low grades of lumber, coupled with controls to assure that all practical steps are taken to obtain high quality logs and to mill them properly. A

higher price for logs may be justified in terms of a greater amount of high grade lumber.

Q8-12. For decision making, joint costs are irrelevant unless they are expected to change as a result

of the decision. Usually, only costs beyond the split-off are relevant.

EXERCISES

E8-1 (1) Net revenue method:	
Gross revenue from sale of by-product	\$20,000
Production cost after separation	5,000
Net revenue from sale of by-product	<u>\$15,000</u>
(2) Market value (reversal cost) method:	
Final market value	\$20,000
Less: Profit (\$20,000 x 10%)	\$2,000
Marketing and administrative expenses ...	2,000
Production cost after separation	<u>5,000</u>
Joint cost allocated to the by-product	<u>\$11,000</u>

E8-2

- (1) Calculation of manufacturing cost before separation for by-products.

	<u>By-Product</u>	
	<u>A</u>	<u>B</u>
Sales	<u>\$6,000</u>	<u>\$3,500</u>
Manufacturing cost after separation	\$1,100	\$ 900
Marketing and administrative expenses	750	550
Profit allowance (A, 15%; B, 12%)	900	420
	<u>\$2,750</u>	<u>\$1,870</u>
Manufacturing cost before separation	<u>\$3,250</u>	<u>\$1,630</u>

E8-2 (Concluded)

(2)

LOGAN COMPANY
Income Statement
For Month Ended April 30

	Main Product	By-Product A	B	Total
Sales	\$75,000	\$6,000	\$3,500	\$84,500
Cost of goods sold:				
Before separation (requirement (1)).	\$32,620	\$3,250	\$1,630	\$37,500
After separation.....	11,500	1,100	900	13,500
	<u>\$44,120</u>	<u>\$4,350</u>	<u>\$2,530</u>	<u>\$51,000</u>
Gross profit.....	\$30,880	\$1,650	\$ 970	\$33,500
Less marketing and administrative expenses.....	6,000	750	550	7,300
Profit from operations.....	<u>\$24,880</u>	<u>\$ 900</u>	<u>\$ 420</u>	<u>\$26,200</u>

E8-3

Product	Market Value at Split-Off	Apportionment of Joint Production Cost*
W.....	\$ 80,000	\$ 64,000
X.....	60,000	48,000
Y.....	40,000	32,000
Z.....	20,000	16,000
Total	<u>\$200,000</u>	<u>\$160,000</u>

$$\frac{\$160,000}{\$200,000} = 80\%$$

E8-4	Z: Market value per unit	\$ 6.00
	Gross profit, consisting of:	
	Operating profit	\$1.00
	Marketing and administrative expenses.....	1.00
		<u>2.00</u>
	Further processing cost	\$ 4.00
		2.00
	Value per unit of by-product at split-off.....	<u>\$ 2.00</u>
	Value of by-product to be credited to joint cost (2,000 units x \$2).....	<u>\$4,000</u>

E8-4 (Concluded)

X and Y:

Product	Ultimate Market Value per Unit	Units Produced	Ultimate Market Value	Processing Cost After Split-Off	Hypo- thetical Market Value	Apportion- ment of Joint Production Cost*
X	\$20	8,000	\$160,000	\$ 40,000	\$120,000	\$ 80,000
Y	25	10,000	250,000	70,000	180,000	120,000
			<u>\$410,000</u>	<u>\$110,000</u>	<u>\$300,000</u>	<u>\$200,000 **</u>

* Ratio to allocate cost prior to separation $\frac{\$200,000}{\$300,000} = \frac{2}{3}$

**\$204,000 cumulative joint cost less \$4,000 value of credit for by-product.

E8-5

(1) Product	Ultimate Market Value per Unit	Units Produced	Ultimate Market Value	Processing Cost After Split-Off	Hypo- thetical Market Value	Apportion- ment of Joint Production Cost
E	\$4.30	30,000	\$129,000	\$30,000	\$ 99,000	\$ 66,000 *
S	6.60	15,000	99,000	24,000	75,000	50,000
C	6.00	13,000	78,000	27,000	51,000	34,000
Total			<u>\$306,000</u>	<u>\$81,000</u>	<u>\$225,000</u>	<u>\$150,000</u>

* \$150,000 + \$225,000 = 2/3; \$99,000 x 2/3 = \$66,000

(2)	Differential revenue (15,000 x (\$6.60 - \$5.25))	\$20,250
	Differential cost	<u>24,000</u>
	Net effect of separable processing	<u><u>\$(3,750)</u></u>

Conclusion: Based on the information given, S should be sold at the split-off point.

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E8-6 (1)

Product	Ultimate Market Value per Unit	Units Produced	Ultimate Market Value	Processing Cost After Split-Off	Hypo- thetical Market Value*	Apportion- ment of Joint Production Cost**	Total Produc- tion Cost	Total Production Cost per Unit	Ending Inventory Units	Cost Assigned to Ending Inventory
A	\$100	1,000	\$100,000	\$ 25,000	\$ 75,000	\$ 54,000	\$ 79,000	\$ 79.00	200	\$15,800
B	80	3,000	240,000	60,000	180,000	129,600	189,600	63.20	500	31,600
C	50	5,000	250,000	105,000	145,000	104,400	209,400	41.88	700	29,316
Total.....			<u>\$590,000</u>	<u>\$190,000</u>	<u>\$400,000</u>	<u>\$288,000</u>	<u>\$478,000</u>			<u>\$76,716</u>

* At the split-off point

** Percentage to allocate joint production cost: $\$288,000 \div \$400,000 = 72\%$

E8-6 (Concluded)

	Product		
	A	B	C
Differential revenue per unit	\$40	\$15	\$25
Differential cost per unit:			
\$25,000 ÷ 1,000	25		
\$60,000 ÷ 3,000		20	
\$105,000 ÷ 5,000			21
	<u>\$15</u>	<u>\$ (5)</u>	<u>\$ 4</u>

Conclusion: Only product B's differential cost exceeds its differential revenue. Therefore, only product B should be sold at the split-off point.

- (3) Yes, because the short-run impact of further processing of B is then:

	B
Differential revenue	\$15
Differential cost: (\$60,000 - \$18,000) ÷ 3,000	14
Benefit to further processing	<u>\$ 1</u>

(In the long-run decision to invest in the capacity (facilities) needed to further process B, the fixed cost should, of course, be considered.)

- (4) No. From part (3), the benefit of further processing is \$1 for each of the 3,000 units of B, or \$3,000. But that must be compared with the benefit of the alternative use of facilities, \$6,000 - \$1,000 = \$5,000 of short-run benefit. So it is better in the short-run to sell B at split-off and devote the facilities (the ones that would have been used to do B's further processing) to their alternative use.

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E8-7 (1) Average unit cost method:

Product	Units Produced	Apportionment of Joint Production Cost	Processing Cost After Split-Off	Total Production Cost
A	3,000	\$ 30,000	\$ 20,000	\$ 50,000
B	4,000	40,000	30,000	70,000
C	3,000	30,000	50,000	80,000
Total		<u>\$100,000</u>	<u>\$100,000</u>	<u>\$200,000</u>

E8-7 (Concluded)

(2) Market value method:

Product	Ultimate Market Value	Processing Cost After Split-Off	Hypo- thetical Market Value	Apportion- ment of Joint Production Cost	Total Production Cost
A	\$ 60,000	\$ 20,000	\$ 40,000	\$ 25,000 *	\$ 45,000
B	110,000	30,000	80,000	50,000	80,000
C	90,000	50,000	40,000	25,000	75,000
Total	<u>\$260,000</u>	<u>\$100,000</u>	<u>\$160,000</u>	<u>\$100,000</u>	<u>\$200,000</u>

$$* \$100,000 \div \$160,000 = .625; \$40,000 \times .625 = \$25,000$$

E8-8

(1) Average unit cost method:

Product	Units Produced	Joint Cost Per Unit	Joint Cost
K	5,000	\$1.40	\$ 7,000
L	20,000	1.40	28,000
M	15,000	1.40	21,000
N	10,000	1.40	14,000
	<u>50,000</u>		<u>\$70,000</u>

$$* \frac{\text{Joint cost}}{\text{Total number of units produced}} = \frac{\$70,000}{50,000} = \$1.40 \text{ per unit}$$

(2) The weighted average method:

Product	Units Produced	x	Points	=	Weighted Units	x	Joint Cost Per Weighted Unit*	Joint Cost
K	5,000		3.0		15,000		\$.50	\$ 7,500
L	20,000		2.0		40,000		.50	20,000
M	15,000		4.0		60,000		.50	30,000
N	10,000		2.5		25,000		.50	12,500
					<u>140,000</u>			<u>\$70,000</u>

$$* \frac{\text{Joint cost}}{\text{Total number of weighted units}} = \frac{\$70,000}{140,000} = \$0.50 \text{ per weighted unit}$$

E8-8 (Concluded)

(3) The market value method:

Product	Ultimate Market Value per Unit	Units Produced	Ultimate Market Value	Processing Cost After Split-Off	Hypo- thetical Market Value	Joint Cost Allocation
K	\$5.50	5,000	\$ 27,500	\$ 1,500	\$ 26,000	\$18,200
L	1.60	20,000	32,000	3,000	29,000	20,300
M	1.50	15,000	22,500	2,500	20,000	14,000
N	3.00	10,000	30,000	5,000	25,000	17,500
			<u>\$112,000</u>	<u>\$12,000</u>	<u>\$100,000</u>	<u>\$70,000</u>

$$* \frac{\text{Joint cost}}{\text{Hypothetical market value}} = \frac{\$70,000}{\$100,000} = .70 = 70\%$$

E8-9 Materials cost:

Product	Unit	x	Points	=	Weighted Units	x	Materials Cost per Weighted Unit	=	Total Materials Cost	+	Product Units	=	Materials Cost per Product Unit
X	10,000		3		30,000		\$2		\$60,000		10,000		\$6
Y	8,000		2		16,000		2		32,000		8,000		4
					<u>46,000</u>				<u>\$92,000</u>				

Conversion cost:

Product	Unit	x	Points	=	Weighted Units	x	Conversion Cost per Weighted Unit	=	Total Conversion Cost	+	Product Units	=	Conversion Cost per Product Unit
X	10,000		5		50,000		\$1.50		\$ 75,000		10,000		\$7.50
Y	8,000		4		32,000		1.50		48,000		8,000		6.00
					<u>82,000</u>				<u>\$123,000</u>				

PROBLEMS

P8-1

(1) Average unit cost method:

Product	Units (kg) Produced	Apportionment of Joint Production Cost	Processing Cost After Split-Off	Total Production Cost
B	10 000	\$265,000*	\$ 580,000	\$ 845,000
C	10 000	265,000	720,000	985,000
Total.....	<u>20 000</u>	<u>\$530,000</u>	<u>\$1,300,000</u>	<u>\$1,830,000</u>

* Joint cost of \$590,000 less \$60,000 by-product credit ($\$15 \times 4\,000\text{ kg}$) = \$530,000; $\$530,000 \div 20\,000\text{ kg} = \26.50 per unit; $\$26.50 \times 10\,000\text{ kg} = \$265,000$.

Product	Total Production Cost per Unit	Units in Finished Goods Inventory	Finished Goods Inventory
B	\$84.50	1 000 kg	\$ 84,500
C	98.50	500	49,250
			<u>\$133,750</u>

(2) Market value method:

Product	Ultimate Market Value	Processing Cost After Split-Off	Hypo- thetical Market Value	Apportion- ment of Joint Production Cost	Total Production Cost
B	\$1,300,000	\$ 580,000	\$ 720,000	\$318,000	\$ 898,000
C	1,200,000	720,000	480,000	212,000	932,000
Total.....	<u>\$2,500,000</u>	<u>\$1,300,000</u>	<u>\$1,200,000</u>	<u>\$530,000*</u>	<u>\$1,830,000</u>

* Joint cost less by-product credit $\$530,000 \div \$1,200,000 = .4417$; $.4417 \times \$720,000 = \$318,024 = \text{approximately } \$318,000$; $.4417 \times \$480,000 = \$212,016 = \text{approximately } \$212,000$.

Product	Total Production Cost per Unit	Units Sold	Cost of Goods Sold
B	\$89.80	9 000 kg	\$ 808,200
C	93.20	9 500	885,400
			<u>\$1,693,600</u>

P8-1 (Concluded)

- (3) **Neither the market value method nor average unit cost method of allocating joint cost is a more accurate way of determining joint product costs. Joint cost, because of its nature, cannot be accurately split up among joint products, since joint cost is incurred to produce one or all of the joint products. That is, joint cost cannot be reduced by dropping one of the products. Thus, to make decisions about joint production, one must look at the revenue and separable cost of each product to determine whether it is profitable on the margin. In such decisions, joint cost is not relevant. The only purpose for allocating joint costs is to determine a cost for inventories on the balance sheet and for cost of goods sold on the income statement.**

For financial statement purposes, in most situations, better arguments can be made for a value-based allocation basis rather than a physically-based one. At times, the physical base can result in absurd allocations of costs among products because of the disproportionate relationship between the relative value of the joint product and the units produced, relative to other joint products.

P8-2

(1)

Product	Ultimate Market Value per Unit	Units Produced	Ultimate Market Value	Separable Processing Cost	Hypo- thetical Market Value	Apportion- ment of Joint Production Cost ¹	Total Cost	May Sales	May Cost of Goods Sold	May Gross Profit
C	\$20.00	15,000	\$300,000	\$ 75,000	\$225,000	\$ 90,000	\$165,000	\$260,000 ²	\$143,000 ³	\$117,000
L	15.00	10,000	150,000	25,000	125,000	50,000	75,000	135,000	67,500	67,500
T	9.50	20,000	190,000	40,000	150,000	60,000	100,000	152,000	80,000	72,000
Total			<u>\$640,000</u>	<u>\$140,000</u>	<u>\$500,000</u>	<u>\$200,000</u>	<u>\$340,000</u>	<u>\$547,000</u>	<u>\$290,500</u>	<u>\$256,500</u>

¹\$200,000 + \$500,000 = 40%²\$13,000 x \$20 = \$260,000³\$165,000 + 15,000 = \$11; \$11 x 13,000 = \$143,000

(2)

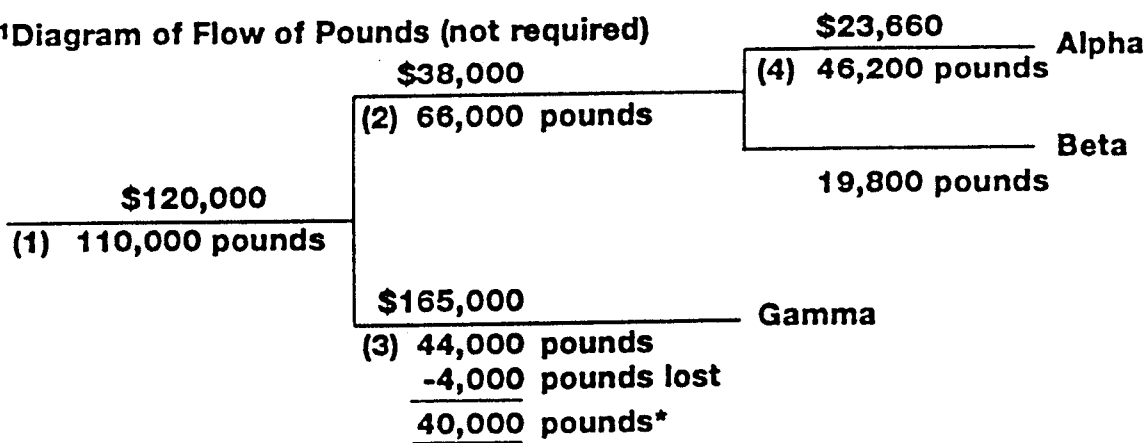
Revenue forgone (20,000 x (\$9.50 - \$7))	\$50,000
Cost saving (separable cost)	40,000
Loss if offer is accepted	<u>\$10,000</u>

The offer should not be accepted.

P8-3

(1) Product	Ultimate Market Value per Unit	Units Produced ¹	Market Value	Processing Cost After Split-Off	Hypo- thetical Market Value	Joint Cost Allocation ³
Alpha	\$ 5	46,200	\$231,000 15,660 ²	\$ 38,000 23,660	\$185,000	\$ 44,400
Gamma ...	12	40,000	480,000	165,000	315,000	75,600
Total.....			<u>\$726,660</u>	<u>\$228,660</u>	<u>\$500,000</u>	<u>\$120,000</u>

¹Diagram of Flow of Pounds (not required)



*Computation of pounds of good output of Gamma:

Let X = good output

$$44,000 - .1X = X$$

$$40,000 = X$$

² Market value of Beta (19,800 pounds x \$1.20)	\$23,760
Less marketing expense of Beta	8,100
Net realizable value of Beta.....	<u>\$15,660</u>

³The joint cost is 24% of the hypothetical market value.

P8-3 (Concluded)

(2)

BROOKS CORPORATION
Statement of Gross Profit for Alpha

Sales (38,400 pounds x \$5)		\$192,000
Production costs:		
Allocated joint cost	\$102,000	
Department 2	38,000	
Department 4	23,660	
Gross cost of production	\$163,660	
Less net realizable value of Beta	15,900 *	
Net cost of production	\$147,760	
Less ending inventory	29,552 **	
Cost of goods sold		118,208
Gross profit		<u>\$ 73,792</u>

* Net realizable value of Beta equals the revenue from Beta (\$24,000) less its related marketing expense (\$8,100).

** Ending inventory equals the net cost of production (\$147,760) times 20%.

P8-4

(1)	Jana	Reta	Total
Sales	\$200,000	\$300,000	\$500,000
Cost of goods sold:			
Joint cost (\$236,000 - Bynd net revenue (\$11,000 - \$5,000 separable cost))			\$230,000
Separable cost (\$215,000 - \$5,000 for Bynd)	210,000	210,000	
Total cost			\$440,000
Gross profit (12% of sales)			<u>\$ 60,000</u>

(2)	Total	Jana	Reta
Ultimate sales value	\$500,000	\$200,000	\$300,000
Less 12% gross profit	60,000	24,000	36,000
Total cost	\$440,000	\$176,000	\$264,000
Separable cost	210,000		210,000
Joint cost allocation	<u>\$230,000</u>	<u>\$176,000</u>	<u>\$ 54,000</u>

(3) Gross profit for Jana and Reta—see line 2 of requirement (2).

P8-5

(1)	Ultimate Market Value per Unit	Units Produced	Ultimate Market Value	Processing Cost After Split-Off	Hypo- thetical Market Value	Apportion- ment of Joint Production Cost*
Product						
SPL-3	\$4.00	700,000	\$2,800,000	\$ 874,000	\$1,926,000	\$ 960,000 **
PST-4	6.00	350,000	2,100,000	816,000	1,284,000	640,000
			<u>\$4,900,000</u>	<u>\$1,690,000</u>	<u>\$3,210,000</u>	<u>\$1,600,000</u>

* Joint production cost.....	\$1,702,000
Less cost assigned to by-product RJ-5 (170,000 gallons x (\$.70-\$.10))	102,000
	<u>\$1,600,000</u>

**(\$1,926,000 + \$3,210,000) x \$1,600,000 = \$960,000

(2)	SPL-3	PST-4	RJ-5
Joint cost allocation.....	\$ 960,000	\$ 640,000	\$102,000
Additional processing cost.....	874,000	816,000	
Total cost	<u>\$1,834,000</u>	<u>\$1,456,000</u>	<u>\$102,000</u>
Divided by gallons produced.....	700,000	350,000	170,000
Cost per gallon.....	<u>\$2.62</u>	<u>\$4.16</u>	<u>\$.60</u>

Inventory costing:

November 1 inventory (gallons)	18,000	52,000	3,000
November production	700,000	350,000	170,000
	<u>718,000</u>	<u>402,000</u>	<u>173,000</u>
November sales	650,000	325,000	150,000
November 30 inventory.....	68,000	77,000	23,000
Cost per gallon	<u>\$2.62</u>	<u>\$4.16</u>	<u>\$.60</u>
Cost assigned to November 30 finished goods inventory	<u>\$ 178,160</u>	<u>\$ 320,320</u>	<u>\$ 13,800</u>

(3) Per gallon sales value beyond the split-off point.....	\$6.00
Per gallon sales value at the split-off point	3.80
Differential sales value	<u>\$2.20</u>
Additional processing cost per gallon (\$816,000 ÷ 350,000 gallons).....	2.33
Per gallon gain (loss) of further processing	<u>\$ (.13)</u>

Alderon Industries should sell PST-4 at the split-off point, as the differential revenue of the sales beyond the split-off point is less than the additional cost of further processing.

Note to the Instructors: The solution format for P8-6 is slightly altered from that used for process cost problem in Chapters 6 and 7. This is done to accommodate the problem's size.

P8-6 (1)

RODOMONTADE COMPANY
Cost of Production Report—Average Method
For February,

	Process 1		Process 2		Process 3	
	Total Cost	Unit Cost	Total Cost	Unit Cost	Total Cost	Unit Cost
Cost Charged to the Department						
Cost from preceding department:						
Work in process—beginning inventory....			\$ 6,000	\$2.0000	\$ 11,500	\$3.8333
Transferred in during this period			21,000	2.1000	63,000	3.1500
Total			<u>\$27,000</u>	<u>\$2.0769</u>	<u>\$ 74,500</u>	<u>\$3.2391</u>
Adjusted cost from preceding department (\$74,500 ÷ (23,000 units – 1,000 lost units))						<u>\$3.3864</u>
Cost added by department:						
Work in process—beginning inventory:						
Labor and factory overhead			\$ 2,000		\$ 3,000	
Cost added during period:						
Materials	\$58,000	\$1.8125				
Labor and factory overhead	30,000	.9375	18,000	\$2.0000	60,000	\$3.0000
Total cost added	<u>\$88,000</u>	<u>\$2.7500</u>	<u>\$20,000</u>	<u>\$2.0000</u>	<u>\$ 63,000</u>	<u>\$3.0000</u>
Less value assigned to the by-product.....	<u>4,000</u>					
Total cost to be accounted for	<u>\$84,000</u>	<u>\$2.8000</u>	<u>\$47,000</u>	<u>\$4.0769</u>	<u>\$137,500</u>	<u>\$6.3864</u>
Cost Accounted for as Follows						
Transferred to next department or to finished goods storeroom						
Work in process—ending inventory:						
Cost from preceding department.....			\$8,308		—	
Adjusted cost from preceding department			—		\$6,773	
Labor and factory overhead			<u>2,000</u>	<u>10,308</u>	<u>3,000</u>	<u>9,773</u>
Total cost accounted for			<u>\$84,000</u>	<u>\$47,000</u>	<u>\$137,500</u>	

P8-6 (Continued)

Additional Computations:

Equivalent production:

	Labor and Factory Overhead	
	Process 2	Process 3
Transferred out.....	9,000 units	20,000 units
Ending inventory (work this period).....	1,000	1,000
	<u>10,000 units</u>	<u>21,000 units</u>

Unit costs:

Materials, Process 1.....	\$58,000	= \$1.8125 per unit
	32,000	
Labor and factory overhead, Process 1.....	<u>\$30,000</u>	= \$.9375 per unit
	32,000	
Total cost to be accounted for, Process 1	<u>\$84,000</u>	= \$2.8000 per unit
	30,000	
Labor and factory overhead, Process 2.....	<u>\$2,000 + \$18,000</u>	= \$2.0000 per unit
	10,000	
Labor and factory overhead, Process 3.....	<u>\$3,000 + \$60,000</u>	= \$3.0000 per unit
	21,000	
Cost from preceding department, Process 2	<u>\$27,000</u>	= \$2.0769 per unit
	13,000	
Cost from preceding department, Process 3	<u>\$74,500</u>	= \$3.2391 per unit
	23,000	

Joint cost apportionment:

	Process 2 Product	Process 3 Product
Sales price	\$10	\$15
Less processing cost subsequent to split-off point	<u>2</u>	<u>3</u>
	<u>\$ 8</u>	<u>\$12</u>

Hypothetical market value at split-off point:

\$8 x 10,000 units transferred	<u>\$80,000</u>	
\$12 x 20,000 units transferred		<u>\$240,000</u>

Joint cost allocation:

\$80,000 x .2625*	<u>\$21,000</u>	
\$240,000 x .2625		<u>\$63,000</u>

* $\$84,000 \div (\$80,000 + \$240,000) = .2625$

P8-6 (Continued)**Unit cost:**

$\$21,000 \div 10,000$ units	<u><u>\$2.10</u></u>	
$\$63,000 \div 20,000$ units		<u><u>\$3.15</u></u>

Transferred to finished goods storeroom:

Process 2.....	$\$4.0769 \times 9,000$ units = \$ 36,692
Process 3.....	$\$6.3864 \times 20,000$ units = \$127,727*

* $\$6.3864 \times 20,000$ units = \$127,728. To avoid a decimal discrepancy, the cost transferred to finished goods storeroom is computed as follows: \$137,500 - \$9,773 cost assigned to ending inventory = \$127,727.

Work in process—ending inventory:**Process 2:**

Cost from preceding department	$\$2.0769 \times 4,000$ units = \$8,308
Labor and factory overhead	$\$2.0000 \times 1,000$ units = \$2,000

Process 3:

Adjusted cost from preceding department.....	$\$3.3864 \times 2,000$ units = \$6,773
Labor and factory overhead	$\$3.0000 \times 1,000$ units = \$3,000

(2)	Finished goods	4,000	
	Work in Process—Process 2	21,000	
	Work in Process—Process 3	63,000	
	Work in Process—Process 1		88,000
	Finished Goods	36,692	
	Work in Process—Process 2		36,692
	Finished Goods	127,727	
	Work in Process—Process 3		127,727

RODOMONTADE COMPANY
Cost of Production Report—Fifo Method
For February

	Process 1		Process 2		Process 3	
	Total Cost	Unit Cost	Total Cost	Unit Cost	Total Cost	Unit Cost
Cost Charged to the Department						
Work in process—beginning inventory					\$ 14,500	
Cost from preceding department:						
Transferred in during the month			\$ 8,000	\$ 2.10	\$ 63,000	\$3.15
Adjusted cost from preceding department (\$63,000 ÷ (20,000 units - 1,000 lost units))...			\$21,000			\$3.32
Cost added by department:						
Materials	\$58,000	\$1.8125				
Labor and factory overhead	30,000	.9375				
Total cost added	\$88,000	\$2.7500	\$18,000	\$2.00	\$ 60,000	\$3.00
Less value assigned to the by-product	4,000		\$2.00		\$ 60,000	\$3.00
Total cost to be accounted for	\$84,000	\$2.8000	\$47,000	\$4.10	\$137,500	\$6.32
Cost Accounted for as Follows						
Transferred to next department or to finished goods storeroom—						
From beginning inventory:						
Inventory cost	\$8,000		\$14,500			
Labor and factory overhead added	4,000 ¹		\$12,000		6,000 ⁵	\$ 20,500
From current production:						
Units started and finished	\$84,000		24,600 ²		107,360 ⁶	
			\$36,600		\$127,860	
Work in process—ending inventory:						
Adjusted cost from preceding department	\$8,400 ³		\$ 6,640 ⁷			
Labor and factory overhead	2,000 ⁴		10,400		3,000 ⁸	9,640
Total cost accounted for	\$84,000		\$47,000		\$137,500	
12,000 x \$2.00 = \$4,000 52,000 x \$3.00 = \$156,000						
26,000 x \$4.10 = \$107,400 617,000 units x \$3.32 = \$205,840						
34,000 x \$2.10 = \$71,400 the cost transferred from current production is computed as fol-						
41,000 x \$2.00 = \$82,000 lows: \$137,500 - (\$20,500 + \$9,640) = \$107,360.						

P8-6 (Continued)

Additional Computations:

Equivalent production:

	Labor and Factory Overhead	
	Process 2	Process 3
Transferred out.....	9,000 units	20,000 units
Less beginning inventory (all units)	3,000	3,000
Started and finished this period	6,000 units	17,000 units
Add beginning inventory (work this period)	2,000	2,000
Add ending inventory (work this period)	1,000	1,000
	<u>9,000 units</u>	<u>20,000 units</u>

Unit costs:

Materials, Process 1.....	<u>\$58,000</u>	= \$1.8125 per unit
	32,000	
Labor and factory overhead, Process 1.....	<u>\$30,000</u>	= \$.9375 per unit
	32,000	
Total cost to be accounted for, Process 1	<u>\$84,000</u>	= \$2.8000 per unit
	30,000	
Labor and factory overhead, Process 2.....	<u>\$18,000</u>	= \$2.0000 per unit
	9,000	
Labor and factory overhead, Process 3.....	<u>\$60,000</u>	= \$3.0000 per unit
	20,000	

Joint cost apportionment:

	Process 2 Product	Process 3 Product
Sales price	\$10	\$15
Less processing cost subsequent to split-off point	<u>2</u>	<u>3</u>
	<u>\$ 8</u>	<u>\$12</u>

Hypothetical market value at split-off point:

\$8 x 10,000 units transferred	<u>\$80,000</u>	
\$12 x 20,000 units transferred		<u>\$240,000</u>

Joint cost allocation:

\$80,000 x .2625*	<u>\$21,000</u>	
\$240,000 x .2625		<u>\$63,000</u>

* $\$84,000 \div (\$80,000 + \$240,000) = .2625$

P8-6 (Concluded)

Unit cost:		
$\$21,000 \div 10,000$ units	<u><u>\$2.10</u></u>	
$\$63,000 \div 20,000$ units		<u><u>\$3.15</u></u>
 (4)		
Finished goods	4,000	
Work in Process—Process 2	21,000	
Work in Process—Process 3	63,000	
Work in Process—Process 1		88,000
Finished Goods	36,600	
Work in Process—Process 2		36,600
Finished Goods	127,860	
Work in Process—Process 3		127,860

CASES**C8-1**

- (1) The market value method of joint cost allocation assigns cost in proportion to each product's market value to all products as follows:

$$\frac{\text{Market Value of Each Product at Split-off}}{\text{Total Market Value of All Products at Split-off}} \times \text{Joint Production Cost}$$

If there is no market value at split-off, then the value at the first sales point, less separable cost, is used. If joint products have a market value at the split-off point, the margin for all joint products at the split-off will be the same.

The joint cost is allocated in proportion to revenue generating ability (as contrasted to some quantitative measures not related to revenue). Therefore, this accomplishes Jim Simpson's objective "that inventoriable cost should be based on each product's ability to contribute to the recovery of joint production cost."

C8-1 (Continued)

- (2) (a) Because both main products have a market value at the split-off point, this value, rather than the final sales value, is used to allocate the joint cost.

Joint production cost to be allocated	\$2,640,000
Net revenue value of by-product (240,000 x (.55 - .05))	120,000
Joint cost to be allocated to main products	<u>\$2,520,000</u>

Product	Units Produced	Market Value at Split-off		Percentage of Total Market Value
		Per Unit	Total	
Pepco-1	900,000 gallons	\$2.00	\$1,800,000	62.5%
Repke-3	720,000 gallons	1.50	1,080,000	37.5
			<u>\$2,880,000</u>	<u>100.0%</u>

Allocation of Joint Cost
November

Pepco-1 (\$2,520,000 x .625)	\$1,575,000
Repke-3 (\$2,520,000 x .375)	945,000
SE-5	120,000
November joint production cost	<u>\$2,640,000</u>

(b)	Pepco-1	Repke-3	SE-5
Allocation of joint production cost	\$1,575,000	\$ 945,000	\$120,000
Additional processing cost after split-off	1,800,000	720,000	—
Total manufacturing cost	<u>\$3,375,000</u>	<u>\$1,665,000</u>	<u>\$120,000</u>
Divide by gallons produced	900,000	720,000	240,000
Manufacturing cost per gallon.	<u>\$ 3.75</u>	<u>\$ 2.3125</u>	<u>\$.50</u>
Inventory costing:			
Inventory, November 1	20,000	40,000	10,000
November production	900,000	720,000	240,000
Inventory available	920,000	760,000	250,000
November sales	800,000	700,000	200,000
Inventory, November 30	120,000	60,000	50,000
Manufacturing cost per gallon.	x \$3.75	x \$2.3125	x \$.50
Cost of finished goods inventory	<u>\$450,000</u>	<u>\$138,750</u>	<u>\$25,000</u>

C8-1 (Concluded)

- (3) When SE-5 becomes a main product, the joint production cost would be allocated proportionally to all three products on the basis of the market value of each product at the split-off point. The net revenue of SE-5 will no longer be deducted from the joint production cost prior to allocation because SE-5 will no longer be a by-product.

C8-2

There are a number of areas that appear to be problematic in Hayes Products' costing and decision-making processes. These areas, which are outlined below, need to be reviewed and perhaps modified.

- (1) The use of the average unit cost method for allocating joint product cost. Units produced, although a simple method of allocation, is not necessarily the best method for apportioning cost across joint products. This method can distort the cost-value relationship of a joint product and give an especially misleading picture of the gross margin provided by a joint product. For example, assume that in meat processing of cattle, one produced ground beef and steaks. Each pound of ground beef would be assigned the same joint cost as each pound of steak, yet the sales prices per pound are quite different. For this reason, it is better to use some value-related allocation base, such as the market or sales value method, to allocate cost.
- (2) Inclusion of all spoilage costs in product cost. Spoilage in production processes can be assessed as normal or abnormal. Whether spoilage is normal (expected) or abnormal (unexpected) should guide the way in which spoilage costs are handled in product costing. Normal spoilage is part of product cost since it is planned for in implementing the production technology. Abnormal spoilage should be written off as a loss in the period, and if the amount is material or the spoilage continues over some period, the source of spoilage should be found and corrected. Hayes Products does not seem to be distinguishing clearly between normal and abnormal spoilage. This needs to be studied, and some changes need to be made in the application of spoilage costs to product.
- (3) Decision making based on fully allocated cost. Hayes appears to be about to make a product line decision on fully allocated cost data with joint cost included. Decisions with relation to any of the products should be based on the separable contribution margin of products, i.e., separable revenue less separable variable cost. This problem needs to be looked at closely since the allocated joint cost figures should be used only for financial statement purposes.

C8-3

- (1) The market value method does not provide additional data for the marketing decision. Joint cost allocation is necessarily arbitrary and, although used for financial accounting purposes, is not relevant to the decision to market DMZ-3 and Pestrol. The VDB joint cost is irrelevant to this decision because it is incurred in both cases, i.e., the method of cost allocation has no impact on the differential profit. Talor Chemical Company should calculate the differential profit of its alternate choices by comparing the differential revenues and differential costs.
- (2) Talor's analysis is incorrect because it incorporates allocated portions of the joint cost of VDB. The weekly cost of VDB (\$246,000) will be incurred whether or not RNA-2 is converted through further processing. Thus, any allocation of the joint cost of VDB is strictly arbitrary and not relevant to the decision to market DMZ-3 and Pestrol. Talor's decision not to process RNA-2 further is incorrect. The decision results in a loss of \$20,000 in profit per week, as indicated by the following analysis:

Revenue from further processing of RNA-2:

DMZ-3 (400,000 x (\$57.50 + 100)).....	\$230,000
Pestrol (400,000 x (\$57.50 + 100))	230,000
Total revenue from further processing.....	\$460,000
Less revenue from sale of RNA-2	320,000
Differential revenue	\$140,000
Differential cost*	120,000
Differential profit	<u>\$ 20,000</u>

* The cost of VDB is not relevant and, thus, is omitted from the solution.

C8-4

- (1) (The requirement does not ask for a list of responsibilities Vickery has violated, but, merely, which of the fifteen responsibilities apply to Vickery's situation.)

Management accountants have a responsibility to:

Competence: Perform their professional duties in accordance with relevant laws, regulations, and technical standards. (The inventory cost Vickery is being asked to accept violates accounting principles of conservatism and of matching current cost against current revenue.)

C8-4 (Concluded)

Prepare complete and clear reports and recommendations after appropriate analyses of relevant and reliable information. (Vickery has convincing evidence that failure to make the adjustment will misstate the resulting financial statements.)

Integrity: Refrain from either actively or passively subverting the attainment of the organization's legitimate and ethical objectives. (There is pressure to subvert legitimate and ethical objectives to the immediate need for favorable financial statements.)

Communicate unfavorable, as well as favorable, information and professional judgments or opinions. (Vickery is being asked to thwart communication of unfavorable information.)

Refrain from engaging in or supporting any activity that would discredit the profession. (Preparing deliberately misleading financial statements, clearly is a discredit to the profession.)

Objectivity: Communicate information fairly and objectively. (Vickery would violate this responsibility if the inventory were not restated.)

Disclose fully all relevant information that could reasonably be expected to influence an intended user's understanding of the reports, comments, and recommendations presented. (This material overstatement of inventory and profit violates this ethical responsibility.)

- (2) In addition to his ethical responsibilities to his company, Vickery has ethical responsibilities to:
- (a) the bank
 - (b) the company's stockholders
 - (c) the management accounting profession

CHAPTER 9

DISCUSSION QUESTIONS

- Q9-1. The most frequently used documents in the procurement and use of materials are purchase requisitions, purchase orders, receiving reports, materials requisitions, bills of materials, and materials ledger records.
- Q9-2. The invoice should be routed to the Accounting Department immediately upon receipt. A copy of the purchase order and a copy of the receiving report with an inspection report should be compared by the accounting clerk. When the invoice is found to be correct in all aspects or has been adjusted for errors or rejects, the accounting clerk approves the invoice, attaches it to the underlying documents if they are in hard-copy form, and sends these documents to another clerk for the preparation of the voucher.
- Q9-3. Inventoriable cost should include all costs incurred to get the product ready for sale to the customer. It includes not only the net purchase price but also the other associated costs, such as freight-in, incurred up to the time products are ready for sale to the customer.
- Q9-4. No, administration costs are assumed to expire with the passage of time and do not attach to the product. Furthermore, administrative costs do not relate directly to inventories, but are incurred for the benefit of all functions of the business.
- Q9-5. The three key questions to answer in designing an inventory control system are:
(a) how much to order—economic order quantity
(b) when to order—order point
(c) safety stock required
- Q9-6. The firm benefits from these techniques by having a consistent, standardized approach to its inventory management. Inventory costs and service to customers will be optimally balanced.
- Q9-7. The purpose of an economic order quantity model is to determine the optimum quantity to order or produce when filling inventory needs. The optimum quantity is defined as that quantity that minimizes the cost of inventory management.
- Q9-8. The decision concerning how much to order or produce at a given time involves a compromise between inventory carrying costs and ordering or setup costs. Examples of inventory carrying costs are: interest on the money invested in inventories that could have been invested elsewhere, property tax and insurance, warehousing or storage, handling, deterioration, and obsolescence. Ordering costs include the cost of preparing the requisition and purchase order, receiving the order, and accounting for the order. Setup costs involve the costs of setting up equipment to make the actual production runs. For all these costs, only those that vary with activity are relevant to the EOQ model.
- Q9-9. The consequences of maintaining inadequate inventory levels include higher purchasing, handling, and transportation costs, loss of quantity discounts, production disruptions, inflation-related price increases when purchases are deferred, and lost sales and customer goodwill.
Measurement of the costs of lost orders and lost repeat business is not easy because measurement may be largely subjective. On the other hand, the other factors listed can be measured with fair certainty and greater ease.
- Q9-10. In computing optimum production run size, CO represents an estimate of the setup cost and CU is the variable manufacturing cost per unit.
- Q9-11. (a) The order point is the low point of stock level that, when reached, means a replenishing order should be placed.
(b) Lead time is the interval between placing an order and delivery of the ordered goods.
(c) Safety stock is the minimum inventory that provides a cushion against reasonably expected maximum demands and against variations in lead time.
- Q9-12. Materials requirements planning (MRP) is a computer simulation that integrates each product's bill of materials, inventory status, and manufacturing process into a feasible production plan.
- Q9-13. Effective utilization of capital, which includes investment in inventory, is the responsibility of general management; therefore, the primary interest is in financial control. Although general or top-level management is interested in providing customers with good products and services, the scheduling of production involves unit control primarily and is the responsibility of production and purchasing departments.
- Q9-14. In the control of materials, the opposing needs are the maintenance of an inventory of sufficient size and diversity for efficient operations, and the maintenance of an investment in inventory at a level that will maximize earnings and minimize costs.
- Q9-15. When a relatively few materials items account for a considerable portion of total inventory investment, selective control is indicated. High-value items would be under tight control, while low-value items would be under simple physical controls.
Automatic control refers to ordering when a materials record shows that the balance on hand has dropped to the order point. At this time, the quantity to order is automatic, having been determined by balancing the cost to order with

the cost to carry inventory. Automatic control is most effective in companies that use an EDP system.

Q9-16. Appendix The average cost method assumes that each batch taken from the store-room is composed of uniform quantities from each shipment in stock at the date of issue. The fifo method is based on the assumption that the first goods received are the first issued. The lifo method is based on the assumption that the latest goods received are the first issued.

Q9-17. Appendix In an inflationary economy, lifo provides a better matching of current costs with current revenue because costs of inventory issued are at more

recent purchase prices. Net cash inflow is generally increased because taxable income is generally decreased, resulting in payment of lower income tax.

Q9-18. Appendix Fifo. The higher costs of the earlier purchases would be charged against cost of goods sold.

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Q9-19. Appendix (a) fifo
(b) fifo
(c) fifo
(d) lifo
(e) fifo
(f) lifo

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EXERCISES

E9-1

- (1) Freight allocated to materials based on cost:

$$\frac{\$280}{\$17,500} = \$0.016 \text{ per dollar of cost}$$

Part A:	\$ 8,600	x	\$0.016	=	\$137.60
Part B:	5,060	x	.016	=	80.96
Part C:	3,840	x	.016	=	61.44
	<u>\$17,500</u>				<u>\$280.00</u>

- (2) Freight allocated to materials based on shipping weight:

$$\frac{\$280}{1\,400 \text{ kilograms}} = \$0.20$$

Part A:	630kg	x	\$0.20	=	\$126
Part B:	490	x	.20	=	98
Part C:	280	x	.20	=	56
	<u>1 400kg</u>				<u>\$280</u>

E9-2

	<u>Units</u>
September production.....	4,200
October production	4,400
November production	4,700
Desired inventory, November 30	<u>3,600</u>
Total to be provided.....	16,900
Quantity on hand, September 1.....	4,400
On order for September delivery	3,600
On order for October delivery.....	<u>4,100</u>
Quantity to order for November delivery	<u>12,100</u>
	<u>4,800</u>

E9-3

(1)	Forecast usage:		
	January.....	4,800 units	
	February	5,000	
	March	<u>5,600</u>	
		15,400 units	
	Desired March 31 inventory level		
	(6,000 x 80%).....	<u>4,800</u>	
	Total to be provided.....		20,200 units
	Scheduled supply:		
	January 1 inventory	6,000 units	
	On order:		
	January delivery	4,100	
	February delivery.....	<u>4,600</u>	<u>14,700</u>
	Quantity to order for March delivery		<u>5,500</u> units
(2)	January 1 inventory	6,000 units	
	On order for January and February delivery	<u>8,700</u>	
		14,700 units	
	Forecast usage—January and February.....	<u>9,800</u>	
(a)	March 1 inventory	4,900 units	
	To order for March delivery (requirement (1)).....	<u>5,500</u>	
		10,400 units	
	Forecast usage—March	<u>5,600</u>	
(b)	March 31 inventory	<u>4,800</u> units	

E9-4

$$(1) \quad \text{EOQ} = \sqrt{\frac{2 \times 100 \times \$5}{\$55 \times 15\%}} = \sqrt{\frac{1,000}{8.25}} = \sqrt{121} = 11 \text{ units}$$

$$(2) \quad \text{EOQ} = \sqrt{\frac{2 \times 2,250 \times \$12}{\$3 \times 20\%}} = \sqrt{\frac{54,000}{.60}} = \sqrt{90,000} = 300 \text{ Ajets}$$

$$(3) \quad \text{EOQ} = \sqrt{\frac{2 \times (1,200 \times 3) \times \$200}{\$25}} = \sqrt{\frac{1,440,000}{25}} \\ = \sqrt{57,600} = 240 \text{ units}$$

E9-4 (Continued)

$$(4) \quad (a) \quad EOQ = \sqrt{\frac{2 \times 25,000 \times \$20}{\$8 \times 25\%}} = \sqrt{\frac{1,000,000}{2}} = \sqrt{500,000}$$

$$= 707 \text{ cartons}$$

$$(b) \quad \frac{\text{Annual required units}}{\text{Economic order quantity}} = \frac{25,000}{707} = 35 \text{ orders per year}$$

$$\frac{365 \text{ days}}{35 \text{ orders}} = 10.4 \text{ or every 10 days orders should be placed}$$

$$(5) \quad (a) \quad EOQ = \sqrt{\frac{2 \times 18,000 \times \$15}{\$15 \times 20\%}} = \sqrt{\frac{540,000}{3}}$$

$$= \sqrt{180,000} = 424$$

$$(b) \quad \frac{18,000}{424} = 42.45 \text{ or approximately 42 orders per year}$$

$$\frac{365 \text{ days}}{42 \text{ orders}} = 8.7 \text{ or approximately one order every 9 days}$$

$$(c) \quad EOQ = \sqrt{\frac{2 \times 18,000 \times \$15}{\$6 \times 20\%}} = \sqrt{\frac{540,000}{1.20}}$$

$$= \sqrt{450,000} = 671$$

$$(6) \quad (a) \quad EOQ = \sqrt{\frac{2 \times 18,000 \times \$15}{\$7.50 \times 20\%}} = \sqrt{\frac{540,000}{1.5}} = \sqrt{360,000}$$

$$= 600 \text{ units}$$

$$(b) \quad \frac{18,000}{600} = 30 \text{ orders per year}$$

$$\frac{365 \text{ days in year}}{30 \text{ orders per year}} = 12.167 \text{ or approximately one order every 12 days}$$

$$(c) \quad EOQ = \sqrt{\frac{2 \times 18,000 \times \$15}{\$2.50 \times 20\%}} = \sqrt{\frac{540,000}{.50}} = \sqrt{1,080,000}$$

$$= 1,039 \text{ units}$$

E9-4 (Continued)

$$(7) \quad (a) \quad EOQ = \sqrt{\frac{2 \times 48,000 \times \$10}{\$20 \times 12\% *}} = \sqrt{\frac{960,000}{2.40}} = \sqrt{400,000}$$

$$= 632 \text{ dozen baseballs}$$

$$\frac{*.40}{\$20} + 10\% \text{ return on investment} = 12\%$$

$$(b) \quad \text{Annual ordering cost} = \frac{RU \times CO}{EOQ} = \frac{48,000 \times \$10}{800} = \$600$$

$$\text{Annual carrying cost} = \frac{CU \times CC \times EOQ}{2}$$

$$= \frac{\$20 \times 12\% \times 800}{2} = \underline{960}$$

Total annual inventory cost to sell 48,000 dozen
baseballs..... \$1,560

$$(8) \quad EOQ = \sqrt{\frac{2 \times 5,000 \times \$1,000}{\$8 \times 20\%}} = \sqrt{\frac{10,000,000}{1.6}} =$$

$$\sqrt{6,250,000} = 2,500 \text{ columns}$$

$$(9) \quad (a) \quad EOQ = \sqrt{\frac{2 \times 12,000 \times \$16}{\$9 \times 20\%}} = \sqrt{\frac{384,000}{1.80}} = \sqrt{213,333}$$

$$= 462 \text{ units}$$

(b) The frequency of order placement:

$$\frac{12,000 \text{ annual usage}}{462 \text{ EOQ}} = 26 \text{ orders per year}$$

$$\frac{365 \text{ days}}{26 \text{ orders}} = 14 \text{ days}$$

$$(c) \quad EOQ = \sqrt{\frac{2 \times 8,000 \times \$16}{\$9 \times 22\%}} = \sqrt{\frac{256,000}{1.98}} = \sqrt{129,293}$$

$$= 360 \text{ units}$$

E9-4 (Concluded)

$$(10) \quad (a) \quad EOQ = \sqrt{\frac{2 \times 500 \times \$6}{\$10 \times .25}} = \sqrt{\frac{6,000}{2.50}} = \sqrt{2,400} = 49 \text{ units}$$

$$\frac{500 \times \$6}{49} + \frac{\$10 \times .25 \times 49}{2} = \frac{\$61.22}{49} + \frac{\$61.25}{2} = \text{total ordering and carrying cost per year}$$

$$(b) \quad 49 + (49 \times .10) = 54 \text{ units per order}$$

$$\frac{500 \times \$6}{54} + \frac{\$10 \times .25 \times 54}{2} = \$55.56 + \$67.50 = \$123.06$$

The effect is small because the total cost curve is relatively flat around the optimum level.

- (11) To compare the two alternatives, the carrying cost and the production initiation cost must be calculated for each alternative. These two amounts are calculated as follows:

Carrying cost = Annual cost of carrying (20%) x manufacturing cost (\$50) x average annual inventory.

Production initiation cost = Number of runs x cost to initiate a run (\$300)

Current situation: 2 production runs of 3,000 units per run

Average inventory: 3,000 units ÷ 2 = 1,500 units

Present costs:

Carrying cost (.20 x \$50 x 1,500)	\$15,000
Production initiation cost (2 x \$300)	600
	<u>\$15,600</u>

Proposed situation:

The EOQ formula can be used to determine production run quantities by substituting cost per order with production initiation cost.

$$\begin{aligned} \text{Production quantity: } & \sqrt{\frac{2 \times 6,000 \times \$300}{\$50 \times .2}} \\ & = \sqrt{\frac{3,600,000}{10}} = \sqrt{360,000} = 600 \text{ units} \end{aligned}$$

Average inventory: 600 ÷ 2 = 300 units

Number of runs: 6,000 ÷ 600 = 10 runs

Proposed costs:	Carrying cost (.20 x \$50 x 300)	\$3,000
	Production initiation cost (10 x \$300)	3,000
		<u>\$6,000</u>
	Expected annual savings	<u>\$9,600</u>

E9-5

$$(1) \quad EOQ = \sqrt{\frac{2 \times (12 \times 1,500) \times \$50}{\$3 \times .40}} = \sqrt{\frac{1,800,000}{1.20}} = \sqrt{1,500,000} = 1,225 \text{ units}$$

- (2) Lots of 2,000 units should be ordered, based on the following computations:

QUANTITATIVE DATA

Order size	1,225 units	2,000 units
Number of orders per year.....	14.7	9
Average inventory	612.5 units	1,000 units

COST DATA

Cost of placing orders at \$50	\$ 735	\$ 450
Cost of carrying inventory:		
612.5 x \$3.00 x .40	735	
1,000 x \$2.85 x .40		1,140
Discounts lost (12 x 1,500 x \$3 x .05)	2,700	
Cost to order and carry	<u>\$4,170</u>	<u>\$1,590</u>

E9-6

- (1) Ordering and carrying costs under current policy:

$$\left(\frac{12}{2} \times \$380 \right) + \left(\$1 \times \frac{500}{2} \right) = \$2,280 + \$250 = \$2,530$$

- (2) Economic order quantity and the related ordering and carrying costs:

$$\sqrt{\frac{2 \times 3,000 \times \$380}{\$1}} = \sqrt{2,280,000} = 1,510 \text{ units}$$

$$\left(\frac{3,000}{1,510} \times \$380 \right) + \left(\$1 \times \frac{1,510}{2} \right) = \$755 + \$755 = \$1,510 \text{ related ordering and carrying costs}$$

E9-6 (Concluded)

- (3) George should decide to order in quantities of 3,000 units, based on the following computations:

QUANTITATIVE DATA

Order size	1,510 units	3,000 units
Number of orders per year.....	1.9868	1
Average inventory	755 units	1,500 units

COST DATA

Cost of placing orders at \$380	\$ 755	\$ 380
Cost of carrying inventory:		
\$1 x 755	755	
(\$1 - \$.05) x 1,500.....		1,425
Discount lost (3,000 x \$5 x .05).....	750	
Cost to order and carry.....	<u>\$2,260</u>	<u>\$1,805</u>

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E9-7 9,600 ÷ 240 = 40 units daily usage

Normal lead time usage (20 days x 40 units).....	800
Safety stock ((30 days - 20 days) x 40 units).....	400
Order point.....	<u>1,200</u>

E9-8

- (1) Maximum use per day..... 600 units
 Normal use per day..... 500
 Safety stock (maximum)..... 100 units x 5 days of lead time = 500 units
- (2) Normal use per day (500) x days of lead time (5)..... 2,500 units
 Safety stock 500
 Order point..... 3,000 units
- (3) Order point..... 3,000 units
 Normal use during lead time (500 x 5) 2,500
 On hand at time order received..... 500 units
 Quantity ordered 3,500
 Normal maximum inventory..... 4,000 units

E9-8 (Concluded)

(4)	Order point.....	3,000 units
	Minimum use during lead time (100 x 5)	<u>500</u>
	On hand at time order received.....	2,500 units
	Quantity ordered	<u>3,500 units</u>
	Absolute maximum inventory	<u>6,000 units</u>

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E9-9

(1)	Maximum use per day.....	200 units
	Normal use per day.....	<u>120</u>
	Safety stock (maximum).....	80 units x 12 days of lead time = 960 units
(2)	Normal use per day (120) x days of lead time (12).....	1,440 units
	Safety stock	<u>960</u>
	Order point.....	<u>2,400 units</u>
(3)	Order point.....	2,400 units
	Normal use during lead time (120 x 12)	<u>1,440</u>
	On hand at time order received.....	960 units
	Quantity ordered	<u>3,000</u>
	Normal maximum inventory.....	<u>3,960 units</u>
(4)	Order point.....	2,400 units
	Minimum use during lead time (80 x 12)	<u>960</u>
	On hand at time order received.....	1,440 units
	Quantity ordered	<u>3,000</u>
	Absolute maximum inventory	<u>4,440 units</u>

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E9-10

Safety Stock Level (Units)	Annual Number of Orders	Probability of Stockout	Expected Annual Stockouts = Stockouts x	Cost per Stockout =	Annual Stockout Cost	Annual Safety Stock Carrying Cost (\$1 per unit)	Annual Combined Cost
10	5	.4	2	\$75	\$150.00	\$10	\$160.00
20	5	.2	1	75	75.00	20	95.00
40	5	.08	.4	75	30.00	40	70.00
80	5	.04	.2	75	15.00	80	95.00

The recommended level of safety stock is 40 units.

E9-11 APPENDIX

(1) Average costing:

Date	Received			Issued			Inventory		
	Quan- tity	Unit Cost	Total Cost	Quan- tity	Unit Cost	Total Cost	Quan- tity	Unit Cost	Balance
Jan. 1							500	\$1.20	\$ 600
6	200	\$1.25	\$250				700	1.21	850
10	400	1.30	520				1,100	1.25	1,370
15				560	\$1.25	\$700	540	1.25	670
25	500	1.40	700				1,040	1.32	1,370
27				400	1.32	528	640	1.32	842

(2) Fifo costing:

Date	Received			Issued			Inventory			
	Quan- tity	Unit Cost	Total Cost	Quan- tity	Unit Cost	Total Cost	Quan- tity	Unit Cost	Total Cost	Balance
Jan. 1							500	\$1.20	\$600	\$ 600
6	200	\$1.25	\$250				500	1.20	600	
							200	1.25	250	850
10	400	1.30	520				500	1.20	600	
							200	1.25	250	
							400	1.30	520	1,370
15				500	\$1.20	\$600	140	1.25	175	
				60	1.25	75	400	1.30	520	695
25	500	1.40	700				140	1.25	175	
							400	1.30	520	
							500	1.40	700	1,395
27				140	1.25	175	140	1.30	182	
				260	1.30	338	500	1.40	700	882

E9-11 APPENDIX (Concluded)**(3) Lifo costing:**

Date	Received			Issued			Inventory			
	Quan- tity	Unit Cost	Total Cost	Quan- tity	Unit Cost	Total Cost	Quan- tity	Unit Cost	Total Cost	Balance
Jan. 1							500	\$1.20	\$600	\$ 600
6	200	\$1.25	\$250				500	1.20	600	
							200	1.25	250	850
10	400	1.30	520				500	1.20	600	
							200	1.25	250	
							400	1.30	520	1,370
15				400	\$1.30	\$520	500	1.20	600	
				160	1.25	200	40	1.25	50	650
25	500	1.40	700				500	1.20	600	
							40	1.25	50	
							500	1.40	700	1,350
27				400	1.40	560	500	1.20	600	
							40	1.25	50	
							100	1.40	140	790

PROBLEMS

P9-1

- (1) $\frac{\text{Budgeted acquisition cost}}{\text{Budgeted purchases}} = \frac{\$18,000}{\$144,000} = 12.5\%$ applied acquisition costing rate for the month
- (2) $\$148,500$ net purchases \times 12.5% applied acquisition costing rate = $\$18,562.50$ applied cost added to materials purchased during the month
- (3) The overapplied acquisition cost of $\$362.50$ ($\$18,562.50$ applied cost - $\$18,200$ actual cost) should be credited to Cost of Goods Sold or prorated to Cost of Goods Sold and inventories.

P9-2

- (1) $EOQ = \sqrt{\frac{2 \times 24,000 \times \$1.20}{\$10 \times 10\%}} = \sqrt{\frac{57,600}{1}} = 240$ units
- (2) $\frac{\text{Annual requirements}}{EOQ} = \frac{24,000}{240} = 100$ orders needed per year
- (3) $\frac{EOQ}{2} \left(\frac{\text{Carrying cost}}{\text{per unit}} \right) + \frac{\text{Annual requirements}}{EOQ} \left(\frac{\text{Ordering cost}}{\text{per order}} \right)$
- $= \frac{240}{2} (\$10 \times 10\%) + \frac{24,000}{240} (\$1.20) = \$120 + \$120 = \$240$ total cost of ordering and carrying blades for the year
- (4) The next order should be placed in three days. This conclusion is arrived at as follows:
- (a) Number of days' supply in each order:
- $$\frac{\text{Days in year}}{\text{Orders per year}} = \frac{360}{100} = 3.6 \text{ days}$$
- (b) Number of days' supply left in inventory:
- $$\frac{\text{Units in inventory}}{EOQ} \times \text{Days' supply in each order} = \frac{400}{240} \times 3.6 \text{ days} = 6 \text{ days' supply left}$$
- (c) Days before next order should be placed:
- $$(\text{Days' supply left}) - (\text{Delivery lead time}) = 6 \text{ days} - 3 \text{ days} = 3$$

P9-2 (Concluded)

- (5) Some of the difficulties most firms have in attempting to apply the EOQ formula to inventory problems are:
- (a) Inventory is not always used at a constant rate; the constant usage assumption is implicit in the EOQ formula.
 - (b) The EOQ formula requires estimates of (1) annual requirements, (2) ordering cost, (3) purchase price per unit, and (4) cost of carrying inventories. These estimates may be extremely difficult to obtain with accuracy.

P9-3

- | | | |
|-----|---|---------------------------|
| (1) | Normal use per day (200) x days of lead time (10) | 2,000 units |
| | Safety stock | <u>300</u> |
| | Order point..... | <u><u>2,300</u></u> units |
| (2) | Order point..... | 2,300 units |
| | Normal use during lead time (200 x 10) | <u>2,000</u> |
| | On hand at time order received | 300 units |
| | Quantity ordered | <u>4,000</u> |
| | Normal maximum inventory | <u><u>4,300</u></u> units |
| (3) | Order point..... | 2,300 units |
| | Minimum use during lead time (150 x 10) | <u>1,500</u> |
| | On hand at time order received | 800 units |
| | Quantity ordered | <u>4,000</u> |
| | Absolute maximum inventory..... | <u><u>4,800</u></u> units |
| (4) | Let S equal cost of storing one unit for one year. | |

$$EOQ = \sqrt{\frac{2 \times RU \times CO}{CU \times CC}}$$

$$4,000 = \sqrt{\frac{2 \times (200 \times 250) \times \$80}{S}}$$

$$4,000 = \sqrt{\frac{8,000,000}{S}}$$

$$16,000,000 = \frac{8,000,000}{S}$$

$$S = \frac{8,000,000}{16,000,000} = \$0.50$$

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P9-4

Units of Safety Stock	Carrying Cost per Unit	Safety Stock = Carrying Cost	Orders per Year	Probability of Running out of Safety Stock	Stockout Cost per Occurrence	Stockout Cost	Total Cost
10	\$3	\$ 30	5	50%	\$80	\$200	\$230
20	3	60	5	40	80	160	220
30	3	90	5	30	80	120	210
40	3	120	5	20	80	80	200
50	3	150	5	10	80	40	190
55	3	165	5	3	80	12	177 lowest cost

P9-5 APPENDIX

(1) Fifo:

Date	Received			Issued			Inventory			
	Quan- tity	Unit Cost	Total Cost	Quan- tity	Unit Cost	Total Cost	Quan- tity	Unit Cost	Total Cost	Balance
March 1							750	\$20.00	\$15,000	\$15,000
3	400	\$19.50	\$ 7,800				750 400	20.00 19.50	15,000 7,800	22,800
5				600	\$20.00	\$12,000	150 400	20.00 19.50	3,000 7,800	10,800
12	350	21.50	7,525				150 400 350	20.00 19.50 21.50	3,000 7,800 7,525	18,325
15				150 350	20.00 19.50	3,000 6,825	50 350	19.50 21.50	975 7,525	8,500
18	500	22.00	11,000				50 350 500	19.50 21.50 22.00	975 7,525 11,000	19,500
22				50 350	19.50 21.50	975 7,525	500	22.00	11,000	11,000
26	550	21.00	11,550				500 550	22.00 21.00	11,000 11,550	22,550
28				500 150	22.00 21.00	11,000 3,150	400	21.00	8,400	8,400
31	200	20.00	4,000				400 200	21.00 20.00	8,400 4,000	12,400

P9-5 APPENDIX (Continued)

(2) Lifo:

Date	Received			Issued			Inventory		
	Quan- tity	Unit Cost	Total Cost	Quan- tity	Unit Cost	Total Cost	Quan- tity	Unit Cost	Total Cost Balance
March 1							750	\$20.00	\$15,000 \$15,000
3	400	\$19.50	\$ 7,800				750	20.00	15,000
							400	19.50	7,800 22,800
5				400	\$19.50	\$ 7,800			
				200	20.00	4,000	550	20.00	11,000 11,000
12	350	21.50	7,525				550	20.00	11,000
							350	21.50	7,525 18,525
15				350	21.50	7,525			
				150	20.00	3,000	400	20.00	8,000 8,000
18	500	22.00	11,000				400	20.00	8,000
							500	22.00	11,000 19,000
22				400	22.00	8,800	400	20.00	8,000
							100	22.00	2,200 10,200
26	550	21.00	11,550				400	20.00	8,000
							100	22.00	2,200
							550	21.00	11,550 21,750
28				550	21.00	11,550			
				100	22.00	2,200	400	20.00	8,000 8,000
31	200	20.00	4,000				400	20.00	8,000
							200	20.00	4,000 12,000

P9-5 APPENDIX (Concluded)

(3) Average:

Date	Received			Issued			Inventory		
	Quan- tity	Unit Cost	Total Cost	Quan- tity	Unit Cost	Total Cost	Quan- tity	Unit Cost	Balance
March 1							750	\$20.000	\$15,000.00
3	400	\$19.50	\$ 7,800				1,150	19.826	22,800.00
5				600	\$19.826	\$11,895.60	550	19.826	10,904.40
12	350	21.50	7,525				900	20.477	18,429.40
15				500	20.477	10,238.50	400	20.477	8,190.90
18	500	22.00	11,000				900	21.323	19,190.90
22				400	21.323	8,529.20	500	21.323	10,661.70
26	550	21.00	11,550				1,050	21.154	22,211.70
28				650	21.154	13,750.10	400	21.154	8,461.60
31	200	20.00	4,000				600	20.769	12,461.60

P9-6 APPENDIX

- (1) Cost of the ending inventory under the fifo method when a periodic inventory system is used:

100 units	@	\$17	=	\$1,700
100	@	14	=	1,400
100	@	12	=	1,200
				<u>\$4,300</u>

- (2) Cost of the ending inventory under the lifo method:

- (a) When a periodic inventory system is used:

200 units	@	\$10	=	\$2,000
100	@	11	=	1,100
				<u>\$3,100</u>

- (b) When a perpetual inventory system is used:

Date	Received			Issued			Inventory			
	Quan- tity	Unit Cost	Total Cost	Quan- tity	Unit Cost	Total Cost	Quan- tity	Unit Cost	Total Cost	Balance
Jan. 1							200	\$10	\$2,000	\$2,000
12	100	\$11	\$1,100				200 100	10 11	2,000 1,100	3,100
Feb. 1				100 100	\$11 10	\$1,100 1,000	100	10	1,000	1,000
April 16	200	12	2,400				100 200	10 12	1,000 2,400	3,400
May 1				100	12	1,200	100 100	10 12	1,000 1,200	2,200
July 15	100	14	1,400				100 100 100	10 12 14	1,000 1,200 1,400	3,600
Nov. 10				100	14	1,400	100 100	10 12	1,000 1,200	2,200
Dec. 5	100	17	1,700				100 100 100	10 12 17	1,000 1,200 1,700	3,900

(1) (a) Average method:

Date	Received			Issued			Inventory		
	Quan- tity	Unit Cost	Total Cost	Quan- tity	Unit Cost	Total Cost	Quan- tity	Unit Cost	Balance
Jan. 2	2,000	\$5	\$10,000				2,000	\$5.000	\$10,000.00
15				500	\$5.000	\$2,500.00	1,500	5.000	7,500.00
31				700	5.000	3,500.00	800	5.000	4,000.00
Feb. 2	1,200	6	7,200				2,000	5.600	11,200.00
15				600	5.600	3,360.00	1,400	5.600	7,840.00
28				900	5.600	5,040.00	500	5.600	2,800.00
Mar. 2	1,500	8	12,000				2,000	7.400	14,800.00
15				600	7.400	4,440.00	1,400	7.400	10,360.00
31				800	7.400	5,920.00	600	7.400	4,440.00
Apr. 2	1,900	7	13,300				2,500	7.096	17,740.00
15				700	7.096	4,967.20	1,800	7.096	12,772.80
30				700	7.096	4,967.20	1,100	7.096	7,805.60

P9-7, APPENDIX (Continued)

(b) First-in, first-out method:

Date	Received			Issued			Inventory			
	Quan- tity	Unit Cost	Total Cost	Quan- tity	Unit Cost	Total Cost	Quan- tity	Unit Cost	Total Cost	Balance
Jan. 2	2,000	\$5	\$10,000				2,000	\$5		\$10,000
15				500	\$5	\$2,500	1,500	5		7,500
31				700	5	3,500	800	5		4,000
Feb. 2	1,200	6	7,200				800	5	\$ 4,000	
							1,200	6	7,200	11,200
15				600	5	3,000	200	5	1,000	
							1,200	6	7,200	8,200
28				200	5	1,000				
				700	6	4,200	500	6		3,000
Mar. 2	1,500	8	12,000				500	6	3,000	
							1,500	8	12,000	15,000
15				500	6	3,000				
				100	8	800	1,400	8		11,200
31				800	8	6,400	600	8		4,800
Apr. 2	1,900	7	13,300				600	8	4,800	
							1,900	7	13,300	18,100
15				600	8	4,800				
				100	7	700	1,800	7		12,600
30				700	7	4,900	1,100	7		7,700

P9-7 APPENDIX (Concluded)

(c) Last-in, first-out method:

Date	Received			Issued			Inventory			
	Quan- tity	Unit Cost	Total Cost	Quan- tity	Unit Cost	Total Cost	Quan- tity	Unit Cost	Total Cost	Balance
Jan. 2	2,000	\$5	\$10,000				2,000	\$5		\$10,000
15				500	\$5	\$2,500	1,500	5		7,500
31				700	5	3,500	800	5		4,000
Feb. 2	1,200	6	7,200				800	5	\$ 4,000	
							1,200	6	7,200	11,200
15				600	6	3,600	800	5	4,000	
							600	6	3,600	7,600
28				600	6	3,600				
				300	5	1,500	500	5		2,500
Mar. 2	1,500	8	12,000				500	5	2,500	
							1,500	8	12,000	14,500
15				600	8	4,800	500	5	2,500	
							900	8	7,200	9,700
31				800	8	6,400	500	5	2,500	
							100	8	800	3,300
Apr. 2	1,900	7	13,300				500	5	2,500	
							100	8	800	
							1,900	7	13,300	16,600
15				700	7	4,900	500	5	2,500	
							100	8	800	
							1,200	7	8,400	11,700
30				700	7	4,900	500	5	2,500	
							100	8	800	
							500	7	3,500	6,800

(2)

	<u>Average</u>	<u>Fifo</u>	<u>Lifo</u>
Sales (5,500 units @ \$10)	\$55,000.00	\$55,000	\$55,000
Cost of goods sold:			
Purchases	\$42,500.00	\$42,500	\$42,500
Less inventory, April 30	7,805.60	7,700	6,800
	<u>\$34,694.40</u>	<u>\$34,800</u>	<u>\$35,700</u>
Gross profit	<u>\$20,305.60</u>	<u>\$20,200</u>	<u>\$19,300</u>

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CASES

C9-1

- (1) (a) Topp Desk Company would be attempting to minimize total setup cost and total carrying cost.

- (b) Variable manufacturing costs per unit:

Direct materials.....	\$ 30
Direct labor.....	14
Variable factory overhead.....	6
Total variable manufacturing cost per unit.....	\$ 50
Number of desks destroyed.....	x 12
Total setup cost.....	<u>\$600</u>

Optimum production run:

$$\sqrt{\frac{2 \times 18,000 \text{ units} \times \$600 \text{ setup cost}}{\$50 * \times 10.8\%}} = \sqrt{\frac{21,600,000}{5.40}} =$$

$$\sqrt{4,000,000} = 2,000 \text{ desks}$$

*Variable manufacturing cost per unit

- (c) Number of production runs per year:

$$\frac{\text{Annual demand}}{\text{Optimum production run}} = \frac{18,000}{2,000} = 9 \text{ production runs}$$

- (2) (a) The following factors affect the desired size of the safety stock for any inventory item.

- (1) Variability of product demand
- (2) Variability of lead time
- (3) Stockout costs
- (4) Carrying costs

- (b) The minimum safety stock level that could be maintained without being worse off than being unable to fill orders equal to an average day's demand is the level at which the safety stock carrying cost equals the cost of a stockout, i.e.,

$$\frac{\text{Stockout cost}}{\text{Per unit carrying cost}} = \frac{\$2,295}{\$50 \times 10.8\%} = \frac{\$2,295}{\$5.40} = 425 \text{ desks}$$

C9-2

(1) Equipment Maintenance Department costs:			
Salaries (2 x 5 x \$9)	\$ 90.00		
Employee benefits (\$90 x 20%)	18.00	\$108.00	
Production department costs:			
Salaries (5 x 5 x \$7.50)	\$187.50		
Variable factory overhead:			
Direct labor hours base (25 x \$2.75).....	68.75		
Machine hours base (1 x \$5).....	5.00	261.25	
Direct materials (\$200 - \$50).....		150.00	
Estimate of Model JE 40 setup costs		<u>\$519.25</u>	

Explanation of costs:

- (a) The full cost of the maintenance salaries and employee benefits is included because the \$10.80 [$\$9.00 + (\$9.00 \times 20\%)$] incurred per labor hour is incurred solely for the purpose of effecting the changeover.
- (b) The other costs of the Equipment Maintenance Department are not included in the estimate because they are fixed costs of the department and will be incurred regardless of the maintenance workers' activities.
- (c) The salaries of the 5 production workers for the full 5 hours each are included in the setup cost because they must be in attendance all of the time, though they are needed only part of the time. If the workers could have been assigned to other jobs during the changeover, then the full amount would not be charged to setup.
- (d) The variable factory overhead costs of the production department applied on the direct labor hours base are incurred as a function of the direct labor hours; therefore, a full 25 hours of cost are assigned to the setup cost.
- (e) The variable factory overhead costs of the production department applied on the machine hours base are incurred as a function of the operation of the machinery; therefore, 1 hour is assigned to setup cost for the 1 hour the machinery is used in testing.
- (f) All production department fixed factory overhead costs (both those applied on the basis of direct labor and those applied on the basis of machine hours) are not included in the setup cost because they would be incurred regardless of the activity in the department.
- (g) The net materials cost of \$150 is included because it represents the unsalvageable portion of the materials used for the setup and not for the production of a salable desk.

C9-2 (Concluded)

(2) The cost items that would be included in an estimate of Pointer Furniture Company's cost of carrying desks in inventory include:

- (a) All costs related to warehousing and handling the desks in inventory that vary in amount by the number of items stored.**
- (b) The cost of the funds committed to the investment in inventory.**

C9-3

(1) Circumstances necessary to shift raw materials inventory carrying costs to the supplier include:

- (a) Reliability of the supplier. Will the supplier ship products on a more rigorous timetable and be willing to keep inventory within its own storage facilities?**
- (b) Adequate alternative supply sources. A large number of qualified alternative suppliers will increase the possibility for favorable contract terms.**
- (c) Careful control of inventory requirements. Are production schedules clearly defined to reduce the potential for stockouts?**

(2) Circumstances necessary to shift finished goods inventory carrying costs to the customer include:

- (a) Understanding customers. Are customers willing to take the risk of inventory storage for an extended period of time?**
- (b) Closer production planning. Can production schedules be refined to such an extent that delays in the sale and distribution of the finished inventory are minimized?**
- (c) Careful control of inventory requirements. Are customer orders carefully monitored and anticipated to reduce the probability of finished goods stockouts?**

CHAPTER 10

DISCUSSION QUESTIONS

- Q10-1. The purpose of a JIT system is to minimize the levels of raw materials and work in process inventory investments, while improving the overall manufacturing process. The intent is to pull inventory through the system only as it is required.
- Q10-2. JIT seeks to eliminate all forms of waste, including production losses such as defects. Successful reduction of these problems contributes to product quality, and, so, is a part of TQM.
- Q10-3. To avoid inventory buildup, the entire JIT system shuts down whenever defects are found; so to achieve a good rate of flow, the number of defects must be small.
- Q10-4. Theoretically, in an ideal JIT system the EOQ is one; each time more output is needed, one more part or unit is produced.
- Q10-5. Although a zero inventory level is unattainable, JIT stimulates improvement in the environmental conditions that cause inventory buildup, such as long setup times, high setup costs, poor quality, and poorly balanced work loads.
- Q10-6. The relationship between velocity and WIP levels is an inverse relationship; doubling the velocity means halving the WIP level, provided the output rate is held constant. This is similar, but not identical, to the relationship expressed in the familiar inventory turnover ratio used in financial statement analysis.
- Q10-7. The strategic advantage of improving velocity throughout the company, from product research and development to shipping, is that the company can then respond faster to any changing customer need or to an opportunity for a new or altered product.
- Q10-8. Reducing the level of WIP also reduces the maximum number of defectives, if the defects are of a kind that will be discovered at the next work station after the units are held waiting between stations. If 100 units are waiting between stations, up to 100 defectives might be produced before the problem would be discovered; if 10 units are held waiting, no more than 10 defectives could be produced before the problem would be discovered.
- Q10-9. A blanket purchase order is an agreement between buyer and seller stating the total quantity expected to be needed over a period of three or six months.
- Q10-10. In many JIT work cells, these distinctions—between direct and indirect labor and between producing departments and some service functions—do not exist, because the same workers (the team assigned to the cell) perform all these tasks.
- Q10-11. In backflush costing, the work in process inventory account is not adjusted throughout the period to reflect all the costs of units in process; there are no detailed subsidiary records maintained for work in process; and a single account may be used for both raw materials and work in process.
- Q10-12. In backflush costing, the materials and work in process inventory accounts might be combined into a single account, because materials might be put immediately into production when they are received.
- Q10-13. Postdeduction is the subtraction from the work in process account of some or all elements of the cost of completed work, after the work is completed.
- Q10-14. The periodic inventory method used by many merchandising companies is analogous to backflush costing as used by manufacturers.
- Q10-15. If a backflush costing system expenses all conversion costs to the cost of goods sold account, the correct amount of conversion cost is included in inventory accounts by making an end-of-period adjustment of the inventory accounts' balances. The offsetting entry is an adjustment of the cost of goods sold account. The correct amount of conversion cost to be included in each inventory account is estimated when inventories are physically counted.

EXERCISES

E10-1 The expected annual savings are \$36,900, consisting of \$14,400 carrying costs savings and \$22,500 savings in the cost of defects, calculated as follows:

$$\begin{aligned}
 \text{Carrying cost savings} &= 20\% \times \text{reduction in average variable cost of WIP} \\
 &= 20\% \times 30\% \times \text{past average variable cost of WIP} \\
 &= .2 \times .3 \times (10 \times 300 \times \$80) \\
 &= \$14,400
 \end{aligned}$$

$$\begin{aligned}
 \text{Savings in cost of defects} &= \$25 \times \text{reduction in number of defective units}
 \end{aligned}$$

$$\begin{aligned}
 &= \$25 \times \begin{array}{c} \text{(reduction in} \\ \text{number of} \\ \text{defective units} \\ \text{produced per} \\ \text{undiscovered} \\ \text{out-of-control} \\ \text{condition)} \end{array} \times \begin{array}{c} \text{(number of out-of-} \\ \text{control conditions} \\ \text{not discovered} \\ \text{immediately)} \end{array} \\
 &= \$25 \times (30\% \times 300 \times 5\%) \times (1/3 \times 600) \\
 &= \$25 \times 4.5 \times 200 \\
 &= \$22,500
 \end{aligned}$$

E10-2 The average lead time will be 26 days, calculated as follows:

$$\text{Reduction of vendor lead time} = 1/6 \times 18 \text{ days} = 3 \text{ days}$$

Because the rate of output will be unchanged, a reduction of WIP to one-third of its present level will triple the velocity. The average order will then remain in WIP only one-third as long, saving two-thirds of time presently being spent in WIP:

$$\begin{aligned}
 \text{Reduction of time in WIP} &= 2/3 \text{ of present time in WIP} \\
 &= 2/3 \times 12 \text{ days} \\
 &= 8 \text{ days}
 \end{aligned}$$

$$\begin{aligned}
 \text{New lead time} &= \text{present lead time} - \text{reductions} \\
 &= 37 \text{ days} - (3 \text{ days} + 8 \text{ days}) \\
 &= 26 \text{ days}
 \end{aligned}$$

This approach can be used even if the other components of total lead time, such as the two days in final inspection, are not stated. If all the components of total lead time are known, as in this exercise, then the new lead time can be calculated by adding all its components:

$$\begin{aligned}
 (5/6 \times 18) + 2 + (1/3 \times 12) + 2 + 3 &= 15 + 2 + 4 + 2 + 3 \\
 &= 26 \text{ days}
 \end{aligned}$$

E10-3 The expected annual savings is \$2,200,000, calculated as follows:

Doubling the velocity of all tasks, from receipt of order to shipment and from ordering materials to issuing materials to production, will reduce WIP and materials inventories by half, therefore:

$$\begin{aligned}\text{Reduction in materials carrying costs} &= 20\% \times \text{materials reduction} \\ &= 20\% \times (1/2 \times \$3,000,000) \\ &= \$300,000\end{aligned}$$

$$\begin{aligned}\text{Reduction in WIP carrying costs} &= 20\% \times \text{WIP reduction} \\ &= 20\% \times (1/2 \times \$5,000,000) \\ &= \$500,000\end{aligned}$$

This change will also reduce customer lead time from eight weeks to four weeks. Because customers are willing to wait up to five weeks for shipment, all shipments can then be made-to-order. There will no longer be a need for finished goods inventory. Once the existing finished goods inventory is liquidated by sales or scrapping, the annual savings from not carrying finished goods will be:

$$\begin{aligned}\text{Reduction in finished goods carrying costs} &= 20\% \times \text{finished goods reduction} \\ &= 20\% \times (100\% \times \$7,000,000) \\ &= \$1,400,000\end{aligned}$$

$$\text{Total savings} = \$300,000 + \$500,000 + \$1,400,000 = \$2,200,000$$

(This exercise is based closely on an actual case of a partial JIT implementation. The name of the company and dollar amounts have been altered.)

E10-4

(1) (a) $\text{Equivalent production} = 4,500 + (.50 \times 20) = 4,510 \text{ units};$

$$\frac{\$300,740}{4,510} = \$66.683 \text{ per unit}$$

(b) $\frac{\$300,000}{4,500} = \66.667 per unit

(c) $\text{units started} = 4,500 + 20 - 24 = 4,496 \text{ units};$

$$\frac{\$300,000}{4,496} = \$66.726 \text{ per unit}$$

(2) $\$667, \text{ because } 20 \times .50 \times \$66.683 = \$666.83.$
 $\$667, \text{ because } 20 \times .50 \times \$66.667 = \$666.67.$
 $\$667, \text{ because } 20 \times .50 \times \$66.726 = \$667.26.$

E10-4 (Concluded)

- (3) Considering that the results of requirement (2) were the same (to the nearest dollar) for all three methods, then method (1) (b) would be recommended because of its ease and simplicity. Method (1) (c) is a close second choice, also because of ease and simplicity. The details of method (1) (a) may not be justifiable in these circumstances.
- (4) Processing speed is very fast, with the result that work in process inventory levels are kept to a very low level—both in absolute terms and in relation to total production activity for a month.

E10-5 Journal entries involving RIP and/or finished goods are:

Raw and In Process.....	456,000	
Accounts Payable		456,000

A summary entry for all receipts of raw materials during the period. When direct materials are used, no entry is needed, because the materials remain in RIP.

Finished Goods.....	455,000	
Raw and In Process		455,000

To backflush material cost from RIP to finished goods. This is a postdeduction. The calculation is:

Material in May 1 RIP balance.....	\$ 19,000
Material received during May.....	456,000
	<u>\$475,000</u>
Material in May 31 RIP, per physical count	20,000
Amount to be backflushed	<u>\$455,000</u>

Cost of Goods Sold.....	461,000	
Finished Goods.....		461,000

To backflush material cost from finished goods to cost of goods sold. This is a postdeduction. The calculation is:

Material in May 1 finished goods	\$ 16,000
Material backflushed to finished goods	455,000
	<u>\$471,000</u>
Material in May 31 finished goods, per physical count.....	10,000
Amount to be backflushed.....	<u>\$461,000</u>

E10-5 (Concluded)

Cost of Goods Sold.....	2,300	
Raw and In Process		300
Finished Goods.....		2,000

Conversion cost in RIP is adjusted from the \$2,300 of May 1 to the \$2,000 estimate at May 31. Conversion cost in finished goods is adjusted from the \$6,500 of May 1 to the \$4,500 estimate at May 31. The offsetting entry is made to the cost of goods sold account, where all conversion costs were charged during May.

E10-6 The journal entries involving RIP and/or finished goods are:

Raw and In Process.....	222,000	
Accounts Payable		222,000

A summary entry for all receipts of raw materials during the period. When direct materials are used, no entry is needed, because the materials remain in RIP.

Finished Goods.....	221,500	
Raw and In Process		221,500

To backflush material cost from RIP to finished goods. This is a postdeduction. The calculation is:

Material in June 1 RIP balance	\$ 10,500
Material received during June	222,000
	<u>\$232,500</u>
Material in June 30 RIP, per physical count	11,000
Amount to be backflushed	<u>\$221,500</u>

Cost of Goods Sold.....	223,500	
Finished Goods.....		223,500

To backflush material cost from finished goods to cost of goods sold. This is a postdeduction. The calculation is:

Material in June 1 finished goods.....	\$ 8,000
Material backflushed from RIP.....	221,500
	<u>\$229,500</u>
Material in June 30 finished goods, per physical count.....	6,000
Amount to be backflushed	<u>\$223,500</u>

E10-6 (Concluded)

Raw and In Process	500	
Finished Goods		300
Cost of Goods Sold		200

Conversion cost in RIP is adjusted from the \$1,200 of June 1 to the \$1,700 estimate at June 30. Conversion cost in finished goods is adjusted from the \$4,000 at June 1 to the \$3,700 estimate at June 30. The offsetting entry is made to the cost of goods sold account, where all conversion costs were charged during June.

E10-7 Journal entries involving the RIP accounts are:

Raw and in Process	200,000	
Accounts Payable		200,000

A summary entry for all receipts of raw materials during the period. When direct materials are used, no entry is needed, because they remain a part of RIP.

Finished Goods	199,800	
Raw and in Process		199,800

To backflush material cost from RIP to Finished Goods. This is a postdeduction. The calculation is:

Material in March 1 RIP balance	\$ 9,000
Material received during March	200,000
	<u>\$209,000</u>
Material in March 31 RIP, per physical count	9,200
Amount to be backflushed	<u>\$199,800</u>

Raw and in Process	300	
Cost of Goods Sold		300

Conversion cost in RIP is adjusted from the \$1,000 of March 1 to the \$1,300 estimate at March 31. The offsetting entry is made to the cost of goods sold account, where all conversion costs were charged during March.

E10-8 Journal entries involving the RIP accounts are:

Raw and in Process	367,000	
Accounts Payable		367,000

A summary entry for all receipts of raw materials during the period. When direct materials are used, no entry is needed, because they remain a part of RIP.

Finished Goods.....	365,400	
Raw and in Process		365,400

To backflush material cost from RIP to Finished Goods. This is a post-deduction. The calculation is:

Material in April 1 RIP balance.....	\$ 29,600
Material received during April.....	367,000
	<u>\$396,600</u>
Material in April 30 RIP, per physical count	31,200
Amount to be backflushed	<u>\$365,400</u>

Raw and in Process	400	
Cost of Goods Sold		400

Conversion cost in RIP is adjusted from the \$1,400 of April 1 to the \$1,800 estimate at April 30. The offsetting entry is made to the cost of goods sold account, where all conversion costs were charged during April.

E10-9 Journal entries involving the RIP accounts are:

Raw and in Process	246,000	
Accounts Payable		246,000

A summary entry for all receipts of raw materials during the period. When direct materials are used, no entry is needed, because they remain a part of RIP.

Cost of Goods Sold.....	247,000	
Raw and in Process		247,000

To backflush material cost from RIP to Cost of Goods Sold. This is a postdeduction. The calculation is:

Material in May 1 RIP balance.....	\$ 11,000
Material received during May.....	246,000
	<u>\$257,000</u>
Material in May 31 RIP, per physical count	10,000
Amount to be backflushed	<u>\$247,000</u>

E10-9 (Concluded)

Raw and in Process	800	
Cost of Goods Sold		800

Conversion cost in RIP is adjusted from the \$1,300 of May 1 to the \$2,100 estimate at May 31. The offsetting entry is made to the cost of goods sold account, where all conversion costs were charged during May.

E10-10

- (1) The most recent purchase involved a quantity greater than the total materials in ending inventories, and that purchase gives a cost of materials of $\$420,000/1,400$, or \$300 per unit of output; therefore,
 Materials cost of finished goods ending inventory
 $= 50 \text{ units} \times \$300 \text{ per unit} = \$15,000$
- (2) The conversion cost per unit is calculated by dividing the total conversion cost by (a) the number of units started, (b) the number completed, or (c) the number completed plus the number of partially converted units in the RIP ending inventory (not an equivalent units calculation):
 - (a) $\$290,160 \div 3,000 = \96.72 conversion cost per unit
 - (b) $\$290,160 \div 3,100 = \93.60 conversion cost per unit
 - (c) $\$290,160 \div 3,120 = \93.00 conversion cost per unit
- (3) The three possible amounts for the conversion cost of the 50 units in finished goods ending inventory are:

$50 \text{ units} @ \$96.72 = \$4,836$ of conversion cost
 $50 \text{ units} @ \$93.60 = \$4,680$ of conversion cost
 $50 \text{ units} @ \$93.00 = \$4,650$ of conversion cost
- (4)

Lowest = $\$15,000 \text{ materials} + \$4,650 \text{ conversion} = \$19,650$
 Highest = $\$15,000 \text{ materials} + \$4,836 \text{ conversion} = \$19,836$
 Dollar difference = $\$19,836 - \$19,650 = \$186$
 Difference, to nearest 1/10 percent = $\$186 \div \$19,650 = 0.9\%$

E10-11

- (1) A \$300 materials cost per unit was calculated in requirement (1) of the previous exercise; therefore,

Materials cost of RIP ending inventory = 220 units x \$300 per unit = \$66,000

- (2) The three possible amounts for the conversion cost of the RIP ending inventory of 20 units, 50% converted, are:

20 units x 50% x \$96.72 = \$967.20 of conversion cost

20 units x 50% x \$93.60 = \$936 of conversion cost

20 units x 50% x \$93.00 = \$930 of conversion cost

It seems inconsistent to assign 50% conversion costs to RIP when the units in RIP were counted as whole physical units in the denominator of the conversion cost per unit calculation in requirement 2(c) of E10-10, and when they were not counted at all in the denominator of the calculation in requirement 2(b) of E10-10. But the total dollar difference assigned to RIP is immaterial. Whatever the amount of conversion costs assigned to RIP and finished goods, the remainder of total conversion costs simply remains in cost of goods sold.

- (3) Lowest = \$66,000 materials + \$930 conversion = \$66,930
Highest = \$66,000 materials + \$967 conversion = \$66,967
Dollar difference = \$66,967 - \$66,930 = \$37
Difference, to nearest 1/10 percent = $\$37 \div \$66,930 = .1\%$

PROBLEMS

P10-1

- (1) The expected annual savings are \$720,000, consisting of \$384,000 carrying costs savings and \$336,000 savings in the cost of defects, calculated as follows:

$$\begin{aligned}
 \text{Carrying cost savings} &= 30\% \times \text{reduction in average variable cost of WIP} \\
 &= 30\% \times 40\% \times \text{past average variable cost of WIP} \\
 &= .3 \times .4 \times (40 \times 200 \times \$400) \\
 &= \$384,000
 \end{aligned}$$

Savings in cost of defects

$$= \$60 \times \text{reduction in number of defective units}$$

$$\begin{aligned}
 &= \$60 \times \left(\begin{array}{c} \text{reduction in number} \\ \text{of defective units} \\ \text{produced per} \\ \text{undiscovered flaw} \end{array} \right) \times \left(\begin{array}{c} \text{number of flaws not} \\ \text{discovered immediately} \end{array} \right)
 \end{aligned}$$

$$= \$60 \times (40\% \times 200 \times 20\%) \times (1/4 \times 1,400)$$

$$= \$60 \times 16 \times 350$$

$$= \$336,000$$

- (2) Likely benefits that are not assessable from the information given include the following:
- (a) Faster cycle time resulting from the higher velocity of WIP. (Because the rate of final output will not change, velocity will change inversely with the change in WIP levels.) The faster cycle time will improve the speed with which orders can be filled, thus increasing customer satisfaction and perhaps increasing perceived product value so that prices can be raised (or price cuts delayed or avoided).
 - (b) If, as a result of the shorter cycle time, total lead time becomes less than the time customers are willing to wait for an order, then the company would no longer need to maintain a finished goods inventory. This possibility would result in additional savings in floor space and other inventory carrying costs.

(The value of the floor space freed up by eliminating 40% of WIP storage is not an additional benefit; inventory carrying costs include storage costs, so the value of the floor space is included in the carrying cost savings calculated in requirement (1).)

- (3) Costs and other negatives to be compared with the savings include:
- (a) The increased likelihood of shutdowns due to work locations being starved for WIP; lower WIP levels at each station represent lower safety stocks, so stockouts are more likely at all locations.
 - (b) The cost of starting a larger number of batches or lots into production, which includes the cost of processing more work orders, pro-

P10-1 (Concluded)

duction orders, and material requisitions. (To reduce average WIP size, either smaller batches must be started at shorter intervals, or protracted stockouts must be allowed to occur; otherwise, the average size of WIP will not drop.)

- (c) The cost of handling more loads of materials. If lot sizes are small enough to require only one load per lot both before and after the change, then a larger number of lots will result in a larger total number of loads.
- (d) The cost of performing a larger number of setups to permit running a larger number of batches or lots of smaller size. Ideally, as part of the JIT implementation, setup cost will be driven down to eliminate this problem.

P10-2

- (1) Protech could achieve an average lead time on these orders of 42 days, calculated as follows:

$$\begin{aligned}
 \text{Reduction of time in WIP} &= 3/4 \text{ of present time in WIP} \\
 &= 3/4 \times (360 \text{ days} + 10) \\
 &= 3/4 \times 36 \text{ days} \\
 &= 27 \text{ days}
 \end{aligned}$$

$$\text{Reduction of vendor lead time} = 1/3 \times 27 \text{ days} = 9 \text{ days}$$

$$\begin{aligned}
 \text{New lead time} &= \text{present lead time} - \text{reductions} \\
 &= 78 \text{ days} - (27 \text{ days} + 9 \text{ days}) \\
 &= 42 \text{ days}
 \end{aligned}$$

Note: It is not stated that Protech defines WIP and WIP turnover in a way that excludes the two days spent in receiving and the three days spent in final inspection. To check that the average cycle time of 360 days/10, or 36 days, does exclude those steps (so that there is no double-counting), note that a cycle time of 36 days, when added to the other intervals mentioned, gives the stated total lead time of 78 days: $6 + 27 + 2 + 36 + 3 + 4 = 78$.

- (2) The advantages of shorter lead time include:
 - (a) The value of the floor space freed up by eliminating three-fourths of WIP storage.
 - (b) Improvement in the speed with which orders can be filled, which should increase customer satisfaction and perhaps increase perceived product value so that prices can be raised (or price cuts delayed or avoided).
 - (c) If the new 42-day total lead time is less than the time customers are willing to wait for an order, then the company would no longer need to maintain a finished goods inventory. This possibility would result in additional savings in floor space and other inventory carrying costs.

P10-2 (Concluded)

- (3) **Costs and other negatives to be compared with the savings include:**
- (a) **The increased likelihood of shutdowns due to work locations being starved for WIP; lower WIP levels at each station represent lower safety stocks, so stockouts are more likely at all locations.**
 - (b) **The cost of starting a larger number of batches or lots into production, which includes the cost of processing more work orders, production orders, and material requisitions. (Reducing average WIP size generally requires starting smaller batches at shorter intervals.)**
 - (c) **The cost of handling more loads of materials. If lot sizes are small enough to require only one load per lot both before and after the change, then a larger number of lots will result in a larger total number of loads.**
 - (d) **The cost of performing a larger number of setups to permit running a larger number of batches, or lots, of smaller size. Ideally, as part of the JIT implementation, setup cost will be driven down to eliminate this problem.**
 - (e) **The time and effort that may be required to induce vendors to reduce their lead time by one-third.**

P10-3

(1)	(a) Raw and in Process	850,000	
	Accounts Payable		850,000
	A summary entry for all receipts of raw materials during the period. When direct materials are used, no entry is needed, because they remain a part of RIP.		
	(b) Factory Overhead Control.....	13,000	
	Supplies		13,000
	Indirect materials are recorded as used.		
	(c) Payroll.....	400,000	
	Accrued Payroll		400,000
	Accrued Payroll	400,000	
	Cash		400,000
	(d) Cost of Goods Sold	60,000	
	Factory Overhead Control.....	120,000	
	Marketing Expenses Control	130,000	
	Administrative Expenses Control	90,000	
	Payroll.....		400,000
	Direct labor is expensed to the cost of goods sold account.		
	(e) Factory Overhead Control.....	681,000	
	Accumulated Depreciation		668,000
	Prepaid Insurance.....		13,000

P10-3 (Continued)

(f)	Factory Overhead Control	83,000	
	Cash		54,000
	Accounts Payable		29,000
(g)	Cost of Goods Sold	897,000	
	Factory Overhead Control		897,000
	Overhead is expensed to the cost of goods sold account.		
(h)	Finished Goods	844,000	
	Raw and In Process		844,000

To backflush material cost from RIP to finished goods. This is a postdeduction. The calculation is:

Material in June 1 RIP balance	\$ 40,000
Material received during June	850,000
	<u>\$890,000</u>
Material in June 30 RIP, per physical count	46,000
Amount to be backflushed	<u>\$844,000</u>

(i)	Cost of Goods Sold	852,000	
	Finished Goods		852,000

To backflush material cost from Finished Goods to Cost of Goods Sold. The calculation is:

Material in June 1 Finished Goods	\$ 190,000
Material cost transferred from RIP	844,000
	<u>\$1,034,000</u>
Material in June 30 finished goods, per physical count	182,000
Amount to be backflushed	<u>\$ 852,000</u>

(j)	Raw and in Process	300	
	Cost of Goods Sold	2,700	
	Finished Goods		3,000

Conversion costs in the inventory accounts are adjusted to the estimates made in the June 30 physical count. For RIP, the adjustment is from the \$1,600 of June 1 to \$1,900 on June 30; for Finished Goods, the adjustment is from the \$180,000 of June 1 to \$177,000 on June 30. The offsetting entry is made to the cost of goods sold account, where all conversion costs were charged during June.

P10-4 (Continued)

(g)	Cost of Goods Sold.....	656,000	
	Factory Overhead Control		656,000
	Overhead is expensed to the cost of goods sold account.		

(h)	Finished Goods.....	615,000	
	Raw and In Process		615,000

To backflush material cost from RIP to Finished Goods. This is a post-deduction. The calculation is:

Material in May 1 RIP balance.....	\$ 30,000
Material received during May.....	620,000
	<u>\$650,000</u>
Material in May 31 RIP, per physical count	35,000
Amount to be backflushed	<u>\$615,000</u>

(i)	Cost of Goods Sold.....	605,000	
	Finished Goods.....		605,000

To backflush material cost from Finished Goods to Cost of Goods Sold. The calculation is:

Material in May 1 Finished Goods.....	\$150,000
Material cost transferred from RIP	615,000
	<u>\$765,000</u>
Material in May 31 Finished Goods, per physical count.....	160,000
Amount to be backflushed	<u>\$605,000</u>

(j)	Raw and In Process	800	
	Finished Goods.....	4,000	
	Cost of Goods Sold.....		4,800

Conversion costs in the inventory accounts are adjusted to the estimates made in the May 31 physical count. For RIP, the adjustment is from the \$1,300 of May 1 to \$2,100 on May 31; for Finished Goods, the adjustment is from the \$130,000 of May 1 to \$134,000 on May 31. The offsetting entry is made to the cost of goods sold account, where all conversion costs were changed during May.

P10-4 (Concluded)

- (2) The three completed accounts are

Raw and in Process				Finished Goods			
5/1	31,300	(h)	615,000	5/1	280,000	(i)	605,000
(a)	620,000			(h)	615,000		
(j)	800			(j)	4,000		
5/31	37,100			5/31	294,000		

Cost of Goods Sold			
5/1	-0-	(j)	4,800
(d)	50,000		
(g)	656,000		
(i)	605,000		
5/31	1,306,200		

P10-5

(1)	Contribution margin of lost sales (20,000 units):	
	Revenue (\$10,800 ÷ 900 units)	\$ 12.00
	Variable costs:	
	Cost of sales (\$4,050 ÷ 900)	\$4.50
	Marketing and administrative (\$900 ÷ 900)	1.00
	Total variable cost	\$5.50
	Unit contribution margin.....	\$6.50
	Volume of lost sales.....	x 20,000
	Total contribution margin of lost sales	\$(130,000)
	Overtime premiums (overtime cost is less than the additional contribution margin of lost sales):	
	15,000 x \$6.50 = \$97,500 > \$40,000	\$ (40,000)
	Rental savings	60,000
	Rental income from owned warehouse	
	(12,000 x .75 x \$1.50)	13,500
	Elimination of insurance and property taxes.....	14,000
	Opportunity cost of funds released from inventory investment:	
	Investment in inventory	\$600,000
	Interest before tax $\left(\frac{.12}{1-.40}\right)$ .....	.20 120,000
	Estimated before-tax dollar savings	<u>\$ 37,500</u>

P10-5 (Concluded)

- (2) **Conditions that should exist in order for a company to install just-in-time inventory successfully include the following:**
- (a) **Top management must be committed and provide the necessary leadership support in order to ensure a company-wide, coordinated effort.**
 - (b) **A detailed system for integrating the sequential operations of the manufacturing process needs to be developed and implemented. Raw materials must arrive when needed for each subassembly, so that the production process functions smoothly.**
 - (c) **Accurate sales forecasts are needed for effective finished goods planning and production scheduling.**
 - (d) **Products should be designed to use standardized parts to reduce manufacturing time and reduce costs.**
 - (e) **Reliable vendors who can deliver quality raw materials on time with minimum lead time must be obtained.**

CHAPTER 11

DISCUSSION QUESTIONS

- Q11-1. Yes, to the extent that it is practical to measure the value added or the productivity of a worker. However, measurement of the contribution of each individual is never exact. Also, a business cannot pay more for materials or labor than the sales price will recover. Materials, workers, and machines produce products and services. There must be a difference between revenue and costs consumed; otherwise, the business cannot survive.
- Q11-2. Productivity may be defined as the measurement of production performance using the expenditure of human effort as a yardstick. In a broader sense, it may be described as the efficiency with which resources are converted into commodities and/or services that people want.
- Q11-3. Productivity is important to a firm because high productivity reduces the unit cost of the output and makes the firm more competitive. It is important to workers because their real earnings should be increased when productivity is high. Productivity is important to society because increased productivity enables society to get more and better output from the basic resources of the economy.
- Q11-4. To measure labor efficiency, it is necessary to establish a standard of performance. This means determining how much a worker should be able to produce, or how much a work crew should be able to produce. The standard is determined by time and motion study, test runs by skilled workers, and averages of past performance by skilled workers.
- Q11-5. The purpose of an incentive wage plan is to induce a worker to produce more, resulting in a higher wage and reduced conversion cost per unit. Frequently, machine output is limited by worker performance. If employee performance can be increased, machine cost per unit of production will decrease. An incentive wage plan may also reduce loafing, indifference, and carelessness, and may generate a cost-conscious labor force.
- Q11-6. Generally, hourly earnings go up with increased production, and labor cost per unit of output is reduced. High production rates also reduce overhead cost per unit of output, which is often the most significant savings.
- Q11-7. (a) During periods of curtailed activity, it is just as necessary to keep costs down as it is when operating at full capacity. Assuming that the incentive wage plan resulted in greater labor efficiency and lower costs per unit at full capacity, then the labor cost per unit should be lower in a slack period if the incentive wage scale is continued. A shorter workweek or some other system of sharing the work would be indicated.
- (b) Ordinarily, it is not a propitious time to initiate an incentive wage plan when a plant is operating far below capacity, because the worker is already fearful of something less than full employment. If a reasonable day's work is being received for the going rate of pay, postponement of the incentive plan is indicated. However, there is a natural tendency for workers to reduce output during such periods, thereby increasing costs, with a tendency to bring about further reduction in the volume that can be sold. With full explanation and understanding of the situation, the incentive wage could be introduced with a plant operating at 60% capacity.
- Q11-8. In the straight piecework plan, each worker is paid a certain amount for each unit produced, while being guaranteed a base hourly wage. In the 100% bonus plan, each worker is paid for the standard time to complete the job or units if the job or units are finished in standard time or less. In the group bonus plan, workers in a group are paid their standard hourly wage. If the group produces units in excess of the standard, the workers are paid for the time saved.
- Q11-9. An organizational or gainsharing incentive plan is designed to provide incentive pay to all employees by way of an organization-wide plan that rewards for improved productivity.
- Q11-10. The basic concept underlying the relationship involved in the cumulative average time learning curve model is that every time the cumulative quantity of units produced is doubled, the cumulative average time per unit is reduced by a given percentage.
- Q11-11. The learning curve theory is used to solve problems such as determining labor costs in bids for government contracts, determining lot costs for various stages of production runs, predicting labor-hour requirements, permitting the calculations of standard labor cost variances, assisting in the evaluation of a manager's performance, and providing a basis for cost control.
- Q11-12. The financial accounting aspect is concerned with a record of earnings of each employee and payment of the workers. Financial accounting records income, FICA, and other payroll taxes and deductions withheld; provides for disbursing funds to workers and to taxing and other agencies; reports to each employee at least annually the amount of wages earned

and the amounts withheld for various purposes; and records the payroll liability and payment each payroll period.

The cost accounting aspect is concerned with time worked on each job or in each cost center, in order to determine the labor hours and labor cost of production.

- Q11-13. An efficient labor force begins with the design of the product and an analysis of production techniques and job requirements. With the personnel department adequately informed about job specifications, it is the function of this department to secure the personnel qualified to do each job. The production planning department keeps the work flowing smoothly. The timekeeping, payroll, and cost accounting departments contribute to the total efficiency by accounting for the time purchased and by making payment for the work as well as charging the cost to the proper department and product.
- Q11-14. (a) Determining labor hours worked by each employee is primarily for payroll purposes and financial accounting.
- (b) Determination of labor hours consumed on each job or in a department is a part of cost determination for a job or process. It should also be a measure of labor efficiency, since hours consumed and productive output can be compared.
- Q11-15. (a) The clock card shows the amount of time an employee spent in the plant each day of a payroll period. It is evidence that the employee's time has been purchased.
- (b) The time ticket shows the amount of time an employee spends each day on each job or in each department. It is an itemized invoice of the time that the employee sells to the employer.
- Q11-16. Since the clock cards show the time employees are in the plant, the first step is to make sure no error exists on the time tickets. If the total time shown on the time tickets is correct, then the workers spent time in the plant when not working or not assigned to specific jobs or departments, or when assigned to maintenance or repair work. For the time that is idle or assigned to indirect labor, a charge is made to Factory Overhead.

Q11-17. Bar codes are symbols that can be processed electronically to identify numbers, letters, or special characters. Bar-coded employee identification cards or badges, and task identifications can be used to replace clock cards and time tickets to collect payroll data and to measure worker activity.

Q11-18. Appendix One method would be to charge the premium costs directly to the products in the same manner as straight-time labor costs. This would be appropriate when particular jobs have to be rushed to completion. A second method would be to treat the premium as an overhead element to be charged to all production through the allocation of overhead. It would be appropriate when the overtime is a recurring condition normally incident to the level of operations.

Q11-19. Appendix The bonus and vacation pay should be accrued over the benefited time period. When the bonus and vacation pay are paid, the accrued liability account is debited and the cash and withholding accounts are credited.

Q11-20. Appendix The recommended method in computing costs under a pension plan is to determine actuarially the eventual pension payments to covered employees and to charge these future payments as a cost of current production over the expected period of active service of covered employees. Costs based on past services should be written off over some reasonable period on a systematic and rational basis that does not distort the operating results of any one year. These costs are incurred in contemplation of the present and future services not only of the individual employee, but also of the organization as a whole. Benefits of the plan—such as improved morale, removal of superannuated employees, and attraction of more desirable personnel—are expected to improve the operating efficiency of a company.

EXERCISES

E11-1

ORANGE CITY CANNING COMPANY
Labor Schedule for Terry Pace
For First Week in June

Hours worked	40
Units produced	1,320
Standard production (40 x 30)	1,200
Efficiency ratio (1,320 ÷ 1,200)	110%
Base wage	\$9
Weekly earnings (\$9 x 40 x 110%)	\$396
Effective hourly rate (\$396 ÷ 40)	\$9.90
Labor cost per unit (\$396 ÷ 1,320)	\$.30

E11-2

(1)	Monday	Tuesday	Wednesday	
Hours x hourly rate	\$64.00	\$64.00	\$64.00	
Units above standard	0	10	15	
Hours saved .....		.50	.75	
Value of time saved		\$ 4.00	\$ 6.00	
80% of value of time saved		\$ 3.20	\$ 4.80	
Earnings	\$64.00	\$67.20	\$68.80	\$200.00

- (2) Efficiency ratio: $\frac{860}{800} = 107.5\%$

Earnings: $107.5\% \times \$8 \text{ hourly rate} \times 40 \text{ hours} = \344

- (3) Earnings: $(\$8 \text{ hourly rate} + 5\% \text{ rate increase}) \times 24 \text{ hours} =$
 $\$8.40 \times 24 \text{ hours} = \201.60

E11-3

Day	Standard Hours for		Actual Hours	Regular Group Wage	Bonus (Hrs. Saved @ \$12.50)	Total Group Earnings	Labor Cost per Unit	Overhead Cost per Unit	Con- version Cost per Unit
	Units Produced	Units Produced							
Monday	460	46.0	48	\$600	\$ 0	\$600.00	\$1.304	\$2.087	\$3.391
Tuesday	475	47.5	48	600	0	600.00	1.263	2.021	3.284
Wednesday	492	49.2	48	600	15.00	615.00	1.250	1.951	3.201
Thursday	500	50.0	48	600	25.00	625.00	1.250	1.920	3.170
Friday	510	51.0	48	600	37.50	637.50	1.250	1.882	3.132

E11-4

Day	Hours Worked	Standard Production	Actual Production	Excess		% Bonus	Base Earnings	Amount Bonus		Total Earnings
				Excess	% Excess					
Monday	80	16,000	17,824	1,824	11.4	5.70	\$ 720	\$ 41.04	\$	761.04
Tuesday	74	14,800	16,206	1,406	9.5	4.75	666	31.64		697.64
Wednesday	80	16,000	18,048	2,048	12.8	6.40	720	46.08		766.08
Thursday	76	15,200	17,480	2,280	15.0	7.50	684	51.30		735.30
Friday	72	14,400	16,733	2,333	16.2	8.10	648	52.49		700.49
Total	382	76,400	86,291	9,891	12.9	6.45	\$3,438	\$222.55		\$3,660.55

- (2) Assuming each employee receives the base wage of \$9 per hour and that all members of the crew worked the same number of hours during the week, earnings per worker would be \$366.06 for the week ($\$3,660.55 \div 10$).

E11-5 19A productivity ratio =

19A standard hours for work done +
 19A total actual direct and indirect labor hours =
 $643,823 + 1,525,324 = .422089$

Hours needed for 19B production at 19A productivity ratio =	
19B standard hours for work done + 19A productivity ratio =	
$558,510 + .422089$	1,323,204
Less 19B total actual direct and indirect labor hours	1,284,983
Hours saved	<u>38,221</u>

Value of wages saved = hours saved x 19B
 average hourly pay plus labor fringe benefits =
 $38,221 \times \$14.70 = \$561,849$

Employee gainsharing incentive total =
 value of wages saved x 50% =
 $\$561,849 \times 50\% = \$280,924.50$

Gainsharing incentive per employee =
 total gainsharing incentive + number
 of eligible employees =
 $\$280,924.50 + 755 \text{ employees} = \372.09

E11-6	1 batch	\$60,000	
	2 batches.....	\$48,000	(80% of \$60,000)
	4 batches.....	\$38,400	(80% of \$48,000)
	8 batches.....	\$30,720	(80% of \$38,400)
	16 batches.....	\$24,576	(80% of \$30,720)

E11-7

Bridge Number	x	Cumulative Average Required Weeks per Bridge
1		100
2		80 (100 weeks x 80%)
4		64 (80 weeks x 80%)
8		51.2 (64 weeks x 80%)

7 additional bridges must be built in order to bring the cumulative average below 52 weeks.

E11-8

- (1) The schedule below demonstrates the 80% learning curve that the company expects to experience in producing the time devices:

<u>Cumulative Lots</u>	x	<u>Cumulative Average Time</u>	=	<u>Cumulative Time</u>
1		90.00 hours		90.00 hours
2		72.00		144.00
4		57.60		230.40
8		46.08		368.64

At an 80% learning factor, the cumulative time to produce 8 lots should be 368.64 hours. At a standard labor rate of \$9 per direct labor hour, the standard amount for total direct labor cost should be set at \$3,317.76 (368.64 x \$9).

- (2) The company should establish the standard for direct labor time equal to the marginal direct labor time required to produce the eighth lot, providing steady-state production occurs after the eighth lot. To assure that this standard time will be accurate, the company should:
- Keep accurate records through the first 8 lots to determine if an 80% learning factor is experienced.
 - Continue to keep accurate records for each successive production lot to provide a basis for:
 - Conformance to expectations about labor time (i.e., steady state production after 8 lots), or
 - Determining when steady-state production does occur.

E11-9 APPENDIX

- (1) Overtime premium charged to production worked on during the overtime hours:

Work in Process.....	495	
Payroll (40 hours x \$9) + (10 hours x 1.5 x \$9).....		495

- (2) Overtime premium charged to factory overhead:

Work in Process (50 hours x \$9)	450	
Factory Overhead Control (10 hours x .5 x \$9)	45	
Payroll.....		495

E11-10 APPENDIX

	Subsidiary Record	Dr.	Cr.
Factory Overhead Control.....		201.60	
Bonus Pay.....	134.40 ¹		
Vacation Pay	67.20 ²		
Liability for Bonus.....			134.40
Liability for Vacation Pay			67.20
¹ $(\$10 + \$32) \times 40 \text{ hours} \times 4 \text{ weeks} = \$6,720 \div 50 \text{ weeks} = \134.40 ² $(\$10 + \$32) \times 40 \text{ hours} \times 2 \text{ weeks} = \$3,360 \div 50 \text{ weeks} = 67.20$			

E11-11 APPENDIX

Factory Overhead Control (\$35,000 x 28%).....	9,800	
Marketing Expenses Control (\$8,000 x 28%).....	2,240	
Administrative Expenses Control (\$7,000 x 28%)	1,960	
Liability for Pensions (\$50,000 x 7.8%)		3,900
Liability for Other Postretirement Benefits (\$50,000 x 2.3%)		1,150
FICA Tax Payable (\$50,000 x 7.5%)		3,750
Federal Unemployment Tax Payable (\$50,000 x .8%)		400
State Unemployment Tax Payable (\$50,000 x 4.6%)		2,300
Workers' Compensation Insurance Payable (\$50,000 x 1%)		500
Medical Insurance Payable (\$50,000 x 4%)..		2,000

CGA-Canada (Adapted). Reprint with permission.

E11-12 APPENDIX

- (1) The entry to record the payroll liability:

Payroll	26,700.00	
Employees Federal Income Tax Payable		2,500.00
Employees State Income Tax Payable		500.00
Employees City Wage Tax Payable		267.00
FICA Tax Payable.....		2,002.50
Accrued Payroll.....		21,430.50

- (2) The entry to distribute the payroll:

Work in Process	18,000.00	
Factory Overhead Control	3,000.00	
Marketing Expenses Control	4,200.00	
Administrative Expenses Control	1,500.00	
Payroll		26,700.00

E11-12 APPENDIX (Concluded)

(3) The entry to record the employer's payroll taxes:

Factory Overhead Control	2,394.00	
Marketing Expenses Control	478.80	
Administrative Expenses Control	171.00	
FICA Tax Payable		2,002.50
State Unemployment Tax Payable		854.40
Federal Unemployment Tax Payable.....		186.90

PROBLEMS

P11-1

(1) Present cost:

Direct labor per hour	\$10
Factory overhead per direct labor hour...	12
	<u>\$22 + 5 units per hour =</u>
	<u>\$4.40 conversion cost per unit</u>

Units Assembled per 8-Hour Day	Piecework Rate	Per Worker per 8-Hour Day			Conversion Cost per Unit
		Direct Labor	Factory Overhead	Total Conversion Cost	
40	\$2.00	\$ 80.00	\$96.00	\$176.00	\$4.40
45	2.12	95.40	96.00	191.40	4.25
50	2.20	110.00	96.00	206.00	4.12
55	2.30	126.50	96.00	222.50	4.05
60	2.40	144.00	96.00	240.00	4.00

- (2) If a production rate above 40 units per employee per 8-hour day is reasonably attainable by the worker, the employee earnings will increase under the piecework proposal. Since conversion cost per unit decreases with increased output, management should favor the piecework proposal.

P11-2

(1)

Regular Workweek				Incentive Wage Plan			
Employee	Hourly Rate	Work-Week	Total Labor Cost	Base Pay (Base Rate x Work Hours)	Incentive Pay (Units Produced x Incentive Premium)	=	Total Labor Cost
Clancy, D.....	\$6.00	x 40 hrs.	= \$240	\$3.50 x 40 hrs.	= \$140	165 x \$1.00 = \$165	\$ 305
Luken, T.....	8.00	x 40 hrs.	= 320	5.50 x 40 hrs.	= 220	165 x 1.00 = 165	385
Schott, J.....	7.00	x 40 hrs.	= 280	4.50 x 40 hrs.	= 180	165 x 1.00 = 165	345
Total direct labor.....			<u>\$840</u>	Total direct labor			<u>\$1,035</u>

\$1,035 - \$840 = \$195 labor cost increase

Proof: $\frac{\$195}{\$840} = 23.2\%$ labor cost increase

P11-2 (Concluded)

- (2) To assess properly the effectiveness of the new plan, it is necessary to analyze its effect on conversion costs and not just on direct labor costs. Although direct labor cost per unit may rise, this increase may be more than offset by distributing the overhead over a larger volume.

A comparison of the two pay plans and their effects on conversion cost per unit shows:

	<u>Total Labor Cost</u>	<u>Labor Cost per Unit</u>	<u>Total Factory Overhead</u>	<u>Overhead per Unit</u>	<u>Total Conversion Cost</u>	<u>Unit Conversion Cost</u>
Incentive wage plan	\$1,035	\$6.27	\$1,200	\$7.27	\$2,235	\$13.55 ¹
Straight hourly rate	840	5.60	1,200	8.00	2,040	13.60 ²
Difference.....		<u>\$.67</u>		<u>\$ (.73)</u>		<u>\$ (.05) net decrease</u>

¹ \$2,235 + 165 = \$13.55

² \$2,040 + 150 = \$13.60

The decrease in conversion cost is minimal; however, the fact that customers can be served sooner might be worth additional labor cost. Based on learning curve theory, the productivity of the worker might increase sufficiently to reach a more satisfactory output and cost level.

P11-3

(1)

Day	Units Produced	Hours	Hourly Rate	Daily Wage	Units Above Standard	Time Saved (Hours)	Value of Time Saved	Premium 60%	Total Daily Earnings	Effective Rate per Hour	Unit Labor Cost
Monday	140	8	\$9	\$72				\$72.00	\$ 9.000		\$.514
Tuesday	160	8	9	72				72.00	9.000		.450
Wednesday	175	8	9	72	15	.75	\$6.75	\$4.05	76.05	9.506	.435
Thursday	180	8	9	72	20	1.00	9.00	5.40	77.40	9.675	.430
Friday	200	8	9	72	40	2.00	18.00	10.80	82.80	10.350	.414

(2)

Day	Units Produced	Standard Production	Piecework Rates			Total Daily Earnings	Effective Rate per Hour	Unit Labor Cost
			Below Standard	Standard Up to 20% Over	More Than 20% Above			
Monday	140	160	\$.40			\$ 56.00	\$ 7.00	\$.40
Tuesday	160	160		\$.48		76.80	9.60	.48
Wednesday	175	160		.48		84.00	10.50	.48
Thursday	180	160		.48		86.40	10.80	.48
Friday	200	160			\$.56	112.00	14.00	.56

P11-3 (Concluded)

(3)	Hours worked	40
	Units produced	855
	Standard production (20 units x 40 hours)	800
	Efficiency ratio (855 ÷ 800).....	1.06875
	Base wage per hour.....	\$9.00
	Base wage plus bonus (1.06875 x \$9)	\$9.61875
	Weekly earnings (\$9.61875 x 40 hours).....	\$384.75
	Unit cost (\$384.75 ÷ 855 units)	\$0.45

P11-4

(1)

Day	Units Produced	Daily Wage	Units Above Standard	Hours Saved	Premium Wage	Total Pay	Labor Cost per Unit (to four decimal places)	Overhead per Unit (to four decimal places)	Conversion Cost per Unit (to four decimal places)
Monday	180	\$48	0	0	\$ 0	\$48.00	\$2.667	\$1.333	\$4.000
Tuesday	200	48	8	1/3	1.80	49.80	.2490	.1200	.3690
Wednesday	220	48	28	1 1/6	6.30	54.30	.2468	.1091	.3559
Thursday	224	48	32	1 1/3	7.20	55.20	.2464	.1071	.3535
Friday	192	48	0	0	0	48.00	.2500	.1250	.3750

(2)

Hours Worked	Units Produced	Standard Production	Efficiency Ratio (nearest %)	Base Wage	Base x Efficiency Ratio	Week's Earnings	Labor Cost per Unit (to four decimal places)	Conversion Cost per Unit (to four decimal places)
40	1,016	960	106	\$6	\$6.36	\$254.40	\$2.504	\$3.685

(3)

Day	Units Produced	Hourly Wage	Amount Earned	Labor Cost per Unit (to four decimal places)	Conversion Cost per Unit (to four decimal places)
Monday	180	\$6.00	\$48.00	\$2.667	\$4.000
Tuesday	200	6.30	50.40	.2520	.3720
Wednesday	220	6.30	50.40	.2291	.3382
Thursday	224	6.30	50.40	.2250	.3321
Friday	192	6.30	50.40	.2625	.3875

P11-5

Straight Piecework

	<u>Dodd</u>	<u>Hare</u>	<u>Lowe</u>
Units produced—regular time	400	410	370
Piecework rate	\$.66	\$.66	\$.66
Piecework pay	\$264.00	\$270.60	\$244.20
Downtime pay	30.00	0	24.00
Overtime pay	0	54.00 ¹	36.00
Total wages	\$294.00	\$324.60	\$304.20
Wages per books	284.00	277.20	302.20
Underpayment	<u>\$ 10.00</u>	<u>\$ 47.40</u>	<u>\$ 2.00</u>

$$16 \times \$6 \times 150\% = \$54$$

Percentage Bonus Plan

	<u>Ober</u>	<u>Rupp</u>
Units produced	250	180
Standard production	200	200
Efficiency ratio	125%	90%
Regular wages	\$240.00	\$200.00
Bonus	60.00 ¹	0
Total wages	\$300.00	\$200.00
Wages per books	280.00	171.00
Underpayment	<u>\$ 20.00</u>	<u>\$ 29.00</u>

$$^{1}25\% \text{ premium} \times \$240 \text{ regular wage} = \$60$$

or \$6.00 hourly rate

x .25 premium

\$1.50 bonus pay

$$\$1.50 \times 40 \text{ hours} = \$60$$

P11-5 (Concluded)

Emerson Efficiency System

	<u>Suggs</u>	<u>Ward</u>
Units produced.....	240	590
Standard production	300	570 ¹
Efficiency ratio.....	80%	103.5%
Bonus rate	20%	45%
Regular wage	\$224.00 ²	\$212.80 ³
Bonus wage	\$ 44.80	95.76
Downtime pay (2 hours x \$5.60).....		11.20
Total wages	\$268.80	\$319.76
Wages per books.....	233.20	280.00
Underpayment.....	<u>\$ 35.60</u>	<u>\$ 39.76</u>

¹ $\frac{600 \text{ units (standard production for 40 hours)}}{40 \text{ hours}} = 15 \text{ units per hour}$

15 units per hour x 38 productive hours = 570 units (standard production for 38 hours)

240 hours x \$5.60 = \$224.00

³38 hours x \$5.60 = \$212.80

P11-6

(1)	Hours worked (5 workers x 40 hours).....	200
	Regular wage (200 hours x \$6).....	\$1,200
	Units produced.....	452
	Bonus	\$52 *
	Weekly earnings	\$1,252
	Unit labor cost (\$1,252 + 452)	\$2.7699
	Unit factory overhead (\$1,400 + 452)	\$3.0973
	Unit conversion cost	\$5.8672

* 452 units produced

400 units standard

52 units above standard

52 units x \$1 workers' share = \$52 bonus

P11-6 (Concluded)

(2)

	Monday	Tuesday	Wednesday	Thursday	Friday	Total
Units	72	81	95	102	102	452
Standard hours for units	36 ¹	40 1/2	47 1/2	51	51	226
Actual hours	40	40	40	40	40	200
Bonus, \$6 x hours saved	—	\$ 3	\$ 45	\$ 66	\$ 66	\$ 180 ²
Total earnings .	\$240	\$243	\$285	\$306	\$306	\$1,380
Unit labor cost.	\$3.3333	\$3.0000	\$3.0000	\$3.0000	\$3.0000	\$3.0531
Unit factory overhead	\$3.8889	\$3.4568	\$2.9474	\$2.7451	\$2.7451	\$3.0973
Unit conversion cost	\$7.2222	\$6.4568	\$5.9474	\$5.7451	\$5.7451	\$6.1504

¹ 400 units per 40 hours = 10 units per hour
 10 units per hour + 5 workers = 2 units per hour
 72 units produced + 2 units per hour = 36 hours standard time

² If the group bonus is computed for the week, rather than daily, the bonus would be \$6 x 26 hours saved, or \$156. Then, \$1,356 + 452 units = \$3 unit labor cost. Overhead cost would be \$1,400 + 452 units, or \$3.0973 per unit.

P11-7

(1)

THOMAS INC.
Quarterly Bonus Allotment
At End of March

Employees Participating	Points Allowed for Each Employee	Total Points	Share per Point	Total Share
1 Works manager	250	250	\$3.125*	\$ 781.25
2 Production engineers..	200	400	3.125	1,250.00
5 Shop supervisors.....	200	1,000	3.125	3,125.00
1 Storekeeper.....	100	100	3.125	312.50
5 Factory office clerks ...	10	50	3.125	156.25
150 Factory workers	20	3,000	3.125	9,375.00
		<u>4,800</u>		<u>\$15,000.00</u>

* 270,000 units actual production
 240,000 units normal production
30,000 units excess over normal

30,000 units x \$.50 = \$15,000
 \$15,000 + 4,800 points = \$3.125 per point

P11-8

(1)

Cumulative Number of Lots	Cumulative Number of Units (Lot Size = 50)	Time in Hours	
		Cumulative Average Time Per Unit	Cumulative Time
1	50	4.0000	
2	100	3.6000 (4.0000 x .9)	360.00 (3.6000 x 100)
4	200	3.2400 (3.6000 x .9)	648.00 (3.2400 x 200)
8	400	2.9160 (3.2400 x .9)	1,166.40 (2.9160 x 400)
16	800	2.6244 (2.9160 x .9)	2,099.52 (2.6244 x 800)

Direct labor hours required to produce the first 800 units	2,099.52
Direct labor hours required to produce the first 200 units	648.00
Direct labor hours required to produce the next order	<u>1,451.52</u>
Number of units in the next order	<u>600</u>
Direct labor hours per unit for the next order (1,451.52 ÷ 600)	<u>2.4192</u>

Catonic Part Number PCB-31
Unit Costs and Prices for Rex Engineering Company

	Estimates Incorporating a 90% Learning Curve
Materials.....	\$180.00
Labor and employee benefits (2.419 x \$20).....	48.38
Variable overhead (50% of labor).....	24.19
Total variable cost	<u>\$252.57</u>
Fixed overhead	<u>40.00</u>
Full cost.....	<u>\$292.57</u>
Profit contribution (10% of full cost)	29.26
Estimated contract price.....	<u><u>\$321.83</u></u>

- (2) The implications of an 80% learning curve as opposed to a 90% learning curve are:
- (a) An 80% learning curve indicates a greater effect of experience on efficiency.
 - (b) Most of the increase in efficiency (decrease in time and cost per unit) due to an 80% learning curve occurs early in the production run; thus, saturation in learning is achieved earlier with an 80% learning curve.

P11-8

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Direct labor hours required to produce the first 800 units	2,099.52
Direct labor hours required to produce the first 200 units	648.00
Direct labor hours required to produce the next order	<u>1,451.52</u>
Number of units in the next order	<u>600</u>
Direct labor hours per unit for the next order (1,451.52 ÷ 600)	<u>2.4192</u>

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P11-8 (Concluded)

- (3) The degree of learning that takes place in an industrial operation would be reduced by:
- (a) a low proportion of assembly labor to machine labor;
 - (b) an operation of low complexity;
 - (c) high employee turnover;
 - (d) tedium;
 - (e) poor working conditions.

P11-9 APPENDIX

- (1) Charge to work-in-process:

Normal working hours = 40 hours x 2 = 80 hours

Let X = overtime hours

$$X = \frac{\$1,140 - (80 \times \$12)}{(\$12 \times 1.5)}$$

X = 10 hours

Therefore, charge to work in process = 90 x \$12 = \$1,080

- (2) Factory overhead charge for Employee #1071:

Company benefits paid by employer.....	\$273.20	
Overtime premium	60.00	(\$1,140 - \$1,080)
	<u>\$333.20</u>	

- (3) The cost of idleness should be charged to the departmental factory overhead account.

P11-10 APPENDIX

(1)	Apr. 7	Payroll	5,890.00	
		Accrued Payroll.....		4,888.70
		Employees Income Tax Payable (9.5%) ..		559.55
		FICA Tax Payable (7.5).....		441.75
	14	Payroll	4,920.00	
		Accrued Payroll.....		4,083.60
		Employees Income Tax Payable		467.40
		FICA Tax Payable		369.00
	21	Payroll	5,900.00	
		Accrued Payroll.....		4,897.00
		Employees Income Tax Payable		560.50
		FICA Tax Payable		442.50
	28	Payroll	4,880.00	
		Accrued Payroll.....		4,050.40
		Employees Income Tax Payable		463.60
		FICA Tax Payable		366.00

P11-10 APPENDIX (Concluded)

(2)

	Subsidiary Record	Dr.	Cr.
Apr. 30 Work in Process		16,400	
Factory Overhead Control		5,600	
Indirect Labor	5,600		
Payroll			22,000
Apr. 30 Factory Overhead Control		4,466	
FICA Tax (\$22,000 x 7.5%)	1,650		
Federal Unemployment Tax (\$22,000 x .8%)	176		
State Unemployment Tax (\$22,000 x 4%)	880		
Vacation Pay (\$22,000 x 8%) ..	1,760		
FICA Tax Payable			1,650
Federal Unemployment Tax Payable			176
State Unemployment Tax Payable			880
Liability for Vacation Pay			1,760

(3)

Payroll				Accrued Payroll			
Apr. 7	5,890	Apr. 1	2,230	Apr. 1	2,230.00	Mar. 31 Bal.	2,230.00
14	4,920	30	22,000	7	4,888.70	Apr. 7	4,888.70
21	5,900		24,230	14	4,083.60	14	4,083.60
28	4,880			21	4,897.00	21	4,897.00
30	2,640			28	4,050.40	28	4,050.40
	24,230				20,149.70	30	2,640.00
							22,789.70
							2,640.00

Payroll	2,640	
Accrued Payroll		2,640

CASES**C11-1****(1) Arguments used by each proponent:****(a) 1,000-pieces-per-hour-rate:**

- (1) Studies show that machines can be operated at this rate.**
- (2) Variances determined by this output rate will measure the ineffective use of the machines.**
- (3) This rate can be a target level to be strived for, and the changing variances will show progress toward this target.**
- (4) A goal of this nature will motivate the supervisor, and thereby the workers, to reach this rate of output.**

(b) 750-pieces-per-hour-rate:

- (1) This rate of output has been attained by some workers.**
- (2) The 1,000-pieces-per-hour rate has not been attained, nor has any rate near to it been attained.**
- (3) The 600-pieces-per-hour rate is an average of actual performance and does not represent good economical performance.**
- (4) The standard cost should reflect production rates that can be attained when good economical performance occurs. The 750-pieces-per-hour rate, capable of being achieved by some workers, would seem to be such a performance.**
- (5) The variances would measure the extent by which this economical level has been exceeded or the extent to which it has not been met.**
- (6) It should provide motivation for the supervisor to improve on the 600-pieces-per-hour current rate and in turn motivate the employees to improve their performance.**

(c) 600-pieces-per-hour rate:

- (1) This rate has been achieved by the departments as a whole. The standard costs should be set to reflect the ability of the whole department.**
- (2) The variances from standard cost based upon the 600-pieces-per-hour rate would measure the departures, favorable and unfavorable, from the current effective level of operations.**
- (3) For two thirds of the workers, the 750-pieces-per-hour rate would be difficult to attain and would tend to frustrate them, thus making even the present 600-pieces-per-hour rate difficult to maintain. For all workers, the 1,000-pieces-per-hour rate could not be attained, thus lowering the morale of the department and probably lowering output below current levels.**
- (4) The 600-pieces-per-hour-rate, when passed down to the production worker, would be an appropriate goal for those three employees who are producing fewer than 600 pieces per hour.**

C11-1 (Concluded)

- (2) The purpose of standard costs and standard cost reporting is to measure the performance of a department against a level of cost incurrence that represents attainable good economical performance. The variances indicate the periods when the performance varied (favorably or unfavorably) from this acceptable level.

To be used effectively, the rate to motivate the supervisor and, thereby, the workers to improve performance would depend upon the perceptions as to what is attainable. It would also depend upon the reward structures within the firm. Other variables would also affect what output rate would motivate improved performances.

The value picked (e.g., 1,000, 750, or 600) must be a compromise between the level that will have the most effective motivational result and that which will be an effective representation of the costs when the department is operating at an acceptable economical level. The 1,000-pieces-per-hour rate should be rejected because it does not provide the basis for a measure of an acceptable cost level. It would also be of questionable value from a motivational point of view, because it appears to be unattainable by the production workers.

The 750-pieces-per-hour rate is a possible choice. It is capable of being achieved by some workers and as such may provide motivation to the supervisor to bring other workers up to that level, thus achieving a departmental output of 750 pieces per hour. It also may represent the appropriate basis for a standard cost because it is a possible acceptable level of performance. It may also be a suitable departmental target established in connection with the introduction of the standard cost system.

The 600-pieces-per-hour rate is also a possible candidate. The Punch Press Department has achieved this level, and three of the six employees have been able to achieve it. It is, however, the current level of output and that may make it ineffective in motivating the department and its workers to improve the level of output. As the basis for standard costs, it could represent an acceptable level of output; but it does not incorporate the possible improvement likely to be obtained in connection with an introduction of a cost system.

The 750-pieces-per-hour rate seems to be the best choice of the three alternatives. More information about the conditions under which the engineering studies were done, the training and experience of the workers, and the trend of worker and department output in recent periods would be necessary, before the number could be chosen with some assurance that it would meet the stated objectives.

C11-2

- (1) An advantage of the new payroll incentive plan is that it recognizes a problem, which should improve employee motivation. Action taken by management will be perceived as a positive effort to resolve a problem, and employees may feel more a part of the group and behave as team members.

Some disadvantages, which could lower employee motivation, are that employees' files are open to scrutiny by peers, and that employees may feel that they have to be a part of the "in group" to be assured recognition for wage increases. The plan could degenerate into a popularity contest.

- (2) Some advantages that should improve employee productivity are the incentives the plan provides for employees to perform efficiently and effectively, and the beneficial competition it promotes among employees, as long as it is in harmony with corporate goals.

A disadvantage that could lower employee productivity is that the plan could lead to collusion among groups of employees to keep productivity levels artificially low. Employees could approve each other's wage requests without appropriate merit. The plan also could result in inefficiencies, because employees who have had their wage increases turned down may not work up to capacity due to a loss of interest.

- (3) Some advantages that should improve goal congruence between the employee and the company are that the plan indicates the company's interest in the needs of the employees, and that the plan may result in increased profit through improved productivity, which may lead to employees earning a larger income through increases in wages.

Some disadvantages that could lower goal congruence are that employees may mistrust a wage plan suggested and implemented by management, and that there may be an overemphasis on a limited range of performance measures.

- (4) Some advantages that should improve administration of the plan are that procedures for requesting a wage increase and for its approval are clear and unambiguous, and the plan allows for relatively quick positive feedback and peer recognition.

Some disadvantages that could hamper plan administration are that there is a limited amount of management input and control, and that there will be additional record-keeping responsibilities associated with the voting procedures and maintenance of employee productivity records and personnel files.

C11-3

- (1) The basic premise of the learning curve is increased productivity as experience is gained in the performance of repetitive tasks. Various inputs to the production process may be used more efficiently as cumulative output increases, but in most production processes the majority of cost savings associated with a learning phenomenon involve the use of human labor.

(2)
$$\frac{(3,200 + 2,240) + 16}{3,200 + 8} = \frac{340}{400} = 85\% \text{ learning rate}$$

- (3) With a learning rate up to cumulative output of 32 units, average direct labor hours used to produce these 32 units should equal 85% of the average direct labor hours used to produce the first 16 units. In short, average hours employed for each unit when 32 units are completed should equal:

$$340 \times .85 = 289 \text{ hours per unit.}$$

This implies a total of $289 \times 32 = 9,248$ hours used in the production of the first 32 units, or

$$9,248 - 3,200 - 2,240 = 3,808 \text{ hours}$$

used in the production of units 17 through 32. If the average hours per unit in this production batch is taken as the direct labor standard, the standard per unit becomes:

$$\frac{3,808 \text{ hours}}{16 \text{ units}} = 238 \text{ hours per unit}$$

- (4) Bid price on order of 96 units:

Raw materials (50 sq. ft. x \$30).....	\$	1,500
Direct labor (238 hours x \$25).....		5,950
Variable factory overhead (238 hours x \$40).....		9,520
Total variable manufacturing cost per unit	\$	16,970
Markup (\$16,970 x 30%)		5,091
Bid price per unit	\$	22,061
Number of units.....	x	96
Total bid price		<u>\$2,117,856</u>

- (5) Some applications of the learning curve in the planning and controlling of business operations are setting performance standards, preparing cost estimates in competitive bidding, determining budget allowances for labor and labor-related costs, scheduling labor requirements, and determining performance evaluations in which periodic progress reports are compared with accomplishments expected under the curve.

C11-4**Shortcomings:**

- (1) Actual payroll hours are not approved by production management.
- (2) There is inadequate segregation of duties within the Payroll Department.
- (3) Personnel Department should not have access to payroll checks.
- (4) Department supervisors should not distribute the payroll checks.

Suggested corrective action:

- (1) All incoming time cards should be signed by both the employee and supervisor.
- (2) The payroll clerk preparing the input for data processing should not do the reconciling, but rather a second clerk should reconcile the payroll journal to the time cards.
- (3) An employee of supervisory level should authorize voiding of computer-generated checks and the subsequent preparation of a manual replacement check.
- (4) Replacement checks should be processed following good internal control procedures.
- (5) All payroll checks, including unsigned replacement checks, should then be given to the Accounting Department rather than to the Personnel Department for storage in a secure location until payday. No Accounting Department employee with payroll recordkeeping responsibility should have access to the undistributed checks.
- (6) On payday, checks should be distributed, preferably by a Treasurer's Department employee or by an Accounting Department employee who does not have record-keeping responsibilities.

C11-5

(The requirement does not ask for a list of responsibilities Osborne has violated, but, merely, which of the fifteen responsibilities apply to Osborne's situation.)

Management accountants have a responsibility to:

Competence: Prepare complete and clear reports and recommendations after appropriate analyses of relevant and reliable information. (Osborne knows that if he consents to Wallace's request, the resulting maintenance job cost reports would be materially misstated and would present false and misleading information.)

Integrity: Refrain from engaging in any activity that would prejudice their ability to carry out their duties ethically. (Osborne is being asked to be a party to an activity that would erode his ability to carry out his duties ethically.)

Communicate unfavorable as well as favorable information and professional judgments or opinions. (Osborne is being asked to thwart communication of unfavorable information.)

C11-5 (Concluded)

Refrain from engaging in or supporting any activity that would discredit the profession. (Preparing deliberately misleading maintenance job cost reports clearly would be a discredit to the profession.)

Objectivity: Communicate information fairly and objectively. (Osborne would violate this responsibility if the maintenance job cost reports are altered.)

Disclose fully all relevant information that could reasonably be expected to influence an intended user's understanding of the reports, comments, and recommendations presented. (The shifting of cost among maintenance jobs would violate this ethical responsibility.)

CHAPTER 12

DISCUSSION QUESTIONS

- Q12-1. Supervisors' salaries, indirect labor, overtime premium, supplies, indirect materials, payroll tax, factory insurance, and depreciation.
- Q12-2. The most important reason for variation in factory overhead is the presence of fixed and variable expenses. Therefore, as production volume changes from month to month, the costs will do likewise. However, overhead also will change because of improved or decreased efficiencies and changes in prices paid for overhead items such as supplies and repairs.
- Q12-3. Predetermined rates are used when it becomes obvious that any other method of charging overhead results in inequitable costing and delays the reporting of financial results. Charging actual overhead to jobs and products can result in charging unreasonable amounts of overhead to various periods and in delayed reporting of cost data. The use of predetermined rates also enhances control through analysis of over- or underapplied factory overhead.
- Q12-4. Six bases used for applying factory overhead are units produced, direct materials cost, direct labor cost, direct labor hours, machine hours, and transactions. Important considerations in selecting a base are the relationship (correlation) of the base used and the use of overhead items in manufacturing operations, as well as the clerical practicability of using a particular base.
- Q12-5. Predetermined rates are used to charge overhead and become the basis for determining the cost of a job or product. Therefore, the reasonableness of such costs is to a large extent determined by the reasonableness of the rates. Since these costs are used for costing inventories and play an important role in establishing sales prices, the selection of proper predetermined rates can be appreciated.
- Q12-6. An objective in selecting the base for a predetermined factory overhead rate is to ensure the application of factory overhead in reasonable proportion to a beneficial or causal relationship to jobs, products, or work performed or to be performed, i.e., for estimating purposes. Ordinarily, the base selected should be closely related to functions represented by the applied overhead cost. If factory overhead costs are predominantly labor oriented, such as supervision and indirect labor, the proper base would probably be direct labor hours. If factory overhead costs are predominantly related to the cost incurred in the ownership and operation of the machinery, the proper base would probably be machine hours.
- Another objective in selecting the base is to minimize clerical cost and effort relative to the benefits attained. When two or more bases provide approximately the same applied overhead cost to specific units of production, the simplest base should be used.
- Q12-7. (a) Theoretical capacity is actually the maximum production possible from a given plant with no allowance made for cessation of operations for holidays, weekends, materials shortages, or machine breakdowns.
- (b) Practical capacity is theoretical capacity less an allowance for interruptions such as breakdowns, delays in receiving supplies, and worker absences. Practical capacity is usually 75 to 85 percent of theoretical capacity.
- (c) Expected actual capacity is practical capacity adjusted for the lack of sufficient demand in a single operating period and may be used in building operating budgets when expected capacity differs substantially from normal capacity.
- (d) Normal capacity is practical capacity adjusted to give consideration to the lack of sufficient demand over a period long enough to include cyclical and seasonal fluctuations. This is usually the basis for long-range planning, standards, and preferably for the determination of overhead rates.
- Q12-8. The underapplied overhead will be higher if maximum capacity is used and lower if normal is used. If this cost is charged to the current period, then maximum capacity will produce a lower, and normal capacity a higher, operating profit.
- Q12-9. (a) Idle capacity costs arise from idle employees and idle facilities. Idle employees give rise to costs such as base wages paid, employer's share of payroll taxes, and other fringe benefit costs. Idle facilities cause capacity costs due to deterioration with time, approaching obsolescence, costs for upkeep, readiness, maintenance, repairs, shelter, and protection of valuables such as insurance.
- (b) When idle capacity is present, an attempt should be made to segregate idle employees and idle facilities through proper reclassification. The accumulation of the cost attributable to these idle workers or facilities in excess of a reasonable budgeted amount might be in some kind

of overhead account to be treated separately as a "management by exception" factor. Idle capacity costs should be accounted for separately for these reasons: (1) to prevent distortion and confusion in the analysis of production costs; (2) to facilitate income determination; (3) to control operations; and (4) to plan next year's budget adequately.

- (c) Excess capacity cost has been identified with those capacity costs that result from greater production capacity than the company could ever hope to use, or from unbalanced equipment or machinery within departments. In creating the forecast budget, it is important to isolate the excess capacity cost so that management can be made aware of its responsibility regarding the excess investment in labor and machines.

Q12-10. (a) Analyze and identify the overhead transactions.

(b) Journalize the transactions.

(c) Enter transactions in general and subsidiary ledgers.

Q12-11. Overhead applied to production is entered as a credit in the factory overhead control account. Actual overhead is debited to the same

account. Therefore, overhead has been overapplied when the account has a credit balance.

Q12-12. Overhead can be overapplied because (a) actual overhead was less than budgeted; (b) capacity utilized was greater than that estimated in computing overhead rates; (c) the overhead estimate was too high (a mistake); (d) the production estimate was too low (a mistake); (e) combinations of the above.

Q12-13. Over- or underapplied factory overhead may be prorated among work in process, finished goods, and cost of goods sold, or it may be treated entirely as a period cost. The first method would have a smaller effect on cost of goods sold and therefore on the net income for the period.

Q12-14. The existence of large underabsorbed variances does not necessarily mean that unit costs are incorrect. An analysis of the underabsorbed figures will indicate (a) whether actual overhead is too high or whether expenses have been incorrectly estimated; and (b) what part of the underabsorption is caused by unused capacity. If actual overhead is considered to be too high and there is idle capacity, unit costs computed are more reasonable than they would be if overhead rates were computed to absorb all of the actual overhead.

EXERCISES

E12-1

- (1) \$1,750,000 fixed overhead and \$720 variable overhead per ton, calculated as follows:

For both the normal capacity and expected actual capacity, the problem states the total budgeted overhead cost and the number of tons of activity. The high-low method of estimating cost behavior can be used to determine the overhead budget, using those two points:

<u>Activity Level</u>	<u>Tons</u>	<u>Budgeted Overhead</u>
Normal capacity	6,000	\$6,070,000
Expected actual	5,000	5,350,000
Difference	<u>1,000</u>	<u>\$ 720,000</u>

$$\text{Variable overhead rate} = \frac{\$720,000}{1,000 \text{ tons}} = \$720 \text{ variable overhead per ton}$$

$$\begin{aligned} \text{Budgeted fixed overhead} &= \$5,350,000 \text{ total overhead} \\ &\quad - (\$720 \times 5,000) \text{ variable overhead} \\ &= \$5,350,000 - \$3,600,000 = \$1,750,000 \end{aligned}$$

$$\begin{aligned} \text{or, budgeted fixed overhead} &= \$6,070,000 \text{ total overhead} \\ &\quad - (\$720 \times 6,000) \text{ variable overhead} \\ &= \$6,070,000 - \$4,320,000 = \$1,750,000 \end{aligned}$$

E12-1 (Concluded)

- (2) The predetermined rate at practical capacity would be \$895 per ton. Using the budget for fixed and variable overhead, a predetermined overhead rate can be calculated at any level of activity within the relevant range. Assuming practical capacity is within that range, the calculation is:

$$\begin{array}{l} \text{Predetermined} \\ \text{overhead rate at} \\ \text{practical capacity} \\ \text{(8,000 tons)} \end{array} = \frac{\text{Budgeted total overhead at practical capacity}}{\text{Practical capacity in tons}}$$

$$\begin{aligned} & \text{Budgeted fixed overhead} \\ & + \text{Budgeted variable} \\ & \text{overhead at 10,000 tons} = \frac{\$1,750,000 + (\$720 \times 10,000)}{10,000 \text{ tons}} \\ & = \frac{\$1,750,000 + \$7,200,000}{10,000 \text{ tons}} = \frac{\$8,950,000}{10,000 \text{ tons}} = \$895 \text{ per ton} \end{aligned}$$

$$\begin{aligned} \text{or, } & \$720 \text{ variable overhead per ton} + (\$1,750,000/10,000 \text{ tons}) \\ & = \$720 \text{ per ton} + \$175 \text{ per ton} = \$895 \text{ per ton.} \end{aligned}$$

E12-2

Work in process balance, September 30	\$12,200
Less materials still in process	5,560
Factory overhead and direct labor still in process	<u>\$ 6,640</u>

Charged to
Work in Process

	Amount	%				
Factory overhead	\$15,840	44%*	x	\$6,640	=	\$2,921.60
Direct labor	<u>20,160</u>	<u>56</u>	x	<u>6,640</u>	=	<u>3,718.40</u>
	<u>\$36,000</u>	<u>100%</u>				<u>\$6,640.00</u>

$$^* \$15,840 \div \$36,000 = 44\%$$

(or)

$$\$15,840 \text{ (factory overhead)} \div \$20,160 \text{ (direct labor)} = .7857$$

Let X = direct labor still in process

$$\text{Then, } X + .7857X = \$6,640$$

$$1.7857X = \$6,640$$

$$X = \$3,718.4297 \text{ direct labor still in process}$$

$$.7857X = \$2,921.5702 \text{ factory overhead still in process}$$

$$\underline{\underline{\$6,639.9999}}$$

E12-3

- (1) $135 \text{ people} \times 8 \text{ hrs. per day} \times 5 \text{ days per week} \times 48 \text{ weeks} = 259,200 \text{ direct labor hrs.}$
- (2) $135 \text{ people} \times 10 \text{ hrs. per day} \times 4 \text{ days per week} \times 48 \text{ weeks} = 259,200 \text{ direct labor hrs.}$

E12-4

Factory overhead rates:

- (1) Units of production: $\$225,000 \div 5,000 \text{ units} = \45
- (2) Materials cost: $\$225,000 \div \$500,000 = .45 = 45\%$
- (3) Direct labor hours: $\$225,000 \div 56,250 \text{ DLH} = \4
- (4) Direct labor cost: $\$225,000 \div (56,250 \text{ DLH} \times \$8) = .50 = 50\%$
- (5) Machine hours: $\$225,000 \div 75,000 \text{ machine hours} = \3

E12-5

- (1) Assuming normal capacity:
- (a) The factory overhead rate: $(\$400,000 \div 50,000) + \$6.69 = \$14.69$
- (b) The fixed part of the factory overhead rate: $\$400,000 \div 50,000 = \8
- (2) Assuming expected actual capacity:
- (a) The factory overhead rate: $(\$400,000 \div 40,000) + \$6.69 = \$16.69$
- (b) The fixed part of the factory overhead rate: $\$400,000 \div 40,000 = \10

E12-6

Actual factory overhead	\$279,000
Applied factory overhead (52,500 machine hours x \$5.10*)	<u>267,750</u>
Underapplied factory overhead for the period	<u>\$ 11,250</u>

* $\$255,000 \div 50,000 \text{ budgeted machine hours} = \5.10

E12-7

(1)	Work in Process.....	1,450,000	
	Materials.....		1,450,000
	Work in Process.....	928,000	
	Payroll.....		928,000
	Factory Overhead Control.....	563,000	
	Materials, Payroll, Accruals, and Various Credits		563,000
	Work in Process.....	551,000	
	Applied Factory Overhead		551,000
	Applied Factory Overhead	551,000	
	Factory Overhead Control.....		551,000

$$\text{Overhead rate} : \frac{\text{Estimated factory overhead}}{\text{Estimated production}} = \frac{\$570,000}{30,000} = \$19 \text{ per drill}$$

(2) Underapplied factory overhead: $\$563,000 - \$551,000 = \$12,000$

E12-8

Actual factory overhead	\$ 9,500
Applied factory overhead (4,100 units x \$2.46)*.....	<u>10,086</u>
Overapplied overhead.....	<u>\$ (586)</u>

* Variable factory overhead rate	\$2.10
Fixed factory overhead rate (\$1,440 ÷ 4,000 units)	<u>.36</u>
Total factory overhead rate	<u>\$2.46</u>

E12-9

(1) Applied factory overhead:

$$\frac{\$16,920}{36,000 \text{ machine hours}} = \$.47 \text{ fixed portion of rate}$$

$$\frac{2.10}{\$2.57} \text{ variable portion of rate}$$

$$\underline{\underline{\$2.57}} \text{ total rate}$$

$\$2.57 \times 2,700 \text{ machine hours} = \$6,939 \text{ applied factory overhead}$

(2)	Actual factory overhead	\$7,400
	Applied factory overhead.....	<u>6,939</u>
	Underapplied overhead	<u>\$ 461</u>

E12-10

Actual factory overhead	\$836,000
Applied factory overhead (210,000 machine hours x \$4).....	<u>840,000</u>
Overapplied factory overhead.....	<u>\$ (4,000)</u>

E12-11

- (1) Fixed portion of the factory overhead application rate:

$$\frac{\$150,000}{100,000 \text{ machine hours}} = \$1.50 \text{ per machine hour}$$

- (2) Variable portion of the factory overhead application rate:

$$\frac{\$250,000}{100,000 \text{ machine hours}} = \$2.50 \text{ per machine hour}$$

- (3) Actual factory overhead \$411,000
 Applied factory overhead (105,000 x \$4.00) 420,000
 Overapplied factory overhead \$ (9,000)

E12-12

Actual factory overhead	\$14,334
Applied factory overhead (200% of \$8,117)	<u>16,234</u>
Overapplied overhead.....	<u>\$ (1,900)</u>

E12-13

	Requirements (1) & (2)		Requirement (3)	
	Account Balance	Percentage of Total	Applied Overhead	Percentage of Total
Work in process	\$ 6,000	5 %	\$ 2,000	4%
Finished goods	38,000	31 $\frac{2}{3}$ %	16,000	32%
Cost of goods sold	76,000	63 $\frac{1}{3}$ %	32,000	64%
Total	<u>\$120,000</u>	<u>100 %</u>	<u>\$50,000</u>	<u>100%</u>
(1)	Work in Process (5% of \$6,000)		300	
	Finished Goods (31 $\frac{2}{3}$ % of \$6,000)		1,900	
	Cost of Goods Sold (63 $\frac{1}{3}$ % of \$6,000)		3,800	
	Factory Overhead Control			6,000
(2)	Factory Overhead Control		6,000	
	Work in Process (5% of \$6,000)			300
	Finished Goods (31 $\frac{2}{3}$ % of \$6,000)			1,900
	Cost of Goods Sold (63 $\frac{1}{3}$ % of \$6,000)			3,800
(3)	Work in Process (4% of \$6,000)		240	
	Finished Goods (32% of \$6,000)		1,920	
	Cost of Goods Sold (64% of \$6,000)		3,840	
	Factory Overhead Control			6,000

PROBLEMS

P12-1

(1)	Actual overhead incurred.....	\$3,385,000
	Applied overhead*	<u>3,325,000</u>
	Underapplied overhead	<u>\$ 60,000</u>

* actual MH x predetermined rate based on expected actual capacity
 = 9,500 MH x (\$3,500,000/10,000 MH)
 = 9,500 MH x \$350 per MH = \$3,325,000

- (2) The predetermined rate at practical capacity would be \$316.67 per machine hour (MH), calculated as follows:

First, find the budgeted total fixed overhead and the budgeted variable overhead rate per MH. The problem states both the total budgeted overhead cost and the number of MH of activity, at both the normal capacity and expected actual capacity levels, so the high-low method of estimating cost behavior can be used:

Activity Level	Machine Hours	Budgeted Overhead
Expected actual	10,000	\$3,500,000
Normal capacity	8,000	<u>3,000,000</u>
Difference	<u>2,000</u>	<u>\$ 500,000</u>

$$\text{Variable overhead rate} = \frac{\$500,000}{2,000 \text{ MH}} = \$250 \text{ variable overhead per MH}$$

$$\begin{aligned} \text{Budgeted fixed overhead} &= \$3,500,000 \text{ total overhead} \\ &\quad - (\$250 \times 10,000) \text{ variable overhead} \\ &= \$3,500,000 - \$2,500,000 = \$1,000,000 \end{aligned}$$

$$\begin{aligned} \text{or, budgeted fixed overhead} &= \$3,000,000 \text{ total overhead} \\ &\quad - (\$250 \times 8,000) \text{ variable overhead} \\ &= \$3,000,000 - \$2,000,000 = \$1,000,000 \end{aligned}$$

Then, using the budget for fixed and variable overhead, a predetermined overhead rate can be calculated at any level of activity within the relevant range. Assuming practical capacity is within that range, the calculation is:

P12-1 (Concluded)

$$\text{Predetermined overhead rate at practical capacity (15,000 MH)} = \frac{\text{Budgeted total overhead at practical capacity}}{\text{Practical capacity in MH}}$$

$$\begin{aligned} & \text{Budgeted fixed overhead} \\ & + \text{Budgeted variable overhead at 15,000 MH} = \frac{\$1,000,000 + (\$250 \times 15,000)}{15,000 \text{ MH}} \\ & = \frac{\$1,000,000 + \$3,750,000}{15,000 \text{ MH}} = \frac{\$4,750,000}{15,000 \text{ MH}} = \$316.67 \text{ per MH} \end{aligned}$$

$$\text{or, } \$250 \text{ variable overhead per MH} + (\$1,000,000 \div 15,000 \text{ MH}) \\ = \$250 \text{ per MH} + \$66.67 \text{ per MH} = \$316.67 \text{ per MH.}$$

- (3) If the actual overhead of \$3,405,000 were underapplied by \$10,000, then Applied Overhead would have a credit balance of \$3,405,000 - \$10,000, or \$3,395,000. The closing entries are:

Applied Overhead	3,395,000	
Factory Overhead Control		3,395,000
Cost of Goods Sold	10,000	
Factory Overhead Control		10,000

(4)	Account Balance	Percentage of Total
Work in process	\$ 200,000	2.5%
Finished goods	400,000	5.0%
Cost of goods sold	7,400,000	92.5%
Total	<u>\$8,000,000</u>	<u>100.0%</u>
Work in Process (2.5 % of \$10,000)	250	
Finished Goods	500	
Cost of Goods Sold	9,250	
Factory Overhead Control		10,000

P12-2

Factory Overhead Cost	(1) <u>Variable Overhead per Unit</u>	(2) <u>Fixed Overhead</u>
Depreciation on factory building and equipment		
Heat, light, and power.....	$\frac{(\$ 8,000 - \$ 6,000)}{(\quad 15,000 - 10,000)}$	$= \$.40$
		$= a + \$.40 (15,000)$
		$a =$
		$2,000$
Supplies used	$\frac{(\$10,500 - \$ 7,000)}{(\quad 15,000 - 10,000)}$	$= .70$
		$= a + \$.70 (15,000)$
		$a =$
		0
Taxes on factory building		$1,500$
Indirect labor	$\frac{(\$70,000 - \$60,000)}{(\quad 15,000 - 10,000)}$	$= 2.00$
		$= a + \$2.00 (15,000)$
		$a =$
		$40,000$
Maintenance	$\frac{(\$18,000 - \$12,000)}{(\quad 15,000 - 10,000)}$	$= 1.20$
		$= a + \$1.20 (15,000)$
		$a =$
		0
Total	<u>\$4.30</u>	<u>\$58,000</u>

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P12-3

(1) Total cost of Job 50:	
Work in process, December 1	\$ 54,000
December costs:	
Materials	45,000
Direct labor $((\$102,000 + 8,500) \times 3,500)$	42,000
Factory overhead $(\$4.50 \times 3,500)$	15,750
	<u>\$156,750</u>
 (2) Factory overhead costs applied to Job 52 during December:	
$\$4.50 \times 2,000 = \$9,000$	
 (3) Total factory overhead costs applied during December:	
$\$4.50 \times 8,500 = \$38,250$	
 (4) Actual December factory overhead incurred:	
Supplies	\$ 3,500
Indirect labor wages.....	15,000
Supervisory salaries.....	6,000
Building occupancy costs	3,500
Factory equipment costs.....	6,000
Other factory costs	5,000
	<u>\$39,000</u>
 (5) An insignificant amount of over- or underapplied factory overhead would be treated as a period cost.	
 (6)	
Actual overhead	\$39,000
Applied overhead	38,250
Underapplied overhead	<u>\$ 750</u>

P12-4**(1) Actual factory overhead:**

Indirect materials and supplies.....	\$ 18,000
Indirect labor.....	53,000
Employee benefits.....	23,000
Depreciation.....	12,000
Supervision	20,000
	<u>\$126,000</u>

(2) Over- or underapplied factory overhead:

Total direct labor, 20—	\$ 70,000
Factory overhead rate per direct labor dollar	160%
Applied factory overhead	\$112,000
Actual factory overhead	<u>126,000</u>
Underapplied factory overhead	<u>\$ 14,000</u>

(3) Amount included in cost of goods sold for Job 1376:

Beginning balance.....	\$ 72,500
Materials and labor, 20—	8,000
Applied factory overhead, 20— (\$7,000 x 160%)	11,200
	<u>\$ 91,700</u>

(4) Cost assigned to the work in process account at the end of 20—:

Beginning balance (Job 1376).....	\$ 72,500
Cost charged to work in process, 20—:	
Materials	\$ 43,000
Labor	70,000
Applied factory overhead	<u>112,000</u>
	225,000
	<u>\$297,500</u>
Less cost of Job 1376, which was completed and sold.....	91,700
	<u>\$205,800</u>

P12-5

- (1) Predetermined factory overhead rate based on normal capacity:

$$\frac{\$29,250}{45,000 \text{ MH}} = \$.65 \text{ variable portion of rate for expected actual and normal capacity}$$

$$\frac{\$18,000}{60,000 \text{ MH}} = \underline{.30} \text{ fixed portion of rate based on normal capacity}$$

$$\underline{\underline{\$.95}} \text{ total rate based on normal capacity}$$

- (2) Predetermined factory overhead rate based on expected actual capacity:

$$\frac{\$29,250}{45,000 \text{ MH}} = \$.65 \text{ variable portion of rate for expected actual and normal capacity}$$

$$\frac{\$18,000}{45,000 \text{ MH}} = \underline{.40} \text{ fixed portion of rate based on expected actual capacity}$$

$$\underline{\underline{\$1.05}} \text{ total rate based on expected actual capacity}$$

- (3) Amount of factory overhead charged to production if the company used the normal capacity rate:

$$47,000 \text{ MH} \times \$.95 = \$44,650$$

- (4) Amount of factory overhead charged to production if the company used the expected actual capacity rate:

$$47,000 \text{ MH} \times \$1.05 = \$49,350$$

(5)	Actual factory overhead	\$47,100
	Applied overhead (from (3) normal capacity rate)	<u>44,650</u>
	Underapplied overhead	<u>\$ 2,450</u>

(6)	Actual factory overhead	\$47,100
	Applied overhead (from (4) expected actual capacity rate)	<u>49,350</u>
	Overapplied overhead	<u><u>\$(2,250)</u></u>

P12-6

(1) Work in Process:		Finished Goods:	
Direct materials	\$ 9,000	Direct materials	\$10,000
Direct labor	16,000	Direct labor	40,000
Factory overhead		Factory overhead	
(2,000 x \$3.60)	7,200	(5,000 x \$3.60)	18,000
Total	<u>\$32,200</u>	Total	<u>\$68,000</u>
(2) Supervision		\$ 17,500	
Indirect labor		29,050	
Heat, light, and power		23,800	
Depreciation—factory buildings		7,500	
Property tax—factory facilities		4,000	
Insurance on factory buildings		3,000	
Transportation in		6,500	
Repairs and maintenance		8,250	
Depreciation—factory equipment		7,500	
Miscellaneous factory overhead		9,900	
Total actual factory overhead		<u>\$117,000</u>	
(3) Actual overhead		\$117,000	
Applied overhead		115,200	
Underapplied overhead		<u>\$ 1,800</u>	

P12-6 (Concluded)

(4)

COLUMBUS COMPANY
Cost of Goods Sold Statement
For January

Materials:			
Inventory, January 1		\$ 21,000	
Purchases	\$108,000		
Less returns to suppliers	<u>5,050</u>	<u>102,950</u>	
Materials available		\$123,950	
Inventory, January 31		<u>9,000</u>	\$114,950
Direct labor			256,000
Applied factory overhead			<u>115,200</u>
January manufacturing cost			\$486,150
Add work in process, January 1			<u>32,500</u>
			\$518,650
Less work in process, January 31			<u>32,200</u>
Cost of goods manufactured			\$486,450
Add finished goods, January 1			<u>18,000</u>
Cost of goods available for sale			\$504,450
Less finished goods, January 31			<u>68,000</u>
Cost of goods sold at normal			\$436,450
Add underapplied factory overhead			<u>1,800</u>
Cost of goods sold at actual			<u><u>\$438,250</u></u>

CASES

C12-1

(1)	Direct Labor Hours	Factory Overhead Costs
High.....	2,760,000 hours	\$34,500,000
Low	2,160,000	29,880,000
Difference	<u>600,000</u> hours	<u>\$ 4,620,000</u>

Variable rate = \$4,620,000 ÷ 600,000 hours = \$7.70 per direct labor hour

	High	Low
Total cost.....	\$34,500,000	\$29,880,000
Variable cost (\$7.70 per direct labor hour)	21,252,000	16,632,000
Fixed element.....	<u>\$13,248,000</u>	<u>\$13,248,000</u>

Estimated total factory overhead for next year:

Total variable factory overhead (2,300,000 x \$7.70).....	\$17,710,000
Total fixed factory overhead	13,248,000
Total factory overhead	<u>\$30,958,000</u>

(2) Utility of cost behavior information:

- (a) Evaluation of product pricing decisions—The calculation of the factory overhead rate required the company to estimate the variable factory overhead cost. In short-term price-cutting situations, the price set should cover at least the variable materials, labor, factory overhead, and nonmanufacturing costs. For the longer term, the total cost assigned to the various products may provide some basis for price differentials among the items.
- (b) Cost control evaluation—The calculation of the factory overhead rate required the company to estimate the fixed factory overhead cost and the variable factory overhead cost per direct labor hour. The amounts are estimates of what the cost should or will be during the next year. The amounts can be used as the basis for preparation of a budget allowance for actual activity to be compared to actual cost incurred. Any difference between the budget amounts and actual cost would be a measure of the effectiveness of factory overhead cost control.
- (c) Development of budgets—The estimates of fixed factory overhead cost and the variable factory overhead cost per direct labor hour are useful in budget development. They permit the company to calculate the estimated factory overhead cost for different activity levels that are being considered as the budget is developed.

CHAPTER 13

DISCUSSION QUESTIONS

- Q13-1. Departmental overhead rates are preferred to a single rate because they improve the control of overhead by department heads responsible for controllable overhead, and they increase the accuracy of product and job costing when products or jobs move through various producing departments.
- Q13-2. Departmentalizing factory overhead is an extension of methods used in establishing a single rate because (a) an application base must be selected and estimated; (b) overhead estimates must be made; and (c) actual overhead must be accumulated and compared with applied overhead. These steps are required for each producing department, whereas with a single rate, only total factory data are necessary.
- Q13-3. The sum of departmental over- or underapplied overhead would be different. Every direct labor hour would have the same amount of applied overhead when a plant-wide overhead rate is used, assuming that the application base is direct labor hours. However, the use of departmental rates results in different amounts of applied overhead, depending on the labor hours in each department and the individual departmental overhead rates. For example, a firm with an overall rate of \$2 would have \$20,000 of applied overhead for 10,000 hours; the same firm with departmental rates of \$1 and \$3 for its two producing departments could have more or less applied overhead, depending on the breakdown of labor hours receiving the \$1 and \$3 overhead charge.
- The total cost of goods sold and total inventory would also be different, because departmental rates could cause different unit costs. Therefore, inventory and cost of goods sold would be influenced by products sold or still on hand. This would not be the case if a blanket rate were used.
- Q13-4. A producing department is directly concerned with manufacturing products or doing work on various jobs. A service department renders service to various departments and is not directly associated with manufacturing operations. The nature of the work done by a department determines whether it is a service or producing department. Examples of producing departments are cutting, finishing, machining, mixing, and refining. Examples of service departments are maintenance, medical, powerhouse, purchasing, receiving, and cost accounting.
- Q13-5. The kinds of departments established to control and charge costs depend on (a) similarity of a company's operations, processes, and machinery; (b) location of operations, processes, and machinery; (c) responsibilities for production and costs; (d) relationship of operations to flow of product; and (e) number of departments or work centers. The number of departments established depends on the emphasis placed on cost control and on the development of overhead rates.
- Q13-6. Physically different segments of a department or cost pools for different kinds of costs within a department may be driven by activity bases that are quite different, thus calling for the use of subdepartments for factory overhead accumulation, application, and analysis for each physical segment or cost pool.
- Q13-7. No. A more correct method is the use of the plant asset records to compute departmental depreciation, property tax, and fire insurance charges, provided the records are sufficiently detailed for this purpose and the work involved is not too complex. Such a method would give proper recognition to the various depreciation rates used and fire insurance premiums paid because of varying types of equipment.
- Q13-8. Factors involved in selecting the most equitable rate for applying factory overhead include consideration of the nature of a department's operations, the relationship of overhead elements to operations involved, and any clerical difficulties arising through the use of a particular rate.
- Q13-9. The several steps followed in establishing departmental factory overhead rates are:
- Estimating direct overhead of producing departments and the direct costs of service departments.
 - Preparing a factory survey for the purpose of distributing indirect departmental costs and service department costs.
 - Estimating and allocating indirect departmental costs.
 - Distributing service department costs.
 - Computing departmental factory overhead rates.
- Q13-10. The questions that must be resolved in allocating service department costs to benefiting departments include:
- Determining which departments are benefited.
 - Selecting an allocation base.
 - Choosing the allocation method, i.e., direct, step, or simultaneous.
- Q13-11. (a) Direct—No service department costs are allocated to other service departments.
(b) Step—Service department costs are allo-

cated in the order of the departments serving the greatest number of departments and receiving service from the smallest number, or in the order of the largest service department cost allocated to other service departments. Once a service department's costs have been allocated, no costs of other service departments are allocated to it.

- (c) **Simultaneous**—The full reciprocal interrelationships of benefits among service departments are considered.

The simultaneous method is the most accurate for product costing and for identifying total costs for operating particular service departments. However, this method is also the most difficult to compute.

- Q13-12. Control of overhead is achieved by comparing actual results with planned or estimated results. To make such comparisons, both types of overhead must be accumulated and reported in the same manner. Since the computation of overhead rates with required overhead estimates precedes the incurrence and accumulation of actual overhead, the computation procedures determine the accounting for actual overhead.
- Q13-13. Departmental over- or underapplied overhead is determined by comparing actual and applied overhead.
- Q13-14. If a complex product line is produced in a non-departmentalized factory or in a single depart-

ment of a factory, one approach to accurate product costing is to use multiple overhead cost pools and multiple bases within a single responsibility center.

- Q13-15. Nonmanufacturing businesses (such as retail stores, financial institutions, insurance companies, educational institutions, and hospitals) should be divided into departments to budget and control costs. For example, a retail store might be departmentalized as follows: administration, occupancy, sales promotion and advertising, purchasing, selling, and delivery. As in manufacturing businesses, departmental costs are prorated to revenue-producing sales departments by using a charging or billing rate. Departmentalization is particularly necessary for hospitals and educational institutions, which must budget their costs on a departmental basis to control costs and to charge adequate cost recovering fees.
- Q13-16. Government agencies employ large numbers of people, and as they spend larger and larger sums of tax money for various services, taxpayers are demanding more efficient use of that money. Therefore, services should be rendered at the lowest cost with the greatest efficiency. Governmental activities should be budgeted and their costs controlled on a responsibility accounting basis. The efficiency of services should be measured by using such units of measurement as per capita, per mile, or per ton.

EXERCISES

E13-1

Work in Process	33,310	
Applied Factory Overhead—Department A (17,000 x \$.89)		15,130
Applied Factory Overhead—Department B (18,000 x \$1.01**)		18,180
* \$17,800 + 20,000 = \$.89		
** \$20,200 + 20,000 = \$1.01		

E13-2

Departmental Overhead Columns					General Ledger	
	Machining	Painting	Assembly	General Factory Cost Pool	Debit	Credit
(a) Factory Overhead Control	1,500.00	600.00	600.00	300.00	3,000.00	
Accumulated Depr.—Buildings						3,000.00
(b) Factory Overhead Control	6,000.00	2,000.00	1,200.00	400.00	9,600.00	
Accumulated Depr.—Machinery						9,600.00
(c) Factory Overhead Control	550.00	203.33	170.00	76.67	1,000.00	
Accrued Property Tax Payable						1,000.00
(d) Factory Overhead Control	450.00	180.00	180.00	60.00	850.00	
Accr. Worker's Compensation						850.00
(e) Factory Overhead Control	600.00		60.00	90.00	750.00	
Accrued Power Payable						750.00
(f) Factory Overhead Control	900.00	360.00	360.00	180.00	1,800.00	
Accounts Payable						1,800.00
(g) Factory Overhead Control	1,800.00		2,300.00	500.00	4,600.00	
Materials						4,600.00

E13-3

	<u>P1</u>	<u>P2</u>	<u>S1</u>	<u>S2</u>
(1)				
Budgeted factory overhead	\$346,000	\$368,000	\$100,000	\$50,000
Department S1 distribution (90/300, 210/300)	30,000	70,000	(100,000)	
Department S2 distribution (64/80, 16/80)	40,000	10,000		(50,000)
Budgeted factory overhead	\$416,000	\$448,000		
Machine hours	÷ 64,000			
Predetermined rate	<u>\$6.50</u>			
Direct labor hours		+ 100,000		
Predetermined rate		<u>\$4.48</u>		

Job 437 overhead cost:

Department P1	
(3 × \$6.50)	\$19.50
Department P2	
(2 × \$4.48)	8.96
	<u>\$28.46</u>

(2) Plantwide predetermined factory overhead rate:

$$\frac{\$864,000}{135,000 \text{ DLH}} = \$6.40 \text{ per DLH}$$

Job 437 overhead cost (2 × \$4.48)	\$19.20
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E13-4

$$(1) \quad \frac{\$40,000 + \$25,000 + \$361,956 + \$420,000}{452,000 + 567,250} = \frac{\$846,956}{1,019,250} = \$0.83$$

	<u>Total</u>	<u>Machining</u>	<u>Assembly</u>	<u>Building and Grounds</u>	<u>Factory Administration</u>
Budgeted factory overhead	\$846,956	\$361,956	\$420,000	\$40,000	\$25,000
Distribution of:					
Building and grounds		18,000	20,000	(40,000) *	2,000
Factory administration ..		13,200	13,800		(27,000) **
Total	<u>\$846,956</u>	<u>\$393,156</u>	<u>\$453,800</u>		
Base:					
Machine hours		195,600			
Direct labor hours			567,250		
Rate		\$2.01	\$0.80		

* 9/20, 10/20, 1/20 to Machining, Assembly, and Factory Administration, respectively.

** 44/90, 46/90 to Machining and Assembly, respectively.

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E13-5

	<u>Total</u>	<u>Cutting</u>	<u>Assembly</u>	<u>Maintenance</u>	<u>Administration</u>
Overhead budget ..	\$1,290,000	\$520,000	\$420,000	\$200,000	\$150,000
Distribution of:					
Maintenance (21/30, 9/30)...		140,000	60,000	(200,000)	
Administration (15/25, 10/25) ..		90,000	60,000		(150,000)
Overhead budget ..	<u>\$1,290,000</u>	<u>\$750,000</u>	<u>\$540,000</u>		
Machine hours		25,000	20,000		
Overhead rate		30.00	\$27.00		

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E13-6

	<u>Total</u>	<u>Producing Departments</u>		<u>Service Departments</u>	
		<u>Mixing</u>	<u>Finishing</u>	<u>Cafeteria</u>	<u>Product Design</u>
Budgeted factory overhead before distribution of service departments	\$364,000	\$104,000	\$200,000	\$10,000	\$50,000
Distribution of service department costs:					
Cafeteria (\$10,000 + 200 employees = \$50)		3,250	6,500	(10,000)	250
Product Design (\$50,250 + 300 product orders = \$167.50)		16,750	33,500		(50,250)
	<u>\$364,000</u>	<u>\$124,000</u>	<u>\$240,000</u>		
Bases: machine hours		40,000	60,000		
Rates		\$3.10	\$4.00		

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E13-7

	<u>Total</u>	<u>Producing Departments</u>		<u>Service Departments</u>	
		<u>P1</u>	<u>P2</u>	<u>S1</u>	<u>S2</u>
Budgeted overhead ...	\$552,750	\$208,000	\$300,000	\$10,000	\$34,750
Distribution of:					
Department S1		4,500	5,250	(10,000)*	250
Department S2		20,000	15,000		(35,000)**
Total factory overhead	<u>\$552,750</u>	<u>\$232,500</u>	<u>\$320,250</u>		

* 180/400 to P1, 210/400 to P2, 10/400 to S2

** 4,000/7,000 to P1, 3,000/7,000 to P2

P1: $\$232,500 \div 4,000$ machine hours = \$58.125 rate per machine hourP2: $\$320,250 + 10,000$ direct labor hours = \$32.025 rate per direct labor hour

E13-7 (Concluded)

- (2) Plant-wide rate: $\$544,750 \div 15,000$ direct labor hours = $\$36.317$ plant-wide rate per direct labor hour
- (3) Individual jobs may require relatively different amounts of time in each department. If P1 is machine-intensive and P2 is labor-intensive, then separate departmental rates would provide a fairer allocation of costs to jobs.

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E13-8

	<u>Total</u>	<u>Main- tenance</u>	<u>Personnel</u>	<u>Machining</u>	<u>Assembly</u>
Budgeted factory overhead.....	\$270,000	\$30,000	\$15,000	\$150,000	\$75,000
Allocate Maintenance (\$30,000 \div 40,000 sq. ft. = \$.75 per sq. ft.)		(30,000)	<u>3,000</u>	14,250	12,750
Allocate Personnel (\$18,000 \div 120 employees = \$150 per employee).			<u>(18,000)</u>	<u>6,000</u>	<u>12,000</u>
	<u>\$270,000</u>			<u>\$170,250</u>	<u>\$99,750</u>
Divided by machine hours				22,700	
Divided by direct labor hours					16,625
Factory overhead rate				\$7.50	\$6.00

(2) Job No. 3752:

	<u>Machining</u>	<u>Assembly</u>	<u>Total</u>
Materials	\$ 60	\$ 7	\$ 67
Direct labor	24	99	123
Factory overhead:			
10 machine hours @ \$7.50.....	75		
11 direct labor hours @ \$6.00		66	141
	<u>\$159</u>	<u>\$172</u>	<u>\$331</u>

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E13-9

- (1) Equation 1: $E = \$20,000 + .20F$
 Equation 2: $F = \$20,000 + .20E$
 Equation 3: $G = \$10,000 + .30E + .10F$

Substituting Equation 2 into Equation 1:

$$\begin{aligned} E &= \$20,000 + .20(\$20,000 + .20E) \\ E &= \$20,000 + \$4,000 + .04E \\ .96E &= \$24,000 \\ E &= \$25,000 \end{aligned}$$

Substituting $E = \$25,000$ into Equation 2:

$$\begin{aligned} F &= \$20,000 + .20(\$25,000) \\ F &= \$25,000 \end{aligned}$$

Substituting $E = \$25,000$ and $F = \$25,000$ into Equation 3:

$$\begin{aligned} G &= \$10,000 + .30(\$25,000) + .10(\$25,000) \\ G &= \$20,000 \end{aligned}$$

(2)

	Producing Departments		Marketing Depart- ment	General Office	Service Departments			Total
	<u>S</u>	<u>T</u>			<u>E</u>	<u>F</u>	<u>G</u>	
Department overhead before distribution of service departments	\$80,000	\$90,000			\$20,000	\$20,000	\$10,000	\$200,000
Distribution of:								
Department E		12,500			(25,000)	5,000	7,500	
Department F	7,500	10,000			5,000	(25,000)	2,500	
Department G	8,000	6,000	\$4,000	\$2,000			(20,000)	
Total	<u>\$75,500</u>	<u>\$118,500</u>	<u>\$4,000</u>	<u>\$2,000</u>				<u>\$200,000</u>

E13-10

Distribution of Department	Total	Production Departments		Service Departments			
		A	B	C	D	E	F
F.....	\$51,000	\$15,000	\$12,000	\$12,000	\$8,000	\$2,000	\$2,000
D.....		1,000			600	400	<u>\$2,000)</u>
C.....		3,400	1,600	2,600	<u>\$(8,600)</u>	1,000	
E.....		1,360	14,600	<u>\$(14,600)</u>			
	<u>\$51,000</u>	<u>\$20,760</u>	<u>\$30,240</u>			<u>\$(3,400)</u>	

E13-11

Actual costs..... Distribution of service department costs:	Total	Production Departments		Service Departments			
		A	B	C	D	E	F
F (5/10, 0, 0, 3/10, 2/10)	\$401,000	\$100,000	\$80,000	\$120,000	\$56,000	\$15,000	\$30,000
D (125/325, 60/325, 100/325, 40/325)		15,000	12,000		9,000	6,000	(30,000)
C (0, 100%, 0).....		25,000	140,000	20,000	(65,000)	8,000	
E (15/40, 25/40).....		10,875	18,125	<u>(140,000)</u>		<u>(29,000)</u>	
Actual costs.....	<u>\$401,000</u>	<u>\$150,875</u>	<u>\$250,125</u>				

E13-12

$$\begin{aligned}\text{Let: } S1 &= \$20,000 + .20S2 \\ S2 &= \$17,600 + .10S1\end{aligned}$$

$$\begin{aligned}\text{Substituting: } S1 &= \$20,000 + .20 (\$17,600 + .10S1) \\ \text{Solving: } S1 &= \$20,000 + \$3,520 + .02S1 \\ .98S1 &= \$23,520 \\ S1 &= \$24,000\end{aligned}$$

$$\begin{aligned}\text{Substituting: } S2 &= \$17,600 + .10 (\$24,000) \\ &= \$17,600 + \$2,400 \\ &= \$20,000\end{aligned}$$

$$\begin{aligned}\text{Total P1 overhead} &= \$94,000 + .40 (S1) + .50 (S2) \\ &= \$94,000 + .40 (\$24,000) + .50 (\$20,000) \\ &= \$94,000 + \$9,600 + \$10,000 \\ &= \$113,600\end{aligned}$$

E13-13

- (1) The dual predetermined overhead rates are:

$$\frac{\$400,000}{16,000 \text{ direct labor hours}} = \$25 \text{ per direct labor hour}$$

and

$$\frac{\$300,000}{4,000 \text{ machine hours}} = \$75 \text{ per machine hour}$$

- (2)

Job #345

Direct material	\$1,000
Direct labor (30 x \$10).....	300
Applied overhead:	
30 x \$25 = \$750	
10 x \$75 = 750	1,500
Total	<u>\$2,800</u>

E13-14

- (1) The dual predetermined overhead rates are:

$$\frac{\$900,000}{3,600 \text{ machine hours}} = \$250 \text{ per machine hour}$$

and

$$\frac{\$600,000}{300 \text{ tons}} = \$2,000 \text{ per ton}$$

- (2) **Job #103**

Parts and materials	\$22,000
Applied overhead:	
70 x \$250 = \$17,500	
4 x \$2,000 = <u>8,000</u>	<u>25,500</u>
Total	<u>\$47,500</u>

PROBLEMS

P13-1

(1)

Distribution of Service Department Overhead
Using the Direct Method

		<u>Producing Departments</u>		<u>Service Departments</u>	
	<u>Total</u>	<u>Grinding</u>	<u>Smoothing</u>	<u>Main- tenance</u>	<u>Gener Factor</u>
Overhead before distribution of service depart- ments	\$681,000	\$175,000	\$230,000	\$76,000	\$200,000
Distribution of Maintenance		12,667	63,333	(76,000)*	
Gen'l Factory		133,333	66,667		(200,000)
Total factory overhead.....	<u>\$681,000</u>	<u>\$321,000</u>	<u>\$360,000</u>		
Machine hours		+ 4,000			
Direct labor hours.			+ 30,000		
Overhead rates:					
per machine hr...		\$ 80.25			
per direct labor hr.			\$ 12		

* 180/1,080 to Grinding, 900/1,080 to Smoothing
 ** 6/9 to Grinding, 3/9 to Smoothing

P13-1 (Continued)

(2) First, the simultaneous equations are solved:

$$\begin{aligned}\text{Let: } M &= \$76,000 + (1/10)G \\ G &= \$200,000 + (720/1,800)M\end{aligned}$$

$$\text{Substituting: } M = \$76,000 + .1(\$200,000 + .40M)$$

$$\text{Solving: } M = \$76,000 + \$20,000 + .04M$$

$$.96M = \$96,000$$

$$M = \$100,000$$

$$\begin{aligned}\text{Substituting: } G &= \$200,000 + .40(\$100,000) \\ &= \$200,000 + \$40,000 = \$240,000\end{aligned}$$

Distribution of Service Department Overhead
Using the Simultaneous Method

		<u>Producing Departments</u>		<u>Service Departments</u>	
	<u>Total</u>	<u>Grinding</u>	<u>Smoothing</u>	<u>Main- tenance</u>	<u>General Factory</u>
Overhead before distribution of service depart- ments	\$681,000	\$175,000	\$230,000	\$ 76,000	\$200,000
Distribution of Maintenance		10,000	50,000	(100,000)	40,000 *
Gen'l Factory		144,000	72,000	24,000	(240,000) **
Total factory overhead.....	<u>\$681,000</u>	<u>\$329,000</u>	<u>\$352,000</u>		
Machine hours		+ 4,000			
Direct labor hours			+ 30,000		
Overhead rates:					
per machine hr...		\$ 82.25			
per direct labor hr.....			\$ 11.73		

* 180/1,800 to Grinding, 900/1,800 to Smoothing, and 720/1,800 to General Factory

** 6/10 to Grinding, 3/10 to Smoothing, and 1/10 to Maintenance

P13-1 (Concluded)**(3) Distribution of Service Department Overhead
Using the Step Method**

	<u>Total</u>	<u>Producing Departments</u>		<u>Service Departments</u>	
		<u>Grinding</u>	<u>Smoothing</u>	<u>Main- tenance</u>	<u>General Factory</u>
Overhead before distribution of service depart- ments	\$681,000	\$175,000	\$230,000	\$76,000	\$200,000
Distribution of:					
Maintenance		7,600	38,000	(76,000)	30,400*
Gen'l Factory		153,600	76,800		(230,400)**
Total factory overhead	<u>\$681,000</u>	<u>\$336,200</u>	<u>\$344,800</u>		
Machine hours		+ 4,000			
Direct labor hours			+ 30,000		
Overhead rates:					
per machine hr..		\$ 84.05			
per direct labor hr.			<u>\$ 11.49</u>		

* 180/1,800 to Grinding, 900/1,800 to Smoothing, and 720/1,800 to General
Factory

** 6/9 to Grinding, 3/9 to Smoothing

P13-2

(1)	<u>Cutting Department</u>	<u>Assembly Department</u>	<u>Finishing Department</u>
Predetermined factory overhead rate	\$ 2.40/MH	\$ 5.00/DLH	\$ 1.60/DL\$
Actual activity base amount...	x 10,800 MH	x 12,400 DLH	x \$66,000
Applied factory overhead	<u>\$25,920</u>	<u>\$62,000</u>	<u>\$105,600</u>

(2)

$$\text{Revised factory overhead rate} = \frac{\left(\begin{array}{c} \text{Actual overhead for} \\ \text{first six months} \end{array} \right) + \left(\begin{array}{c} \text{Projected overhead for} \\ \text{second six months} \end{array} \right)}{\left(\begin{array}{c} \text{Actual activity base} \\ \text{for first six months} \end{array} \right) + \left(\begin{array}{c} \text{Projected activity base} \\ \text{for second six months} \end{array} \right)}$$

Cutting Department (machine hours):

$$\frac{\$22,600 + \$23,400}{10,800 + 9,200} = \frac{\$46,000}{20,000} = \$2.30 \text{ per machine hour}$$

Assembly Department (direct labor hours):

$$\frac{\$56,800 + \$57,500}{12,400 + 13,000} = \frac{\$114,300}{25,400} = \$4.50 \text{ per direct labor hour}$$

Finishing Department (direct labor dollars):

$$\frac{\$98,500 + \$96,500}{\$66,000 + \$64,000} = \frac{\$195,000}{\$130,000} = \$1.50 \text{ per direct labor dollar}$$

P13-2 (Concluded)

- (3) The applied overhead accounts should be adjusted by the difference in the factory overhead rates (revised rate less original rate) times the actual activity for the first six months.

Cutting Department	(((\$2.30 - \$2.40) x 10,800)	\$ (1,080)
Assembly Department	(((\$4.50 - \$5.00) x 12,400)	(6,200)
Finishing Department	(((\$1.50 - \$1.60) x \$66,000)	(6,600)
Decrease in applied factory overhead		<u><u>\$ (13,880)</u></u>

The applied overhead adjustment is allocated to the inventory accounts and cost of goods sold on the basis of the unadjusted overhead component in each account.

Work in Process	\$ 12,000	5%
Finished Goods.....	48,000	20
Cost of Goods Sold.....	180,000	75
	<u><u>\$240,000</u></u>	<u><u>100%</u></u>

	<u>Debit</u>	<u>Credit</u>
Applied Factory Overhead—Cutting	1,080	
Applied Factory Overhead—Assembly.....	6,200	
Applied Factory Overhead—Finishing	6,600	
Work in Process Inventory (\$13,880 x .05)		694
Finished Goods (\$13,880 x .20)		2,776
Cost of Goods Sold (\$13,880 x .75)		10,410

P13-3

	Producing Departments			Service Departments		
	Dept. 10	Dept. 12	Dept. 14	Store-room	Repairs and Maintenance	General Factory Cost Pool
Direct departmental overhead:						
Supervision	\$20,500	\$16,000	\$14,000	\$7,200	\$8,000	\$24,000
Indirect labor	5,400	6,000	8,000	6,133	7,200	18,000
Indirect supplies	4,850	5,600	5,430	1,400	3,651	1,070
Labor fringe benefits	6,872	9,349	10,145	640	760	2,100
Equipment depreciation	6,000	8,000	10,000	560	1,740	1,100
Property tax, depreciation of buildings, etc						20,000
Total	\$43,622	\$44,949	\$47,575	\$15,933	\$21,351	\$66,270
Proration of light and power	1,860	2,325	2,790	279	1,116	930
Total	\$45,482	\$47,274	\$50,365	\$16,212	\$22,467	\$67,200
Distribution of service departments:						
General Factory Cost Pool	16,800	20,160	23,520	2,688	4,032	(67,200)*
Storeroom	8,694	5,670	2,835	(18,900)**	1,701	
Repairs and Maintenance	9,024	7,896	11,280		(28,200)***	
Total—producing departments	\$80,000	\$81,000	\$88,000			
Machine hours	800	900	1,600			
Overhead rate per machine hr.	\$100.00	\$90.00	\$55.00			

* General Factory Cost Pool can be distributed either on the basis of \$.80 per square foot ($\$67,200 \div 84,000$ sq. ft) or on the basis of the following percentages: 25%, 30%, 35%, 4%, and 6% for the first five departments. The percentages are determined by dividing the square footage in each department by the total square footage.

** Storeroom can be distributed either on the basis of \$.07 per requisition ($\$18,900 \div 270,000$ requisitions) or on the basis of the following percentages: 46%, 30%, 15%, and 9% for the three producing and one service departments. The percentages are determined by dividing the number of requisitions in each department by the total requisitions.

*** Repairs and maintenance can be distributed either on the basis of \$1.88 per maintenance hour ($\$28,200 \div 15,000$ hours) or on the basis of percentages: 32%, 28%, and 40% to the three producing departments. The percentages are determined by dividing the maintenance hours in each department by the total maintenance hours.

P13-4

(1)

	Departments			
	Repair	Power	Molding	Assembly
Department costs.....	\$48,000	\$250,000	\$204,000	\$320,000
Allocation of service department costs:				
Repair (1/9, 8/9).....	(48,000)		5,333	42,667
Power (7/8, 1/8).....		(250,000)	218,750	31,250
Total overhead cost.....			\$428,083	\$393,917
Direct labor hours			40,000	160,000
Overhead rate per direct labor hour.....			\$10.70	\$2.46

(2) Algebraic calculations:

R = Repair Department

P = Power Department

$$R = \$48,000 + .20P$$

$$P = \$250,000 + .10R$$

Substituting: $R = \$48,000 + .20 (\$250,000 + .10R)$

Solving: $R = \$48,000 + \$50,000 + .02R$

$$.98R = \$98,000$$

$$R = \$100,000$$

Substituting: $P = \$250,000 + .10 (\$100,000)$

$$P = \$260,000$$

	Departments			
	Repair	Power	Molding	Assembly
Department costs.....	\$ 48,000	\$250,000	\$204,000	\$320,000
Allocation of service department costs:				
Repair (1/10, 1/10, 8/10).....	(100,000)	10,000	10,000	80,000
Power (2/10, 7/10, 1/10).....	52,000	(260,000)	182,000	26,000
Total overhead cost.....			\$396,000	\$426,000
Direct labor hours			40,000	160,000
Overhead rate per direct labor hour			\$9.90	\$2.66

(3) Allocating service department costs to producing departments only ignores any service rendered by one service department to another, while the simultaneous method recognizes service departments' support to one another through the use of simultaneous equations. The latter method is more complete and should lead to results of greater use to management.

P13-5

(1)	<u>Total</u>	<u>P1</u>	<u>P2</u>	<u>S1</u>	<u>S2</u>
Before distribution	\$65,000	\$25,000	\$23,800	\$ 7,200	\$9,000
Distribution of S1 (4/9, 5/9)....		3,200	4,000	(7,200)	
Distribution of S2 (2/6, 4/6)....		3,000	6,000		(9,000)
After distribution.....	<u>\$65,000</u>	<u>\$31,200</u>	<u>\$33,800</u>		

(2)	<u>Total</u>	<u>P1</u>	<u>P2</u>	<u>S1</u>	<u>S2</u>
Before distribution	\$65,000	\$25,000	\$23,800	\$7,200	\$9,000
Distribution of S2 (2/10, 4/10, 4/10).....		1,800	3,600	3,600	(9,000)
Distribution of S1 (4/9, 5/9)....		4,800	6,000	(10,800)	
After distribution.....	<u>\$65,000</u>	<u>\$31,600</u>	<u>\$33,400</u>		

(3) Let: $S1 = \$7,200 + .40S2$
 $S2 = \$9,000 + .10S1$

Substituting: $S1 = \$7,200 + .40(\$9,000 + .10S1)$

Solving: $.96S1 = \$10,800$
 $S1 = \$11,250$

Substituting: $S2 = \$9,000 + .10(\$11,250)$
 $S2 = \$10,125$

	<u>Total</u>	<u>P1</u>	<u>P2</u>	<u>S1</u>	<u>S2</u>
Before distribution	\$65,000	\$25,000	\$23,800	\$7,200	\$ 9,000
Distribution of S1 (4/10, 5/10 1/10).....		4,500	5,625	(11,250)	1,125
Distribution of S2 (2/10, 4/10, 4/10).....		2,025	4,050	4,050	(10,125)
After distribution.....	<u>\$65,000</u>	<u>\$31,525</u>	<u>\$33,475</u>		

P13-6

(1) Let: x = Powerhouse; y = Personnel; z = General Factory

$$\begin{array}{rcl} \text{Equation 1:} & x & = \$16,000 + .10y + .20z \\ & x - .10y - .20z & = \$16,000 \end{array}$$

$$\begin{array}{rcl} \text{Equation 2:} & y & = \$29,500 + .10x + .15z \\ & -.10x + y - .15z & = \$29,500 \end{array}$$

$$\begin{array}{rcl} \text{Equation 3:} & z & = \$42,000 + .20x + .05y \\ & -.20x - .05y + z & = \$42,000 \end{array}$$

Multiply Equation 2 by 10 and add to Equation 1:

$$\begin{array}{rcl} & x - .10y - .20z & = \$16,000 \\ & -x + 10.00y - 1.50z & = 295,000 \\ \hline & 9.90y - 1.70z & = \$311,000 \end{array}$$

Multiply Equation 3 by 5 and add to Equation 1:

$$\begin{array}{rcl} & x - .10y - .20z & = \$16,000 \\ & -x - .25y + 5.00z & = 210,000 \\ \hline & - .35y + 4.80z & = \$226,000 \end{array}$$

Then eliminate y between the resulting equations:

$$\begin{array}{rcl} & 9.90y - 1.70z & = \$311,000 \\ & -.35y + 4.80z & = \$226,000 \\ \hline (.35)(9.90y) - (.35)(1.70z) & = (.35)(\$311,000) \\ (9.90)(-.35y) + (9.90)(4.80z) & = (9.90)(\$226,000) \\ \hline 3.465y - .595z & = \$108,850 \\ -3.465y + 47.520z & = \$2,237,400 \\ \hline 46.925z & = \$2,346,250 \\ z & = \$50,000 \end{array}$$

From the last equation, $z = \$50,000$; putting $z = \$50,000$ in any one of the equations in which x has been eliminated enables one to find y :

$$\begin{array}{rcl} 9.90y - 1.70z & = \$311,000 \\ 9.90y - 1.70(\$50,000) & = \$311,000 \\ 9.90y & = \$396,000 \\ y & = \$40,000 \end{array}$$

Then putting $y = \$40,000$ and $z = \$50,000$ in any one of the original equations enables one to find x :

$$\begin{array}{rcl} x - .10y - .20z & = \$16,000 \\ x - .10(\$40,000) - .20(\$50,000) & = \$16,000 \\ x & = \$30,000 \end{array}$$

Hence the solution is:

$$\begin{array}{l} x = \$30,000 \\ y = \$40,000 \\ z = \$50,000 \end{array}$$

P13-6 (Concluded)

(2)

	<u>Total</u>	<u>Mixing</u>	<u>Refining</u>	<u>Finishing</u>	<u>Power-house</u>	<u>Personnel</u>	<u>General Factory</u>
Primary cost.....	\$482,500	\$200,000	\$ 90,000	\$105,000	\$16,000	\$29,500	\$42,000
Distribution:							
Powerhouse.....		7,500	7,500	6,000	(30,000)	3,000	6,000
Personnel		14,000	12,000	8,000	4,000	(40,000)	2,000
General Factory		12,500	10,000	10,000	10,000	7,500	(50,000)
	<u>\$482,500</u>	<u>\$234,000</u>	<u>\$119,500</u>	<u>\$129,000</u>			

P13-7

(1) Annual normal cost center overhead rates:

	<u>Total Rate</u>	<u>Fixed Rate</u>	<u>Variable Rate</u>
Department 10:			
Cost Center 10-1	\$2.40	\$.90	\$1.50
Cost Center 10-2	3.00	1.15	1.85
Department 20:			
Cost Center 20-1	\$1.15	\$.32	\$.83
Cost Center 20-2	1.25	.30	.95

(2) Factory overhead applied to:

	<u>Cost Centers</u>	<u>Depts.</u>
Department 10:		
Cost Center 10-1: 1,220 machine hours x \$2.40 =	\$2,928	
Cost Center 10-2: 2,000 machine hours x \$3.00 =	6,000	\$8,928
Department 20:		
Cost Center 20-1: 2,250 labor hours x \$1.15 =	\$2,587.50	
Cost Center 20-2: 1,650 labor hours x \$1.25 =	2,062.50	\$4,650

(3)

	<u>Dept. 10</u>	<u>Dept. 20</u>
Actual factory overhead	\$9,430.00	\$4,005.00
Factory overhead applied	8,928.00	4,650.00
Underapplied (overapplied)	<u>\$ 502.00</u>	<u>\$ (645.00)</u>

P13-8

- (1) The dual predetermined overhead rates are:

$$\frac{\$400,000}{16,000 \text{ direct labor hours}} = \$25 \text{ per direct labor hour}$$

and

$$\frac{\$600,000}{20,000 \text{ machine hours}} = \$30 \text{ per machine hour}$$

- (2) Job #564

Direct material	\$2,000
Direct labor (30 x \$10).....	300
Applied overhead:	
30 x \$25 = \$750	
10 x \$30 = 300.....	1,050
Total	<u>\$3,350</u>

- (3) Job #632

Direct material	\$2,000
Direct labor (30 x \$10).....	300
Applied overhead:	
30 x \$25 = \$ 750	
60 x \$30 = 1,800	2,550
Total	<u>\$4,850</u>

- (4) (a) A single predetermined overhead rate based on direct labor hours would be:

$$\frac{\$400,000 + \$600,000}{16,000 \text{ direct labor hours}} = \$62.50 \text{ per direct labor hour}$$

P13-8 (Concluded)

(b) Job #564	
Direct material	\$2,000
Direct labor (30 x \$10).....	300
Applied overhead (30 x \$62.50).....	1,875
Total	<u>\$4,175</u>

(c) Job #632	
Direct material	\$2,000
Direct labor (30 x \$10).....	300
Applied overhead (30 x \$62.50).....	1,875
Total	<u>\$4,175</u>

- (5) The competitive implications of a single overhead rate are that on jobs requiring much labor and little machine time (e.g., Job #564), MTI will compute its costs at too high a level and will therefore quote too high a price to the customer. These jobs will probably be lost to competitors who know their costs better. On jobs requiring much machine time and little labor (e.g., Job #632), MTI will calculate its costs at too low a level and will, therefore, quote too low a price. These jobs will probably be won by MTI because of the low price, but will generate less profit than expected, or perhaps even a loss.

CASES**C13-1**

- (1) **Empco Inc. is currently using a plant-wide overhead rate that is applied on the basis of direct labor dollars. In general, a plant-wide manufacturing overhead rate is acceptable only if a similar relationship between overhead and direct labor exists in all departments, or the company manufactures products which receive proportional services from each department.**
- In most cases, departmental overhead rates are preferable to plant-wide overhead rates because plant-wide overhead rates do not provide:**
- **a framework for reviewing overhead costs on a departmental basis, identifying departmental cost overruns, or taking corrective action to improve departmental cost control.**
 - **sufficient information about product profitability, thus, increasing the difficulties associated with management decision-making.**
- (2) **Because Empco uses a plant-wide overhead rate applied on the basis of direct labor dollars, the elimination of direct labor in the Drilling Department through the introduction of robots may appear to reduce the overhead cost of the Drilling Department to zero. However, this change will not reduce fixed manufacturing expenses such as depreciation, plant supervision, etc. In reality, the use of robots is likely to increase fixed expenses because of increased depreciation expense. Under Empco's current method of allocating overhead costs, these costs will merely be absorbed by the remaining departments.**
- (3) (a) **In order to improve the allocation of overhead costs in the Cutting and Grinding Departments, Empco should:**
- **establish separate overhead accounts and rates for each of these departments;**
 - **select an application basis for each of these departments that best reflects the relationship of the departmental activity to the overhead costs incurred (e.g., direct labor hours, machine hours, etc.);**
 - **identify, if possible, fixed and variable overhead costs and establish fixed and variable overhead rates.**
- (b) **In order to accommodate the automation of the Drilling Department in its overhead accounting system, Empco should:**
- **establish separate overhead accounts and rates for the Drilling Department;**
 - **identify, if possible, fixed and variable overhead costs and establish fixed and variable overhead rates;**
 - **apply overhead costs to the Drilling Department on the basis of robot or machine hours.**

C13-2

- (1) The company should use departmental overhead rates since the two departments are producing heterogeneous products. The added accuracy is required for pricing decisions and for better cost control information.
- (2) The fixed cost of both service departments should be allocated based on long-range facilities utilization. Variable cost of purchasing would be better allocated using a cost driver, such as purchase orders, because there is a stronger explained relationship than by use of volume of materials ordered. Allocation of variable cleaning cost based on square footage seems reasonable; however, the variable cost of maintaining equipment should be isolated and charged to departments based on the cost of services provided.

A fuller consideration of the interactive benefits of departments would be achieved by use of the step or simultaneous methods, and preferably the simultaneous method. Such consideration is desirable because the service departments provide services to each other.

C13-3

A letter to the president of Summerville Inc:

- (1) Dear Sir:

From a study of the manufacturing operations of Summerville Inc., it is recommended that in distributing its factory overhead, the company use predetermined overhead rates applied as percentages of the direct labor cost. The company should use predetermined rates based on normal capacity rather than actual overhead rates because of the wide cyclical fluctuations in its business. Using actual rates would, due to large fixed overhead costs, make the per unit overhead cost high in the low production periods and low in the high production periods. Using predetermined rates, the per unit overhead cost would be level the year round. For quoting prices and pricing inventories per unit, costs which are neither inflated nor deflated by the cost of factory facilities are best.

The company should use departmental overhead rates because the rates obviously vary so markedly between departments. An overall rate would not be correct for any department. Summerville Inc.'s overhead is a large part of factory cost, and any inaccuracy in the per unit cost caused by the use of an overall rate would be material. If all the products made used all departments proportionately, an overall rate would result in a substantially accurate total (but not departmental) unit overhead cost. However, in Summerville Inc. the products do not use all the departments proportionately. Furthermore, use of departmental rates aids in pinpointing cost control responsibility.

C13-3 (Concluded)

- (2) Wage rates are substantially uniform within the separate departments, and departmental labor costs are closely proportionate to labor time. Therefore, distributing the factory overhead on the basis of direct labor cost would in this case effect about as accurate a distribution as would the direct labor hours base. The clerical expense of the direct labor cost base would be low because the method does not require accumulation of the number of direct labor hours applicable to each job.

Applying overhead on the basis of prime cost is not recommended because of the wide differences in the costs of the materials used to make a given lamp or fixture. Factory overhead is the cost of factory facilities. The factory facilities used to make a lamp of silver are not more than those used to make the same lamp of copper. For this reason, the use of prime cost (since it includes materials cost) would result in an excessive charge to lamps using expensive materials.

Sincerely,

C13-4

- (1) The ten cost items can be categorized into four basic groups for purposes of discussion:

	<u>Item</u>	<u>Allocation Method</u>	<u>Justification</u>
I.	All items in this category should be distributed.		
	(a) Salaries and benefits	Direct	The costs of these two items are directly incurred by the activity centers and can be controlled by the supervisor. A part of the salaries and benefits might be excluded from a variable cost charging rate.
	(b) Supplies	Direct	

C13-4 (Continued)

	<u>Item</u>	<u>Allocation Method</u>	<u>Justification</u>
II.	All items in this category should be distributed because a direct causal basis exists, but they should be excluded from a variable cost charging rate.		
(c)	Equipment maintenance	Direct	The costs of these items are directly incurred by the activity centers but are controlled by corporate policy. They would be included in a full cost charging rate and excluded from a variable cost charging rate.
(d)	Insurance	Direct	
(g)	Equipment and furniture depreciation	Direct	The costs of these items are directly incurred by the activity centers. They are not controllable by the centers in the usual sense. They would be included in a full cost rate and excluded from a variable cost charging rate.
(e)	Heat and air conditioning	Direct (one center only)	
(h)	Building improvements depreciation	Direct (one center only)	
III.	This item should be distributed because a reasonable measure for estimating the causal relationship exists.		
(f)	Electricity	Equipment and wattage ratings	A reasonable estimate can be made of the electrical charges that can be controlled by efficient use of equipment. The cost should be included in a full cost and a variable cost charging rate.

C13-4 (Concluded)

	<u>Item</u>	<u>Allocation Method</u>	<u>Justification</u>
IV.	The following items should be distributed if a full cost charging rate is required.		
(f)	Building occupancy and security	Square feet	There is no cost control benefit from allocation of these costs. The only reason to allocate is for a full cost charging rate.
(j)	Corporate administrative charges	Number of employees or some other general basis	
(2)	The number of hours selected for determining the charging rate depends upon the purpose of establishing the rate. If the objective is to charge user departments for all the costs of Computer Operations, the actual hours that can be identified with the user departments will be included in the base hours. This amounts to 3,500 hours, determined as follows:		

Actual User Time

Testing and debugging programs	250
Setup of jobs	500
Processing jobs	2,750
Total hours	<u>3,500</u>

To promote cost control, the company might consider a dual charging rate, whereby the variable costs would be charged over actual user time (3,500 hours) and fixed costs over available time (4,242 hours).

Available Time

Testing and debugging programs	250
Setup of jobs	500
Processing jobs	2,750
Idle time	742
Total hours	<u>4,242</u>

C13-5

(1)	Actual factory overhead	\$65,000	
	Applied factory overhead	<u>60,000</u>	(15,000 hrs. x \$4)
	Underapplied factory overhead	<u>\$ 5,000</u>	

- (2) (a) The 100 overtime hours resulted in \$400 additional applied factory overhead. The overtime premium increased the actual factory overhead of the department \$525 $((\$10.50 + 2) \times 100 \text{ hours})$. The extent to which these items affect the underapplied factory overhead depends on whether or not they were included in estimates used in computing the \$4 factory overhead rate.
- (b) Wage increases to direct laborers do not affect factory overhead directly. However, such increases will cause an increase in numerous fringe benefit costs such as FICA tax, unemployment taxes, worker's compensation, and pensions. If the increase were also granted to indirect workers of all categories, the increase in factory overhead might be substantial, causing a larger underapplied overhead amount, or a smaller overapplied amount.
- (c) The Fabricating Department's share of the loss would be \$112.50 and would be a factor in causing a larger, underapplied overhead amount, or a smaller overapplied amount. Since the distribution was most likely a management decision, the reason(s) should be given in an explanatory note in the cost reports and the supervisor relieved of the responsibility.

C13-8

(1) Allocation basis:

	October		November	
	Hours	%	Hours	%
Machine hours:				
Fast food furniture	1,320	6.67	2,560	13.06
Custom furniture	18,480	93.33	17,040	86.94
	<u>19,800</u>	<u>100.00</u>	<u>19,600</u>	<u>100.00</u>
Direct labor hours:				
Fast food furniture	10,000	25.00	17,500	40.00
Custom furniture	30,000	75.00	26,250	60.00
	<u>40,000</u>	<u>100.00</u>	<u>43,750</u>	<u>100.00</u>

Cost reallocation:

	October		November	
	Dollars	%	Dollars	%
Machine hour base:				
Maintenance	\$ 50,000		\$ 48,000	
Depreciation	42,000		42,000	
Property tax	8,000		8,000	
All other	32,000		24,500	
Total to be allocated	\$132,000		\$122,500	
Fast food furniture	\$ 8,800	6.67	\$ 16,000	13.06
Custom furniture	123,200	93.33	106,500	86.94
	<u>\$132,000</u>	<u>100.00</u>	<u>\$122,500</u>	<u>100.00</u>

	October		November	
	Dollars	%	Dollars	%
Labor hour base:				
Supervision	\$ 13,000		\$ 13,000	
Employee benefits	95,000		109,500	
Total to be allocated	\$108,000		\$122,500	
Fast food furniture	\$ 27,000	25.00	\$ 49,000	40.00
Custom furniture	81,000	75.00	73,500	60.00
	<u>\$108,000</u>	<u>100.00</u>	<u>\$122,500</u>	<u>100.00</u>

- (2) When gross profit is recalculated, with the factory overhead reallocated on the base recommended by the controller, as shown in the following schedule, the figures tend to support the controller's conclusion. Also, the allocation bases suggested appear to have a reasonable relationship to the costs being allocated.

C13-6 (Concluded)

AQUA FURNISHINGS COMPANY
Revised Statement of Gross Profit
(In thousands)

	October		November	
	Fast Food Furniture	Custom Furniture	Fast Food Furniture	Custom Furniture
Gross sales.....	\$400.0	\$900.0	\$800.0	\$ 800.0
Direct materials.....	\$200.0	\$225.0	\$400.0	\$ 200.0
Direct labor:				
Forming.....	17.0	82.0	31.0	72.0
Finishing	40.0	142.0	70.0	125.0
Assembly.....	33.0	60.0	58.0	53.0
Factory overhead allocation:				
Machine hour base	8.8	123.2	16.0	106.5
Labor hour base	27.0	81.0	49.0	73.5
Cost of goods sold.....	\$325.8	\$713.2	\$624.0	\$ 630.0
Gross profit	\$ 74.2	\$186.8	\$176.0	\$ 170.0
Gross profit percentage	18.6%	20.8%	22.0%	21.25%

CHAPTER 14

DISCUSSION QUESTIONS

- Q14-1. Compared to traditional costing, ABC is a more thorough application of cost traceability. Traditional costing traces only direct material and direct labor to output; ABC recognizes that many other costs are traceable, if not to output, then to other cost objects called activities.
- Q14-2. The role of activities in assigning costs to products, using ABC, is to serve as the link between products and costs: activities are required to produce output, and it is the activities that consume resources, thus causing costs to be incurred. This differs from traditional costing in which output is assumed to cause costs.
- Q14-3. Examples of significant, costly activities in manufacturing are setting up, changing designs, receiving materials, requisitioning materials, moving materials and products, ordering from vendors, and inspecting.
- Q14-4. The two circumstances that must be present for a traditional costing system to report distorted product costs are a complex cost structure and a diverse product line.
- Q14-5. A complex cost structure is present if a significant part of overhead cost is not related to the volume of output.
- Q14-6. A diverse product line is one in which different products consume different mixes of volume-related and nonvolume-related costs.
- Q14-7. The four levels of costs and drivers in ABC are the unit level, the batch level, the product level, and the plant level.
- Q14-8. If a product consumes 10% of all unit-level activities and 30% of all batch-level activities, traditional costing will under-report its cost by assigning 10% of all overhead costs to the product, including 10% of batch-level costs, when 30% of batch-level costs should be assigned to the product.
- Q14-9. When both low-volume and high-volume products are produced in a company using traditional costing, the low-volume product is likely to have its cost distorted by a larger percentage than the high-volume product. The low-volume product's cost is generally distorted downward by traditional costing, and the high-volume product's cost is distorted upward.
- Q14-10. In assigning plant-level costs to products, ABC offers little or no advantage over traditional costing.
- Q14-11. The difference between CM and ABC is primarily explained by the fact that ABC is a long-run decision-making technique, while CM is short-run analysis.
- Q14-12. If a product is discontinued, the costs reported for that product by ABC will not necessarily be avoided, because ABC only measures how resources are consumed by products, not how spending will be affected by discontinuing a product. Avoiding a cost requires that less be spent on some resource(s), and ABC does not predict changes in spending. (This is also true of traditional absorption costing.)
- Q14-13. The relationship between ABC and ABM is that ABM uses information obtained from ABC to make improvements in the firm.
- Q14-14. The area of ABM that follows directly from ABC's revision of product costs is the strategic realignment of the firm's pricing structure and product line, permitting the firm to retain or regain high-volume business in spite of pricing pressure, and prompting management to reexamine the roles of some low-volume products.
- Q14-15. The high costs of some activities, especially non-value-added activities, can focus attention on the need to reduce or eliminate them.
- Q14-16. ABC can lead to improved decisions in designing a product because ABC tells the cost of each activity required in producing the product. This information permits designers to make design decisions more accurately, so that the most cost-effective design can be selected.
- Q14-17. The link between ABC and TQM is that ABC reveals the costs of each activity, including those that do not add value, and TQM seeks to reduce or eliminate non-value-added activities. Thus, ABC can focus attention in a TQM effort and can prioritize TQM's improvements.

P14-4 (Continued)

(2) **SHAUTON COMPANY**
Product Costs from Activity Based Costing System

Overhead rates:

\$135,000 setup-related costs divided by 90 setups = \$1,500 per setup

\$240,000 design-related costs divided by 8,000 design hours = \$30 per design hour

\$825,000 other overhead divided by 30,000 direct labor hours = \$27.50 per direct labor hour

	<u>Fancy</u>	<u>Plain</u>	<u>Total</u>
Direct material	\$ 60,000	\$ 160,000	\$ 220,000
Direct labor	28,000	272,000	300,000
Overhead:			
\$1,500 x 45 setups	67,500		
\$1,500 x 45 setups		67,500	135,000
\$30 x 3,000 design hrs	90,000		
\$30 x 5,000 design hrs		150,000	240,000
\$27.50 x 2,800 DLH	77,000		
\$27.50 x 27,200 DLH		748,000	825,000
Total cost	<u>\$322,500</u>	<u>\$1,397,500</u>	<u>\$1,720,000</u>
Units produced	+ 200	+ 16,000	
Cost per unit	<u>\$1,612.50</u>	<u>\$ 87.34</u>	

- (3) Because the existing system used direct labor hours as the only allocation base and Fancy consumed $2,800/30,000 = 9\frac{1}{3}\%$ of direct labor hours, the existing system allocated $9\frac{1}{3}\%$ of all overhead to Fancy. The activity information indicates Fancy consumed $45/90 = 50\%$ of setup-related activity and $3,000/8,000 = 37.5\%$ of design-related activity, so the reconciliation is as follows:

	<u>Total</u>	<u>Per Unit</u>
Cost of Fancy from traditional system, calculated in requirement (1)	\$200,000	\$1,000.00
Adjustments for:		
Understatement of setup costs, \$135,000 x (50% - $9\frac{1}{3}\%$)	\$54,900	
Understatement of design costs, \$240,000 x (37.5% - $9\frac{1}{3}\%$)	<u>67,600</u>	
Total adjustments	<u>122,500</u>	<u>612.50</u>
Cost of Fancy from ABC system, as calculated in requirement (2)	<u>\$322,500</u>	<u>\$1,612.50</u>

E14-5 The existing system allocated only $50/50,000 = 0.1\%$ of all overhead to Product RK last year; but Product RK accounted for $120/6,000 = 2\%$ of design change activity last year. Therefore, with respect to design change costs only, the existing system understated RK's cost last year by a total of:

$$(2\% - 0.1\%) \times \$2,000,000 = \$38,000 \text{ understatement}$$

E14-6 The existing system allocated $\$40,000/\$200,000 = 20\%$ of all overhead to Product BB last year; but BB accounted for only $2/200 = 1\%$ of the activity of maintaining supplies of purchased subassemblies last year. Therefore, with respect to the cost of maintaining supplies of purchased subassemblies only, the existing system overstated BB's cost last year by a total of:

$$(20\% - 1\%) \times \$50,000 = \$9,500 \text{ overstatement}$$

E14-7

(1) \$126 of overhead cost will be allocated to a unit of #456, calculated as follows:

$$\frac{\$1,400,000}{10,000 \text{ machine hours}} \times 90 \text{ machine hours} = \$12,600;$$

$$\frac{\$12,600}{100 \text{ units of Product \# 456}} = \$126 \text{ per unit}$$

(2) \$554 of overhead cost will be allocated to a unit of #456, calculated as follows:

$$\frac{\$300,000}{120 \text{ setups}} \times 6 \text{ setups} = \$15,000 \text{ of batch-level cost;}$$

$$\frac{\$500,000}{4,000 \text{ design hours}} \times 280 \text{ design hours} = \$35,000 \text{ of product-level cost;}$$

$$\frac{\$200,000 + \$400,000}{10,000 \text{ machine hours}} \times 90 \text{ machine hours} = \$5,400 \text{ of unit- and plant-level cost.}$$

Therefore, the overhead allocated to a unit of Product #456 is:

$$(\$15,000 + \$35,000 + \$5,400)/100 \text{ units} = \$55,400/100 \text{ units} = \$554 \text{ per unit}$$

E14-8 Because the traditional system uses machine hours as the only allocation base, Product #456 is allocated $90/10,000 = 0.9\%$ of all overhead. The activity data indicate #456 should be assigned $6/120 = 5\%$ of batch-level costs, $280/4,000 = 7\%$ of product-level costs, and 0.9% of all other overhead. The reconciliation is:

	<u>Total</u>	<u>Per Unit</u>
Cost of #456 from traditional system, as calculated in part (1) of E14-7	\$12,600	\$126
Adjustments for:		
Understatement of batch-level costs, $\$300,000 \times (5\% - 0.9\%) \dots\dots\dots$	\$12,300	
Understatement of product-level costs, $\$500,000 \times (7\% - 0.9\%) \dots\dots\dots$	<u>30,500</u>	
Total adjustments	<u>\$42,800</u>	<u>428</u>
Cost of #456 from ABC system, as calculated in part (2) of E14-7	<u>\$55,400</u>	<u>\$554</u>

E14-9

- (1) \$140 of overhead cost will be allocated to a unit of #456, calculated as follows:

$$\frac{\$1,400,000}{20,000 \text{ DL hours}} \times 200 \text{ DL hours} = \$14,000;$$

$$\frac{\$14,000}{100 \text{ units of Product \# 456}} = \$140 \text{ per unit}$$

- (2) \$740 of overhead cost will be allocated to a unit of #456, calculated as follows:

$$\frac{\$300,000}{500 \text{ setup hours}} \times 30 \text{ setup hours} = \$18,000 \text{ of batch-level cost;}$$

$$\frac{\$500,000}{40 \text{ design changes}} \times 4 \text{ design changes} = \$50,000 \text{ of product-level cost;}$$

$$\frac{\$200,000 + \$400,000}{20,000 \text{ DL hours}} \times 200 \text{ direct labor hours} = \$6,000 \text{ of unit- and plant-level cost.}$$

Therefore, the overhead allocated to a unit of Product #456 is:

$$(\$18,000 + \$50,000 + \$6,000)/100 \text{ units} = \$74,000/100 \text{ units} = \$740 \text{ per unit}$$

E14-10 Because the traditional system uses direct labor hours as the only allocation base, Product #456 is allocated $200/20,000 = 1\%$ of all overhead. The activity data indicate #456 should be assigned $30/500 = 6\%$ of batch-level costs, $4/40 = 10\%$ of product-level costs, and 1% of all other overhead. The reconciliation is:

	<u>Total</u>	<u>Per Unit</u>
Cost of #456 from traditional system, as calculated in part (1) of E14-9	\$14,000	\$140
Adjustments for:		
Understatement of batch-level costs, $\$300,000 \times (6\% - 1\%)$	\$15,000	
Understatement of product-level costs, $\$500,000 \times (10\% - 1\%)$	<u>45,000</u>	
Total adjustments	<u>\$60,000</u>	<u>600</u>
Cost of #456 from ABC system, as calculated in part (2) of E14-9	<u>\$74,000</u>	<u>\$740</u>

E14-11 Activities g, u, y, and dd are the only ones that definitely add value. Activity k is questionable, because a single deburring after drilling would be sufficient to remove all burrs. The first deburring, k, is probably performed to make it easier and safer for workers to handle the product in the interim. If the need for so much handling can be eliminated (perhaps through automated material-handling equipment), k could be eliminated with no loss of value to the customer (and perhaps at a net savings to the company), so it is really a non-value-added activity.

PROBLEMS

P14-1

- (1) The overhead rates in the existing costing system are \$20 per machine hour, and \$14 per direct labor hour, calculated as follows:

$$\frac{\$80,000 \text{ of machine-related overhead}}{4,000 \text{ machine hours}} = \$20 \text{ per machine hour}$$

$$\frac{\$280,000 \text{ of remaining overhead costs}}{20,000 \text{ DLH}} = \$14 \text{ per direct labor hour}$$

- (2) Making only the changes suggested by the study, the structure of the ABC system would be:

<u>Pool</u>	<u>Driver</u>
machine operation	machine hours
setup and material handling	setups
other materials-related	purchase orders
all remaining overhead.....	direct labor hours

The study did not suggest any change for machine operation cost, nor for the "other overhead" category.

- (3) The ABC system's overhead rates (driver rates) are \$16.25 per machine hour, \$45 per setup, \$50 per purchase order, and \$10.75 per direct labor hour, calculated as follows:

$$\frac{\$65,000 \text{ of machine operation overhead}}{4,000 \text{ machine hours}} = \$16.25 \text{ per machine hour}$$

$$\frac{\$15,000 \text{ of machine-setup overhead plus } \$30,000 \text{ of materials handling overhead}}{1,000 \text{ setups}} = \$45 \text{ per setup}$$

$$\frac{\$35,000 \text{ of other materials-related cost}}{700 \text{ purchase orders}} = \$50 \text{ per purchase order}$$

$$\frac{\$215,000 \text{ of "other overhead "}}{20,000 \text{ DLH}} = \$10.75 \text{ per direct labor hour}$$

P14-2

- (1) The three overhead rates in the existing costing system are \$17.50 per machine hour, \$.80 per direct material dollar, and \$1.25 per direct labor dollar, calculated as follows:

$$\frac{\$700,000 \text{ of machine-related overhead}}{40,000 \text{ machine hours}} = \$17.50 \text{ per machine hour}$$

$$\frac{\$800,000 \text{ of materials-related overhead}}{\$1,000,000 \text{ of direct material cost}} = 80\% \text{ of direct material cost or } \$.80 \text{ per direct material dollar}$$

$$\frac{\$2,500,000 \text{ of other overhead cost}}{\$2,000,000 \text{ of direct labor cost}} = 125\% \text{ of direct labor cost or } \$1.25 \text{ per direct labor dollar}$$

- (2) Making only the changes suggested by the study, the structure of the ABC system would be:

<u>Pool</u>	<u>Driver</u>
machine operation	machine hours
setup and material handling	setups
materials administration	purchase orders
freight-in	material pounds
all remaining overhead.....	direct labor cost

The study did not suggest any change for machine operation cost, nor for the "all remaining overhead" category.

- (3) The ABC system's overhead rates are \$12.50 per machine hour, \$1,000 per setup, \$35 per purchase order, \$.75 per pound of materials, and \$1.25 per direct labor dollar, calculated as follows:

$$\frac{\$500,000 \text{ of machine-operation overhead}}{40,000 \text{ machine hours}} = \$12.50 \text{ per machine hour}$$

$$\frac{\$200,000 \text{ of machine-setup overhead plus } \$300,000 \text{ of materials handling overhead}}{500 \text{ setups}} = \$1,000 \text{ per setup}$$

$$\frac{\$350,000 \text{ of materials administration overhead}}{10,000 \text{ purchase orders}} = \$35 \text{ per purchase order}$$

P14-2 (Concluded)

$$\frac{\$150,000 \text{ of freight-in}}{200,000 \text{ pounds of materials}} = \$0.75 \text{ per pound of materials}$$

$$\frac{\$2,500,000 \text{ of other overhead cost}}{\$2,000,000 \text{ of direct labor cost}} = 125\% \text{ of direct labor cost or } \$1.25 \text{ per direct labor dollar}$$

P14-3

(1) DRAPER COMPANY
Product Costs from Existing Costing System

Overhead rate: \$4,500,000 of overhead divided by \$3,000,000 of direct labor cost = 150% of direct labor cost

	<u>Standard</u>	<u>Custom</u>	<u>Total</u>
Direct material.....	\$ 882,000	\$ 12,500	\$ 894,500
Direct labor.....	2,910,000	90,000	3,000,000
Overhead:			
150% x \$2,910,000.....	4,365,000		
150% x \$90,000.....		135,000	4,500,000
Total cost	<u>\$8,157,000</u>	<u>\$237,500</u>	<u>\$8,394,500</u>
Units produced	+ 73,500	+ 125	
Cost per unit.....	<u>\$ 110.98</u>	<u>\$ 1,900</u>	

P14-3 (Continued)

(2)

DRAPER COMPANY
Product Costs from Activity Based Costing System

Overhead rates:**\$300,000 setup-related costs divided by 60 setups = \$5,000 per setup****\$900,000 design-related costs divided by 15,000 design hours = \$60 per design hour****\$3,300,000 other overhead divided by \$3,000,000 DL cost = 110% of direct labor cost**

	Standard	Custom	Total
Direct material	\$ 882,000	\$ 12,500	\$ 894,500
Direct labor	2,910,000	90,000	3,000,000
Overhead:			
\$5,000 x 30 setups	150,000		
\$5,000 x 30 setups		150,000	300,000
\$60 x 12,000 design hrs	720,000		
\$60 x 3,000 design hrs		180,000	900,000
110% x \$2,910,000	3,201,000		
110% x \$90,000		99,000	3,300,000
Total cost	\$7,863,000	\$531,500	\$8,394,500
Units produced.	+ 73,500	+ 125	
Cost per unit	\$ 106.98	\$ 4,252	

- (3) Because the existing system used direct labor cost as the only allocation base and Custom consumed $\$90,000/\$3,000,000 = 3\%$ of direct labor cost, the existing system allocated 3% of all overhead to Custom. The activity information indicates Custom consumed $30/60 = 50\%$ of setup-related activity and $3,000/15,000 = 20\%$ of design-related activity, so the reconciliation is as follows:

	Total	Per Unit
Cost of Custom from traditional system, as calculated in requirement (1)	\$237,500	\$1,900
Adjustments for:		
Understatement of setup-related costs, $\$300,000 \times (50\% - 3\%)$	\$141,000	
Understatement of design-related costs, $\$900,000 \times (20\% - 3\%)$	153,000	
Total adjustments	294,000	2,352
Cost of Custom from ABC system, as calculated in requirement (2)	\$531,500	\$4,252

P14-3 (Concluded)

- (4) The only costs handled differently by the two costing systems were the \$300,000 of setup-related costs and \$900,000 of design-related costs, for a total of \$1,200,000; this represents only 27% of the total overhead of \$4,500,000.

The change in the costing system caused the reported cost of Custom to change from \$237,500 to \$531,500, which is an increase of 124%.

P14-4

- (1) **SHAUTON COMPANY**
Product Costs from Existing Costing System

Overhead rate: \$1,200,000 of overhead divided by 30,000 direct labor hours = \$40 per direct labor hour			
	<u>Fancy</u>	<u>Plain</u>	<u>Total</u>
Direct material.....	\$ 60,000	\$ 160,000	\$ 220,000
Direct labor.....	28,000	272,000	300,000
Overhead:			
\$40 x 2,800 DLH	112,000		
\$40 x 27,200 DLH		1,088,000	1,200,000
Total cost	<u>\$200,000</u>	<u>\$1,520,000</u>	<u>\$1,720,000</u>
Units produced	+ 200	+ 16,000	
Cost per unit.....	<u>\$ 1,000</u>	<u>\$ 95</u>	

P14-4 (Continued)

(2) **SHAUTON COMPANY**
Product Costs from Activity Based Costing System

Overhead rates:

\$135,000 setup-related costs divided by 90 setups = \$1,500 per setup

\$240,000 design-related costs divided by 8,000 design hours = \$30 per design hour

\$825,000 other overhead divided by 30,000 direct labor hours = \$27.50 per direct labor hour

	<u>Fancy</u>	<u>Plain</u>	<u>Total</u>
Direct material	\$ 60,000	\$ 160,000	\$ 220,000
Direct labor	28,000	272,000	300,000
Overhead:			
\$1,500 x 45 setups	67,500		
\$1,500 x 45 setups		67,500	135,000
\$30 x 3,000 design hrs	90,000		
\$30 x 5,000 design hrs		150,000	240,000
\$27.50 x 2,800 DLH	77,000		
\$27.50 x 27,200 DLH		748,000	825,000
Total cost	<u>\$322,500</u>	<u>\$1,397,500</u>	<u>\$1,720,000</u>
Units produced	+ 200	+ 16,000	
Cost per unit	<u>\$1,612.50</u>	<u>\$ 87.34</u>	

- (3) Because the existing system used direct labor hours as the only allocation base and Fancy consumed $2,800/30,000 = 9\frac{1}{3}\%$ of direct labor hours, the existing system allocated $9\frac{1}{3}\%$ of all overhead to Fancy. The activity information indicates Fancy consumed $45/90 = 50\%$ of setup-related activity and $3,000/8,000 = 37.5\%$ of design-related activity, so the reconciliation is as follows:

	<u>Total</u>	<u>Per Unit</u>
Cost of Fancy from traditional system, calculated in requirement (1)	\$200,000	\$1,000.00
Adjustments for:		
Understatement of setup costs, \$135,000 x (50% - $9\frac{1}{3}\%$)	\$54,900	
Understatement of design costs, \$240,000 x (37.5% - $9\frac{1}{3}\%$)	<u>67,600</u>	
Total adjustments	<u>122,500</u>	<u>612.50</u>
Cost of Fancy from ABC system, as calculated in requirement (2)	<u>\$322,500</u>	<u>\$1,612.50</u>

P14-4 (Concluded)

- (4) The only costs handled differently by the two costing systems were the \$135,000 of setup-related costs and \$240,000 of design-related costs, for a total of \$375,000; this represents only 31.25% of the total overhead of \$1,200,000.

The change in the costing system caused the reported cost of Fancy to change from \$200,000 to \$322,500, which is an increase of 61.25%.

P14-5

- (1) **TUNNEY COMPANY**
Product Costs from Existing Costing System

Overhead rate: \$1,000,000 of overhead divided by 50,000 direct labor hours = \$20 per direct labor hour

	Normal	Enhanced	Super	Total
Direct material	\$ 60,000	\$ 20,000	\$ 5,000	\$ 85,000
Direct labor	300,000	35,000	5,000	340,000
Overhead:				
\$20 x 45,000 DLH.....	900,000			
\$20 x 4,500 DLH.....		90,000		
\$20 x 500 DLH.....			10,000	1,000,000
Total cost	<u>\$1,260,000</u>	<u>\$145,000</u>	<u>\$20,000</u>	<u>\$1,425,000</u>
Units produced.....	+ 30,000	+ 1,000	+ 50	
Cost per unit	<u>\$ 42</u>	<u>\$ 145</u>	<u>\$ 400</u>	

P14-5 (Concluded)

(2)

TUNNEY COMPANY
Product Costs from Activity Based Costing System

Overhead rates:**\$400,000 batch-level overhead divided by 500 requisitions = \$800 per requisition****\$600,000 other overhead divided by 50,000 direct labor hours = \$12 per direct labor hour**

	Normal	Enhanced	Super	Total
Direct material	\$ 60,000	\$ 20,000	\$ 5,000	\$ 85,000
Direct labor	300,000	35,000	5,000	340,000
Overhead:				
\$800 x 150 req	120,000			
\$800 x 200 req		160,000		
\$800 x 150 req			120,000	400,000
\$12 x 45,000 DLH	540,000			
\$12 x 4,500 DLH		54,000		
\$12 x 500 DLH			6,000	600,000
Total cost	<u>\$1,020,000</u>	<u>\$269,000</u>	<u>\$136,000</u>	<u>\$1,425,000</u>
Units produced	+ 30,000	+ 1,000	+ 50	
Cost per unit	<u>\$ 34</u>	<u>\$ 269</u>	<u>\$ 2,720</u>	

- (3) Because the existing system used direct labor hours as the only allocation base and Super consumed $500/50,000 = 1\%$ of direct labor hours, the existing system allocated 1% of all overhead to Super. The activity information indicates Super consumed $150/500 = 30\%$ of batch-level activity, so the reconciliation is as follows:

	Total	Per Unit
Cost of Super from traditional system, as calculated in requirement (1)	\$ 20,000	\$ 400
Adjustment for understatement of batch-level costs, $\$400,000 \times (30\% - 1\%)$	116,000	2,320
Cost of Super from ABC system, as calculated in requirement (2)	<u>\$136,000</u>	<u>\$2,720</u>

- (4) The only costs handled differently by the two costing systems were the \$400,000 of batch-level costs, which represents only 40% of the total overhead of \$1,000,000.

The change in the costing system caused the reported cost of Super to change from \$20,000 to \$136,000, which is an increase of 580%.

P14-6

(1)

TEKSIZE COMPANY
Product Costs from Existing Costing System

Overhead rate: \$1,500,000 of overhead divided by 50,000 direct labor hours = \$30 per direct labor hour

	Regular	Large	Total
Direct material.....	\$ 10,000	\$ 40,000	\$ 50,000
Direct labor.....	120,000	480,000	600,000
Overhead:			
\$30 x 10,000 DLH.....	300,000		
\$30 x 40,000 DLH.....		1,200,000	1,500,000
Total cost.....	\$430,000	\$1,720,000	<u>\$2,150,000</u>
Units produced.....	+ 10,000	+ 10,000	
Cost per unit.....	<u>\$ 43</u>	<u>\$ 172</u>	

(2)

TEKSIZE COMPANY
Product Costs from Activity Based Costing System

Overhead rates:
\$515,000 setup-related costs divided by 103 setups = \$5,000 per setup
\$985,000 other overhead divided by 50,000 direct labor hours = \$19.70 per DLH

	Regular	Large	Total
Direct material.....	\$ 10,000	\$ 40,000	\$ 50,000
Direct labor.....	120,000	480,000	600,000
Overhead:			
\$5,000 x 51 setups.....	255,000		
\$5,000 x 52 setups.....		260,000	515,000
\$19.70 x 10,000 DLH.....	197,000		
\$19.70 x 40,000 DLH.....		788,000	985,000
Total cost.....	\$582,000	\$1,568,000	<u>\$2,150,000</u>
Units produced.....	+ 10,000	+ 10,000	
Cost per unit.....	<u>\$ 58.20</u>	<u>\$ 156.80</u>	

P14-6 (Concluded)

- (3) Because the existing system used direct labor hours as the only allocation base and Regular consumed $10,000/50,000 = 20\%$ of direct labor hours, the existing system allocated 20% of all overhead to Regular. The activity information indicates Regular consumed $51/103 = 49.51456\%$ of setup-related activity, so the reconciliation is as follows:

	<u>Total</u>	<u>Per Unit</u>
Cost of Regular from traditional system, as calculated in requirement (1)	\$430,000	\$43.00
Adjustment for understatement of setup-related costs, $\$515,000 \times (49.51456\% - 20\%)$...	<u>152,000</u>	<u>15.20</u>
Cost of Regular from ABC system, as calculated in requirement (2)	<u>\$582,000</u>	<u>\$58.20</u>

- (4) Yes, Teksize Company does have a diverse product line in the sense in which the term is used in ABC. The fact that the two products have the same annual unit volumes does not matter, because the existing cost system does not use units as the allocation base. Regular represents only 20% of direct labor hours but nearly 50% of setup-related costs, while Large has a very different mix, so a diverse product line is present in Teksize Company.

CASES

C14-1

(1)

DALLAS DIVISION
Product Costs from Existing Costing System

Overhead rate: \$800,000 of overhead divided by 20,000 direct labor hours = \$40 per direct labor hour

	#321	#333
Direct material	\$ 6,000	\$ 150
Direct labor	30,000	600
Overhead:		
\$40 x 7,200 DLH.....	288,000	
\$40 x 120 DLH.....		4,800
Total cost.....	\$324,000	\$5,550
Units produced.....	+ 2,400	+ 6
Cost per unit	<u>\$ 135</u>	<u>\$ 925</u>

(2)

DALLAS DIVISION
Product Costs from Activity Based Costing System

Overhead rates:
\$240,000 batch-level costs divided by 1,600 setups = \$150 per setup
\$200,000 product-level costs divided by 2,000 design hours = \$100 per design hour
\$360,000 other overhead divided by 20,000 direct labor hours = \$18 per DLH

	#321	#333
Direct material	\$ 6,000	\$ 150
Direct labor	30,000	600
Overhead:		
\$150 x 40 setups.....	6,000	
\$150 x 4 setups.....		600
\$100 x 320 design hrs.....	32,000	
\$100 x 200 design hrs.....		20,000
\$18 x 7,200 DLH.....	129,600	
\$18 x 120 DLH.....		2,160
Total cost.....	\$203,600	\$ 23,510
Units produced.....	+ 2,400	+ 6
Cost per unit	<u>\$ 84.83</u>	<u>\$3,918.33</u>

C14-1 (Continued)

	#321	#333
(3) Usual selling price	\$150	\$1,500
Product cost.....	135	925
Gross margin.....	<u>\$ 15</u>	<u>\$ 575</u>
Percent of sales	<u>10%</u>	<u>38%</u>
	#321	#333
(4) Usual selling price	\$150.00	\$ 1,500.00
Product cost.....	84.83	3,918.33
Gross margin (loss)	<u>\$ 65.17</u>	<u>\$(2,418.33)</u>
Percent of sales	<u>43%</u>	<u>(161%)</u>

- (5) The ABC system shows that the relative profitabilities of the two products are the reverse of what is shown by the existing system: the existing system shows a very modest gross margin of 10% on #321, which is probably not enough to cover its marketing and administrative costs, while showing a respectable 38% gross margin on #333. In contrast, the ABC system shows a 43% gross margin on #321 and a substantial loss on #333. The low-volume product appears to be the more profitable of the two under the existing system, but appears to be a money loser under ABC; the high-volume product appears weak under the existing system, but highly profitable under ABC.
- (6) Based on the results of the ABC study, Dallas division management should consider meeting the competitor's prices on #321; this pricing strategy can be profitable in the long run and should avoid loss of market share. The strategy for #333 is not as clear. Customers are not likely to accept the 200% price increase needed to make #333 reasonably profitable, and Dallas could lose some customers who also buy large amounts of #321, if management discontinues #333 or increases its price too much. Management should consider several possibilities for low-volume products such as #333:
- (a) Reduce batch- and product-level costs enough to become an efficient producer of low-volume products. This may require creation of a small job-shop environment in a portion of the plant (or in another facility) where low-volume products could be made more efficiently. The case indicates the existing plant was designed to produce long runs efficiently, which may explain the high batch- and product-level costs.

C14-1 (Concluded)

- (b) Reduce the number of products by designing a new one that can be substituted for several low-volume, unprofitable products that can then be discontinued; this essentially exchanges several low-volume products for one of much higher volume, with substantial batch- and product-level savings.
- (c) Convince one of the current buyers of the low-volume products to become a distributor of several such products; buying them from Dallas in larger quantities, maintaining small inventories, and selling them to other customers. This can reduce Dallas' batch-level costs and marketing costs, but it risks the loss of customers who like to buy the full line from one supplier.
- (d) Raise prices gradually until all products are reasonably priced. This does not mean all products must show profits. (It is acceptable for a good customer to occasionally buy a money-losing product.) Rather, it means that the company should not continue making a money-losing product without a good reason. It is not acceptable to have a customer who buys only the money-losing products, nor for the company to continue making a money-losing product that no "good customers" are buying.
- (e) In addition to the usual per-unit prices, charge a lump-sum amount per order for any small order of a low-volume product. This charge could be set at a level to cover estimated batch- and product-level costs.

C14-2

(1)

WARRENTON DIVISION
Product Costs from OPICS

Overhead rate: \$1,930,000 of overhead divided by 25,000 direct labor hours = \$77.20 per DLH

	#33	#44
Direct material	\$15,000	\$120,000
Direct labor	6,000	60,000
Overhead:		
\$77.20 x 450 DLH.....	34,740	
\$77.20 x 6,000 DLH.....		463,200
Total cost.....	\$55,740	\$643,200
Units produced.....	+ 100	+ 2,000
Cost per unit	<u>\$557.40</u>	<u>\$ 321.60</u>

C14-2 (Continued)

(2)

WARRENTON DIVISION
Product Costs from TPICS

Overhead rates:**\$340,000 machine-related costs divided by 20,000 machine hours = \$17 per MH****\$330,000 materials-related costs divided by \$1,320,000 direct material cost =
25% of direct material cost****\$360,000 + \$900,000 of remaining costs divided by 25,000 direct labor hours =
\$50.40 per direct labor hour**

	#33	#44
Direct material	\$15,000	\$120,000
Direct labor	6,000	60,000
Overhead:		
\$17 x 300 MH	5,100	
\$17 x 3,000 MH		51,000
25% x \$15,000	3,750	
25% x \$120,000		30,000
\$50.40 x 450 DLH.....	22,680	
\$50.40 x 6,000 DLH.....		302,400
Total cost.....	\$52,530	\$563,400
Units produced.....	+ 100	+ 2,000
Cost per unit	<u>\$525.30</u>	<u>\$ 281.70</u>

- (3) TPICS is not an ABC system because all the allocation bases are at the unit level. The changes management made do show many of the attributes typically associated with a change to ABC: the increase in the number of overhead cost pools, the attempt to create homogeneous cost pools, and the use of three distinct allocation bases. These changes show an attempt was made to capture differences among the demands placed on resources by the different products. But because there are no batch- or product-level drivers used, the system cannot capture the demands placed on batch- and product-level activities, i.e., it is not an ABC system.

C14-2 (Continued)

(4)

WARRENTON DIVISION
Product Costs from Proposed New Costing System

Overhead rates:

**\$100,000 troubleshooting costs + \$140,000 machine setup costs divided by
 3,000 setup hours = \$80 per setup hour**

\$135,000 material handling costs divided by 15,000 loads = \$9 per load

**\$195,000 materials administration costs divided by 10,000 vendor orders =
 \$19.50 per vendor order**

**\$260,000 engineering design costs divided by 4,000 design hours = \$65 per
 design hour**

**\$200,000 machine operation costs + \$900,000 other overhead divided by
 20,000 machine hours = \$55 per machine hour**

	<u>#33</u>	<u>#44</u>
Direct material	\$15,000	\$120,000
Direct labor	6,000	60,000
Overhead:		
\$80 x 300 setup hrs	24,000	
\$80 x 400 setup hrs		32,000
\$9 x 20 loads	180	
\$9 x 60 loads		540
\$19.50 x 90 orders	1,755	
\$19.50 x 150 orders		2,925
\$65 x 280 design hrs	18,200	
\$65 x 300 design hrs		19,500
\$55 x 300 MH	16,500	
\$55 x 3,000 MH		165,000
Total cost.....	<u>\$81,635</u>	<u>\$399,965</u>
Units produced.....	<u>+ 100</u>	<u>+ 2,000</u>
Cost per unit	<u><u>\$816.35</u></u>	<u><u>\$ 199.98</u></u>

- (5) The proposed new costing system is an ABC system because it uses cost drivers that include non-unit-level drivers. The unit-level driver is machine hours, the batch-level drivers are setup hours and loads handled, and the product-level driver is design hours. Vendor orders could be either a batch- or product-level driver, depending on whether orders are placed for each batch; the case does not tell whether this is so.
- (6) For the low-volume product, #33, the proposed ABC system shows a substantially higher cost than did either of the other two systems. This is the general result when ABC implemented and compared with traditional systems. At the usual selling price of \$800, the ABC system says this product is a money loser. Equally, or perhaps more importantly, the proposed ABC system shows that the high-volume product can be priced very competitively.

C14-2 (Concluded)

- (7) Based on the results of the ABC study, Warrenton's management should consider meeting the competitor's prices on #44; this pricing strategy can be profitable in the long run and should avoid loss of market share. The strategy for #33 is not as clear. Some customers may not accept the price increase needed to make #33 reasonably profitable, and Warrenton could lose some customers who also buy large amounts of #44 if management discontinues #33 or hikes its price too much. Management should consider several possibilities for low-volume products such as #33:
- (a) Reduce batch- and product-level costs enough to become an efficient producer of low-volume products. This may require creation of a small job-shop environment in a portion of the plant (or in another facility), where low-volume products could be made more efficiently.
 - (b) Reduce the number of products, by designing a new product that can be substituted for several low-volume, unprofitable products that can then be discontinued; this essentially exchanges several low-volume products for one of much higher volume, with substantial batch- and product-level savings.
 - (c) Convince one of the current buyers of the low-volume products to become a distributor of several such products; buying them from Warrenton in larger quantities, maintaining small inventories, and selling them to other customers. This can reduce Warrenton's batch-level and marketing costs, but it risks the loss of customers who like to buy the full line from one supplier.
 - (d) Raise prices gradually until all products are reasonably priced. This does not mean all products must show profits. (It is acceptable for a good customer to occasionally buy a money-losing product.) Rather, it means that the company should not continue making a money-losing product without a good reason. It is not acceptable to have a customer who buys only the money-losing products, nor for the company to continue making a money-losing product that no "good customers" are buying.
 - (e) In addition to the usual sales price, charge a lump-sum amount per order for any small order of a low-volume product. This charge could be set at a level to cover estimated batch- and product-level costs.

CHAPTER 15

DISCUSSION QUESTIONS

- Q15-1. Profit planning encompasses (a) sales estimating and sales planning programs; (b) budgeting programs for control of all costs, both manufacturing and nonmanufacturing; (c) planning and programming additions to or deletions from working capital and plant investment; and, (d) a review of all factors that have an impact on return on investment, both from a short-term viewpoint of one year and longer periods of time. The profit-planning function must not be merely financial in scope. It must disclose the methods and programs by which the financial goals are to be achieved.
- Q15-2. A budget is the expected target that management strives to achieve, whereas a forecast is a level of revenue or cost that an organization predicts will occur.
- Q15-3. The three approaches for setting profit objectives are:
- A priori. Management specifies a given rate of return to be achieved in the long run and then draws up plans for achieving that rate.
 - A posteriori. Management draws up plans and then sets the rate resulting from the plans.
 - Pragmatic. Management uses a target profit standard that has been tested empirically and sanctioned by experience.
- Q15-4. Long-range planning deals with specific areas of the company's plans, such as future sales, long-term capital expenditures, research and development activities, financial requirements, and the profit goal. Short-range budgeting places the planning and particularly control into periods of three, six, or twelve months.
- Q15-5. A budget is a detailed financial statement of the organization's strategy. It converts general strategy statements into specific plans of action, measured financially. It is related to control, because it is the fundamental guideline for what the organization should do. Thus, it is the benchmark against which actual performance is compared. This process of comparison is a vital part of the control function in the organization.
- Q15-6. In carrying out management's functions of planning, organizing, and control for the development of a budgetary control program, it is necessary to:
- organize the budget committee
 - organize the entire budgetary control program
 - plan sales with the sales manager
 - determine the finished goods inventory requirement in harmony with the sales budget
- plan production with the production manager based on the sales budget
 - meet with heads of all departments—both producing and service—relative to direct materials, direct labor, and factory overhead costs required for the production budgeted
 - establish materials purchase requirements based on production planning, a department's materials requirements, or the production budget
 - establish expense budgets with marketing, administrative, and financial division heads
 - budget capital expenditures and prepare a research and development budget.
 - develop a cash budget
 - coordinate and summarize company-wide budgets into a master budget—summarized in the budgeted income statement and balance sheet
- Q15-7. The periodic budget represents a formal communication channel within a company for the following reasons:
- The periodic budget involves a formal commitment on the part of management to take positive actions to make actual events correspond to the formal budget.
 - The periodic budget is usually reviewed and approved by a higher authority and, once approved, is changed only in unusual specified circumstances.
 - The periodic budget contains explicit statements of the implementation of management objectives for a period of time, published to all parties with control responsibility.
 - Comparison of actual results with the periodic budget forms the basis for management control, motivation, and performance evaluation.
- Q15-8. Budgets are required for planning, monitoring, and motivating, and because they include estimates, they always involve uncertainty. The process of budget preparation forces identification of variables and attempts at estimation. Reiteration should improve the process, and the process should cause a positive attitude to attain goals. Of course, a poorly estimated budget can cause dysfunctional behavior.
- In this situation, the budget should provide incentive for going after bids. The inclusion of budgeted and actual contribution margin data

in periodic reports offers an early indication of below par contribution, or the possible need to reduce bid prices, or other corrective action that may be required.

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- Q15-9. All employees (including executive management) must accept the importance of budgeting and be willing to participate fully in budget preparation and implementation, or the budget will not work.
- Q15-10. (a) Effective use of budgeting should result in better performance by the organization because of better performance by the managers. The behavioral benefit lies in the ability of the budget and the budgeting process to motivate managers to accomplish the organization objectives. This is done by using the budget as a vehicle for communicating company objectives, establishing subobjectives in accord with manager objectives, and providing a thoroughly understood common basis for performance measurement and feedback.
- (b) The budgeting process has been subject to criticism by behavioral scientists and others on several counts:
- (1) The most serious charge is that the budgeting process fails to recognize that individuals may not accept company objectives as their own. The result is lack of effort to achieve these objectives.
 - (2) The level of objectives set may be established without regard to how this will motivate the manager to achieve the objectives. The results may include underachievement of potentially obtainable levels of performance and/or destruction of employee morale.
 - (3) The budget is used as a pressure device to force conformity to and acceptance of the objectives established in the budget. This often results in employees finding ways to "beat" the budget rather than actually improving performance.
 - (4) The budget is administered by individuals not directly involved in the operating activity of the organization and not particularly skillful in dealing with people.
- (c) The most serious problem that must be overcome in order to solve the problems identified by the criticisms in (b) is the

lack of understanding of the forces that cause managers to act as they do. It must be recognized that the traditional assumptions underlying the budget and budget process are not entirely valid. Such assumptions include:

- (1) Managers automatically accept company objectives as their own.
- (2) Tight standards are best because they represent hard-to-reach goals, which most people strive to achieve.
- (3) Upper levels of management are best equipped to establish operating subobjectives.

It is necessary to recognize the behavioral influences (psychological and sociological) on the work of managers.

The most common specific recommendation is the use of participative budgeting, since it provides for an opportunity to identify objectives of the manager and company, increases the ability of both to develop operating activities to reach the objectives, and enhances the likelihood of setting objectives at levels effective in motivating managers toward company goals.

- Q15-11. Commercial expenses are grouped into functions by their actions or operating units. These functions are looked upon as departments and should be set along organizational lines in order to identify the expense with an authorized and responsible individual. Grouping by products and by territories may be desirable as well.
- Q15-12. The budgeted income statement summarizes in one statement the results of the complete plan of action. It expresses in financial terms the end results of proposed plans. It can also be used to test the adequacy or inadequacy of those plans.
- Q15-13. The budgeted balance sheet reveals the expected financial condition at the end of a particular period. One of the measures of the adequacy of proposed operating and financial plans is the effect of the execution of these plans on the financial condition of the business. If the budgeted balance sheet shows a potential unsatisfactory condition, proposed plans can be reviewed and perhaps revised to produce satisfactory results.

EXERCISES

E15-1

BROWN BROTHERS
Budget of Sales Revenue and Gross Profit
For the Year 20B

Product	Sales in Pounds*	Average Sales Price per Pound**	Cost of Goods Sold per Pound***	Gross Profit per Pound	Sales Revenue	Gross Profit
Rex-Z	20,000	\$34.50	\$25.00	\$9.50	\$ 690,000	\$190,000
Sip-X	12,600	24.15	18.00	6.15	304,290	77,490
Tok-Y	7,500	18.90	14.30	4.60	141,750	34,500
					<u>\$1,136,040</u>	<u>\$301,990</u>

* Product	19A Sales	Increase	19B Sales
Rex-Z	10,000	200.00%	20,000
Sip-X	9,000	140.00%	12,600
Tok-Y	7,500	100.00%	7,500

** Product	19A Price	Increase	19B Price
Rex-Z	\$30.00	115.00%	\$34.50
Sip-X	23.00	105.00%	24.15
Tok-Y	18.00	105.00%	18.90

*** Product	19A Price	19A GP	19A Cost	Increase	19B Cost
Rex-Z	\$30.00	\$10.00	\$20.00	125.00%	\$25.00
Sip-X	23.00	8.00	15.00	120.00%	18.00
Tok-Y	18.00	5.00	13.00	110.00%	14.30

E15-2

FINEFLEX CORPORATION
Production Budget
For the Second Quarter Ending June 30, 20-

	Units of Flop	Units of Olap	Units of Ryke
Sales forecast	21,000	37,500	54,000
Add desired ending inventory (June 30)....	6,000	10,500	13,000
Quantity required for the quarter.....	27,000	48,000	67,000
Less beginning inventory (April 1).....	(5,500)	(11,000)	(14,500)
Required production for the quarter	<u>21,500</u>	<u>37,000</u>	<u>52,500</u>

E15-3

MAGIC ENTERPRISES
Production Budget
For the Quarter Ending March 31, 20—

	<u>Moon Glow</u>	<u>Enchanting</u>	<u>Day Dream</u>
Units required for sales.....	250,000	175,000	300,000
Add ending inventory of finished units	<u>15,000</u>	<u>10,000</u>	<u>20,000</u>
Total units required	265,000	185,000	320,000
Less beginning inventory of finished units	<u>16,000</u>	<u>12,000</u>	<u>25,000</u>
Units to be transferred to finished goods.....	249,000	173,000	295,000
Add ending work in process inventory	<u>4,200</u>	<u>2,000</u>	<u>6,000</u>
	253,200	175,000	301,000
Less beginning work in process inventory	<u>2,000</u>	<u>1,800</u>	<u>5,600</u>
Equivalent units to be produced	<u>251,200</u>	<u>173,200</u>	<u>295,400</u>

E15-4

(1)

	<u>Low Band</u>	<u>Mid Band</u>	<u>High Band</u>	<u>Low and Mid Band</u>	<u>Mid and High Band</u>	<u>Three Band</u>
Units required to meet sales budget.....	200	300	400	250	350	200
Add desired ending inventory....	<u>40</u>	<u>30</u>	<u>50</u>	<u>50</u>	<u>50</u>	<u>30</u>
Total units required during period.....	240	330	450	300	400	230
Less beginning inventory	<u>(50)</u>	<u>(30)</u>	<u>(70)</u>	<u>(20)</u>	<u>(30)</u>	<u>(20)</u>
Required production quantity....	<u>190</u>	<u>300</u>	<u>380</u>	<u>280</u>	<u>370</u>	<u>210</u>

E15-4 (Concluded)**(2) Materials purchases requirements:**

Model	Production Require- ment	Per Unit Materials Requirements			Total Materials Requirements		
		Metal Tubing	Inductors	Feed- line Con- nectors	Metal Tubing	Induc- tors	Feed- line Con- nectors
Low band	190	10 feet	1	1	1,900 feet	190	190
Mid band	300	7	1	1	2,100	300	300
High band	380	5	1	1	1,900	380	380
Low and mid band	280	17	2	1	4,760	560	280
Mid and high band ...	370	12	2	1	4,440	740	370
Three band	210	22	3	1	4,620	630	210
Quantity required to meet production budget					19,720	2,800	1,730
Add desired ending materials inventory					7,000	800	500
Total quantity of materials required for the period					26,720	3,600	2,230
Deduct materials on hand at the beginning of the period					6,000	1,000	1,500
Materials purchases requirements					20,720	2,600	730

E15-5**(1) Sales budget for fourth quarter:**

Product	Quantity	Unit Price	Sales Revenue
X	4,500	\$12.00	\$ 54,000
Y	2,000	25.00	50,000
Z	3,000	20.00	60,000
Total budgeted sales			<u>\$164,000</u>

(2) Production budget for fourth quarter:

	Product		
	X	Y	Z
Budgeted sales in units	4,500	2,000	3,000
Desired ending inventory	900	400	500
Quantity required	5,400	2,400	3,500
Beginning inventory	600	500	400
Required production	<u>4,800</u>	<u>1,900</u>	<u>3,100</u>

E15-5 (Concluded)**(3) Materials usage budget for fourth quarter:**

Product	Planned Pro- duction	Materials Required Per Unit			Total Materials Required		
		A	B	C	A	B	C
X	4,800	3	1	2	14,400	4,800	9,600
Y	1,900	2	2	4	3,800	3,800	7,600
Z	3,100	1	3	2	3,100	9,300	6,200
					<u>21,300</u>	<u>17,900</u>	<u>23,400</u>

(4) Materials purchase budget for fourth quarter:

	Material			Total
	A	B	C	
Production requirement	21,300	17,900	23,400	
Desired ending inventory	2,500	2,000	2,000	
Quantity required	23,800	19,900	25,400	
Beginning inventory	2,000	1,000	2,500	
Quantity to be purchased	21,800	18,900	22,900	
Unit cost	\$.50	\$ 2.00	\$ 1.50	
Purchase requirement	<u>\$10,900</u>	<u>\$37,800</u>	<u>\$34,350</u>	<u>\$83,050</u>

E15-6**(1)**

	Tribolite	Polycal	Powder X
Units required to meet sales budget	80,000	40,000	100,000
Add ending inventory	6,000	2,000	8,000
Total units required	86,000	42,000	108,000
Less beginning inventory	5,000	4,000	10,000
Planned production	<u>81,000</u>	<u>38,000</u>	<u>98,000</u>

E15-6 (Concluded)

(2)

	Material A	Material B
Tribolite	81,000 x 1 = 81 000 kg	81,000 x 2 = 162 000 kg
Polycal	38,000 x 2 = 76 000	—
Powder X	—	98,000 x 1 = 98 000
	<u>157 000 kg</u>	<u>260 000 kg</u>
Add ending inventory	<u>12 000</u>	<u>15 000</u>
	169 000 kg	275 000 kg
Less beginning inventory	<u>9 500</u>	<u>11 000</u>
Units to be purchased	159 500 kg	264 000 kg
Cost per kilogram	<u>x \$.20</u>	<u>x \$.10</u>
Total cost of purchases	<u>\$31,900</u>	<u>\$26,400</u>

(3)

	Tribolite	Polycal	Power X	Total
Materials:				
A: 81,000 x 1 x \$.20	\$16,200			\$ 16,200
38,000 x 2 x \$.20		\$15,200		15,200
B: 81,000 x 2 x \$.10	16,200			16,200
98,000 x 1 x \$.10			\$ 9,800	9,800
	<u>\$32,400</u>	<u>\$15,200</u>	<u>\$ 9,800</u>	<u>\$ 57,400</u>
Direct Labor:				
81 x 50 x \$8	\$32,400			\$ 32,400
38 x 125 x \$8		\$38,000		38,000
98 x 12.5 x \$8			\$ 9,800	9,800
	<u>\$32,400</u>	<u>\$38,000</u>	<u>\$ 9,800</u>	<u>\$ 80,200</u>
Factory overhead—variable:				
81 x 50 x \$6	\$24,300			\$ 24,300
38 x 125 x \$6		\$28,500		28,500
98 x 12.5 x \$6			\$ 7,350	7,350
	<u>\$24,300</u>	<u>\$28,500</u>	<u>\$ 7,350</u>	<u>\$ 60,150</u>
Total variable manufacturing cost	<u>\$89,100</u>	<u>\$81,700</u>	<u>\$26,950</u>	<u>\$197,750</u>
Fixed manufacturing cost (not allocated to products)				40,000
Total manufacturing cost				<u>\$237,750</u>

E15-7

WKZ INC.
Budgeted Cost of Goods Manufactured and Sold Statement
For the year 20—

Materials:	
Beginning inventory.....	\$ 500,000
Purchases.....	<u>2,600,000⁵</u>
Materials available for use	\$3,100,000
Ending inventory.....	<u>600,000</u>
Cost of materials used.....	\$2,500,000
Labor.....	4,340,000
Factory overhead	<u>1,840,000⁴</u>
Total manufacturing cost	\$8,680,000 ³
Add beginning work in process inventory.....	<u>100,000</u>
	\$8,780,000
Deduct ending work in process inventory	<u>300,000</u>
Cost of goods manufactured	\$8,480,000 ²
Add beginning finished goods inventory.....	<u>800,000</u>
Cost of goods available for sale.....	\$9,280,000
Deduct ending finished goods inventory	<u>1,000,000</u>
Cost of goods sold	<u><u>\$8,280,000¹</u></u>

¹ Earnings (6% of \$20,000,000 = \$1,200,000).....	10% of sales
Marketing, administrative, and financial expenses	<u>21</u>
	31% of sales
Cost of goods sold (\$8,280,000)	<u>69</u>
	<u>100% of sales</u>

² Cost of goods sold	+	Ending finished goods inventory	-	Beginning finished goods inventory	=	Cost of goods manufactured
\$8,280,000		\$1,000,000		\$800,000		\$8,480,000

³ Cost of goods manufactured	+	Ending work in process inventory	-	Beginning work in process inventory	=	Total manufacturing cost (materials, labor, and factory overhead)
\$8,480,000		\$300,000		\$100,000		\$8,680,000

⁴ Total manufacturing cost	-	Labor (50% of manufacturing cost)	-	Cost of materials used	=	Factory overhead
\$8,680,000		\$4,340,000		\$2,500,000		\$1,840,000

⁵ Cost of materials used	+	Ending materials inventory	-	Beginning materials inventory	=	Materials purchases
\$2,500,000		\$600,000		\$500,000		\$2,600,000

E15-8

PATZ COMPANY
Budgeted Income Statement
Second Quarter, 20—

Sales (\$500,000 first quarter sales x 2)	\$1,000,000
Cost of goods sold (\$1,000,000 sales x (100% - 40%))	600,000
Gross profit (\$1,000,000 sales x 40%)	<u>\$ 400,000</u>
Commercial expenses:	
Uncollectible accounts (\$1,000,000 sales x 2%)	\$ 20,000
Depreciation ((\$800,000 ÷ 20 years) x 1/4 year)	10,000
Marketing:	
Variable (\$1,000,000 sales x 10%)	100,000
Fixed	50,000
Administration (all fixed)	<u>30,000</u>
	<u>210,000</u>
Income before income tax	<u><u>\$ 190,000</u></u>

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E15-9

MEXIA CORPORATION
Budgeted Income Statement
For the Year Ending December 31, 20B

Sales (\$9,000,000 in 19A x 1.05 quantity increase x 1.10 price increase)	\$10,395,000
Less cost of goods sold (\$6,000,000 x 1.05 quantity increase x 1.06 cost increase)	6,678,000
Gross profit	<u>\$ 3,717,000</u>
Less commercial expenses:	
Marketing expenses (\$780,000 + \$420,000 increase in advertising)	\$1,200,000
Administrative expenses	<u>900,000</u>
	<u>2,100,000</u>
Operating income before taxes and interest	<u>\$ 1,617,000</u>
Less interest expense (\$140,000 + (\$400,000 asset increase x 10% rate))	180,000
Income before income tax	<u>\$1,437,000</u>
Less income tax expense (\$1,447,000 x .40 tax rate)	574,800
Net income	<u><u>\$ 862,200</u></u>

PROBLEMS

P15-1

(1) Sales Budget

	Unit	Price	Total
Thingone	60,000	\$ 70	\$4,200,000
Thingtwo	40,000	100	4,000,000
Projected sales.....			<u>\$8,200,000</u>

(2) Production Budget

	Thingone	Thingtwo
Projected sales	60,000	40,000
Desired inventories, December 31, 20B.....	25,000	9,000
	<u>85,000</u>	<u>49,000</u>
Less expected inventories, January 1, 20B.....	20,000	8,000
Production required (units).....	<u>65,000</u>	<u>41,000</u>

(3) Raw Materials Purchases Budget

	Raw Materials			Total
	A	B	C	
Thingone (65,000 units projected to be produced)	260,000 lbs.	130,000 lbs.	—	
Thingtwo (41,000 units projected to be produced)	205,000	123,000	41,000 units	
Production requirement.....	465,000 lbs.	253,000 lbs.	41,000 units	
Add desired inventories, December 31, 19B.....	36,000	32,000	7,000	
Total requirements	501,000 lbs.	285,000 lbs.	48,000 units	
Less expected inventories, January 1, 19B	32,000	29,000	5,000	
Purchase requirements.....	469,000 lbs.	256,000 lbs.	43,000 units	
Cost per pound or unit	\$8	\$5	\$3	
Total cost of purchases.....	<u>\$3,752,000</u>	<u>\$1,280,000</u>	<u>\$129,000</u>	<u>\$ 5,161,000</u>

P15-1 (Concluded)

(4) Direct Labor Budget					
	Projected Production (Units)	Hours per Unit	Total	Rate	Total
Thingone	65,000	2	130,000	\$8	\$1,040,000
Thingtwo	41,000	3	123,000	9	1,107,000
					<u>\$2,147,000</u>

(5) Finished Goods Inventory Budget, December 31, 20B					
Thingone:					
Raw materials:					
A—4 pounds @ \$8			\$32		
B—2 pounds @ \$5			10	\$42	
				16	
Direct labor—2 hours @ \$8					
Factory overhead—2 hours @ \$2 per direct labor hour				4	
				<u>\$62</u>	
\$62 x 25,000 units					\$1,550,000
Thingtwo:					
Raw materials:					
A—5 pounds @ \$8			\$40		
B—3 pounds @ \$5			15		
C—1 unit @ \$3			3	\$58	
				27	
Direct labor—3 hours @ \$9					
Factory overhead—3 hours @ \$2 per direct labor hour				6	
				<u>\$91</u>	
\$91 x 9,000 units					819,000
Budgeted finished goods inventory, December 31, 20B					<u>\$2,369,000</u>

P15-2

(1)

ROLETTER COMPANY
Budget for Production and Direct Labor
For the Quarter Ending March 31, 20B

	Month			Quarter
	January	February	March	
Sales (units).....	10,000	12,000	8,000	30,000
Add ending inventory*	16,000	12,500	13,500	13,500
Total units required	26,000	24,500	21,500	43,500
Less beginning inventory.....	16,000	16,000	12,500	16,000
Units to be produced.....	10,000	8,500	9,000	27,500
Direct labor hours per unit.....	x 2.0	x 2.0	x 1.5	
Total hours of direct labor time needed	<u>20,000</u>	<u>17,000</u>	<u>13,500</u>	<u>50,500</u>
Direct labor costs:				
Wages (\$8.00 per DLH)	\$160,000	\$136,000	\$108,000	\$404,000
Pension contributions (\$0.25 per DLH).....	5,000	4,250	3,375	12,625
Workers' compensation insurance (\$0.10 per DLH)	2,000	1,700	1,350	5,050
Employee medical insurance (\$0.40 per DLH).....	8,000	6,800	5,400	20,200
Employer's social security and unemployment taxes (\$8.00 x 0.10 = \$0.80 per DLH)	16,000	13,600	10,800	40,400
Total direct labor cost.....	<u>\$191,000</u>	<u>\$162,350</u>	<u>\$128,925</u>	<u>\$482,275</u>

*100% of the first following month's sales plus 50% of the second following month's sales.

P15-2 (Concluded)

- (2) (a) Components of the periodic budget, other than the production budget and the direct labor budget, that would also use the sales data include:
- (1) the sales budget
 - (2) the cost of goods manufactured and sold budget
 - (3) the marketing and administrative expenses budget
 - (4) the budgeted income statement
- (b) Components of the periodic budget, other than the production budget and the direct labor budget, that would also use the production data include:
- (1) the direct materials budget
 - (2) the factory overhead budget
 - (3) the cost of goods manufactured and sold budget
- (c) Components of the periodic budget, other than the production budget and the direct labor budget, that would also use the direct labor hour data include:
- (1) the factory overhead budget (for determining the overhead application rate if based on direct labor hours)
- (d) Components of the periodic budget, other than the production budget and the direct labor budget, that would also use the direct labor cost data include:
- (1) the factory overhead budget (for determining the overhead application rate if based on direct labor dollars and for determining the cost of employee benefits attributable to wages earned by direct labor)
 - (2) the cost of goods manufactured and sold budget
 - (3) the cash budget
 - (4) the budgeted income statement

P15-3

(1)	Estimated sales for third quarter (July—September)	18,000
	Add ending inventory (7,000 x 80%).....	5,600
		<u>23,600</u>
	Less beginning inventory	5,600
	Production.....	<u>18,000</u>

(2)	Material		
	101	211	242
Units to be produced	18,000	18,000	18,000
Materials rate	x 6	x 4	x 2
Units of materials required	108,000	72,000	36,000
Add ending inventory:			
5,600 x 6	33,600		
5,600 x 4		22,400	
5,600 x 2			11,200
	<u>141,600</u>	<u>94,400</u>	<u>47,200</u>
Less beginning inventory.....	35,000	30,000	13,000
Purchases	106,600	64,400	34,200
Cost per unit.....	x \$2.40	x \$3.60	x \$1.20
Total cost of purchases.....	<u>\$255,840</u>	<u>\$231,840</u>	<u>\$41,040</u>

(3)	Process	Production	Hours per Unit	Total Hours	Total Labor Rate	Total Labor Cost
	Forming	18,000	.80	14,400	\$8.00	\$115,200
	Assembly	18,000	2.00	36,000	5.50	198,000
	Finishing	18,000	.25	4,500	6.00	27,000
				<u>54,900</u>		<u>\$340,200</u>

(4)	Expected annual production	60,000 units
	Actual production through June 30	27,000
	Expected production during last six months of 20A.....	33,000 units
	Variable factory overhead per unit (\$162,000 ÷ 27,000)	x \$6.00
	Budgeted variable factory overhead	\$198,000
	Budgeted fixed factory overhead.....	93,000
	Total budgeted factory overhead	<u>\$291,000</u>

P15-4

(1) Revised Sales Budget in Units Based on the Index

	Territories				6-Month Total
	<u>I</u>	<u>II</u>	<u>III</u>	<u>Other</u>	
1-lb. package.....	9,000 ¹	13,500	10,800	551,700	585,000
2-lb. package.....	10,800 ²	16,200	10,800	704,700	742,500
Total	<u>19,800</u>	<u>29,700</u>	<u>21,600</u>	<u>1,256,400</u>	<u>1,327,500</u>

¹10,000 x .9 = 9,000²12,000 x .9 = 10,800

(2) Sales Budget in Dollars

	Territories				6-Month Total
	<u>I</u>	<u>II</u>	<u>III</u>	<u>Other</u>	
1-lb. package.....	\$2,250 ¹	\$ 3,375	\$2,700	\$137,925	\$146,250
2-lb. package.....	5,400 ²	8,100	5,400	352,350	371,250
Total.....	<u>\$7,650</u>	<u>\$11,475</u>	<u>\$8,100</u>	<u>\$490,275</u>	<u>\$517,500</u>

¹ 9,900 revised estimate x \$.25 (per package) = \$2,250²10,800 revised estimate x \$.50 (per package) = \$5,400

(3) Materials Purchases

	Grain R		Grain S		Total	
	<u>Bu.</u>	<u>Cost</u>	<u>Bu.</u>	<u>Cost</u>	<u>Bu.</u>	<u>Cost</u>
January.....	5,000	\$ 6,500	2,000	\$ 2,400	7,000	\$ 8,900
February	2,000	2,800	1,000	1,200	3,000	4,000
March.....	—	—	3,000	3,750	3,000	3,750
April	8,000	12,000	3,000	3,000	11,000	15,000
May	3,000	4,500	—	—	3,000	4,500
June.....	4,000	6,400	4,000	4,000	8,000	10,400
	<u>22,000</u>	<u>\$32,200</u>	<u>13,000</u>	<u>\$14,350</u>	<u>35,000</u>	<u>\$46,550</u>

P15-4 (Concluded)**(4) Materials Requirements for Production**

Production of 585,000 1-lb. packages	585,000 lbs.
Production of 742,500 2-lb. packages	<u>1,485,000</u>
Total materials requirements for six months	<u>2,070,000 lbs.</u>

Three bushels of grain in the proportions of 2R:1S produce 198 lbs. of finished product. R weighs 70 lbs. per bushel and S weighs 80 lbs. per bushel.

Grain	Bushels	Weight per Bushel	Lbs.
R	2	70 lbs.	140
S	1	80 lbs.	<u>80</u>
			220
		10% loss	<u>22</u>
		Weight of finished product ...	<u>198</u>

Since each 198 lbs. of product calls for 220 lbs. of grain, the total weight of grain required for 2,070,000 lbs. is:

$\frac{220}{198} \times 2,070,000 = 2,300,000$ lbs., to be apportioned as follows:

Grain R = $\frac{140}{220} \times 2,300,000 = 1,463,636$ lbs. = 20,909 bushels @ 70 lbs. each

Grain S = $\frac{80}{220} \times 2,300,000 = 836,364$ lbs. = 10,455 bushels @ 80 lbs. each

(5) Materials Account (Fifo Basis)

	Grain R		Grain S	
	Bu.	Cost	Bu.	Cost
Inventory, January 1	10,000	\$12,000	3,000	\$ 3,000
Purchases	22,000	32,200	13,000	14,350
Total	<u>32,000</u>	<u>\$44,200</u>	<u>16,000</u>	<u>\$17,350</u>
Put into production:				
Beginning inventory	10,000	\$12,000	3,000	\$ 3,000
January purchases	5,000	6,500	2,000	2,400
February purchases	2,000	2,800	1,000	1,200
March purchases	—	—	3,000	3,750
April purchases	<u>3,909</u>	<u>5,864</u>	<u>1,455</u>	<u>1,455</u>
Total consumption	<u>20,909</u>	<u>\$27,164</u>	<u>10,455</u>	<u>\$11,805</u>
Inventory, June 30	<u>11,091</u>	<u>\$17,036</u>	<u>5,545</u>	<u>\$ 5,545</u>

P15-5

(1) **Budgeted Income Statement**
(000s omitted)

	Quarter				Total
	First	Second	Third	Fourth	
Sales:					
Commercial	\$250	\$266	\$275	\$300	\$1,091
Government.....	100	120	110	115	445
Total	\$350	\$386	\$385	\$415	\$1,536
Cost of goods sold	161	178	177	191	707
Gross profit	\$189	\$208	\$208	\$224	\$ 829
Other operating expenses:					
Advertising	\$ 6	\$ 6	\$ 6	\$ 6	\$ 24
Selling	35	39	39	42	155
Administrative	32	35	35	38	140
General office.....	23	25	25	27	100
Total.....	\$ 96	\$105	\$105	\$113	\$ 419
Income before income tax.....	\$ 93	\$103	\$103	\$111	\$ 410
Income tax.....	37	41	41	44	163
Net income	\$ 56	\$ 62	\$ 62	\$ 67	\$ 247

P15-5 (Concluded)

(2)

**Budgeted Income Statement
with 5% Increase in Commercial Sales
(000s omitted)**

	Quarter				Total
	First	Second	Third	Fourth	
Sales:					
Commercial	\$263	\$279	\$289	\$315	\$1,146
Government	100	120	110	115	445
Total	\$363	\$399	\$399	\$430	\$1,591
Cost of goods sold	167	184	184	198	733
Gross profit	\$196	\$215	\$215	\$232	\$ 858
Other operating expenses:					
Advertising	\$ 6	\$ 6	\$ 6	\$ 6	\$ 24
Selling	36	40	40	43	159
Administrative	33	36	36	39	144
General office	24	26	26	28	104
Total	\$ 99	\$108	\$108	\$116	\$ 431
Income before income tax.....	\$ 97	\$107	\$107	\$116	\$ 427
Income tax	39	43	43	46	171
Net income	<u>\$ 58</u>	<u>\$ 64</u>	<u>\$ 64</u>	<u>\$ 70</u>	<u>\$ 256</u>

P15-6(1)

JOHNSON AND SMITH, CERTIFIED PUBLIC ACCOUNTANTS
Time Allocation Budget
For Year Ending June 30, 20N

	<u>Johnson</u>	<u>Smith</u>	<u>Vickers</u>	<u>Lowe</u>	<u>Kennedy</u>	<u>Quinn</u>	<u>Garcia</u>	<u>Hammond</u>	<u>Lyons</u>
Maximum hours									
52 weeks x									
40 hours	<u>2,080</u>	<u>2,080</u>	<u>2,080</u>	<u>2,080</u>	<u>2,080</u>	<u>2,080</u>	<u>2,080</u>	<u>2,080</u>	<u>2,080</u>
Less budgeted									
nonchargeable									
hours:									
Administration ...	719	363	0	0	0	0	0	0	0
Other misc.	392	388	308	240	161	121	1,308	748	848
CPA exam	0	0	0	0	24	24	0	0	0
Vacation	173	173	120	80	80	80	120	80	80
Holidays	56	56	56	56	56	56	56	56	56
Illness	40	0	96	96	96	96	96	96	96
Unassigned	0	0	0	8	38	78	0	0	0
Total	<u>1,380</u>	<u>980</u>	<u>580</u>	<u>480</u>	<u>455</u>	<u>455</u>	<u>1,580</u>	<u>980</u>	<u>1,080</u>
Budgeted chargeable									
hours	<u>700</u>	<u>1,100</u>	<u>1,500</u>	<u>1,600</u>	<u>1,625</u>	<u>1,625</u>	<u>500</u>	<u>1,100</u>	<u>1,000</u>

P15-6 (Continued)

(2)

JOHNSON AND SMITH, CERTIFIED PUBLIC ACCOUNTANTS
Schedule Computing Billing Rates by Employee
For Year Ending June 30, 20N

	<u>Vickers</u>	<u>Lowe</u>	<u>Kennedy</u>	<u>Quinn</u>	<u>Garcia</u>	<u>Hammond</u>	<u>Lyons</u>	<u>Total</u>	<u>Allocable Amount</u>
Total salary.....	\$31,200	\$24,960	\$20,800	\$20,800	\$14,560	\$12,480	\$12,480	\$137,280	
Adjust salary for non-chargeable time of secretaries.....					(11,060)	(5,880)	(6,480)	(23,420)	\$ 23,420
Salaries applicable to chargeable time.....	\$31,200	\$24,960	\$20,800	\$20,800	\$ 3,500	\$ 6,600	\$ 6,000	\$113,860	
Other allocable items:									
Fringe benefits.....									35,000
Operating expenses..									62,370
Income contribution..									50,000
Total allocable amount									<u>\$170,790</u>
Amount allocated	<u>46,800</u>	<u>37,440</u>	<u>31,200</u>	<u>31,200</u>	<u>5,250</u>	<u>9,800</u>	<u>9,000</u>	<u>170,790</u>	
Total amount included in billing rate.....	<u>\$78,000</u>	<u>\$62,400</u>	<u>\$52,000</u>	<u>\$52,000</u>	<u>\$ 8,750</u>	<u>\$16,500</u>	<u>\$15,000</u>	<u>\$284,650</u>	
Budgeted chargeable hours.....	<u>1,500</u>	<u>1,600</u>	<u>1,625</u>	<u>1,625</u>	<u>500</u>	<u>1,100</u>	<u>1,000</u>		
Budgeted billing rate	<u>\$52.00</u>	<u>\$39.00</u>	<u>\$32.00</u>	<u>\$32.00</u>	<u>\$ 17.50</u>	<u>\$ 15.00</u>	<u>\$ 15.00</u>		

P15-6 (Concluded)

(3) **JOHNSON AND SMITH, CERTIFIED PUBLIC ACCOUNTANTS**
Budgeted Income Statement
For Year Ending June 30, 20N

Revenue from chargeable time:

<u>Employee</u>	<u>Billable Hours</u>	<u>Billing Rate</u>	<u>Gross Fees</u>	
Johnson.....	700	\$90.00	\$ 63,000	
Smith	1,100	70.00	77,000	
Vickers.....	1,500	52.00	78,000	
Lowe	1,600	39.00	62,400	
Kennedy	1,625	32.00	52,000	
Quinn	1,625	32.00	52,000	
Garcia	500	17.50	8,750	
Hammond	1,100	15.00	16,500	
Lyons	1,000	15.00	15,000	\$424,650

Expenses of producing revenue:**Salaries:**

Partners	\$100,000	
Professional staff	97,760	
Secretaries.....	39,520	
Fringe benefits.....	35,000	
Other operating expenses	62,370	334,650

Gross profit.....

\$ 90,000

P15-7

Schedule 1
Sales Budget

	Areas		Total
	South	Southwest	
Model 150			
Units	3,000	4,000	7,000
Unit price	\$ 175	\$ 175	\$ 175
Total	\$ 525,000	\$ 700,000	\$1,225,000
Model 100			
Units	5,000	7,000	12,000
Unit price	\$ 120	\$ 120	\$ 120
Total	\$ 600,000	\$ 840,000	\$1,440,000
Model 50			
Units	7,000	8,000	15,000
Unit price	\$ 90	\$ 90	\$ 90
Total	\$ 630,000	\$ 720,000	\$1,350,000
Total	\$1,755,000	\$2,260,000	\$4,015,000

Schedule 2
Production Budget

	Model		
	150	100	50
Units required to meet sales budget (Schedule 1)	7,000	12,000	15,000
Add ending inventory	200	400	300
Total units required	7,200	12,400	15,300
Less beginning inventory	200	300	400
Planned production for the year	<u>7,000</u>	<u>12,100</u>	<u>14,900</u>

P15-7 (Continued)

Schedule 3
Direct Materials Budget in Units

	<u>Units to Be Manufactured</u>	<u>Lumber In Board Feet</u>	<u>Speakers</u>	<u>Finish In Pints</u>
Model 150				
Units to be manufactured (Schedule 2)	7,000			
Materials rate		<u>12</u>	<u>5</u>	<u>2</u>
Units of materials required		<u>84,000</u>	<u>35,000</u>	<u>14,000</u>
Model 100				
Units to be manufactured (Schedule 2)	12,100			
Materials rate		<u>8</u>	<u>3</u>	<u>1</u>
Units of materials required		<u>96,800</u>	<u>36,300</u>	<u>12,100</u>
Model 50				
Units to be manufactured (Schedule 2)	14,900			
Materials rate		<u>6</u>	<u>2</u>	<u>1</u>
Units of materials required		<u>89,400</u>	<u>29,800</u>	<u>14,900</u>
Total units of materials required ..		<u><u>270,200</u></u>	<u><u>101,100</u></u>	<u><u>41,000</u></u>

Schedule 4
Purchases Budget

	<u>Lumber</u>	<u>Materials Speakers</u>	<u>Finish</u>	<u>Total</u>
Units required for production (Schedule 3)	270,200	101,100	41,000	
Add ending inventory	<u>30,000</u>	<u>8,000</u>	<u>2,000</u>	
	300,200	109,100	43,000	
Less beginning inventory	<u>40,000</u>	<u>10,000</u>	<u>1,500</u>	
Units to be purchased	260,200	99,100	41,500	
Estimated unit cost	\$.75	\$ 15.00	\$ 2.00	
Total cost of purchases	<u><u>\$195,150</u></u>	<u><u>\$1,486,500</u></u>	<u><u>\$83,000</u></u>	<u><u>\$1,764,650</u></u>

P15-7 (Continued)

Schedule 5
Cost of Materials Required for Production

	Materials			
	Lumber	Speakers	Finish	Total
Model 150				
Units of materials required for production (Schedule 3)	84,000	35,000	14,000	
Unit cost.....	\$.75	\$ 15.00	\$ 2.00	
Total	<u>\$ 63,000</u>	<u>\$ 525,000</u>	<u>\$28,000</u>	\$ 616,000
Model 100				
Units of materials required for production (Schedule 3)	96,800	36,300	12,100	
Unit cost.....	\$.75	\$ 15.00	\$ 2.00	
Total	<u>\$ 72,600</u>	<u>\$ 544,500</u>	<u>\$24,200</u>	641,300
Model 50				
Units of materials required for production (Schedule 3)	89,400	29,800	14,900	
Unit cost.....	\$.75	\$ 15.00	\$ 2.00	
Total	<u>\$ 67,050</u>	<u>\$ 447,000</u>	<u>\$29,800</u>	543,850
Total.....	<u><u>\$202,650</u></u>	<u><u>\$1,516,500</u></u>	<u><u>\$82,000</u></u>	<u><u>\$1,801,150</u></u>

P15-7 (Continued)

Schedule 6
Direct Labor Budget

	<u>Cutting</u>	<u>Assembling</u>	<u>Finishing</u>	<u>Total</u>
Model 150				
Hours per unit .....	.375	2.000	.375	
Units to be manufactured (Schedule 2)	<u>7,000</u>	<u>7,000</u>	<u>7,000</u>	
Hours of labor required	<u>2,625</u>	<u>14,000</u>	<u>2,625</u>	
Labor cost per hour	<u>\$ 6.00</u>	<u>\$ 5.00</u>	<u>\$ 4.00</u>	
Total labor cost	<u>\$15,750</u>	<u>\$ 70,000</u>	<u>\$10,500</u>	\$ 96,250
Model 100				
Hours per unit .....	.375	1.500	.250	
Units to be manufactured (Schedule 2)	<u>12,100</u>	<u>12,100</u>	<u>12,100</u>	
Hours of labor required	<u>4,537.5</u>	<u>18,150</u>	<u>3,025</u>	
Labor cost per hour	<u>\$ 6.00</u>	<u>\$ 5.00</u>	<u>\$ 4.00</u>	
Total labor cost	<u>\$27,225</u>	<u>\$ 90,750</u>	<u>\$12,100</u>	130,075
Model 50				
Hours per unit .....	.375	1.500	.250	
Units to be manufactured (Schedule 2)	<u>14,900</u>	<u>14,900</u>	<u>14,900</u>	
Hours of labor required	<u>5,587.5</u>	<u>22,350</u>	<u>3,725</u>	
Labor cost per hour	<u>\$ 6.00</u>	<u>\$ 5.00</u>	<u>\$ 4.00</u>	
Total labor cost	<u>\$33,525</u>	<u>\$111,750</u>	<u>\$14,900</u>	160,175
Total	<u>\$76,500</u>	<u>\$272,500</u>	<u>\$37,500</u>	<u>\$386,500</u>

P15-7 (Continued)

Schedule 7
Factory Overhead Budget
(Applied Overhead)

	<u>Cutting</u>	<u>Assembling</u>	<u>Finishing</u>	<u>Total</u>
<u>Model 150</u>				
Units to be manufactured (Schedule 2)	7,000	7,000	7,000	
Estimated department factory overhead	\$ 1.00	\$ 2.00	\$.75	
Total cost.....	<u>\$ 7,000</u>	<u>\$14,000</u>	<u>\$ 5,250</u>	\$ 26,250
<u>Model 100</u>				
Units to be manufactured (Schedule 2)	12,100	12,100	12,100	
Estimated department factory overhead	\$ 1.00	\$ 1.50	\$.50	
Total cost.....	<u>\$12,100</u>	<u>\$18,150</u>	<u>\$ 6,050</u>	36,300
<u>Model 50</u>				
Units to be manufactured (Schedule 2)	14,900	14,900	14,900	
Estimated department factory overhead	\$ 1.00	\$ 1.50	\$.50	
Total cost.....	<u>\$14,900</u>	<u>\$22,350</u>	<u>\$ 7,450</u>	44,700
Total factory overhead.....	<u><u>\$34,000</u></u>	<u><u>\$54,500</u></u>	<u><u>\$18,750</u></u>	<u><u>\$107,250</u></u>

P15-7 (Continued)

Schedule 8
Beginning and Ending Inventories

	<u>Beginning Inventory</u>			<u>Ending Inventory</u>		
	<u>Units</u>	<u>Cost</u>	<u>Total</u>	<u>Units</u>	<u>Cost</u>	<u>Total</u>
Materials:						
Lumber.....	40,000	\$.75	\$ 30,000	30,000	\$.75	\$ 22,500
Speakers.....	10,000	15.00	150,000	8,000	15.00	120,000
Finish	1,500	2.00	3,000	2,000	2.00	4,000
Total			<u>\$183,000</u>			<u>\$146,500</u>
Work in process: None						
Finished goods:						
Model 150	200	\$98.00	\$ 19,600	200	\$105.50	\$ 21,100
Model 100	300	62.00	18,600	400	66.75	26,700
Model 50	400	47.00	18,800	300	50.25	15,075
Total			<u>\$ 57,000</u>			<u>\$ 62,875</u>
Total			<u><u>\$240,000</u></u>			<u><u>\$209,375</u></u>

Schedule 9
Budgeted Cost of Goods Manufactured and Sold Statement

Materials:	
Beginning inventory (Schedule 8).....	\$ 183,000
Add purchases (Schedule 4).....	<u>1,764,650</u>
Total goods available for use.....	\$1,947,650
Less ending inventory (Schedule 8)	<u>146,500</u>
Cost of materials used (Schedule 5)	\$1,801,150
Direct labor (Schedule 6)	386,500
Factory overhead (Schedule 7).....	<u>107,250</u>
Total manufacturing cost	\$2,294,900
Add beginning inventory of finished goods (Schedule 8)	<u>57,000</u>
Cost of goods available for sale.....	\$2,351,900
Less ending inventory of finished goods (Schedule 8)	<u>62,875</u>
Cost of goods sold	<u><u>\$2,289,025</u></u>

P15-7 (Concluded)

Schedule 10
Budgeted Income Statement

	<u>Amount</u>
Sales—all models (Schedule 1)	\$4,015,000.00
Cost of goods sold (Schedule 9)	<u>2,289,025.00</u>
Gross profit	\$1,725,975.00
Marketing expense	\$500,000
Administrative expenses	<u>300,000</u>
	800,000.00
Income before income tax	\$ 925,975.00
Provision for income tax	<u>462,987.50</u>
Net income	<u>\$ 462,987.50</u>

P15-8

Schedule 1—Sales Budget

Economy Model

	<u>Eastern US</u>	<u>Western US</u>	<u>Europe</u>	<u>Asia</u>	<u>Total</u>
Units	60,000	50,000	75,000	25,000	210,000
Unit price \$	50	50	50	50	50
Total	<u>\$3,000,000</u>	<u>\$2,500,000</u>	<u>\$ 3,750,000</u>	<u>\$1,250,000</u>	<u>\$10,500,000</u>

Standard Model

Units	40,000	45,000	60,000	35,000	180,000
Unit price \$	70	70	70	70	70
Total	<u>\$2,800,000</u>	<u>\$3,150,000</u>	<u>\$ 4,200,000</u>	<u>\$2,450,000</u>	<u>\$12,600,000</u>

Deluxe Model

Units	20,000	25,000	35,000	30,000	110,000
Unit price \$	90	90	90	90	90
Total	<u>\$1,800,000</u>	<u>\$2,250,000</u>	<u>\$ 3,150,000</u>	<u>\$2,700,000</u>	<u>\$ 9,900,000</u>
Total	<u>\$7,600,000</u>	<u>\$7,900,000</u>	<u>\$11,100,000</u>	<u>\$6,400,000</u>	<u>\$33,000,000</u>

P15-8 (Continued)

Schedule 2—Production Budget

	<u>Economy Model</u>	<u>Standard Model</u>	<u>Deluxe Model</u>
Units required to meet sales budget (from Schedule 1)	210,000	180,000	110,000
Add desired ending inventory	<u>20,000</u>	<u>15,000</u>	<u>10,000</u>
Total units required for year.....	230,000	195,000	120,000
Less beginning inventory	<u>15,000</u>	<u>15,000</u>	<u>15,000</u>
Production required for the year.....	<u>215,000</u>	<u>180,000</u>	<u>105,000</u>

Schedule 3—Direct Materials Budget in Units

<u>Economy Model</u>	<u>Box</u>	<u>Trans- formers</u>	<u>Diode Rectifiers</u>	<u>Filters</u>	<u>Resistors</u>	<u>Wire (in feet)</u>
Units to be manufactured (Schedule 2).....	215,000	215,000	215,000	215,000	215,000	215,000
Materials quantity per unit	<u>1</u>	<u>1</u>	<u>2</u>	<u>2</u>	<u>5</u>	<u>5</u>
Total quantity of materials required	<u>215,000</u>	<u>215,000</u>	<u>430,000</u>	<u>430,000</u>	<u>1,075,000</u>	<u>1,075,000</u>
<u>Standard Model</u>						
Units to be manufactured (Schedule 2).....	180,000	180,000	180,000	180,000	180,000	180,000
Materials quantity per unit	<u>1</u>	<u>2</u>	<u>4</u>	<u>3</u>	<u>8</u>	<u>6</u>
Total quantity of materials required	<u>180,000</u>	<u>360,000</u>	<u>720,000</u>	<u>540,000</u>	<u>1,440,000</u>	<u>1,080,000</u>
<u>Deluxe Model</u>						
Units to be manufactured (Schedule 2).....	105,000	105,000	105,000	105,000	105,000	105,000
Materials quantity per unit	<u>1</u>	<u>3</u>	<u>5</u>	<u>6</u>	<u>10</u>	<u>8</u>
Total quantity of materials required	<u>105,000</u>	<u>315,000</u>	<u>525,000</u>	<u>630,000</u>	<u>1,050,000</u>	<u>840,000</u>
Total units of materials required for production ..	<u>500,000</u>	<u>890,000</u>	<u>1,675,000</u>	<u>1,600,000</u>	<u>3,565,000</u>	<u>2,995,000</u>

P15-8 (Continued)

Schedule 4—Materials Purchases Budget							
	<u>Box</u>	<u>Trans- formers</u>	<u>Diode Rectifiers</u>	<u>Filters</u>	<u>Resistors</u>	<u>Wire (in feet)</u>	<u>Total</u>
Units required for production (Schedule 3) ..	500,000	890,000	1,675,000	1,600,000	3,585,000	2,995,000	
Add desired ending inventory	<u>5,000</u>	<u>10,000</u>	<u>25,000</u>	<u>20,000</u>	<u>50,000</u>	<u>40,000</u>	
Total units needed during the period.....	505,000	900,000	1,700,000	1,620,000	3,635,000	3,035,000	
Less units in beginning inventory	<u>10,000</u>	<u>15,000</u>	<u>25,000</u>	<u>25,000</u>	<u>10,000</u>	<u>30,000</u>	
Units to be purchased during period	495,000	885,000	1,675,000	1,595,000	3,605,000	3,005,000	
Estimated cost per unit	<u>\$1.50</u>	<u>\$4.50</u>	<u>\$7.00</u>	<u>\$1.75</u>	<u>\$2.00</u>	<u>\$5.50</u>	
Total cost of purchases	<u>\$742,500</u>	<u>\$3,982,500</u>	<u>\$1,172,500</u>	<u>\$2,791,250</u>	<u>\$721,000</u>	<u>\$1,502,500</u>	<u>\$10,912,250</u>

P15-8 (Continued)

Schedule 5—Cost of Materials for Production

	Box	Trans- formers	Diode Rectifiers	Filters	Resistors	Wire (in feet)	Total
Economy Model							
Units required for production (Schedule 3)	215,000	215,000	430,000	430,000	1,075,000	1,075,000	
Cost per unit (Schedule 4) ..	\$1.50	\$4.50	\$.70	\$1.75	\$.20	\$.50	
Total cost	<u>\$322,500</u>	<u>\$ 967,500</u>	<u>\$ 301,000</u>	<u>\$ 752,500</u>	<u>\$ 215,000</u>	<u>\$ 537,500</u>	<u>\$3,086,000</u>
Standard Model							
Units required for production (Schedule 3)	180,000	360,000	720,000	540,000	1,440,000	1,080,000	
Cost per unit (Schedule 4) ..	\$1.50	\$4.50	\$.70	\$1.75	\$.20	\$.50	
Total cost	<u>\$270,000</u>	<u>\$1,620,000</u>	<u>\$ 504,000</u>	<u>\$ 945,000</u>	<u>\$ 288,000</u>	<u>\$ 540,000</u>	<u>4,167,000</u>
Deluxe Model							
Units required for production (Schedule 3)	105,000	315,000	525,000	630,000	1,050,000	840,000	
Cost per unit (Schedule 4) ..	\$1.50	\$4.50	\$.70	\$1.75	\$.20	\$.50	
Total cost	<u>\$157,500</u>	<u>\$1,417,500</u>	<u>\$ 367,500</u>	<u>\$1,102,500</u>	<u>\$ 210,000</u>	<u>\$ 420,000</u>	<u>3,675,000</u>
Total	<u>\$750,000</u>	<u>\$4,005,000</u>	<u>\$1,172,500</u>	<u>\$2,800,000</u>	<u>\$ 713,000</u>	<u>\$1,497,500</u>	<u>\$10,938,000</u>

P15-8 (Continued)

Schedule 6—Direct Labor Budget

<u>Assembly Department</u>	<u>Economy Model</u>	<u>Standard Model</u>	<u>Deluxe Model</u>	<u>Total</u>
Units to be produced (Schedule 2).....	215,000	180,000	105,000	
Hours required per unit..	.50	.75	1.00	
Hours required	107,500	135,000	105,000	347,500
Labor rate per hour	\$ 10.00	\$ 10.00	\$ 10.00	\$ 10.00
Total departmental labor cost for product.....	<u>\$1,075,000</u>	<u>\$1,350,000</u>	<u>\$1,050,000</u>	<u>\$3,475,000</u>
<u>Testing Department</u>				
Units to be produced (Schedule 2).....	215,000	180,000	105,000	
Hours required per unit..	.05	.05	.05	
Hours required	10,750	9,000	5,250	25,000
Labor rate per hour	\$ 12.00	\$ 12.00	\$ 12.00	\$ 12.00
Total departmental labor cost for product.....	<u>\$ 129,000</u>	<u>\$ 108,000</u>	<u>\$ 63,000</u>	<u>\$ 300,000</u>
Total labor cost for the period	<u>\$1,204,000</u>	<u>\$1,458,000</u>	<u>\$1,113,000</u>	<u>\$3,775,000</u>

Schedule 7—Budgeted Machine Hours in Testing Department

	<u>Economy Model</u>	<u>Standard Model</u>	<u>Deluxe Model</u>	<u>Total</u>
Units to be produced (Schedule 2)	215,000	180,000	105,000	
Hours of machine time required to test unit .....	.15	.25	.35	
Total machine hours required.....	<u>32,250</u>	<u>45,000</u>	<u>36,750</u>	<u>114,000</u>

P15-8 (Continued)

Schedule 8—Budgeted Factory Overhead and Departmental Rates

	<u>Fixed Cost</u>	<u>Variable Rate</u>	<u>Budgeted Hours</u>	<u>Variable Cost</u>	<u>Budgeted Departmental Overhead</u>
Assembly Department					
Indirect materials and supplies	\$158,000	\$1.50	347,500	\$521,250	\$ 679,250
Indirect labor.....	350,000	.50	347,500	173,750	523,750
Payroll taxes.....	382,500	.05	347,500	17,375	399,875
Employee fringe benefits.....	347,500				347,500
Equipment depreciation	65,000				65,000
Repairs and maintenance	25,000	.40	347,500	139,000	164,000
Allocated building cost	12,000				12,000
Allocated general factory costs	241,125				241,125
Total departmental budgeted overhead.....					\$2,432,500
Budgeted overhead allocation base (direct labor hours)					347,500
Predetermined departmental factory overhead rate					<u>\$ 7.00</u>
Testing Department					
Indirect materials and supplies	\$157,000	\$.35	114,000	\$ 39,900	\$ 196,900
Indirect labor.....	250,000	1.00	114,000	114,000	364,000
Payroll taxes.....	55,000	.10	114,000	11,400	66,400
Employee fringe benefits.....	114,000				114,000
Equipment depreciation	215,000				215,000
Repairs and maintenance	35,000	1.50	114,000	171,000	206,000
Allocated building cost	9,000				9,000
Allocated general factory costs	82,700				82,700
Total departmental budgeted overhead					\$1,254,000
Budgeted overhead allocation base (machine hours)					114,000
Predetermined departmental factory overhead rate					<u>\$ 11.00</u>
Assembly Department budget factory overhead					\$2,432,500
Testing Department budgeted factory overhead					1,254,000
Total budgeted factory overhead.....					<u>\$3,686,500</u>

P15-8 (Continued)

Schedule 9—Budgeted Unit Product Cost

	Economy Model			Standard Model			Deluxe Model		
	Quantity Required	Estimated Unit Cost	Total Cost	Quantity Required	Estimated Unit Cost	Total Cost	Quantity Required	Estimated Unit Cost	Total Cost
Materials:									
Boxes	1	\$ 1.50	\$ 1.50	1	\$ 1.50	\$ 1.50	1	\$ 1.50	\$ 1.50
Transformers	1	4.50	4.50	2	4.50	9.00	3	4.50	13.50
Diode rectifiers	2	.70	1.40	4	.70	2.80	5	.70	3.50
Filters	2	1.75	3.50	3	1.75	5.25	6	1.75	10.50
Resistors	5	.20	1.00	8	.20	1.60	10	.20	2.00
Wire	5	.50	2.50	6	.50	3.00	8	.50	4.00
Total materials			<u>\$14.40</u>			<u>\$23.15</u>			<u>\$35.00</u>
Labor:									
Assembly Dept. ....	.50	\$10.00	\$ 5.00	.75	\$10.00	\$ 7.50	1.00	\$10.00	\$10.00
Testing Dept. ....	.05	12.00	.60	.05	12.00	.60	0.05	12.00	.60
Total labor			<u>\$ 5.60</u>			<u>\$ 8.10</u>			<u>\$10.60</u>
Applied overhead:									
Assembly Dept. (DLH based) .....	.50	\$ 7.00	\$ 3.50	.75	\$ 7.00	\$ 5.25	1.00	\$ 7.00	\$ 7.00
Testing Dept. (MH based) .....	.15	11.00	1.65	.25	11.00	2.75	0.35	11.00	3.85
Total overhead			<u>\$ 5.15</u>			<u>\$ 8.00</u>			<u>\$10.85</u>
Total cost per unit			<u>\$25.15</u>			<u>\$38.25</u>			<u>\$56.45</u>

P15-8 (Concluded)

Schedule 10—Beginning and Ending Inventories

	Beginning Inventory			Ending Inventory		
	Quantity	Unit Cost	Total Cost	Quantity	Unit Cost	Total Cost
Materials:						
Boxes	10,000	\$ 1.50	\$ 15,000	5,000	\$ 1.50	\$ 7,500
Transformers	15,000	4.50	67,500	10,000	4.50	45,000
Diode rectifiers	25,000	.70	17,500	25,000	.70	17,500
Filters	25,000	1.75	43,750	20,000	1.75	35,000
Resistors	10,000	.20	2,000	50,000	.20	10,000
Wire	30,000	.50	15,000	40,000	.50	20,000
Total materials			<u>\$ 160,750</u>			<u>\$ 135,000</u>
Work in Process: None						
Finished Goods:						
Economy Model	15,000	\$25.00	\$ 375,000	20,000	\$25.15	\$ 503,000
Standard Model	15,000	38.50	577,500	15,000	39.25	588,750
Deluxe Model	15,000	55.25	828,750	10,000	56.45	564,500
Total finished goods			<u>\$1,781,250</u>			<u>\$1,656,250</u>
Total inventory			<u>\$1,942,000</u>			<u>\$1,791,250</u>

Schedule 11—Budgeted Cost of Goods Manufactured and Sold

Materials:	
Beginning inventory (Schedule 10)	\$ 160,750
Add purchases (Schedule 4)	<u>10,912,250</u>
Materials available for use	\$11,073,000
Less ending inventory (Schedule 10)	<u>135,000</u>
Cost of materials used in production (Schedule 5)	\$10,938,000
Direct labor (Schedule 6)	3,775,000
Factory overhead (Schedule 8)	<u>3,686,500</u>
Cost of goods manufactured during the period	\$18,399,500
Add finished goods beginning inventory (Schedule 10)	<u>1,781,250</u>
Cost of goods available for sale	\$20,180,750
Less finished goods ending inventory (Schedule 10)	<u>1,656,250</u>
Cost of goods sold	<u>\$18,524,500</u>

Schedule 12—Budgeted Income Statement

Sales (from Schedule 1)	\$33,000,000
Less cost of goods sold (Schedule 11)	<u>18,524,500</u>
Gross profit	\$14,475,500
Less commercial expenses:	
Marketing expenses	\$6,145,000
Administrative expenses	<u>2,330,500</u>
Income before taxes	\$ 8,475,500
Less income tax (40% tax rate)	<u>2,400,000</u>
Net income	<u>\$ 3,600,000</u>

P15-9
(1)

CL CORPORATION
Prospective Statement of Income and Retained Earnings
For Year Ending December 31, 20B
(000s omitted)

Revenue:			
Sales		\$600,000	
Other income		<u>9,000</u>	\$609,000
Expenses:			
Cost of goods manufactured and sold:			
Materials	\$213,000		
Direct labor	218,000		
Variable factory overhead	130,000		
Fixed factory overhead	<u>12,750</u>		
	\$573,750		
Beginning inventory	<u>48,000</u>		
	\$621,750		
Ending inventory	<u>114,750</u>	* \$507,000	
Marketing:			
Salaries	\$ 16,000		
Commissions	20,000		
Promotion and advertising	<u>45,000</u>	81,000	
General and administration:			
Salaries	\$ 16,000		
Travel	2,500		
Office costs	<u>9,000</u>	<u>27,500</u>	<u>615,500</u>
Income (loss) before income tax			\$ (6,500)
Income tax refund (40%)			<u>2,600</u>
Net income (loss)			\$ (3,900)
Beginning retained earnings			<u>108,200</u>
Subtotal			\$104,300
Less dividends			<u>5,000</u>
Ending retained earnings			<u>\$ 99,300</u>
* Beginning inventory			
Adding to inventory (450,000 - 400,000)		<u>50,000</u>	
Ending inventory		90,000 units	
19B cost per unit (\$573,750 ÷ 450,000)		x \$1.275	
Cost of ending inventory		<u>\$114,750</u>	

P15-9 (Continued)

CL CORPORATION
Balance Sheet
 Prospective as of December 31, 20B
 (000s omitted)

Assets			
Current assets:			
Cash	\$	1,200	
Accounts receivable		80,000	
Inventory		114,750	
Income tax receivable		2,600	\$198,550
Plant and equipment		\$130,000	
Less accumulated depreciation		41,000	89,000
Total assets			<u>\$287,550</u>
Liabilities and Shareholders' Equity			
Current liabilities:			
Accounts payable	\$45,000		
Accrued payables	23,250		
Notes payable	50,000		\$118,250
Shareholders' equity:			
Common stock	\$70,000		
Retained earnings	99,300		169,300
Total liabilities and shareholders' equity			<u>\$287,550</u>

- (2) (a) The profit performance for 20B is forecast to be much poorer than in 20A. A loss after income tax of \$3.9 million is predicted, compared to a profit after income tax of \$12.6 million. The company experienced the loss despite a 33% increase in unit sales volume. The major problem seems to be in the inability to raise prices and/or in cost control. The costs rose in every area of activity:
- (1) Variable manufacturing costs per unit increased 7.5% (from \$1.16 to \$1.2467).
 - (2) Fixed manufacturing costs increased \$750,000, or 6.3%.
 - (3) Marketing costs, excluding commissions, increased \$16 million, or 36%.
 - (4) General and administrative costs increased \$3.5 million, or 15%.

P15-9 (Concluded)

(b) All areas will require special cost analysis because the costs in all areas increased, but special attention should be paid to:

(1) Production cost increases, because although relatively small in percentage, the dollar amount is high due to the volume of units.

(2) Selling and promotion cost increases, because the rate of these cost increases was greater than the rate of sales increase.

The sales price was not increased in spite of the increased cost. The high sales volume increase may be the result of too low a price. Further investigation into market price and price-volume relationship is needed.

A review of the balance sheet indicates a material deterioration in the company's working capital position. Inventory has more than doubled. This increase appears to have been financed by a significant increase in current liabilities (more than a three-fold increase) and a material decline in cash. The need for so large an increase in inventory and the effect of declining profitability on the cash and working capital position need to be thoroughly investigated.

(c) The following improvements should be considered by management:

(1) Improved coordination between sales, inventory control, and production, and a re-evaluation of the product pricing policy.

(2) Development of a standard cost system to monitor product costs.

(3) Development of a line of credit for short-term liquidity problems.

CASES**C15-1**

- (1) Business planning and budgeting activities for Maiton Company are important because:**
- (a) A long-run commitment of resources to specialized assets is about to be made. A one-time decision for major expansion that could involve a large amount of financial resources over a long period of time is about to be undertaken. This investment will be committed to specialized assets and can be recovered only from the production and sale of one particular valve.**
 - (b) The daily operations of the company will become more complex. Mai has had no experience with the day-to-day operations of a large business. The business planning and budgeting procedures will provide Mai the opportunity to review the company performance and will allow the company to develop and evaluate alternative courses of action to satisfy corporate objectives.**
 - (c) They will assist in obtaining capital from external sources. An expansion program of this magnitude, with a significant amount of initial funding, will require the generation of additional capital either through borrowing or issuing stock. Obtaining necessary funds can be enhanced by, and may require an orderly presentation of, the business plan and budget activities.**
 - (d) They will highlight potential problem situations. Disciplined business planning and budgetary procedures could emphasize a variety of problem situations that might be encountered during the period of the plan.**
- (2) Listed below are the major problems that would most likely be disclosed because Maiton Company is about to experience a significant growth.**
- (a) The lack of adequate production facilities to manufacture the valve at the quantities required. The company has served a small part of the market. The new segment is much larger, thus calling for more production facilities than previously needed.**
 - (b) The lack of adequate internal capital sources to finance the asset expansion (both working capital and plant and equipment). The company is small and probably generates modest amounts of capital. The amount is not likely to be enough to meet the new requirements. Consequently, the company will need to seek capital from the outside, and probably has little experience because it grew slowly and had no previous need for outside capital.**
 - (c) The lack of adequate management resources (people) to administer the company as it grows. The company is small and, thus, probably solely run by George Mai. As it grows, there will be the need for more managerial people. This need probably cannot be met with current employees.**

C15-1 (Concluded)

- (d) Lack of planning and budget skills. The company probably has had little need for planning. Consequently, it may experience difficulty in organizing for and developing a five-year plan. Specific problems could occur with regard to forecasting, production, marketing, and cost of capital.

C15-2

- (1) Factors that Marval Products needs to consider in its periodic review of long-range planning include the following:
 - (a) The current state of the economy and its expected future status;
 - (b) The current and future availability of resources, such as personnel, plant and equipment, and capital;
 - (c) Consumer attitudes with regard to product appeal, changing travel modes and patterns, and changing life styles and affluence;
 - (d) The level of industry sales, Marval's current and projected market share, and Marval's degree of influence or dominance in the industry;
 - (e) The product lines with respect to the nature of the production process, length of time the product has been established, and utilization of resources and plant capacity.
- (2) Factors that Marval Products needs to consider when developing the sales component of its annual budget include the following:
 - (a) The pricing strategy;
 - (b) The size of Marval's market share and the relationship to its competitors;
 - (c) The sales mix of products so that contribution can be maximized;
 - (d) Available production capacity;
 - (e) The effect of advertising on sales volume;
 - (f) National and international economic conditions.

C15-3

- (1) Division and plant personnel biases that may be included in the submission of budget estimates include the following:**
 - (a) Budget sales estimates probably would tend to be lower than actually expected because of the high volatility in product demand and the current reward/penalty system for missing the budget.**
 - (b) Budget cost estimates will be higher than actually expected in order to protect the divisions against the effects of down-side risk of business slumps and the possibility of increased higher costs. The reward/penalty system encourages this action.**
 - (c) Plant and division management can incorporate slack and padding into the budget without the likelihood that it will be removed, because corporate headquarters does not appear to get actively involved in the actual budget preparation.**
- (2) Sources of information that corporate management can use to monitor divisional and plant budget estimates include:**
 - (a) Regional and national leading economic indicators and trends in consumer preference and demand;**
 - (b) Industry and trade association sales projections and performance data;**
 - (c) Prior year performance by reporting units as measured by their financial, production, and sales reports;**
 - (d) Performance of similar divisions and plants.**
- (3) Services that could be offered by corporate management in the development of budget estimates are as follows:**
 - (a) Providing economic forecasts with regard to expected inflationary trends and overall business cycles;**
 - (b) Providing national and regional industry sales forecasts for products as developed by corporate management or obtained by management from other sources;**
 - (c) Sponsoring training programs for plant and divisional personnel on budgeting techniques;**
 - (d) Informing divisions of overall corporate goals in terms of sales, market share, and profit.**
- (4) Factors that corporate management should consider in deciding whether or not it should become more involved in the budget process include consideration of costs and benefits and the resulting behavioral effects.**
 - (a) Costs to be evaluated include:**
 - (1) Increased costs at the corporate level, because more time and perhaps additional staff will be required.**
 - (2) Possible lower profits, due to an unfavorable change in division and plant management attitudes and motivation.**

C15-3 (Concluded)

- (b) Benefits to be considered include possible profit improvement from:
 - (1) More accurate budget estimates that might reduce lost sales and/or reduce costs incurred;
 - (2) More effective management because of more realistic budgets;
 - (3) Improved coordination and control of the budget process.
- (c) Behavioral variables to be considered include:
 - (1) Effect on goal congruence;
 - (2) Effect on the communication channels between corporate management and divisional management;
 - (3) Effect of restricting authority over the budget process at the divisional level;
 - (4) Possible negative effect on motivation and morale, due to loss of authority and autonomy;
 - (5) Effect on performance due to a potential reduction or increase in bonuses.

C15-4

Schaffer Company appears to have a well-developed budgetary system. Budgets for each of the important areas requiring attention—sales, production, inventory levels, expenses, and capital investments—are included in the process. Insufficient details are provided to properly evaluate the construction and use of the budgets for sales, capital investment, and production and inventory levels. Thus, the analysis in this case must focus on the expense side of the budgeting process.

Although an elaborate budget process exists, analysis of the expense procedures reveals a number of shortcomings for planning and control purposes. The basic input to the expense budget for the coming year is the first six months of the current year's actual performance, the expense budget (modified to reflect uncontrollable events), and the corporate expense reduction percentage. The next expense budget is basically last year's actual costs reduced by the computed expense percentage.

This approach does not capture the full potential of the budget for planning purposes, which should be forward-looking. The Schaffer budget is based primarily on past results and does not recognize any planned changes in operating activities. The across-the-board corporate expense reduction target does not consider the differences among plants in opportunities for cost improvements. The review of division management may permit the "strong" managers to build slack into the budget. And the facts do not make clear whether the proposed budget is based upon the current year's sales volume or the planned volume for the budget year. Without such an adjustment, an additional weakness exists in the procedure.

The process also falls short for control purposes. The major shortcoming is its failure to incorporate changes in operations that occur subsequent to August. Comparisons of performances that include these late changes, with budgets that do not, will not provide useful information for control. The inclusion of allocated corporation and division costs in plant budgets would make the expense budgets less effective for control purposes, because they contain irrelevant data for plant-level cost control. The possibility that some division managers may be able to introduce slack into their budgets also reduces the effectiveness for cost control.

The budget process appears to omit the plant managers from active participation in budget preparation and revision. Their participation would improve the cost control and planning benefits of the budget process. The use of across-the-board expense cuts and inclusion of allocated costs in the budgets used for performance measurement is further evidence that the company has failed to consider the effect of its system on management employees.

With its budgetary system, the company tries to plan and control its operations. To this end, the company is better off for having developed its system. However, further benefits could be gained by eliminating the weaknesses in its procedures.

C15-5

- (1) **The manufacturing manager's views can be separated into two arguments—the use of the same improvement targets for all plants and inconsistent application of target revisions. In both cases, the manufacturing manager's arguments are valid.**

The manufacturing manager claims that the use of the same improvement targets for all plants fails to recognize the different abilities of plants to achieve targets. His criticism is valid because plants do have different opportunities for improvement, and this should be recognized in establishing improvement targets. While his arguments may be valid to support his view that older plants have less opportunity for improvement, there are insufficient data presented to verify his claim.

The manufacturing manager objects to the newer plants' obtaining revised targets and then being able to perform better than the revised target. The modification of targets in light of new information is an appropriate budgeting technique. Newer plants may need such revisions because their inexperience makes it more difficult to set parameters and exercise control. However, the manufacturing manager's argument is valid because adjustments have not been available to all plants, and, furthermore, the adjustments granted to new plants appear to make it easier for them to achieve targets.

The resulting treatment in establishing and revising targets, when coupled with a performance appraisal and reward system, does appear to discriminate in favor of the newer plants. This would apparently lead to lower bonuses, appraisals, and morale among management of the older plants.

- (2) **Both old and new plants have the capability of concealing slack in their budgets. The older plants cannot introduce budgetary slack through their cost estimates because their costs have established a pattern over the years. However, the plant management knows those areas of operations where changes and improvements can be initiated. These operating changes can be initiated after the budget is adopted.**

The newer plants can incorporate budgetary slack in other ways. Their cost estimates are more uncertain because the plants are newer. The plant operations have not stabilized, so plant management may be able to inflate costs slightly above what can be realistically expected of them. There may be more opportunities for improved operations that may not be recognized at the time the budget is adopted. In addition, there is some lag in incorporating into the budget the cost savings of the increased experience of the workers and the efficiency in functioning of the equipment and machinery.

C15-6

- (1) The budget practices described in the case are not likely to produce effective budget control in the long run, because several weaknesses can be identified:
- (a) There appears to be no participation of plant personnel in the budget development.
 - (b) Given that there have been five managers in four years, the managers have had no opportunity to assess whether the budget is realistic.
 - (c) It appears that adjustments to the budget, subsequent to its adoption, are not permitted even in the light of new information.
 - (d) The budget is being used to pressure the plant manager.
- (2) The immediate effect will be a frustrated manager, who will not meet the budget and who will be replaced as a result of being unwilling to sacrifice the future for the present, or a frustrated manager, who meets the budget by making decisions that sacrifice the future for the present. In either case, Drake Inc. is unfavorably affected.

The long-term effect will be to reduce the management effectiveness of Drake Inc. employees. The arbitrary method of budget development, lack of participation, and the use of the budget as a pressure device will result in loss of talented managers, development of nonproductive methods by managers to "beat" the budget, decisions taken to meet the budget but which are detrimental to the company in the long run, and low morale and motivation.

If the present methods of budget administration continue, David Green may adopt nonproductive methods and become an ineffective manager. However, if he is talented and continues to raise such issues as the poor condition of the plant and his short tenure, it is likely he will resign or be fired.

CHAPTER 16

DISCUSSION QUESTIONS

- Q16-1. A capital expenditure is an expenditure intended to benefit future periods. It is normally associated with the acquisition or improvement of plant assets. The real distinction between a capital and revenue expenditure is not the immediate charging of the expenditure to income, as opposed to its gradual amortization, but the length of time required for its recovery in cash. Recoveries of revenue expenditures, such as product costs, are expected to take place in a matter of weeks or, at the most, months. The financial recovery of capital expenditures is measured in terms of years.
- Q16-2. Purposes of a research and development program are:
- (a) A planned search for new knowledge pertaining to the industry without reference to a specific application.
 - (b) Creation of a new product or improvement of an existing product.
 - (c) Invention of a new or improved process or machinery to make a finished product or component.
- Reasons for a research and development program are:
- (a) To protect the sales dollar, that is, to meet competition. Improving the quality of performance of products or achieving cost savings in either operating or capital expenditures falls into this category.
 - (b) To do research to promote new sales dollars, either by entering a new market or by significantly expanding an existing market.
 - (c) To investigate problems with respect to environmental protection, safety, working conditions, etc.
- Q16-3. Budgetary procedures for research and development expenditures are designed to:
- (a) force management to think about planned expenditures;
 - (b) coordinate research and development plans with the immediate and long-range plans of the company;
 - (c) force the research and development staff to consider major nonfinancial aspects of the program, such as personnel, equipment, and facilities requirements.
- Q16-4. A cash budget involves detailed estimates of anticipated cash receipts and disbursements for a specified period of time. It is designed to assist management in coordinating cash flow from operations as a basis for financial plans and control. The cash budget provides a systematic approach to the synchronization of cash resources with needs. It assists management in making intelligent decisions concerning capital expenditures, dividend policies, investments, and other financial matters, and often exerts a cautionary influence on any of the above plans. Periodic reports comparing actual with planned receipts and disbursements permit effective and continuous control of cash by signaling significant deviations from the financial plans for the period.
- Q16-5. (a) Nonmanufacturing businesses must plan for the future just as carefully as manufacturing concerns. Seasonal patterns in revenues and expenditures must be provided for, and required equipment replacement and expansions must be budgeted.
- (b) Not-for-profit organizations generally operate on relatively fixed incomes that are received at one time. Such receipt patterns are common for organizations that rely on tax dollars for support. These funds must be allocated throughout the year in order to maintain operations. Careful budget plans are a necessity for such allocations.
- Q16-6. PPBS stands for Planning, Programming, Budgeting System, and is an analytical tool focused on the output or final results rather than input or initial dollars expended. The output is directly relatable to planned goals or objectives.
- Q16-7. Zero-base budgeting (ZBB) is a planning and budgeting tool using cost-benefit analysis of projects and functions to improve an organization's resource allocation. Budget requests consist of decision packages that are analyzed, evaluated, and ranked in a priority order based on cost-benefit analysis. Management can then evaluate possible activities for the coming period, selecting those that will best achieve organizational goals.
- Traditional budgeting tends to concentrate on the differential change from the prior year, assuming that existing activities are essential, must be continued, are currently performed in a cost-efficient and optimum manner, and will be cost-effective in the coming year. Costs are developed more on a line-item rather than an activity basis. ZBB organizes all budget costs in the form of activities and/or operations (decision packages) and evaluates the effectiveness of each decision package as if it were a new activity.

- Q16-8. (a) Zero-base budgeting requires managers to justify their entire budget request. It places the burden of proof on the manager to justify why any money at all should be budgeted. It does this by starting with the assumption that zero will be spent on each activity, so the budgeting process begins with a base of zero.
- (b) The two kinds of alternatives considered for each activity are (1) different ways of performing the activity and (2) different levels of effort in performing the activity.
- (c) A decision package includes an analysis of an activity's cost and purpose, alternative courses of action, measures of performance of the activity, consequences of not performing the activity, and the activity's benefits.
- (d) A package identifies and describes one activity in sufficient detail so that it can be evaluated and compared with other activities.
- (e) Success in the implementation of zero-base budgeting requires the following:
1. Linkage of zero-base budgeting with short- and long-range planning
 2. Sustained support and commitment from executive management
 3. Innovation by managers in developing decision packages
 4. Acceptance of zero-base budgeting by persons who must perform the budgeting work

Q16-9. Prospective information should be provided in external financial statements when it will enhance the reliability of the user's predictions.

Q16-10. PERT is particularly appropriate as a scheduling and controlling technique for projects consisting of a large number of tasks, some of which cannot be started until others are complete, and some of which can be undertaken concurrently.

Conceptually, the reference is to a network of interdependent activities which, as a group, require considerable time to complete. There is usually substantial set-up time (and cost) associated with analyzing, defining, and estimating each discrete project activity; thus, the benefit is in projects requiring a considerable amount of time and consisting of a relatively complex network.

PERT allows the user to update and revise scheduled activities and thereby determine the effects of changes on the overall project. It is particularly appropriate when the timing of individual activities and the project completion date are critical to success.

Q16-11. Slack is computed by subtracting the earliest expected time from the latest allowable time.

The earliest expected time is the earliest time that an activity can be expected to start, because of its relationship to pending activities. The latest allowable time is the latest time that an activity may begin and not delay completion of the project. Slack is determinable only in relation to an entire path through the network.

Q16-12. PERT/cost is really an extension of PERT. With time-options available, it seems advisable to assign cost to time and activities, thereby providing total financial planning and control by functional responsibility.

Q16-13. Computer support offers distinct advantages to PERT users. PERT is a mathematically-oriented technique and is therefore ideally suited to the high-speed response of computers for deriving the critical path, slack times, and costs, and for storing and reporting results to management. Revisions to all schedule elements, whether during the initial estimating phase or during the active project phase, can be updated and the revised results promptly reported.

Computer support is helpful in dealing with large, complex networks of interdependencies and when project control requires timely progress reporting against the updated plan. Most program packages offer a variety of reporting features and formats, including graphic network display as well as printed reports at various summary levels. Current reporting provides information to project managers, enabling quick reaction to deviations.

- Q16-14. The traditional budget focuses on one set of assumptions. The probabilistic budget provides for evaluating several sets of assumptions, including the probability of each and a composite expected value, range, and standard deviation for each budget element.

EXERCISES

E16-1

	<u>January</u>	<u>February</u>	<u>March</u>
Beginning cash balance	<u>\$ 6,000</u>	<u>\$20,500</u>	<u>\$26,500</u>
Budgeted cash receipts:			
Collect accounts receivable:			
November credit sales:			
(\$60,000 x 10%)	\$ 6,000		
December credit sales:			
(\$70,000 x 60%)	42,000		
(\$70,000 x 10%)		\$ 7,000	
January credit sales:			
(\$50,000 x 25%)	12,500		
(\$50,000 x 60%)		30,000	
(\$50,000 x 10%)			\$ 5,000
February credit sales:			
(\$60,000 x 25%)		15,000	
(\$60,000 x 60%)			36,000
March credit sales:			
(\$70,000 x 25%)			17,500
Total cash receipts.....	<u>\$60,500</u>	<u>\$52,000</u>	<u>\$58,500</u>
Cash available during month.....	<u>\$66,500</u>	<u>\$72,500</u>	<u>\$85,000</u>
Budgeted cash disbursements:			
Pay accounts payable:			
December purchases:			
(\$20,000 x 80%)	\$16,000		
January purchases:			
(\$15,000 x 20%)	3,000		
(\$15,000 x 80%)		\$12,000	
February purchases:			
(\$25,000 x 20%)		5,000	
(\$25,000 x 80%)			\$20,000
March purchases:			
(\$20,000 x 20%)			4,000
Payroll	21,000	22,000	23,000
Miscellaneous cash expenses.....	6,000	7,000	6,000
Debt retirement.....			26,000
Total cash disbursements.....	<u>\$46,000</u>	<u>\$46,000</u>	<u>\$79,000</u>
Ending cash balance	<u>\$20,500</u>	<u>\$26,500</u>	<u>\$ 6,000</u>

E16-2

Finished Goods

	<u>April</u>	<u>May</u>	<u>June</u>
Units required to meet sales budget	9,000	10,000	12,000
Add desired ending inventory (20% of following month's sales)	2,000	2,400	2,200
Total units required	11,000	12,400	14,200
Less estimated beginning inventory (20% of current month's sales)	1,800	2,000	2,400
Planned production	<u>9,200</u>	<u>10,400</u>	<u>11,800</u>

Materials

	<u>April</u>	<u>May</u>	<u>June</u>
Units required to meet planned production (planned production x 3)	27,600	31,200	35,400
Add desired ending inventory (40% of following month's production requirements)	12,480	14,160	
Total materials required	40,080	45,360	
Less estimated beginning inventory (40% of current month's requirements)	11,040	12,480	
Planned purchases	<u>29,040</u>	<u>32,880</u>	

Cash disbursements during May for payment of accounts payable for material purchases:

$$\begin{aligned}
 1/3 \times 29,040 \times \$20 \times .98 &= \$189,728 \\
 2/3 \times 32,880 \times \$20 \times .98 &= \underline{429,632} \\
 &= \underline{\underline{\$619,360}}
 \end{aligned}$$

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E16-3 Par production budget:

	<u>June</u>	<u>July</u>
Units required to meet sales budget.....	50,000	30,000
Add desired ending inventory	<u>3,000</u>	<u>3,000</u>
Total units required	53,000	33,000
Less beginning inventory	<u>5,000</u>	<u>3,000</u>
Planned production	<u>48,000</u>	<u>30,000</u>

Tee purchases budget:

	<u>June</u>	<u>July</u>
Units required for production:		
48,000 x 3	144,000	
30,000 x 3		90,000
Add desired ending inventory	<u>14,000</u>	<u>11,000</u>
	158,000	101,000
Less beginning inventory	<u>20,000</u>	<u>14,000</u>
Units to be purchased	<u>138,000</u>	<u>87,000</u>

Cash disbursements in July for purchases of Tee:

$$138,000 \times \$5 \times \frac{1}{3} \times .98 = \$225,400$$

$$87,000 \times \$5 \times \frac{2}{3} \times .98 = \underline{284,200}$$

$$\underline{\underline{\$509,600}}$$

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E16-4

(1)

CROCKETT COMPANY
Cash Budget
For July

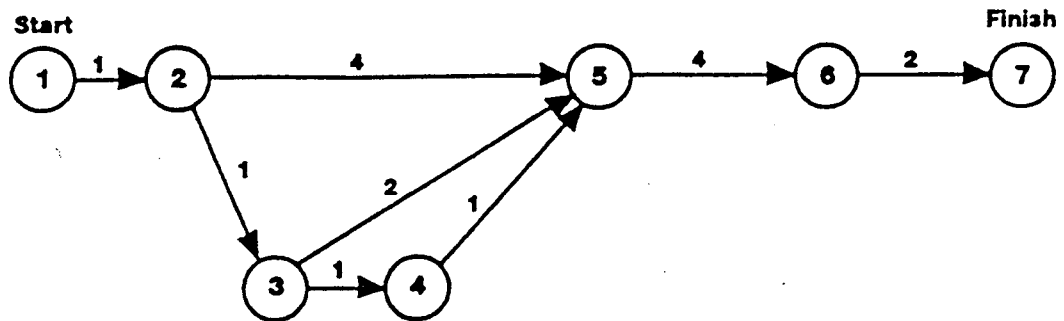
Cash balance, July 1		\$ 5,000
Cash receipts:		
June sales (\$30,000 x 48%)	\$14,400	
July sales (\$40,000 x 50%).....	20,000	34,400
Cash available		\$39,400
Cash disbursements:		
June purchases (\$10,000 x 75%)	\$ 7,500	
July purchases (\$15,000 x 25%)	3,750	
Other marketing and administrative expenses.....	10,000	
Income tax.....	2,000*	
Dividends	15,000	38,250
Cash balance, July 31		<u>\$ 1,150</u>
*Calculation of June income tax:		
Sales.....	\$30,000	
Cost of goods sold.....	12,000	
Gross profit	\$18,000	
Commercial expenses:		
Depreciation.....	\$4,000	
Other marketing and administrative.....	9,000	13,000
Taxable income.....	\$ 5,000	
Income tax (\$4,000 x 40%)	\$ 2,000	

- (2) Since the desired minimum cash balance is \$5,000, arrangements should be made to borrow \$3,850 (\$5,000 - \$1,150).

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E16-5

(1) PERT network:



(2) Alternate paths and times and the critical path and the expected project time:

1-2-5-6-7 = 11 weeks ← critical path
1-2-3-5-6-7 = 10 weeks
1-2-3-4-5-6-7 = 10 weeks

(3) The two activities in question are 3-4 and 4-5. If these activities were eliminated, there would be no effect on the critical path or the expected completion time because 3-4 and 4-5 are not on the critical path.

E16-6

(1)	Activity	$(t_o$	$+ t_m(4)$	$+ t_p)$	= Total	$+ 6$	= t_e
	1-2	1	2(4)	3	12	6	2.00
	1-3	2	6(4)	9	35	6	5.83
	1-4	1	4(4)	6	23	6	3.83
	2-6	2	11(4)	18	64	6	10.67
	3-5	4	6(4)	8	36	6	6.00
	4-5	3	4(4)	5	24	6	4.00
	5-6	4	5(4)	6	30	6	5.00

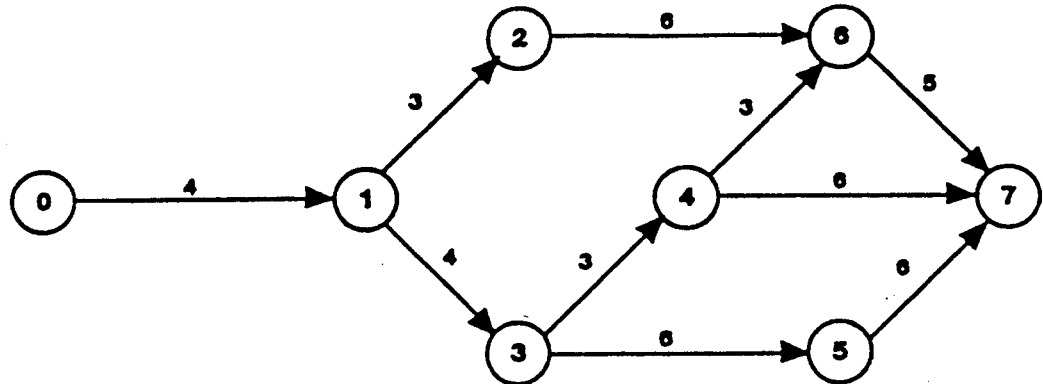
(2)	Path	$t_e s$	Total t_e
	1-2-6	$2 + 10.67$	12.67
	1-4-5-6	$3.83 + 4 + 5$	12.83
	1-3-5-6	$5.83 + 6 + 5$	16.83 ← critical path

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E16-8

$$(1) \quad t_e = (t_o + 4t_m + t_p) + 6 = (1 + (4 \times 2) + 9) + 6 = 3 \text{ days}$$

(2)



(3)

Path	Time Required	
0-1-2-6-7	$= 4 + 3 + 6 + 5$	$= 18 \text{ days}$
0-1-3-4-6-7	$= 4 + 4 + 3 + 3 + 5$	$= 19 \text{ days}$
0-1-3-4-7	$= 4 + 4 + 3 + 6$	$= 17 \text{ days}$
0-1-3-5-7	$= 4 + 4 + 6 + 6$	$= 20 \text{ days}$

The critical path is 0-1-3-5-7, because it requires the greatest total time (20 days).

(4)	Critical path time.....	20 days
	Less time required after event 2:	
	Activity 2-6	6 days
	Activity 6-7	5 days
		<u>11 days</u>
	Maximum time to event 2	9 days
	Estimated time to event 2:	
	Activity 0-1	4 days
	Activity 1-2	3 days
		<u>7 days</u>
	Slack time at event 2.....	<u>2 days</u>

PROBLEMS

P16-1

(1) Budgeted cash disbursements during June:

Purchase of materials:

May (11,250 ¹ x \$20 x 46%)	\$103,500	
June (12,180 ² x \$20 x 54%)	<u>131,544</u>	\$235,044

Marketing, general, and administrative expenses:

May (\$51,550 ³ x 46%)	\$23,713	
June (\$49,300 ⁴ x 54%)	<u>26,622</u>	50,335

Wages and salaries

37,900⁵

Total \$323,279

¹ May 31 ending inventory (11,400 x 130%)	14,820 units
May production	<u>11,900</u>
Materials needed in May	26,720 units
April 30 ending inventory (\$309,400 ÷ \$20)	<u>15,470</u>
May purchases	<u>11,250</u> units
² June 30 ending inventory (12,000 x 130%)	15,600 units
June production	<u>11,400</u>
Materials needed in June	27,000 units
May 31 ending inventory	<u>14,820</u>
June purchases	<u>12,180</u> units

³ (\$357,000 May sales x 15%) – \$2,000 depreciation = \$51,550

⁴ (\$342,000 June sales x 15%) – \$2,000 depreciation = \$49,300

⁵ Accrued payroll on June 1	\$ 3,300
Payroll earned during June	<u>38,000</u>
	\$41,300
Accrued payroll on June 30	<u>3,400</u>
Cash paid out for payroll	<u><u>\$37,900</u></u>

(2) Budgeted cash collections during May:

March sales (\$354,000 x 9%)	\$ 31,860
April sales (\$363,000 x 97% x 60%)	211,266
April sales (\$363,000 x 25%)	<u>90,750</u>
Total	<u><u>\$333,876</u></u>

P16-1 (Concluded)

(3) Budgeted units of inventory to be purchased during July:	
July 31 ending inventory (12,200 x 130%)	15,860 units
July production	<u>12,000</u>
Materials needed in July	27,860 units
June 30 ending inventory (12,000 x 130%)...	<u>15,600</u>
July purchases	<u><u>12,260</u></u> units

P16-2

	<u>April</u>	<u>May</u>	<u>June</u>
Beginning cash balance.....	\$ 100,000	\$ 100,000	\$ 100,000
Cash receipts during month:			
Collections of accounts receivable:			
February sales:			
(\$2,000,000 x 40%).....	\$ 800,000		
March sales:			
(\$1,800,000 x 60%).....	1,080,000		
(\$1,800,000 x 40%).....		\$ 720,000	
April sales:			
(\$2,200,000 x 60%).....		1,320,000	
(\$2,200,000 x 40%).....			\$ 880,000
May sales:			
(\$2,500,000 x 60%).....			1,500,000
Total cash collections	<u>\$1,880,000</u>	<u>\$2,040,000</u>	<u>\$2,380,000</u>
Cash available for use during month	<u>\$1,980,000</u>	<u>\$2,140,000</u>	<u>\$2,480,000</u>
Cash disbursements during month:			
Accounts payable for purchases:			
February purchases:			
(\$2,000,000 February sales x 50% x 40% x 20%)	\$ 80,000		
(\$1,800,000 March sales x 50% x 60% x 20%)	108,000		
March purchases:			
(\$1,800,000 March sales x 50% x 40% x 80%)	288,000		
(\$2,200,000 April sales x 50% x 60% x 80%)	528,000		
(\$1,800,000 March sales x 50% x 40% x 20%)		\$ 72,000	
(\$2,200,000 April sales x 50% x 60% x 20%)		132,000	
April purchases:			
(\$2,200,000 April sales x 50% x 40% x 80%)		352,000	
(\$2,500,000 May sales x 50% x 60% x 80%)		600,000	
(\$2,200,000 April sales x 50% x 40% x 20%)			\$ 88,000
(\$2,500,000 May sales x 50% x 60% x 20%)			150,000
May purchases:			
(\$2,500,000 May sales x 50% x 40% x 80%)			400,000
(\$2,800,000 June sales x 50% x 60% x 80%).....			672,000
Wages (20% of current sales):			
April (\$2,200,000 x 20%)	440,000		
May (\$2,500,000 x 20%)		500,000	
June (\$2,800,000 x 20%).....			560,000
General and administrative expenses:			
Salaries (1/12 x \$480,000).....	40,000	40,000	40,000
Promotion (1/12 x \$660,000).....	55,000	55,000	55,000
Property taxes (1/4 x \$240,000)	0	0	50,000
Insurance (1/12 x \$360,000).....	30,000	30,000	30,000
Utilities (1/12 x \$300,000)	25,000	25,000	25,000
Income taxes (\$1,020,000 income x 40% tax rate)	408,000	0	0
Total cash disbursements	<u>\$2,002,000</u>	<u>\$1,808,000</u>	<u>\$2,070,000</u>
Cash balance before borrowing or investment.....	\$ (22,000)	\$ 334,000	\$ 410,000
Cash to be borrowed (or invested).....	122,000	(234,000)	(310,000)
Ending cash balance.....	<u>\$ 100,000</u>	<u>\$ 100,000</u>	<u>\$ 100,000</u>

P16-3

MAYNE MANUFACTURING COMPANY
Cash Budget
For the Years Ending March 31

	20B	20C
Balance of cash at beginning	0	\$ 75,000
Cash generated from operations:		
Collections from customers—		
Schedule A.....	<u>\$825,000</u>	<u>\$1,065,000</u>
Disbursements:		
Direct materials—Schedule B.....	\$220,000	\$ 245,000
Direct labor.....	300,000	360,000
Variable overhead.....	100,000	120,000
Fixed costs.....	<u>130,000</u>	<u>130,000</u>
Total disbursements.....	<u>\$750,000</u>	<u>\$ 855,000</u>
Excess of cash collections over cash		
disbursements from operations.....	<u>\$ 75,000</u>	<u>210,000</u>
Cash available from operations	\$ 75,000	\$285,000
Cash received from liquidation of existing		
accounts receivable and inventories	<u>90,000</u>	<u>0</u>
Total cash available	\$165,000	\$285,000
Payments to general creditors		
(liquidation proceeds)	<u>90,000</u>	<u>270,000</u> ²
Balance of cash at end	<u>\$ 75,000</u> ¹	<u>\$ 15,000</u>

¹ This amount could have been used to pay general creditors or carried forward to the beginning of the next year.

² (\$800,000 x 60%) - \$90,000

P16-3 (Concluded)

Schedule A—Collections from customers:

	20B	20C
Sales.....	\$900,000	\$1,080,000
Beginning accounts receivable	0	75,000
Total.....	\$900,000	\$1,155,000
Less ending accounts receivable	75,000	90,000
Collections from customers	<u>\$825,000</u>	<u>\$1,065,000</u>

Schedule B—Disbursements for direct materials:

	20B	20C
Direct materials required for production.....	\$200,000	\$ 240,000
Required ending inventory	40,000 ³	50,000 ⁴
Total.....	\$240,000	\$ 290,000
Less beginning inventory.....	0	40,000
Purchases.....	\$240,000	\$ 250,000
Beginning accounts payable.....	0	20,000
Total.....	\$240,000	\$ 270,000
Less ending accounts payable	20,000	25,000
Disbursements for direct materials.....	<u>\$220,000</u>	<u>\$ 245,000</u>

³ 12,000 units x 2/12 = 2,000; 2,000 x \$20 per unit = \$40,000

⁴ 15,000 units x 2/12 = 2,500; 2,500 x \$20 per unit = \$50,000

P16-4

Production Budget:

Required to meet sales forecast:		
January (\$360,000 sales + \$150 per unit).....	2,400	
February (\$450,000 sales + \$150 per unit)	3,000	
March (\$480,000 sales + \$150 per unit)	<u>3,200</u>	8,600
Desired finished goods ending inventory:		
((((\$600,000 April sales + \$150 per unit) x 10%) ÷ 100)		500
Total quantity of product to produce		<u>9,100</u>

Direct Materials Purchases Budget:

Materials required for production (9,100 units x \$20).....	\$182,000
Desired materials ending inventory	2,000
Total direct materials purchases during first quarter	<u>\$184,000</u>

P16-4 (Concluded)

Cash Budget for First Quarter Ending March 31, 20A:

January 1, cash balance		\$	0
Cash receipts:			
Investment by owner	\$ 50,000		
Mortgage taken out	150,000		
Collections of accounts receivable:			
January sales:			
(\$360,000 x 30% x 80% x 98%)	84,672		
(\$360,000 x 30% x 20%)	21,600		
(\$360,00 x 30%)	108,000		
(\$360,000 x 38%)	136,800		
February sales:			
(\$450,000 x 30% x 80% x 98%)	105,840		
(\$450,000 x 30% x 20%)	27,000		
(\$450,000 x 30%)	135,000		
March sales:			
(\$480,000 x 30% x 80% x 98%)	112,896		
(\$480,000 x 30% x 20%)	28,800		
			960,608
Total cash available for use during quarter		\$	960,608
Cash disbursements:			
Accounts payable	\$184,000		
Direct labor ((9,100 x \$30) - \$7,500)	265,500		
Variable overhead (9,100 x \$15)	136,500		
Factory rent (\$10 x 5,000 capacity x 3)	150,000		
Sales commissions (8,600 units x \$8)	68,800		
Office rentals (\$12,000 x 3)	36,000		
Interest payment (\$150,000 x 2% x 3)	9,000		
Payment of principal on long-term note	30,000		
Equipment purchases	150,000		
			1,029,800
March cash balance before current financing		\$	(69,192)
Current financing required			84,162
Desired March 31 cash balance		\$	<u>15,000</u>

P16-5

(1)

TRIPLE-F HEALTH CLUB
Budgeted Statement of Income (Cash Basis)
For the Year Ending October 31, 20C
(000s omitted)

Cash revenue:	
Annual membership fees, $\$355 \times 1.1 \times 1.03$	\$402.2
Lesson and class fees, $\frac{\$234}{\$180} \times \$234$	304.2
Miscellaneous, $\frac{\$2.0}{\$1.5} \times \$2$	2.7
Total cash revenue	<u>\$709.1</u>
Cash expenses:	
Manager's salary and benefits, $\$36 \times 1.15$	\$ 41.4
Regular employees' wages and benefits, $\$190 \times 1.15$	218.5
Lesson and class employee wages and benefits, $\$195 \times 1.3 \times 1.15$	291.5
Towels and supplies, $\$16 \times 1.25$	20.0
Utilities (heat and light), $\$22 \times 1.25$	27.5
Mortgage interest, $\$360 \times .09$	32.4
Miscellaneous, $\$2 \times 1.25$	2.5
Total cash expenses	<u>\$633.8</u>
Cash income	<u>\$ 75.3</u>
Cash payments:	
Mortgage payment	\$ 30.0
Accounts payable balance at 10/31/B	2.5
Accounts payable on equipment at 10/31/B	15.0
Planned new equipment purchase	25.0
Total cash payments	<u>\$ 72.5</u>
Cash surplus	<u>\$ 2.8</u>
Beginning cash balance	<u>8.3</u>
Cash available for working capital and to acquire property	<u>\$ 10.1</u>

- (2) Operating problems that Triple-F Health Club could experience in 20C include:
- (a) The lessons and classes contribution to cash will decrease because the projected wage increase for lesson and class employees is not made up by the increased volume of lessons and classes.
 - (b) Operating expenses are increasing faster than revenues from membership fees.
 - (c) Triple-F seems to have a cash management problem. Although there appears to be enough cash generated for the club to meet its obligations, past due amounts occur. Perhaps the cash balance may not be large enough for day-to-day operating purposes.

P16-5 (Concluded)

- (3) Jane Crowe's concern with regard to the board's expansion goals are justified. The 20C budget projections show only a minimal increase of \$2.8 in the cash balance. The total cash available is well short of the \$60.0 annual additional cash needed for the land purchase over and above the club's working capital needs; however, it appears that the new equipment purchases can be made on an annual basis. If the board desires to purchase the adjoining property, it is going to have to consider significant increases in fees or other methods of financing, such as membership bonds or additional mortgage debt.

P16-6

- (1) Schedule of budgeted cash receipts by month for the third quarter of 20A (000s omitted):

Month	Billings		Receipts		
	Actual/ Estimated Amount	Percentages		July	August
		Class	Timing		
May	\$5,000	90%	20%	\$ 900	
May	5,000	10	40	200	
June	5,000	90	50	2,250	
June	5,000	10	40	200	
June	5,000	90	20		\$ 900
June	5,000	10	40		200
July	4,500	90	20	810	
July	4,500	10	10	45	
July	4,500	90	50		2,025
July	4,500	10	40		180
July	4,500	90	20		
August	5,000	10	40		\$ 810
August	5,000	90	20		180
August	5,000	10	10		900
August	5,000	90	50		50
September	5,500	10	40		2,250
September	5,500	90	20		200
September	5,500	10	20		990
September			10		55
Total receipts from billings				\$4,405	\$4,255
Endowment fund income				175	175
Total cash receipts				<u>\$4,580</u>	<u>\$4,430</u>
					<u>\$4,660</u>

P16-6 (Concluded)

- (2) Schedule of budgeted cash disbursements by month for the third quarter of 20A (000s omitted):

	Disbursements		
	July	August	September
Salaries			
Variable:			
\$4,500 x 20%.....	\$ 900		
\$5,000 x 20%.....		\$1,000	
\$5,500 x 20%.....			\$1,100
Total variable	\$ 900	\$1,000	\$1,100
Fixed	1,500	1,500	1,500
Total salaries	\$2,400	\$2,500	\$2,600
Purchases of previous month	1,200	1,250	1,500
Interest.....	—	—	450
Depreciation (not relevant)	—	—	—
Total cash disbursements	<u>\$3,600</u>	<u>\$3,750</u>	<u>\$4,550</u>

(3)	(000 omitted)		\$ 300
	Cash balance—July 1, 20A.....		
	Cash receipts in third quarter:		
	July.....	\$4,580	
	August.....	4,430	
	September.....	4,660	13,670
	Total cash available.....		\$13,970
	Cash disbursements in third quarter:		
	July.....	\$3,600	
	August.....	3,750	
	September.....	4,550	11,900
	Projected cash balance—September 30, 20A.....		\$ 2,070
	Minimum end-of-month cash balance required		185
	(\$1,850 x 10%)		\$ 1,885
	Cash available to acquire capital items		(3,700)
	Capital expenditures planned for October 1, 20A		<u>\$ 1,815</u>
	Amount of borrowing necessary on October 1, 20A		

P16-7

(1)

1	<u>5</u>	+	<u>7</u>	+	<u>10</u>	7	= 22 critical path
1	<u>5</u>	+	<u>10</u>	+	<u>5</u>	7	= 20
1	<u>5</u>	+	<u>7</u>	+	<u>5</u>	7	= 17
1	<u>5</u>	+	<u>5</u>	+	<u>10</u>	7	= 20

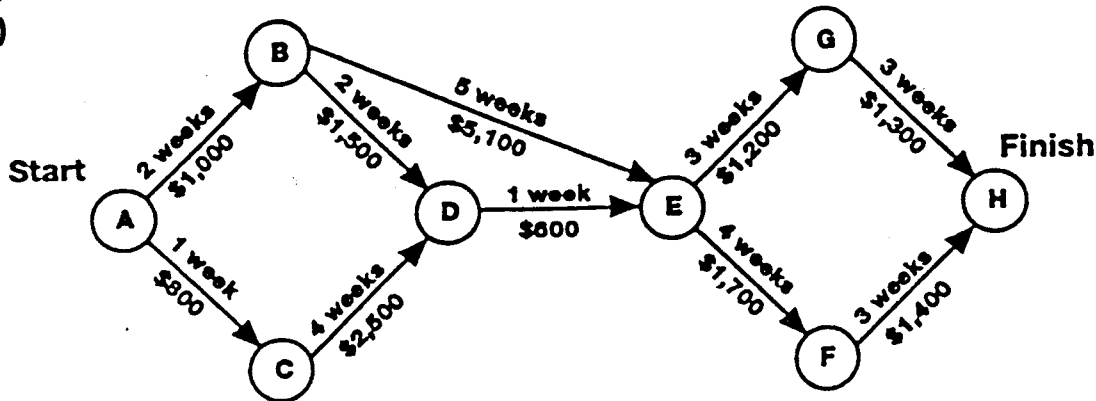
(2)

Day	Activities	Cost
1	A, B	\$ 800 + \$ 800
2	A, B	\$ 800 + \$ 800 = \$1,600
3	A, B	\$ 800 + \$ 800 = \$1,600
4	A, B	\$ 800 + \$ 800 = \$1,600
5	A, B	\$ 800 + \$ 800 = \$1,600
6	F, C, D, E	\$ 800 + \$ 800 = \$1,600
7	F, C, D, E	\$2,000 + \$1,500 + \$ 500 + \$2,000 = \$6,000
8	F, C, D, E	\$2,000 + \$1,500 + \$ 500 + \$2,000 = \$6,000
9	F, C, D, E	\$2,000 + \$1,500 + \$ 500 + \$2,000 = \$6,000
10	F, C, D, E	\$2,000 + \$1,500 + \$ 500 + \$2,000 = \$6,000
11	F, C, D, I	\$2,000 + \$1,500 + \$ 500 + \$2,000 = \$6,000
12	F, C, D, I	\$2,000 + \$1,500 + \$ 500 + \$2,000 = \$6,000
13	H, C, I	\$2,000 + \$1,500 + \$ 500 + \$3,000 = \$7,000
14	H, C, I	\$2,000 + \$1,500 + \$3,000 = \$6,500
15	H, C, I	\$2,000 + \$1,500 + \$3,000 = \$6,500
16	H, G, I	\$2,000 + \$1,000 + \$3,000 = \$6,000
17	H, G, I	\$2,000 + \$1,000 + \$3,000 = \$6,000
18	H, G, I	\$2,000 + \$1,000 + \$3,000 = \$6,000
19	H, G, I	\$2,000 + \$1,000 + \$3,000 = \$6,000
20	H, G, I	\$2,000 + \$1,000 + \$3,000 = \$6,000
21	H	\$2,000 = \$2,000
22	H	\$2,000 = \$2,000

CGA-Canada (adapted). Reprint with permission.

P16-8

(1)



(2)

Path	Time Required
A-B-E-G-H	= 2 + 5 + 3 + 3 = 13 weeks
A-B-E-F-H	= 2 + 5 + 4 + 3 = 14 weeks
A-B-D-E-G-H	= 2 + 2 + 1 + 3 + 3 = 11 weeks
A-B-D-E-F-H	= 2 + 2 + 1 + 4 + 3 = 12 weeks
A-C-D-E-G-H	= 1 + 4 + 1 + 3 + 3 = 12 weeks
A-C-D-E-F-H	= 1 + 4 + 1 + 4 + 3 = 13 weeks

The critical path is A-B-E-F-H, because it is the longest path.

(3)

The total cost of the project as planned is:

Activity	Normal Cost
A-B.....	\$ 1,000
A-C.....	800
B-D.....	1,500
B-E.....	5,100
C-D.....	2,500
D-E.....	600
E-F.....	1,700
E-G.....	1,200
F-H.....	1,400
G-H.....	1,300
Total normal cost	<u>\$17,100</u>

P16-8 (Concluded)

- (4) Since the critical path requires 14 weeks, at least 2 weeks must be cut from the project in order to complete it in 12 weeks. As originally planned (determined from requirement (2)), the following three paths require more than 12 weeks:

<u>Path</u>	<u>Time Required</u>
A-B-E-G-H = 2 + 5 + 3 + 3	= 13 weeks
A-B-E-F-H = 2 + 5 + 4 + 3	= 14 weeks
A-C-D-E-F-H = 1 + 4 + 1 + 4 + 3	= 13 weeks

The first place to start reducing time is the critical path, A-B-E-F-H, because the largest amount of time must be cut from this path. In this project, each activity on the critical path can be crashed, so the first activity to crash should be the one that has the smallest crash cost per week. By crashing activity F-H, which costs \$2,800, path A-B-E-F-H is shortened by one week to 13 weeks. In addition, since activity F-H is on path A-C-D-E-F-H, it is shortened to the required 12 weeks. Now one more week must be cut from activity A-B-E-F-H and from activity A-B-E-G-H to bring each path and the total project down to 12 weeks. The activity that costs the least to crash and that is common to both paths is activity B-E, which will cost \$5,200 to crash one week. The only other way to reduce both paths by one week would be to crash one activity on each path (activity E-G for \$4,600 or G-H for \$2,300 on path A-B-E-G-H and also activity E-F on path A-B-E-F-H for \$3,700), which will result in a minimum additional cost of \$6,000. Therefore, the minimum cost to reduce the total project time from 14 weeks to 12 weeks is \$8,000, resulting from reducing activity B-E and F-H by one week each for costs of \$2,800 and \$5,200, respectively. Since the minimum additional cost of cutting two days off of the total time required to complete the project is \$8,000, the minimum total cost of completing the project in 12 weeks is \$25,100 (\$17,100 normal cost from requirement (3) plus \$8,000 additional cost).

P16-9

- (1) The normal critical path is:

$$A \xrightarrow{3} B \xrightarrow{5} E \xrightarrow{1} H \xrightarrow{1} K \xrightarrow{1} L = 11 \text{ weeks}$$

The normal cost to be incurred in opening the store is the sum of the normal cost of all 14 activities—\$85,000.

- (2) The minimum time in which the store could be opened is 8 weeks at an additional cost of \$11,500, or a total cost of \$96,500 (\$85,000 + \$11,500).

Alternative Paths	Expected Time	Potential Time Reduction	New Time
A-B-E-H-K-L	11 weeks	4 (A-B, B-E)	7 weeks
A-C-F-I-K-L	7	—	7
A-C-F-J-K-L	10	2 (F-J, J-K)	8
A-D-G-J-K-L	7	2 (D-G, J-K)	5

The new critical path becomes A-C-F-J-K-L.

Reduced time programs would be initiated on the following activities:

Activities	Reduced Time	Reduced Cost
A-B	1 week	\$ 4,500
B-E	3	3,500
F-J	2	2,000
J-K	1	1,500
		<u>\$11,500</u>

The activity D-G reduction is excluded because it would not contribute to reducing the total project time.

- (3) The store should be opened on the normal schedule because the cost (\$11,500) exceeds the benefit (\$6,000). The reduced program would save 3 weeks at a cost of \$11,500, while the earlier opening can be expected to yield an operating income of \$2,000 per week, or a total of \$6,000.

CASES

C16-1

- (1) **Network analysis forces the company to plan ahead and develop a detailed plan for project completion. It presents a visualization of all individual tasks and their interrelationships. Network analysis provides management with timely information for controlling schedules, shows the effects on the entire project of changes made to individual activities, and allows for the continual updating of project progress.**

Disadvantages of network analysis as a means of organizing and coordinating projects include the use of probabilistic schedules that may be highly subjective, a bias toward overly optimistic time estimates often based on management expectations, and the need for cooperation among a large number of units to establish consistent priorities. A disproportionate amount of management time and effort may be required for planning for the benefit received; there may be other alternatives that could be more effective.
- (2) **Norm Robertson would be concerned with the delay in activity A-D because it would shift the critical path from Start-B-C-F-I-J-Finish. Shiela Neill's estimate of the time for activity A-D (10 to 12 weeks) results in Start-A-D-G-J-Finish requiring 23 to 25 weeks. Furthermore, Neill's comment that activity A-D cannot start until after activity B-E means that B-E becomes part of this new critical path, making the critical path Start-B-E-A-D-G-J-Finish with a time requirement of 28 to 30 weeks. Thus, the change in the relationship of the activities would change the critical path even more, so that the project will be completed 8 to 10 weeks later than the original estimate.**
- (3) **Norm Robertson developed the PERT diagram for the Vector-12 project with inadequate input. Robertson should have consulted all the departments involved in the project to ensure that the expected times required to complete the activities were attainable. Because Neill was not consulted, the time requirement for activity A-D was incorrect, and the relationship between activities A-D and B-E was missing from the network.**
- (4) **The behavioral problems that could arise within Caltron Inc. as a consequence of the planning of the Vector-12 project include:**
 - (a) **A lack of commitment to the project on the part of the department directors, particularly Neill, because of their exclusion from the planning process.**
 - (b) **Conflict among the department directors that could affect future working relationships.**
 - (c) **A lack of goal congruence among the departments involved.**

CHAPTER 17

DISCUSSION QUESTIONS

- Q17-1. Responsibility accounting is a program encompassing all operating management for which the accounting, cost, or budget divisions provide technical assistance in the form of daily, weekly, or monthly control reports. The objective of responsibility accounting is to provide management with a useful cost control tool. To be effective as a control mechanism, the responsibility accounting system records and reports costs incurred as a result of each activity to the individual in the company who is responsible for controlling the activity.
- Q17-2. The emphasis of responsibility accounting is on internal cost control rather than on determining product cost. This requires a shift in emphasis from determining the cost of resources used in manufacturing a product to determining the amount of control individual managers have over cost. Responsibility accounting determines the cost incurred by an activity or group of activities, rather than the cost incurred to produce a product.
- Q17-3. Controllable costs are those that are incurred as the result of, or for the benefit of, a business activity. Presumably, such a cost will increase or decrease as a result of the level of efficiency with which the activity that generates the cost is conducted or managed. To be effective, responsibility accounting must hold a manager responsible for only those costs that he or she can control.
- Q17-4. The organization must be arranged so that there are no overlapping lines of responsibility (i.e., no more than one individual should be responsible for each activity). In addition, each individual in the organization must have a clear understanding of his or her responsibilities, and must have sufficient authority to take the actions necessary to meet those responsibilities.
- Q17-5. The cost of any expenditure classification is composed of two elements: the unit price and the quantity of the items used. One individual may have control of price while another individual has control of quantity. Even in cases where price does not change, the quantity used may not be fully controllable by the individual who oversees the activity that consumes the item. The quality of the item may affect the quantity used and the quality may be determined by the purchaser, or the efficiency with which the item is used may be affected by decisions made at the executive management level (e.g., personnel changes and machinery acquisitions). Since the accountant cannot always determine absolute control, costs should be assigned on the basis of relative control, and variances should be viewed as questions rather than as answers.
- Q17-6. Opinion is divided on this subject. Some believe that for the most effective overhead control, department heads should be charged only for those costs that they incur. If they are charged with uncontrollable costs, they could spend significant amounts of time trying to control cost that they have no ability to control, or they may become frustrated and give up trying to control any costs. On the other hand, some believe that department heads should appreciate the fact that many auxiliary costs must be incurred to support their activities; therefore, they should be charged with a fair share of such costs, clearly labeled as uncontrollable.
- Q17-7. Total costs of service department overhead are included in overhead rates in order to charge jobs and products with all overhead incurred in their production. Actual service department costs are controlled if they are accumulated in service department accounts where they can be assigned to service department managers. If service department costs are charged directly to producing departments, such costs become an indirect, noncontrollable item of the department's receiving the charges.
- Q17-8. Service department costs should be charged to user departments by predetermined billing rates rather than by allocating actual cost at the end of the period. The use of predetermined rates makes it possible to determine service department efficiency through the computation of spending and idle capacity variances. In addition, user department efficiency can be evaluated more effectively by eliminating noncontrollable costs from service department charges. This is particularly important where user departments have some control over the amount of the services used. In such cases, users should be held accountable for their use of services, but the rates for pricing those services should be known by the users in advance.
- Q17-9. (a) No. The charge is an arbitrary allocation of cost. It cannot be influenced directly by actions of the division management.
(b) Yes and no. The amount of computer service used is within the control of the division management. However, the cost per unit of service varies with the efficiency of the computer facility and the amount of use by other divisions. Consequently, the charge is only partly controllable by division management.

- (c) Yes. The charge for goods purchased from another division is controllable by the division management, provided that the quantity of goods purchased is controllable by the division management and that the price is an externally established market price.
- Q17-10. (a) The higher electric power costs may be the result of any one or combination of the following:
- (1) increases in the prices paid for fuel, labor, maintenance, etc.,
 - (2) inefficient operating practices or machine failures within the power department,
 - (3) the acquisition of expensive new capacity, and/or
 - (4) increased production of electricity required to meet user demand.
- (b) To the extent that any inefficiencies exist in the power department, the current allocation scheme will pass them on to the user departments. With the kind of allocation used by Emmons Company, it is not possible to determine what caused the cost increase. A better system of handling this department's cost would be to charge user departments for actual usage on the basis of a predetermined variable rate, and for available usage on the basis of the power department's ability to provide service at maximum capacity. Budgeted fixed cost should be allocated on the basis of ability to provide service, because the Electric Power Department cannot control actual usage. This approach would make it possible to compute spending variances for the Electric Power Department, which are useful in evaluating the department's operating efficiency.
- Q17-11. (a) Higher total cost incurred by the Maintenance Department (i.e., increases in the prices and/or quantities of the various items of cost in the Maintenance Department), fewer total hours of maintenance service provided to all user departments during the period, or a combination of both could result in a higher actual maintenance cost per hour. However, such increases in costs should remain in the Maintenance Department and not be charged to the users.
- (b) An improved method for distributing Maintenance Department cost would be to establish a predetermined rate to be charged for each hour of maintenance service provided to users. The rate would be established annually by dividing the budgeted hours of service to be performed during the period into budgeted Maintenance Department cost for the same period. Using this predetermined rate, each user department's maintenance cost would depend on the number of hours of service it received. By using the predetermined rate, the actual cost could be compared with total charges made to users and the difference decomposed into spending and idle capacity variances for the Maintenance Department. These variances are useful in evaluating the efficiency of Maintenance Department activity.
- A further refinement would be to require the Maintenance Department to submit estimates of cost to users before providing services. This would not only give the department receiving the service some idea of the cost of the work, but would also restrain the Maintenance Department from spending too much time on a job.
- Q17-12. The flexible budget (a) provides the monthly budget allowance regardless of the fluctuating monthly volume of production; (b) permits not having to estimate the operating activity of a month in advance of the period for which the budget is prepared; and (c) recognizes the fixed and variable nature of costs, which leads to easy adjustments when evaluating actual performance.
- Q17-13. A spending variance is the difference between actual cost and the budget allowance (i.e., the budgeted amount adjusted for the actual level of activity experienced). It is caused by differences between the prices and the quantities of the various items of cost budgeted and actually incurred. To the extent that a manager has control over either price or quantity, or both, the manager has control over the amount of the spending variance. However, if the manager does not have control over both prices and quantities, the manager has only limited control over the amount of the spending variance. Nevertheless, since a manager may have some control over spending variances, they are used to evaluate efficiency in responsibility reporting.
- Q17-14. To aid management in evaluating and controlling cost, a spending variance for each item or classification of cost should be reported to responsible management each period. Itemized variances tell responsible management which item was inefficiently used. This detailed information pinpoints where the search to identify causes should begin.
- Q17-15. An idle capacity variance is the amount of over- or underapplied budgeted fixed factory overhead. In responsibility reporting, it is used

as a measure of capacity utilization. To the extent that management can control capacity utilization, the idle capacity variance can be controlled. However, the amount of capacity utilized is often a function of forces outside the control of individual department supervisors.

Q17-16. The two primary purposes of responsibility reports are:

- (a) To motivate individuals to achieve a high level of performance by reporting efficiencies and inefficiencies to responsible managers and their superiors.
- (b) To provide information that will help responsible managers identify inefficiencies so that they can more efficiently control costs.

Q17-17. Dysfunctional behaviors that can result from the practice of evaluating managerial performance rather than evaluating activities follow:

- (a) Managers tend to take actions that are self serving rather than beneficial to the company as a whole.
- (b) Managers concentrate on meeting the budget rather than on obtaining the best level of performance that can be achieved. The use of budgets tends to thwart continuous improvement.
- (c) Since budgets are based on current operations, managers tend to focus their attention on short-run targets and ignore the long-term needs of the business.
- (d) Managers who are unable to subvert the system sufficiently to get acceptable evaluations, but who are otherwise competent and efficient, become frustrated, do not get promoted, and often leave the company.

Q17-18. Responsibility accounting and reporting should not be abandoned despite the fact that its use in evaluating the performance of managers results in dysfunctional behavior. To overcome the problem of dysfunctional behavior, responsibility reports should be used to evaluate the performance of business activities, not managers. Managers should be evaluated on the basis of multiple activities of which cost control is only one. Managers should be encouraged to experiment with new approaches, to improve product quality, to enlist the cooperation of their department workers in improving output, to cooperate with other departments, and to work for the long-term success of the company. Using responsibility reports as an aid in evaluating the efficiency of business activities, instead of managers, takes pressure off managers to defend their actions as they relate to cost, and makes it possible for them to pursue other desirable business activities.

Q17-19. Some problems that limit the usefulness of control data reported to managers in a responsibility accounting and reporting system are:

- (a) Most responsibility accounting and reporting systems improperly base allowable budgets on volume-based measures of activity that have little to do with cost incurrence (e.g., labor hours, machine hours, etc.). If nonvolume measures (e.g., machine setups, retooling, moving or storing parts or product, etc.) are major cost drivers, activity based costing should be used as the basis for budgeting and preparing variance reports.
- (b) Control data available in a responsibility reporting system are too aggregated to be useful. This criticism stems from an attempt to use responsibility reports for operating control. Even itemized variance reports may not be sufficient to solve this problem.
- (c) Control data available to managers are financial and not easily interpreted by operating level managers, who are not trained in accounting and finance. The accounting staff should provide assistance, when practical, in training operating personnel in the use of financial reports. In addition, nonfinancial measures that can be easily understood by operating managers should be reported along with financial data, when practical.
- (d) Control data available to managers are not timely enough to be useful. This criticism stems from an attempt to use financial based responsibility reports for day-to-day operating control. More frequent reporting will not likely solve this problem, because it still takes days or weeks to collect the necessary data and prepare financial reports. A better solution is to use statistical process control and other operating control systems for day-to-day operating control, and to use periodic financial reports to evaluate the financial effectiveness of the business systems and the process control systems used in monitoring activity.

Q17-20. Despite the fact that nonfinancial measures of operating performance are more easily interpreted and can be made available on a more timely basis than financial data, financial reports generated by a responsibility accounting system still have value because they provide information about the impact of business systems on income. To be effective, management must not only believe that reducing inventory, spoilage, or rework will improve profitability, but also it must monitor the impact that such efforts have on income. The tie between changes in business systems and the effect of those changes on income is provided by financial reports.

EXERCISES

E17-1

- (1) Maintenance Department cost should be charged to all departments on the basis of a predetermined charging rate and could be computed as follows:

Fixed cost.....	\$ 7,500
Variable cost (15,000 x \$8.50)	127,500
Total Maintenance Department cost	<u>\$135,000</u>

$$\frac{\$135,000}{15,000 \text{ hours}} = \$9 \text{ per maintenance hour}$$

The actual Maintenance Department cost for November, \$132,000 would be charged directly to that department. The \$9 charging rate is used to charge other departments for Maintenance Department service received. The November charges would be \$126,000 (14,000 actual maintenance hours x \$9 charging rate).

The same approach would be followed for General Factory cost, except that transfers and charges for such costs would be made to producing departments only. The rate would be determined as follows:

Fixed cost.....	\$30,000
Variable cost (1,000 x \$20)	20,000
Total General Factory cost	<u>\$50,000</u>

$$\frac{\$50,000}{1,000 \text{ employees}} = \$50 \text{ per employee}$$

The actual cost charged to the General Factory in November would be \$51,000, and General Factory cost charged to producing departments would be \$49,000 (980 actual employees x \$50 charging rate).

E17-1 (Concluded)

(2)	Maintenance Dept.	General Factory
Actual cost	\$132,000	\$51,500
Budget allowance:		
Variable cost:		
14,000 hours x \$850..	\$119,000	
980 employees x \$20		\$19,600
Fixed cost	7,500	30,000
	126,500	49,600
Spending variance	\$ 5,500 unfav.	\$ 1,900 unfav.
Budget allowance	\$126,500	\$49,600
Cost charged out:		
14,000 hours x \$9.....	126,000	
980 employees x \$50....		49,000
Idle capacity variance	\$ 500 unfav.	\$ 600 unfav.
Total variance	\$ 6,000 unfav.	\$ 2,500 unfav.

E17-2

(1) Billing rates: Carpenter Shop: $\frac{\$20,000}{2,000 \text{ hrs.}} = \10 per hour

Electricians: $\frac{\$30,000}{2,500 \text{ hrs.}} = \12 per hour

(2) Charged to producing departments:

	Department			
	1	2	3	Total
Carpenter Shop*	\$ 4,000	\$ 8,000	\$ 4,500	\$16,500
Electricians**	12,000	10,200	6,600	28,800
Total.....	\$16,000	\$18,200	\$11,100	\$45,300

*400 x \$10 = \$4,000; 800 x \$10 = \$8,000; 450 x \$10 = \$4,500

** 1,000 x \$12 = \$12,000; 850 x \$12 = \$10,200; 550 x \$12 = \$6,600.

E17-2 (Concluded)**(3) Variances in each service department:**

	Monthly Budget	Fixed Cost Percentage	Fixed Cost	Variable Cost	Variable Rate Per Hour
Carpenter Shop	\$20,000	70%	\$14,000	\$6,000	\$3.00
Electricians	30,000	80	24,000	6,000	2.40

	Carpenter Shop			Electricians	
Actual cost.....	\$19,800		Actual cost.....	\$27,700	
Budget allowance:			Budget allowance:		
Variable cost (1,650			Variable cost (2,400		
hrs. x \$3.00)	\$ 4,950		hrs x \$2.40)	\$ 5,760	
Fixed cost.....	14,000	18,950	Fixed cost.....	24,000	29,760
Spending variance ..	\$ 850	unfav.	Spending variance ..	\$ (2,060)	fav.
Budget allowance ...	\$18,950		Budget allowance ...	\$29,760	
Cost charged to			Cost charged to		
producing depart-			producing depart-		
ments (req. 2).....	16,500		ments (req. 2).....	28,800	
Idle capacity variance	\$ 2,450 unfav.		Idle capacity variance	\$ 960 unfav.	

E17-3**(1) Billing rate for Maintenance Department:**

Fixed rate: \$12,800 total fixed cost ÷ 3,200 normal maintenance hours..... \$ 4.00 per hour

Variable rate: Variable rate per maintenance hour for labor \$8.70

Variable rate per maintenance hour for other costs:

Supervision	\$.50		
Tools and supplies ..	.75		
Miscellaneous .....	.05	1.30	10.00

Total..... \$14.00 per hour

Billing rate for Payroll Department:

Fixed rate: \$12,000 budgeted fixed cost ÷ 1,200 average number of employees \$10 per employee

Variable rate 2

Total..... \$12 per employee

The billing rate for the Maintenance Department was based on the number of maintenance hours worked, because it was the only variable given on which a measure of operating results could be computed. For the Payroll Department, the billing rate was based on the number of employees, because it was an adequate measure of operating results for that department.

E17-3 (Concluded)

(2) Maintenance Department:			
Actual cost.....			\$47,200
Budget allowance based on actual hours:			
Variable cost (3,355 hours x \$10).....	\$33,550		
Fixed cost	12,800	46,350	
Spending variance		\$ 850 unfav.	
Budget allowance based on actual hours...		\$46,350	
Cost charged out (3,355 hours x \$14).....		46,970	
Idle capacity variance.....		\$ (620) fav.	
Payroll Department:			
Actual cost.....			\$13,875
Budget allowance based on actual number of employees:			
Variable cost (1,165 employees x \$2)	\$ 2,330		
Fixed cost	12,000	14,330	
Spending variance		\$ (455) fav.	
Budget allowance based on actual number of employees		\$14,330	
Cost charged out (1,165 employees x \$12)		13,980	
Idle capacity variance.....		\$ 350 unfav.	

E17-4

	Producing Departments		Service Departments		Total
	A	B	X	Y	
Fixed cost*	\$1,200	\$2,400	\$1,440	\$ 960	\$ 6,000
Variable cost (rate x hours)**	1,600	2,600	1,400	1,200	6,800
Total.....	\$2,800	\$5,000	\$2,840	\$2,160	\$12,800

* Dept.	Hours	%	Fixed cost
A	10,000	20%	\$1,200
B	20,000	40	2,400
X	12,000	24	1,440
Y	8,000	16	960
	50,000	100%	\$8,000

** A =	8,000 hrs.
B =	13,000
X =	7,000
Y =	6,000
	34,000 hrs.
\$6,800	
34,000 hrs. = \$.20 variable rate	

E17-4 (Concluded)

- (2) The two general principles for the allocation of service department costs applicable under the circumstances are (a) distribution on the basis of service or benefit received for the variable cost; and (b) distribution on the basis of readiness to serve or capacity that must be maintained for the fixed cost.

This solution distributes all variable costs incurred. A predetermined variable cost rate should be calculated, so that the efficiency of the power plant could be judged. The present \$.20 rate is based on the actual monthly consumption and cost.

E17-5

(1)

<u>Benefiting Department</u>	<u>Standby Capacity</u>	<u>% of Total</u>	<u>Quarterly Fixed Cost Billing</u>
Cutting	35,000	35%	\$2,450
Grinding	26,000	26	1,820
Polishing	30,000	30	2,100
Stores.....	9,000	9	630
Total	<u>100,000</u>	<u>100%</u>	<u>\$7,000</u>

$$\begin{aligned}
 \text{Variable rate} &= \text{Variable Cost} \div \text{Expected Annual Capacity} \\
 &= \$30,000 \div 300,000 \text{ KWH} \\
 &= \$0.10 \text{ per KWH}
 \end{aligned}$$

E17-5 (Concluded)

	Benefiting Department				
	Cutting	Grinding	Polishing	Stores	Total
First Quarter Billing:					
Variable rate.....	\$.10	\$.10	\$.10	\$.10	\$.10
Actual consumption	29,500	20,000	29,000	6,500	85,000
Variable cost	\$ 2,950	\$ 2,000	\$ 2,900	\$ 650	\$ 8,500
Fixed cost.....	2,450	1,820	2,100	630	7,000
Total	\$ 5,400	\$ 3,820	\$ 5,000	\$1,280	\$15,500
Second Quarter Billing:					
Variable rate.....	\$.10	\$.10	\$.10	\$.10	\$.10
Actual consumption	33,500	24,750	23,500	8,250	90,000
Variable cost	\$ 3,350	\$ 2,475	\$ 2,350	\$ 825	\$ 9,000
Fixed cost.....	2,450	1,820	2,100	630	7,000
Total	\$ 5,800	\$ 4,295	\$ 4,450	\$1,455	\$16,000
Third Quarter Billing:					
Variable rate.....	\$.10	\$.10	\$.10	\$.10	\$.10
Actual consumption	32,750	21,250	25,500	6,500	86,000
Variable cost	\$ 3,275	\$ 2,125	\$ 2,550	\$ 650	\$ 8,600
Fixed cost.....	2,450	1,820	2,100	630	7,000
Total	\$ 5,725	\$ 3,945	\$ 4,650	\$1,280	\$15,600
Fourth Quarter Billing:					
Variable rate.....	\$.10	\$.10	\$.10	\$.10	\$.10
Actual consumption	28,250	23,000	27,750	6,000	85,000
Variable cost	\$ 2,825	\$ 2,300	\$ 2,775	\$ 600	\$ 8,500
Fixed cost.....	2,450	1,820	2,100	630	7,000
Total	\$ 5,275	\$ 4,120	\$ 4,875	\$1,230	\$15,500
Total	\$22,200	\$16,180	\$18,975	\$5,245	\$62,600
(2)	First	Second	Third	Fourth	Annual
	Quarter	Quarter	Quarter	Quarter	Total
Actual cost	\$15,450	\$16,200	\$15,900	\$15,400	\$ 62,950
Less budget allowance:					
Variable rate	\$.10	\$.10	\$.10	\$.10	\$.10
Actual KWH provided	85,000	90,000	86,000	85,000	346,000
Variable cost.....	\$ 8,500	\$ 9,000	\$ 8,600	\$ 8,500	\$ 34,600
Fixed cost.....	7,000	7,000	7,000	7,000	28,000
Budget allowance	\$15,500	\$16,000	\$15,600	\$15,500	\$ 62,600
Spending variance	\$ (50)	\$ 200	\$ 300	\$ (100)	\$ 350
	fav.	unfav.	unfav.	fav.	unfav.

E17-6

UNIVERSITY MOTOR POOL
Budget Report for March

	Monthly Budget	March Actual	(Over) Under
Gasoline	\$ 5,513	\$ 5,323	\$ 190
Oil, minor repairs, parts, and supplies.....	378	380	(2)
Outside repairs	236	50	186
Insurance	525	525	—
Salaries and benefits	2,500	2,500	—
Depreciation	2,310	2,310	—
Total	<u>\$11,462</u>	<u>\$11,088</u>	<u>\$ 374</u>
Number of automobiles.....	21	21	—
Total miles.....	63,000	63,000	—
Cost per mile	\$.1819	\$.1760	\$.0059

Supporting calculations for monthly budget amounts:

Gasoline: $\frac{63,000 \text{ miles}}{16 \text{ miles per gal.}} \times \$1.40 \text{ per gallon} = \$5,512.50$

Oil, minor repairs, parts,
and supplies: $63,000 \times \$0.006 \text{ per mile} = \378

Outside repairs: $\frac{\$135 \text{ per auto} \times 21 \text{ autos}}{12 \text{ months}} = \236.25

Insurance: Annual cost for one auto: $\$6,000 \div 20 \text{ autos} = \300
 Annual cost for 21 autos: $21 \times \$300 = \$6,300$
 Monthly cost: $\$6,300 \div 12 = \525

Salaries and benefits: No change
 $\frac{\$30,000 \text{ annual cost}}{12 \text{ months}} = \$2,500 \text{ per month}$

Depreciation: Annual depreciation per auto:
 $\$26,400 \div 20 \text{ autos} = \$1,320$
 Annual depreciation for 21 autos:
 $\$1,320 \text{ per auto} \times 21 = \$27,720$
 Monthly depreciation: $\$27,720 \div 12 = \$2,310$

E17-7

CLAYTON COMPANY
Assembly Department
Flexible Budget—90% Level

Direct materials (90% x \$20,000)	\$18,000
Direct labor (90% x \$11,250)	10,125
Supervision	500
Indirect materials (\$250 + (90% x (\$1,750 - \$250)))	1,600
Property tax	300
Maintenance (\$600 + (90% x (\$1,600 - \$600)))	1,500
Power (\$200 + (90% x (\$300 - \$200)))	290
Insurance	175
Depreciation	1,600
Total	<u>\$34,090</u>

E17-8 ONE MONTH FLEXIBLE BUDGET FOR FINISHING DEPARTMENT**Operating level**

Based on labor hours	800	900	1,000	1,100
Percentage of capacity	<u>80%</u>	<u>90%</u>	<u>100%</u>	<u>110%</u>

Variable cost:

Indirect labor	\$ 1,200.00	\$ 1,350.00	\$ 1,500.00	\$ 1,650.00
Factory supplies	1,880.00	2,115.00	2,350.00	2,585.00
Power	600.00	675.00	750.00	825.00
Rework operations	400.00	450.00	500.00	550.00
Payroll taxes	1,040.00	1,170.00	1,300.00	1,430.00
Repair and maintenance	320.00	360.00	400.00	440.00
General factory	160.00	180.00	200.00	220.00
Total variable cost	<u>\$ 5,600.00</u>	<u>\$ 6,300.00</u>	<u>\$ 7,000.00</u>	<u>\$ 7,700.00</u>

Fixed Cost:

Indirect labor	\$ 4,000.00	\$ 4,000.00	\$ 4,000.00	\$ 4,000.00
Supervision	2,500.00	2,500.00	2,500.00	2,500.00
Factory supplies	900.00	900.00	900.00	900.00
Power	500.00	500.00	500.00	500.00
Rework operations	200.00	200.00	200.00	200.00
Payroll taxes	800.00	800.00	800.00	800.00
Repair and maintenance	600.00	600.00	600.00	600.00
Property insurance	700.00	700.00	700.00	700.00
Property taxes	300.00	300.00	300.00	300.00
Vacation pay	2,200.00	2,200.00	2,200.00	2,200.00
Employee pension costs	1,200.00	1,200.00	1,200.00	1,200.00
Employee health plan	1,800.00	1,800.00	1,800.00	1,800.00
Machinery depreciation	1,000.00	1,000.00	1,000.00	1,000.00
Water and heat	600.00	600.00	600.00	600.00
Building occupancy	1,000.00	1,000.00	1,000.00	1,000.00
General factory	1,500.00	1,500.00	1,500.00	1,500.00
Total fixed cost	<u>\$19,800.00</u>	<u>\$19,800.00</u>	<u>\$19,800.00</u>	<u>\$19,800.00</u>
Total cost	<u>\$25,400.00</u>	<u>\$26,100.00</u>	<u>\$26,800.00</u>	<u>\$27,500.00</u>

E17-9

	<u>Original Budget</u>	<u>Budget Allowance</u>	<u>Actual Cost</u>	<u>Spending Variance Unfav. (Fav.)</u>
Capacity hours	<u>8,000</u>	<u>8,800</u>	<u>8,800</u>	
Variable costs:				
Supplies	\$ 2,000	\$ 2,200	\$ 2,300	\$ 100
Repairs and maintenance	800	880	900	20
Indirect labor	4,000	4,400	4,300	(100)
Power and light	1,200	1,320	1,400	80
Heat	400	440	500	60
Subtotal	<u>\$ 8,400</u>	<u>\$ 9,240</u>	<u>\$ 9,400</u>	
Fixed costs:				
Building expense	\$ 800	\$ 800	\$ 840	40
Depreciation—machinery	2,400	2,400	2,400	0
Property tax and insurance	400	400	420	20
Subtotal	<u>\$ 3,600</u>	<u>\$ 3,600</u>	<u>\$ 3,660</u>	
Total costs	<u>\$12,000</u>	<u>\$12,840</u>	<u>\$13,060</u>	<u>\$ 220</u>
Applied factory overhead		<u>13,200</u>		unfav.
Idle capacity variance		<u>\$ (360) fav.</u>		
Actual factory overhead		\$13,060		
Applied factory overhead		<u>13,200</u>		
Overapplied factory overhead		<u>\$ (140)</u>		
Spending variance		\$ 220 unfav.		
Idle capacity variance		<u>(360) fav.</u>		
Overapplied factory overhead		<u>\$ (140)</u>		

E17-10

	Original Budget	Budget Allowance	Actual Cost	Spending Variance Unfav. (Fav.)
Direct labor hours.....	<u>10,000</u>	<u>9,600</u>	<u>9,600</u>	
Variable costs:				
Indirect labor.....	\$ 70,000	\$ 67,200	\$ 70,000	\$2,800
Payroll taxes.....	61,500	59,040	60,000	960
Factory supplies.....	27,000	25,920	28,000	2,080
Electric utility.....	12,000	11,520	12,000	480
Gas utility.....	6,000	5,760	6,100	340
Water utility.....	1,500	1,440	1,500	60
Machinery repairs	10,000	9,600	10,000	400
Maintenance	21,000	20,160	15,000	(5,160)
Overtime premium	9,000	8,640	9,000	360
Subtotal	<u>\$218,000</u>	<u>\$209,280</u>	<u>\$211,600</u>	
Fixed costs:				
Supervision	\$ 48,000	\$ 48,000	\$ 48,000	0
Indirect labor.....	36,000	36,000	36,000	0
Vacation pay.....	40,000	40,000	40,500	500
Payroll taxes.....	8,000	8,000	8,000	0
Employee insurance.....	12,000	12,000	12,250	250
Factory supplies.....	19,000	19,000	19,000	0
Electric utility.....	15,000	15,000	15,000	0
Gas utility.....	9,000	9,000	9,000	0
Water utility.....	5,000	5,000	5,000	0
Maintenance	23,000	23,000	23,000	0
Machinery depreciation	50,000	50,000	50,000	0
Building rent.....	15,000	15,000	15,000	0
Property taxes.....	12,000	12,000	13,000	1,000
Property insurance.....	15,000	15,000	15,250	250
Subtotal	<u>\$307,000</u>	<u>\$307,000</u>	<u>\$309,000</u>	
Total costs	<u>\$525,000</u>	<u>\$516,280</u>	<u>\$520,600</u>	<u>\$4,320</u>
Applied factory overhead		504,000		unfav.
Idle capacity variance		<u>\$ 12,280</u>	unfav.	
Actual factory overhead		\$520,600		
Applied factory overhead		504,000		
Underapplied factory overhead		<u>\$ 16,600</u>		
Spending variance.....		\$ 4,320	unfav.	
Idle capacity variance		12,280	unfav.	
Underapplied factory overhead		<u>\$ 16,600</u>		

PROBLEMS

P17-1

(1) Factory overhead applied for each producing department:

Dept. A:	20,480 hrs.	x	\$4.20	=	\$86,016
Dept. B:	29,850 hrs.	x	3.10	=	92,535
Dept. C:	20,100 hrs.	x	3.75	=	75,375

(2) Over- or underapplied factory overhead for each producing department:

Expenses	Producing Departments		
	A	B	C
Actual department factory overhead	\$56,020	\$52,850	\$42,580
Proration of service departments:			
Utilities (on actual kwh).....	13,755*	16,170	12,530
Repairs and maintenance (on actual dlh)	18,432**	26,865	18,090
Total actual department factory overhead	\$88,207	\$95,885	\$73,200
Applied factory overhead	86,016	92,535	75,375
(Over-) or underapplied factory overhead	<u>\$ 2,191 unfav.</u>	<u>\$ 3,350 unfav.</u>	<u>\$ (2,175) fav.</u>

* $39,300 \times \$0.35 = \$13,755$

** $20,480 \times \$0.90 = 18,432$

(3) Total variance for each service department:

	Repairs and Maintenance	Utilities
Actual cost before allocation of Utilities		
Department cost	\$56,320	\$50,040
Utilities Department cost allocation (18,950 kwh x \$.35)	6,633	
	<u>\$62,953</u>	
Services allocated (sold) to other departments:		
(70,430 hrs. x \$.90).....	63,387	
(140,250 kwh x \$.35)		49,088
(Over-) or underallocated service department costs.....	<u>\$ (434) fav.</u>	<u>\$ 952 unfav.</u>

P17-2**(1) Maintenance Department:**

$$\frac{\text{Total estimated cost}}{\text{Total estimated maintenance hours}} = \frac{\$10,500}{3,500} = \$3 \text{ per maintenance hour}$$

Utilities Department:

$$\frac{\text{Total estimated cost}}{\text{Total estimated kwh}} = \frac{\$8,400}{70,000} = \$0.12 \text{ per kwh}$$

	Producing		Service	
	Planers	Radial Drills	Maintenance	Utilities
Variable overhead.....	\$15,000	\$ 9,000	\$ 4,500	\$3,600
Fixed overhead.....	18,000	15,000	6,000	4,800
Direct departmental overhead ..	\$33,000	\$24,000	\$10,500	\$8,400
Distribution—service depts.:				
Maintenance:				
(2,500 x \$3)	7,500			
(1,000 x \$3)		3,000	<u>(10,500)</u>	
Utilities:				
(45,000 x \$.12)	5,400			
(25,000 x \$.12)		3,000		<u>(8,400)</u>
Total factory overhead.....	<u>\$45,900</u>	<u>\$30,000</u>		
Direct labor hours	12,000	7,500		
Overhead rate per dlh	\$3.825	\$4		

P17-2 (Continued)

(3)	<u>Planers</u>	<u>Radial Drills</u>
Spending variance:		
Actual factory overhead	\$3,120.00	\$2,300
Add distribution— service departments*	<u>1,440.00</u>	<u>480</u>
Total departmental factory overhead	\$4,560.00	\$2,780
Budget allowance based on actual hours:		
Variable:**		
Planers (1,020 x \$2.325).....	\$2,371.50	
Radial Drills (680 x \$2)		\$1,360
Fixed	<u>1,500.00</u>	<u>1,250</u>
	3,871.50	2,610
Spending variance.....	<u>\$ 688.50 unfav.</u>	<u>\$ 170 unfav.</u>

*Distribution of service department costs to producing departments:

	<u>Planers</u>	<u>Radial Drills</u>
Maintenance:		
Planers(320 hrs. x \$3)	\$ 960	
Radial Drills (80 hrs. x \$3)		\$ 240
Utilities:		
Planers (4,000 hrs. x \$.12)	480	
Radial Drills (2,000 hrs. x \$.12)		240
	<u>\$1,440</u>	<u>\$ 480</u>

**Variable overhead rate:

Planers: $\$3.825 - (\$18,000 \div 12,000) = \$2.325$

Radial Drills: $\$4 - (\$15,000 \div 7,500) = \$2$

Idle capacity variance:	<u>Planers</u>	<u>Radial Drills</u>
Budget allowance based on actual hours	\$3,871.50	\$2,610
Less applied factory overhead:		
Planers (1,020 hrs. x \$3.825).....	3,901.50	
Radial Drills (680 hrs. x \$4).....		2,720
Idle capacity variance	<u>\$ (30.00) fav.</u>	<u>\$ (110) fav.</u>

P17-2 (Continued)

(4)	Maintenance	Utilities
Actual service department cost	\$ 1,170	\$ 710
Distributed to producing departments:		
Maintenance (400 hrs. x \$3)	1,200	
Utilities (6,000 kwh x \$.12)		720
Overdistributed	<u>\$ (30)</u>	<u>\$ (10)</u>

Spending variance:

Actual service department cost	\$1,170.00		\$710.00	
Budget allowance based on actual hours:				
Variable	\$ 514.28 ¹		\$308.40 ²	
Fixed	500.00	1,014.28	400.00	708.40
Spending variance		<u>\$ 155.72 unfav.</u>		<u>\$ 1.60 unfav.</u>

Idle capacity variance:

Budget allowance based on actual hours	\$1,014.28		\$708.40	
Less applied overhead:				
Maintenance (400 hrs. x \$3)	1,200.00			
Utilities (6,000 kwh x \$.12)			720.00	
Idle capacity variance		<u>\$ (185.72) fav.</u>		<u>\$ (11.60) fav.</u>
Net variance		<u>\$ (30.00) fav.</u>		<u>\$ (10.00) fav.</u>

¹ Estimated variable expense = $\frac{\$4,500}{3,500}$ = \$1.2857 per maintenance hour

\$1.2857 x 400 hours = \$514.28

² Estimated variable expense = $\frac{\$3,600}{70,000}$ = \$.0514 per kwh

\$.0514 x 6,000 kws = \$308.40

P17-2 (Concluded)**(5) Reconciliation of total variances:**

Actual factory overhead		\$7,300.00
Less: Applied to work in process—		
Planers	\$3,901.50	
Applied to work in process—		
Radial Drills	2,720.00	6,621.50
Net total variance		<u>\$ 678.50</u> unfav.

Variances:	<u>Unfavorable</u>	<u>Favorable</u>
Spending variance—Planers	\$ 688.50	
Spending variance—Radial Drills	170.00	
Idle capacity variance—Planers..		\$ 30.00
Idle capacity variance—		
Radial Drills		110.00
Spending variance—Maintenance	155.72	
Spending variance—Utilities	1.60	
Idle capacity variance—		
Maintenance		185.72
Idle capacity variance—Utilities..		11.60
	<u>\$1,015.82</u>	<u>\$ 337.32</u>
Net total variance	<u>\$ 678.50</u> unfav.	

P17-3

(1) Budget allowance for each producing department in January:

(a) Based on scheduled production hours:

Variable factory overhead:	<u>Machining</u>	<u>Assembly</u>
(5,000 units x \$.45 ¹ per unit) or (1,250 hours x \$1.80 per hour)	\$2,250	
(5,000 units x \$.38 ² per unit) or (1,000 hours x \$1.90 per hour)		\$1,900.00
Fixed factory overhead:		
(\$17,520 + 12 months).....	1,460	
(\$34,230 + 12 months).....		2,852.50
Share of service department cost:		
Maintenance (1,250 hours x \$.50 ³ per hour)	625	
Maintenance (1,000 hours x \$.50 per hour) .		500.00
Janitorial (\$1,980 + 12 months).....	165	
Janitorial (\$2,970 + 12 months).....		247.50
Total budget allowance	<u>\$4,500</u>	<u>\$5,500.00</u>

¹ Machining: $\$27,000 \div 60,000 \text{ units} = \$.45 \text{ per unit}$; $\$27,000 \div 15,000 \text{ hours} = \1.80 per hour

² Assembly: $\$22,800 \div 60,000 \text{ units} = \$.38 \text{ per unit}$; $\$22,800 \div 12,000 \text{ hours} = \1.90 per hour

³ Maintenance: $\$13,500 \div 27,000 \text{ hours} = \$.50 \text{ per direct labor hour}$

(b) Budget allowance based on actual production hours:

Variable factory overhead:	<u>Machining</u>	<u>Assembly</u>
(1,340 hours x \$1.80 per hour)	\$2,412	
(1,030 hours x \$1.90 per hour)		\$1,957.00
Fixed factory overhead:		
(\$17,520 + 12 months).....	1,460	
(\$34,230 + 12 months)		2,852.50
Share of service department cost:		
Maintenance (1,340 hours x \$.50 per hour) .	670	
Maintenance (1,030 hours x \$.50 per hour) .		515.00
Janitorial (\$1,980 + 12 months).....	165	
Janitorial (\$2,970 + 12 months).....		247.50
Total budget allowance	<u>\$4,707</u>	<u>\$5,572.00</u>

P17-3 (Continued)

The budget allowances calculated in (a) and in (b) include the service department shares by two different methods: the share of the Maintenance Department cost is based on the charging rate of \$.50 and the actual hours worked, which is in harmony with the general procedure advocated. The share of the Janitorial Department cost is based on 1/12 of the apportioned cost. This approach is used because it is believed that janitorial services have no relationship to the number of hours worked in the production departments. In fact, the illustration could be made more realistic by basing the apportionment of Janitorial Department cost on the basis of the relative amount of floor space occupied by the producing departments. As long as no change in the space has been reported, the share would remain as established in the budget figures.

It should be noted further that the maintenance cost could be charged to the producing departments on the basis of maintenance hours and not direct labor hours. An additional refinement would apportion fixed cost on the basis of a predetermined maintenance schedule, and the variable cost on the basis of maintenance hours actually used.

- (2) Spending and idle capacity variances for each producing department, based on actual production hours:

	<u>Machining</u>	<u>Assembly</u>
Actual departmental factory overhead	\$4,200	\$5,240.00
Add share of budgeted service department costs:		
Maintenance Department	670	515.00
Janitorial Department	165	247.50
Total actual factory overhead	\$5,035	\$6,002.50
Budget allowance based on actual production hours	<u>4,707</u>	<u>5,572.00</u>
Spending variance	<u>\$ 328</u> unfav.	<u>\$ 430.50</u> unfav.
 Budget allowance based on actual production hours	 \$4,707	 \$5,572.00
Applied factory overhead:		
(1,340 hours x \$3.60 per hour)....	4,824	
(1,030 hours x \$5.50 per hour)....		5,665.00
Idle capacity variance	<u>\$ (117)</u> fav.	<u>\$ (93.00)</u> fav.

P17-3 (Concluded)

(3) Spending variance for each service department:

	Maintenance	Janitorial
Actual cost (month of January)	\$1,350.00	\$1,040
Budget allowance*	<u>1,147.93</u>	<u>825</u>
Spending variance.....	<u>\$ 202.07 unfav.</u>	<u>\$ 215 unfav.</u>
*Variable factory overhead:		
(\$5,100 ÷ 27,000 budgeted hours = \$.189 per hour) (2,370 actual hours × \$.189 per hour)	\$ 447.93	
(\$2,700 ÷ 12 months)		\$ 225
Fixed factory overhead:		
(\$8,400 ÷ 12 months)	700.00	
(\$7,200 ÷ 12 months)		600
Budget allowance.....	<u>\$1,147.93</u>	<u>\$ 825</u>

P17-4

	80%	90%	100%
Capacity.....	40,000	45,000	50,000
Direct labor hours.....	40,000	45,000	50,000
Variable costs:	\$ 4,000	\$ 4,500	\$ 5,000
Indirect labor	18,000	20,250	22,500
Payroll taxes and fringe benefits.....	57,240	64,395	71,550 ¹
Power and light	1,200	1,350	1,500 ²
Inspection.....	4,800	5,400	6,000 ³
Other semivariable costs.....	6,000	6,750	7,500 ⁴
Total variable costs	<u>\$ 91,240</u>	<u>\$102,645</u>	<u>\$114,050</u>
Fixed costs:			
Depreciation	\$ 9,000	\$ 9,000	\$ 9,000
Insurance	1,500	1,500	1,500
Maintenance cost.....	24,000	24,000	24,000
Property tax.....	1,500	1,500	1,500
Supervisory staff	36,000	36,000	36,000
Power and light	200	200	200
Inspection.....	4,200	4,200	4,200
Other semivariable costs.....	1,400	1,400	1,400
Total fixed costs	<u>\$ 77,800</u>	<u>\$ 77,800</u>	<u>\$ 77,800</u>
Total factory overhead	<u>\$169,040</u>	<u>\$180,445</u>	<u>\$191,850</u>

P17-4 (Concluded)**¹Payroll taxes and fringe benefits:**

Direct labor cost = 50,000 hrs. x \$7.50 = \$375,000

Indirect labor cost = 50,000 hrs. x \$.45 = 22,500

\$397,500 x .18 = \$71,550

²Power and light:

	<u>Hours</u>	<u>Cost</u>
High.....	50,000	\$1,700
Low.....	40,000	<u>1,400</u>
Difference.....	<u>10,000</u>	<u>\$ 300</u>

\$300
10,000 hrs. - \$.03 per direct labor hour

Total cost	\$1,700
Variable cost (50,000 hrs. x \$.03).....	<u>1,500</u>
Fixed cost.....	<u>\$ 200</u>

³Inspection:

	<u>Hours</u>	<u>Cost</u>
High.....	50,000	\$10,200
Low.....	40,000	<u>9,000</u>
Difference.....	<u>10,000</u>	<u>\$ 1,200</u>

\$1,200
10,000 hrs. - \$.12 per direct labor hour

Total cost	\$10,200
Variable cost (50,000 hrs. x \$.12).....	<u>6,000</u>
Fixed cost.....	<u>\$ 4,200</u>

⁴Other semivariable expenses:

	<u>Hours</u>	<u>Cost</u>
High.....	50,000	\$8,900
Low.....	40,000	<u>7,400</u>
Difference.....	<u>10,000</u>	<u>\$1,500</u>

\$1,500
10,000 hrs. - \$.15 per direct labor hour

Total cost	\$8,900
Variable cost (50,000 hrs. x \$.15).....	<u>7,500</u>
Fixed cost.....	<u>\$1,400</u>

P17-5

(1) ONE MONTH FLEXIBLE BUDGET FOR FABRICATION DEPARTMENT

Operating level

Based on machine hours	1,600	1,800	2,000	2,200
Percentage of capacity	<u>80%</u>	<u>90%</u>	<u>100%</u>	<u>110%</u>

Variable cost:

Indirect labor	\$ 3,440.00	\$ 3,870.00	\$ 4,300.00	\$ 4,730.00
Factory supplies.....	1,200.00	1,350.00	1,500.00	1,650.00
Power.....	800.00	900.00	1,000.00	1,100.00
Rework operations.....	480.00	540.00	600.00	660.00
Payroll taxes	560.00	630.00	700.00	770.00
Repair and maintenance	400.00	450.00	500.00	550.00
General factory	320.00	360.00	400.00	440.00
Total variable cost.....	<u>\$ 7,200.00</u>	<u>\$ 8,100.00</u>	<u>\$ 9,000.00</u>	<u>\$ 9,900.00</u>

Fixed cost:

Indirect labor	\$ 2,000.00	\$ 2,000.00	\$ 2,000.00	\$ 2,000.00
Supervision	2,000.00	2,000.00	2,000.00	2,000.00
Factory supplies.....	600.00	600.00	600.00	600.00
Power.....	450.00	450.00	450.00	450.00
Payroll taxes	1,000.00	1,000.00	1,000.00	1,000.00
Repair and maintenance	1,400.00	1,400.00	1,400.00	1,400.00
Property insurance.....	750.00	750.00	750.00	750.00
Property taxes.....	500.00	500.00	500.00	500.00
Vacation pay.....	1,700.00	1,700.00	1,700.00	1,700.00
Employee pension costs	1,000.00	1,000.00	1,000.00	1,000.00
Employee health plan.....	800.00	800.00	800.00	800.00
Machinery depreciation	3,500.00	3,500.00	3,500.00	3,500.00
Water and heat.....	400.00	400.00	400.00	400.00
Building occupancy.....	900.00	900.00	900.00	900.00
General factory	1,000.00	1,000.00	1,000.00	1,000.00
Total fixed cost.....	<u>\$18,000.00</u>	<u>\$18,000.00</u>	<u>\$18,000.00</u>	<u>\$18,000.00</u>
Total cost	<u>\$25,200.00</u>	<u>\$26,100.00</u>	<u>\$27,000.00</u>	<u>\$27,900.00</u>

P17-5 (Concluded)

(2)

FABRICATION DEPARTMENT
Variance Report
For the Month of February, 20—

	Budget Allowance Normal Capacity	Budget Allowance Actual Capacity	Actual Cost	Spending Variance unfav. (fav.)
Based on machine hours	1,800	1,880		
Percentage of capacity	<u>90%</u>	<u>93%</u>		
Variable cost:				
Indirect labor	\$ 3,870.00	\$ 3,999.00	\$ 4,125.00	\$126.00
Factory supplies	1,350.00	1,395.00	1,554.00	159.00
Power.....	900.00	930.00	970.50	40.50
Rework operations.....	540.00	558.00	1,088.25	530.25
Payroll taxes	630.00	651.00	675.50	24.50
Repair and maintenance.....	450.00	465.00	125.75	(339.25)
General factory	360.00	372.00	385.00	13.00
Total variable cost	<u>\$ 8,100.00</u>	<u>\$ 8,370.00</u>	<u>\$ 8,924.00</u>	
Fixed cost:				
Indirect labor	\$ 2,000.00	\$ 2,000.00	\$ 2,000.00	0.00
Supervision	2,000.00	2,000.00	2,000.00	0.00
Factory supplies	600.00	600.00	600.00	0.00
Power.....	450.00	450.00	450.00	0.00
Payroll taxes	1,000.00	1,000.00	1,000.00	0.00
Repair and maintenance.....	1,400.00	1,400.00	1,400.00	0.00
Property insurance	750.00	750.00	785.00	35.00
Property taxes.....	500.00	500.00	490.00	(10.00)
Vacation pay	1,700.00	1,700.00	1,700.00	0.00
Employee pension costs	1,000.00	1,000.00	1,000.00	0.00
Employee health plan	800.00	800.00	845.00	45.00
Machinery depreciation	3,500.00	3,500.00	3,500.00	0.00
Water and heat	400.00	400.00	465.00	65.00
Building occupancy.....	900.00	900.00	900.00	0.00
General factory	1,000.00	1,000.00	1,000.00	0.00
Total fixed cost	<u>\$18,000.00</u>	<u>\$18,000.00</u>	<u>\$18,135.00</u>	
Total cost.....	<u>\$26,100.00</u>	<u>\$26,370.00</u>	<u>\$27,059.00</u>	<u>\$689.00</u>
Applied factory overhead (\$14.50 rate x 1,880 actual hours).....		26,970.00		unfav.
Idle capacity variance.....		<u>\$ (600.00) fav.</u>		
Actual factory overhead cost.....		\$27,059.00		
Applied factory overhead.....		<u>26,970.00</u>		
Underapplied factory overhead		<u>\$ 89.00</u>		
Spending variance		\$ 689.00 unfav.		
Idle capacity variance.....		(600.00) fav.		
Underapplied factory overhead		<u>\$ 89.00</u>		

P17-6

(1) ONE MONTH FLEXIBLE BUDGET FOR ASSEMBLY DEPARTMENT

Operating level

Based on direct labor hours	1,200	1,350	1,500	1,650
Percentage of capacity	<u>80%</u>	<u>90%</u>	<u>100%</u>	<u>110%</u>

Variable cost:

Indirect labor	\$ 2,700.00	\$ 3,037.50	\$ 3,375.00	\$ 3,712.50
Factory supplies.....	1,440.00	1,620.00	1,800.00	1,980.00
Power.....	420.00	472.50	525.00	577.50
Rework operations.....	600.00	675.00	750.00	825.00
Payroll taxes	420.00	472.50	525.00	577.50
Repair and maintenance	180.00	202.50	225.00	247.50
General factory	240.00	270.00	300.00	330.00
Total variable cost.....	<u>\$ 6,000.00</u>	<u>\$ 6,750.00</u>	<u>\$ 7,500.00</u>	<u>\$ 8,250.00</u>

Fixed cost:

Indirect labor	\$ 2,500.00	\$ 2,500.00	\$ 2,500.00	\$ 2,500.00
Supervision	1,800.00	1,800.00	1,800.00	1,800.00
Factory supplies.....	500.00	500.00	500.00	500.00
Power.....	150.00	150.00	150.00	150.00
Rework operations.....	600.00	600.00	600.00	600.00
Payroll taxes	1,000.00	1,000.00	1,000.00	1,000.00
Repair and maintenance	350.00	350.00	350.00	350.00
Property insurance.....	150.00	150.00	150.00	150.00
Property taxes.....	200.00	200.00	200.00	200.00
Vacation pay.....	1,800.00	1,800.00	1,800.00	1,800.00
Employee pension costs	1,200.00	1,200.00	1,200.00	1,200.00
Employee health plan.....	500.00	500.00	500.00	500.00
Machinery depreciation	450.00	450.00	450.00	450.00
Water and heat.....	400.00	400.00	400.00	400.00
Building occupancy.....	900.00	900.00	900.00	900.00
General factory	1,000.00	1,000.00	1,000.00	1,000.00
Total fixed cost.....	<u>\$13,500.00</u>	<u>\$13,500.00</u>	<u>\$13,500.00</u>	<u>\$13,500.00</u>
Total cost	<u>\$19,500.00</u>	<u>\$20,250.00</u>	<u>\$21,000.00</u>	<u>\$21,750.00</u>

P17-6 (Concluded)

(2)

ASSEMBLY DEPARTMENT
Variance Report
 For the Month Ending August 31, 20—

	Budget Allowance Normal Capacity	Budget Allowance Actual Capacity	Actual Cost	Spending Variance unfav. (fav.)
Based on direct labor hours	1,350	1,290		
Percentage of capacity	<u>80%</u>	<u>86%</u>		
Variable cost:				
Indirect labor	\$ 3,037.50	\$ 2,902.50	\$ 3,250.00	\$ 347.50
Factory supplies	1,620.00	1,548.00	1,654.00	106.00
Power	472.50	451.50	465.00	13.50
Rework operations	675.00	645.00	488.25	(156.75)
Payroll taxes	472.50	451.50	451.50	0.00
Repair and maintenance	202.50	193.50	1,175.75	982.25
General factory	270.00	258.00	385.00	127.00
Total variable cost	<u>\$ 6,750.00</u>	<u>\$ 6,450.00</u>	<u>\$ 7,869.50</u>	
Fixed cost:				
Indirect labor	\$ 2,500.00	\$ 2,500.00	\$ 2,500.00	\$ 0.00
Supervision	1,800.00	1,800.00	1,800.00	0.00
Factory supplies	500.00	500.00	500.00	0.00
Power	150.00	150.00	150.00	0.00
Rework operations	600.00	600.00	600.00	0.00
Payroll taxes	1,000.00	1,000.00	1,000.00	0.00
Repair and maintenance	350.00	350.00	350.00	0.00
Property insurance	150.00	150.00	165.00	15.00
Property taxes	200.00	200.00	210.50	10.50
Vacation pay	1,800.00	1,800.00	2,200.00	400.00
Employee pension costs	1,200.00	1,200.00	1,200.00	0.00
Employee health plan	500.00	500.00	500.00	0.00
Machinery depreciation	450.00	450.00	450.00	0.00
Water and heat	400.00	400.00	465.00	65.00
Building occupancy	900.00	900.00	900.00	0.00
General factory	1,000.00	1,000.00	1,000.00	0.00
Total fixed cost	<u>\$13,500.00</u>	<u>\$13,500.00</u>	<u>\$13,990.50</u>	
Total cost	<u>\$20,250.00</u>	<u>\$19,950.00</u>	<u>\$21,860.00</u>	<u>\$1,910.00</u>
Applied factory overhead (\$15.00 rate x 1,290 actual hours)		<u>19,350.00</u>		unfav.
Idle capacity variance		<u>\$ 600.00 unfav.</u>		
Actual factory overhead cost		<u>\$21,860.00</u>		
Applied factory overhead		<u>19,350.00</u>		
Underapplied factory overhead		<u>\$ 2,510.00</u>		
Spending variance		<u>\$ 1,910.00 unfav.</u>		
Idle capacity variance		<u>600.00 unfav.</u>		
Underapplied factory overhead		<u>\$ 2,510.00</u>		

CASES**C17-1**

- (1) The factors that influence the behavior of the production managers, described in the case, conflict with the factors that motivate the maintenance managers. The production managers have been given a monetary incentive to improve the costs in their own departments. They require the support of the other departments, (e.g., Storeroom and Maintenance) to achieve their objective; but the incentives (monetary and otherwise) have not changed in the other departments.

To improve their costs and earn the incentives, the production managers have postponed repairs; demanded emergency repairs more frequently than in the past; demanded repair work be done more quickly to reduce downtime; demanded special treatment in some cases; placed undue pressures on maintenance managers; and complained about the maintenance charges.

The results of the demands by the production managers conflict with the following factors, which appear to be important to the maintenance managers and reflect on their performance: good relations with other managers; high quality repair work, including making machinery safe and maintaining its normal life; and orderly work scheduling.

- (2) If monetary incentives to the production managers are to be continued, complaints and conflicts could be reduced by revising the charging system as follows: develop predetermined hourly charging rates for each skill level within the Maintenance Department; develop predetermined or budgeted hours for routine or repetitive maintenance work; develop budgeted costs for parts and materials; use maintenance job time cards that are initialed by production managers when the job is done; and develop a penalty rate to be charged to those production managers who need quick service that could have been avoided by timely maintenance scheduling.

Increased productivity and reduced conflicts between managers probably could be more effectively achieved by revising the reward and evaluation structure. Evaluations and rewards for individual efforts should be eliminated, and cooperation and continuous improvement should be encouraged and rewarded. High rejection rates and internal conflict suggest that far more is wrong with the current system than just the charging rates.

C17-2

- (1) Various alternative answers may be considered acceptable depending upon the justifications given and top management's reactions to any resulting variances. The main objective is to ensure that the costs are allocated to the areas that are responsible for the incurrence of the costs.
- (a) \$6,000 cost of idle time in the Assembly Department—This should be charged to the Machining Department because it is a direct result of their decision to change production schedules. By charging Machining with this cost, they become aware of the overall effects of scheduling changes and the overall cost to the company of their decision. Some justification could be given to charging \$300 of this to the Purchasing Department because that would have been the added cost to the company if the schedule had not been changed and it is a direct result of the Purchasing Department's decision to go with a new supplier.
 - (b) \$1,000 savings in costs due to layoffs in Machining Department—This should be credited to the Machining Department because it is a direct result of their decision to lay off machinists.
 - (c) \$1,500 cost of training in the Machining Department—This should be charged to the Machining Department because it is a direct result of their decision to lay off machinists who must be subsequently replaced. This would ensure that they are aware of the total effect of their decision on the overall company instead of just their own department.
 - (d) \$20,000 lost profit on sales resulting from Assembly Department downtime—This is an opportunity cost that is not normally recognized in the accounting records and, therefore, would not be charged to any department. In evaluating the Assembly Department, consideration should be given to the shutdown that occurred in the Machining Department and its effects on the output of the Assembly Department.
- (2) Overall, the company's present budget and reward (bonus) system would appear to be causing a lack of goal congruence, poor communication, and an overall employee dissatisfaction caused, in whole or in part, by the following:
- (a) The company does not appear to be following the basic concepts of responsibility accounting and reporting (as evidenced in (1)). The company should try to ensure that the responsibility for a cost is directly related to the authority to control the cost in order to establish a fair evaluation system.
 - (b) The company appears to have a "budget-constrained" style of evaluation, in that all managers seem to have their prime concern focused on meeting their budget regardless of the overall effect on the company. A "profit-conscious" style would be more appropriate,

C17-2 (Concluded)

- where a manager would feel free to exceed his budget if it would benefit the overall company (without fear of adversely affecting his/her evaluation). For example, Winston would have been prepared to have the added cost of air freight charged to his department, resulting in a considerable cost savings to the overall company.
- (c) The company's present reward system of giving bonuses based on a manager's ability to meet budget tends to place too much emphasis on the short-term, to the possible detriment of the long-term. Managers are making decisions to ensure their bonuses instead of maximizing the overall company objectives. An example of this might be the decision of Valquez to lay off workers to save \$1,000 in this period and, therefore, get the bonus, even though output was reduced. This action would result in added costs of \$1,500 to replace the workers in the next period.
 - (d) Generally, an all or nothing bonus system such as this is a poor motivator, because too much emphasis is placed on meeting the budget. This may lead to a lack of goal congruence as evidenced in this case—manipulation of the data to meet the budget in one particular period and/or overall employee frustration due to their inability to meet unrealistic budgets.
 - (e) The company's overall attitude seems to be that variances from budget represent poor performance by the managers. This could lead to serious motivational and morale problems with the staff. Emphasis should be placed on the fact that variances are only attention directors and indicate the need to investigate why things were different from expected. The variances may indicate that the original budget was wrong and should be up-dated (for example, the price of part # 88 would appear to be unrealistic), that overall company objectives and/or procedures need to be changed, or that things have happened that are different from expected but beyond the control of anyone within the organization.
 - (f) The company would appear to be using a static budget for its evaluations, as evidenced by the fact that Valquez and Dixon received their bonuses for being under their original budgeted costs for the period. It is also evidenced by the fact that Winston had an annual limit to the amount of air freight costs allowed instead of an allowance based on the total purchases made in the period. Evaluations should be based on a comparison of actual results and expected results using a flexible budget, based on actual levels of activity achieved. This is to isolate the variances caused by efficiencies/inefficiencies as opposed to those caused by a change in volume of activity from that which was originally expected.

C17-3

- (1) (a) Daniel's perception of Scott, the controller, is that she is:**
 - (1) an accountant who knows and cares little about the production aspects of organization;**
 - (2) unsympathetic and not helpful in providing services to the production departments;**
 - (3) an accountant who is unwilling to change or request executive management to make changes in reporting requirements.**
- (b) Daniel's perception of corporate headquarters is that it is:**
 - (1) unfair because they are using the cost report as the sole judge of performance, thereby ignoring more realistic cost comparisons, product quality, employee pride, and motivation;**
 - (2) insensitive to the needs and concerns of production people;**
 - (3) resistant to change in reporting policies and budgetary processes.**
- (c) Daniel's perception of the cost report is that it is:**
 - (1) a shortsighted report overemphasizing cost minimization as a single objective;**
 - (2) inflexible and not subject to the changing production levels and operating conditions of a dynamic production process;**
 - (3) a biased report highlighting shortcomings and failing to give proper recognition to improvements in performance or innovative processes.**
- (d) Daniel's perception of himself is that he is a:**
 - (1) qualified production manager interested in a quality product at a reasonable price;**
 - (2) frustrated manager unable to get satisfactory cooperation from the Accounting Department or executive management;**
 - (3) discouraged production manager recognizing that the current reporting situation is nearly hopeless, and that others before him have been equally unsuccessful.**
- (2) Daniel's perceptions adversely affect his behavior and performance as a production manager. Operating in a "no win" situation in which he believes performance reports do not fairly represent his accomplishments, plus the inability to communicate his desires or needs to appropriate people in top management, can inhibit motivational desires and curtail incentive.**
- (3) Changes that could be made in the cost reports that would make the information more meaningful and less threatening to the production managers are as follows:**
 - (a) Include a more detailed breakdown of labor and overhead costs.**
 - (b) Use a budget allowance based on actual activity rather than a static master budget for measuring performance, so that changed conditions, volume changes, and fixed versus variable costs are recognized in the reporting process.**

C17-3 (Concluded)

- (c) **Separate controllable costs from noncontrollable costs and clearly identify those elements of the report for which the production manager is directly responsible. These actions will provide a more meaningful analysis of operations and managers will know responsibilities.**
- (d) **A variance column that highlights both favorable and unfavorable circumstances would provide a less negative report. Significant variances could be highlighted to draw attention to them.**

C17-4

- (1) **Functional and dysfunctional behavioral responses:**
 - (a) **Delaying action on certain reports during periods of peak activity could be dysfunctional. If the reports contain information requiring immediate attention, any delay in action would have to be dysfunctional. If the reports continue to accumulate with no action taking place (i.e., the department heads do not catch up during the lulls), this definitely is dysfunctional behavior.**
 - (b) **Having too many reports so that no action or the wrong action is taken is a dysfunctional response and a good example of information overload. The department heads were unable to assimilate the supplied information properly, and therefore they either did not use it, or used it incorrectly.**
 - (c) **Delaying action until reminded by someone can be dysfunctional. If delays continually take place and result in complications and/or delays in other departments, this lack of action is dysfunctional.**
 - (d) **The department heads' actions can be considered both functional and dysfunctional. The development of information from alternative sources is dysfunctional to the firm because the formal system is not producing the information in a usable form and the process of developing information from other sources probably has a cost. However, the fact that the department head was able to generate the needed information from other sources in order that action could be taken is a functional response to the problem.**

C17-4 (Concluded)

- (2) **The dysfunctional behavior that occurred in McCumber Company was a direct result of management's failure to recognize that information systems are dynamic. Once a system is designed and implemented, it should be continually reviewed to acknowledge and incorporate any changes. A systems study committee, composed of both systems staff and users, should be established to review the present system and to educate users as to information needs and the uses of information. During the systems review, the committee's attention should be directed toward information needed by department heads and the information's form and timing. Unnecessary reports should be eliminated, and individual reports should be redesigned so that only relevant information is included. Once the reporting system is revised, the system should be reviewed periodically to see that it is functioning smoothly and to make any necessary corrections.**

CHAPTER 18

DISCUSSION QUESTIONS

- Q18-1. Standard costs are the predetermined costs of manufacturing products during a specific period under current or anticipated operating conditions. Standards aid in planning and controlling operations.
- Q18-2. A few uses of standard costs are:
- (a) establishing budgets
 - (b) controlling costs by motivating employees and measuring efficiencies
 - (c) simplifying costing procedures and expediting cost reports
 - (d) assigning costs to materials, work in process, and finished good inventories
 - (e) forming the basis for establishing contract bids and for setting sales prices
- Q18-3. To set sales prices, executives need cost information furnished by the accounting department. Since standard costs represent the cost that should be attained in a well-managed plant operated at normal capacity, they are ideally suited for furnishing information that will enable the sales department to price products.
- Budgets are used for planning and coordinating future activities and for controlling current activities. When budget figures are based on standard costs, the accuracy of the resulting budget is strongly influenced by the reliability of the standard costs. With standards available, production figures can be translated into the manufacturing costs.
- Q18-4. Standards are an integral part of job order and process cost accumulation, but do not comprise a system that could be utilized in lieu of one of the accumulation methods. Costs may be accumulated with or without the use of standards.
- Q18-5. Criteria to be used when selecting the operational activities for which standards are to be set include the following:
- (a) The activity should be repetitive in nature, with the repetition occurring in relatively short cycles.
 - (b) The input and output (product or service) of the activity should be measurable and uniform.
 - (c) The elements of cost, such as direct materials, direct labor, and factory overhead, must be defined clearly at the unit level of activity.
- Q18-6. Normal or currently attainable standards are preferable to theoretical or ideal standards for (a) performance evaluation and/or employee motivation, and (b) budgeting and planning. Theoretical or ideal standards are not realistically attainable. As a consequence of using such standards, employees may become discouraged rather than motivated, and budgets or plans are likely to be distorted and unreliable.
- Q18-7. Behavioral issues that need to be considered when selecting the level of performance to be incorporated into standards include the following:
- (a) The standards must be legitimate. The standards need not reflect the actual cost of a single item or cycle. However, they ideally will represent the cost that should be incurred in the production of a given product or the performance of a given operation.
 - (b) The standards must be attainable. When the standards are set too high, the repeated failure to achieve them will tend to reduce the motivation for attainment. The converse is also true. Standards that are too loose represent an invitation to relax.
 - (c) The participant should have a voice or influence in the establishment of standards and resulting performance measures. Involvement in the formulation of standards gives the participant a greater sense of understanding and commitment.
- Q18-8. (a) The role of the accounting department in the establishment of standards is to determine their ability to be quantified and to provide dollar values for specific unit standards.
- (b) In the establishment of standards, the role of the department in which the performance is being measured is to provide information for realistic standards, and to allow for subsequent performance evaluation for the purpose of detecting problems and improving performance.
- (c) The role of the industrial engineering department in the establishment of standards is to provide reliable measures of physical activities related to the standards of performance, and to verify the consistency of the performance between departments.
- Q18-9. The factory overhead variable efficiency variance is a measure of the efficient or inefficient use of the "base" that was used in allocating factory overhead to production. To the extent that the activity used as an allocation base drives variable factory overhead, the variable efficiency variance is a measure of the cost

savings or cost incurrence that is attributable to the efficient or inefficient use of that activity.

Q18-10. The factory overhead spending variance is a measure of the efficient or inefficient use of the various items of factory overhead. It is caused by differences in the prices paid for the items of overhead actually used (i.e., the differences between the actual quantity at the actual price and the actual quantity at the standard price for all items of factory overhead) and the differences in the quantities of the various items of factory overhead actually used (i.e., the differences between the standard quantity allowed for the actual level of the activity base at the standard price and the actual quantity used at the standard price for all items of factory overhead).

Q18-11. The factory overhead volume variance is a measure of the under- or over-utilization of plant facilities. It is the difference between the total budgeted fixed factory overhead and the amount charged to (or chargeable to) actual production based on the standard quantity allowed for the activity base used to allocate overhead. The volume variance may be thought of as the amount of under- or overapplied budgeted fixed factory overhead.

Q18-12. After variances have been determined, management should:

- (a) decide whether each variance is sufficiently significant to require investigation and explanation
- (b) investigate and obtain, from the responsible department head, explanations of significant variances
- (c) take corrective action and recognize and reward desirable performance, where appropriate
- (d) revise standards if needed

Q18-13. (a) Features of tolerance limits include:

- (1) A standard cost control system is established, specifying expected performance levels.
- (2) An information system is designed to highlight the areas most in need of investigation and possible corrective action.
- (3) Variance ranges for areas and items are computed. Management does not spend time on parts of the operations that produce satisfactory performance levels within these ranges.
- (4) Management's attention and efforts are concentrated on significant variances from expected results, which signal the presence of unplanned conditions needing investigation.

- (b) Tolerance limits have potential benefits because they may result in more effective use of management time. The man-

ager's time is not wasted on the process of identifying important problems or in working on unimportant ones. The manager should be able to concentrate efforts on important problems, because the technique highlights them.

- (c) It may be difficult to determine which variances are significant. Also, by focusing on variances above a certain level, other useful information, such as trends, may not be noticed at an early stage.

If the evaluation system is in any way directly tied to the variances, subordinates may be tempted to cover up negative exceptions or not report them at all. In addition, subordinates may not receive reinforcement for the reduction and maintenance of cost levels, but only reprimands for those items which exceed the range. Subordinate morale may suffer because of the lack of positive reinforcement for work well done. Using tolerance limits may also affect supervisory employees in an unsatisfactory manner. Supervisors may feel that they are not getting a complete review of operations because they are always keying on problems. In addition, supervisors may think that they are excessively critical of their subordinates. A negative impact on supervisory morale may result.

Q18-14. Overemphasis on price variances can result in a large number of low cost vendors, high levels of inventory, and poor quality materials and parts. Since the emphasis is on price rather than quality or reliability, purchasing will likely have a large number of low cost vendors available, who can be played one against the other to get the lowest possible prices. In addition, purchasing will likely purchase inventory in large quantities to take advantage of purchase discounts and to reduce the need to place rush orders that result in premium prices. Inventory tends to become unnecessarily large, resulting in excessive carrying costs, and material quality tends to decline, resulting in poor product quality and/or excessive spoilage, scrap, and rework.

Overemphasis on efficiency variances can result in long production runs, large work in process inventories, and attempts to control quality through inspection alone. Long production runs require fewer machine set ups and reduce the amount of inefficiency resulting from the learning required to change production from one product to another. Large work in process inventories result from long production runs, and large inventories are likely to be viewed by department managers as buffers

that can be used to absorb machine breakdowns, employee absenteeism, and slack demand for the product. Although carrying large inventories is costly, the carrying costs do not affect the efficiency variance, which in turn encourages departmental managers to over-produce. Since efficiency variances measure the use of inputs in relation to output volume, efforts to control quality tend to be oriented to

inspection alone. Stopping the process to experiment with alternative production methods to permanently correct a problem or improve quality can result in an unfavorable labor efficiency variance. In contrast, increasing the volume of production and reworking or discarding defects has a smaller impact on the efficiency variance.

EXERCISES

E18-1

	<u>Quantity</u>	x	<u>Unit Cost</u>	=	<u>Amount</u>
Actual materials purchased at actual cost	4,500 lbs.		\$13.41 actual		\$60,345
Actual materials purchased at standard cost	4,500		<u>13.50</u> standard		<u>60,750</u>
Materials purchase price variance	4,500		<u>\$ (.09)</u>		<u>\$ (405) fav.</u>

	<u>Quantity</u>	x	<u>Unit Cost</u>	=	<u>Amount</u>
Actual materials used at actual cost	4,000 lbs.		\$13.41 actual		\$53,640
Actual materials used at standard cost	4,000		<u>13.50</u> standard		<u>54,000</u>
Materials price usage variance	4,000		<u>\$ (.09)</u>		<u>\$ (360) fav.</u>

	<u>Quantity</u>	x	<u>Unit Cost</u>	=	<u>Amount</u>
Actual materials used at standard cost	4,000 lbs.		\$13.50 standard		\$54,000
Standard quantity allowed at standard cost	<u>3,800</u>		13.50 standard		<u>51,300</u>
Materials quantity variance	<u>200</u> lbs.		13.50 standard		<u>\$ 2,700 unfav.</u>

E18-2

	<u>Quantity</u>	x	<u>Unit Cost</u>	=	<u>Amount</u>
Actual materials purchased at actual cost	5,000		\$22.10 actual		\$110,500
Actual materials purchased at standard cost	5,000		<u>22.50</u> standard		<u>112,500</u>
Materials purchase price variance	5,000		<u>\$ (.40)</u>		<u>\$ (2,000) fav.</u>

	<u>Quantity</u>	x	<u>Unit Cost</u>	=	<u>Amount</u>
Actual materials purchased at standard cost	5,000		\$22.50 standard		\$112,500
Actual materials issued at standard cost	<u>4,400</u>		22.50 standard		<u>99,000</u>
Materials inventory variance	<u>600</u>		22.50 standard		<u>\$ 13,500 unfav.</u>

E18-2. (Concluded)

	<u>Quantity</u>	x	<u>Unit Cost</u>	=	<u>Amount</u>	
Actual materials issued at standard cost.....	4,400		\$22.50 standard		\$99,000	
Standard quantity of materials at standard cost.....	<u>4,300</u>		22.50 standard		<u>96,750</u>	
Materials quantity variance	<u>100</u>		22.50 standard		<u>\$ 2,250</u>	unfav.

E18-3

(1)	<u>Quantity</u>	x	<u>Unit Cost</u>	=	<u>Amount</u>	
Actual materials purchased at actual cost.....	6,000		\$4.20 actual		\$25,200	
Actual materials purchased at standard cost.....	6,000		<u>4.00 standard</u>		<u>24,000</u>	
Materials purchase price variance	6,000		<u>\$.20</u>		<u>\$ 1,200</u>	unfav.
	<u>Quantity</u>	x	<u>Unit Cost</u>	=	<u>Amount</u>	
Actual materials used at standard cost.....	7,100		\$4.00 standard		\$28,400	
Standard quantity allowed at standard cost.....	<u>6,900</u>		4.00 standard		<u>27,600</u>	
Materials quantity variance	<u>200</u>		4.00 standard		<u>\$ 800</u>	unfav.
(2)	<u>Quantity</u>	x	<u>Unit Cost</u>	=	<u>Amount</u>	
Materials beginning inventory	2,000		\$4.12 actual		\$ 8,240	
Materials purchased during month.....	<u>6,000</u>		4.20 actual		<u>25,200</u>	
Materials available for use..	8,000		4.18 average		\$33,440	
Materials issued to production.....	<u>7,100</u>		4.18 average		<u>29,678</u>	
Materials ending inventory	<u>900</u>		4.18 average		<u>\$ 3,762</u>	
	<u>Quantity</u>	x	<u>Unit Cost</u>	=	<u>Amount</u>	
Actual materials used at actual average cost.....	7,100		\$4.18 average		\$29,678	
Actual materials used at standard cost.....	7,100		<u>4.00 standard</u>		<u>28,400</u>	
Materials price usage variance	7,100		<u>\$.18</u>		<u>\$ 1,278</u>	unfav.

E18-3 (Concluded)

	<u>Quantity</u>	x	<u>Unit Cost</u>	=	<u>Amount</u>
(3)					
Materials beginning inventory	2,000		\$4.12 actual		\$ 8,240
Materials purchased during month	6,000		4.20 actual		25,200
Materials available for use..	8,000				<u>\$33,440</u>
Materials issued to production	2,000		4.12 oldest		8,240
	5,100		4.20 newest		21,420
Materials ending inventory	<u>900</u>		4.20 newest		<u>\$ 3,780</u>
	<u>Quantity</u>	x	<u>Unit Cost</u>	=	<u>Amount</u>
Actual materials used at actual cost	2,000		\$4.12 oldest		\$ 8,240
	5,100		4.20 newest		21,420
	7,100				<u>\$29,660</u>
Actual materials used at standard cost	7,100		4.00 standard		<u>28,400</u>
Materials price usage variance					<u>\$ 1,260</u> unfav.
(4)					
Materials beginning inventory	2,000		\$4.12 actual		\$ 8,240
Materials purchased during month	6,000		4.20 actual		25,200
Materials available for use..	8,000				<u>\$33,440</u>
Materials issued to production	6,000		4.20 newest		25,200
	1,100		4.12 oldest		4,532
Materials ending inventory .	<u>900</u>		4.12 oldest		<u>\$ 3,708</u>
	<u>Quantity</u>	x	<u>Unit Cost</u>	=	<u>Amount</u>
Actual materials used at actual cost	6,000		\$4.20 newest		\$25,200
	1,100		4.12 oldest		4,532
	7,100				<u>\$29,732</u>
Actual materials used at standard cost	7,100		4.00 standard		<u>28,400</u>
Materials price usage variance					<u>\$ 1,332</u> unfav.

E18-4

	<u>Hours</u>	x	<u>Rate</u>	=	<u>Amount</u>
Actual labor hours worked..	650		\$ 9.80 actual		\$6,370
Actual labor hours worked..	650		10.00 standard		6,500
Labor rate variance.....	650		\$ (.20)		\$ (130) fav.
	<u>Hours</u>	x	<u>Rate</u>	=	<u>Amount</u>
Actual labor hours worked..	650		\$10.00 standard		\$6,500
Standard hours allowed (1,200 units x 1/2 hour labor).....	600		10.00 standard		6,000
Labor efficiency variance....	50		10.00 standard		\$ 500 unfav.

E18-5

(1)	<u>Quantity</u>	x	<u>Unit Cost</u>	=	<u>Amount</u>
Actual materials purchased	1,500		\$3.80 actual		\$5,700
Actual materials purchased	1,500		4.00 standard		6,000
Materials purchase price variance	1,500		\$ (.20)		\$ (300) fav.
	<u>Quantity</u>	x	<u>Unit Cost</u>	=	<u>Amount</u>
Actual materials used	1,350		\$3.80 actual		\$5,130
Actual materials used	1,350		4.00 standard		5,400
Materials price usage variance	1,350		\$ (.20)		\$ (270) fav.
	<u>Quantity</u>	x	<u>Unit Cost</u>	=	<u>Amount</u>
Actual materials used	1,350		\$4.00 standard		\$5,400
Standard quantity allowed ..	1,020		4.00 standard		4,080
Materials quantity variance	330		4.00 standard		\$1,320 unfav.
(2)	<u>Hours</u>	x	<u>Rate</u>	=	<u>Amount</u>
Actual labor hours worked..	310		\$12.20 actual		\$3,782
Actual labor hours worked..	310		12.00 standard		3,720
Labor rate variance.....	310		\$.20		\$ 62 unfav.
	<u>Hours</u>	x	<u>Rate</u>	=	<u>Amount</u>
Actual labor hours worked..	310		\$12.00 standard		\$3,720
Standard labor hours allowed.....	340		12.00 standard		4,080
Labor efficiency variance....	(30)		12.00 standard		\$ (360) fav.

E18-6

Actual factory overhead	\$166,000	
Standard overhead chargeable to actual production (11,000 standard hours allowed x \$12.50 overhead rate) ..	<u>137,500</u>	
Overall factory overhead variance	<u>\$ 28,500</u>	unfav.

Actual factory overhead	\$166,000	
Budget allowance based on standard hours allowed:		
Variable overhead (11,000 standard machine hours allowed x \$4.50 variable overhead rate) \$49,500		
Fixed overhead budgeted	<u>96,000</u>	
Controllable variance	<u>145,500</u>	
	<u>\$ 20,500</u>	unfav.

Budget allowance based on standard hours allowed (from above)	\$145,500	
Standard factory overhead chargeable to production (11,000 standard hours allowed x \$12.50 overhead rate) ..	<u>137,500</u>	
Volume variance	<u>\$ 8,000</u>	unfav.
Controllable variance	\$20,500	unfav.
Volume variance	<u>8,000</u>	unfav.
Overall factory overhead variance	<u>\$28,500</u>	unfav.

E18-7

Actual factory overhead	\$130,000	
Standard overhead chargeable to actual production (5,700 standard hours allowed x \$22 overhead rate)	<u>125,400</u>	
Overall factory overhead variance	<u>\$ 4,600</u>	unfav.

Actual factory overhead	\$130,000	
Budget allowance based on standard hours:		
Variable overhead (5,700 standard hours x \$6) \$34,200		
Fixed overhead	<u>96,000</u>	
Controllable variance	<u>130,200</u>	
	<u>\$ (200)</u>	fav.

Budget allowance based on standard hours (from above)	\$130,200	
Standard factory overhead chargeable to production (from above)	<u>125,400</u>	
Volume variance	<u>\$ 4,800</u>	unfav.
Controllable variance	\$ (200)	fav.
Volume variance	<u>4,800</u>	unfav.
Overall factory overhead variance	<u>\$ 4,600</u>	unfav.

E18-8

Actual factory overhead		\$121,000	
Standard overhead chargeable to actual production (4,200 standard hours allowed x \$24.80 overhead rate)....		<u>104,160</u>	
Overall factory overhead variance		<u>\$ 16,840</u>	unfav.
Actual factory overhead		\$121,000	
Budget allowance based on actual machine hours:			
Variable overhead (4,600 actual machine hours x \$5.80 variable overhead rate)	\$26,680		
Fixed overhead budgeted	<u>85,500</u>	<u>112,180</u>	
Spending variance		<u>\$ 8,820</u>	unfav.
Budget allowance based on actual machine hours		\$112,180	
Budget allowance based on standard hours allowed:			
Variable overhead (4,200 standard machine hours allowed x \$5.80 variable overhead rate)	\$ 24,360		
Fixed overhead budgeted	<u>85,500</u>	<u>109,860</u>	
Variable efficiency variance		<u>\$ 2,320</u>	unfav.
Budget allowance based on standard hours allowed		\$109,860	
Standard overhead chargeable to actual production (4,200 standard hours allowed x \$24.80 overhead rate)....		<u>104,160</u>	
Volume variance		<u>\$ 5,700</u>	unfav.
Spending variance		\$ 8,820	unfav.
Variable efficiency variance		<u>2,320</u>	unfav.
Volume variance		<u>5,700</u>	unfav.
Overall factory overhead variance		<u>\$ 16,840</u>	unfav.

E18-9

Actual factory overhead		\$ 10,500	
Standard overhead chargeable to actual production (2,050 standard hours allowed x \$5 overhead rate).....		<u>10,250</u>	
Overall factory overhead variance		<u>\$ 250</u>	unfav.
Actual factory overhead		\$ 10,500	
Budget allowance based on actual hours:			
Variable overhead (1,900 actual hours x \$1.50) \$ 2,850			
Fixed overhead <u>7,000</u>		<u>9,850</u>	
Spending variance		<u>\$ 650</u>	unfav.
Budget allowance based on actual hours (from above)		\$ 9,850	
Budget allowance based on standard hours:			
Variable overhead (2,050 standard hours x \$1.50) <u>\$ 3,075</u>			
Fixed overhead <u>7,000</u>		<u>10,075</u>	
Variable efficiency variance.....		<u>\$ (225)</u>	fav.
Budget allowance based on standard hours (from above)		\$ 10,075	
Standard factory overhead chargeable to production (from above).....		<u>10,250</u>	
Volume variance		<u>\$ (175)</u>	fav.
Spending variance		\$ 650	unfav.
Variable efficiency variance.....		(225)	fav.
Volume variance		<u>(175)</u>	fav.
Overall factory overhead variance		<u>\$ 250</u>	unfav.

E18-10

Actual factory overhead	\$700,000
Standard overhead chargeable to actual production (38,000 units x 2 standard hours per unit x \$9 overhead rate).....	<u>684,000</u>
Overall factory overhead variance	<u>\$ 16,000</u> unfav.

E18-10. (Concluded)

(1) Two-variance method:

Actual factory overhead	\$700,000	
Budget allowance based on standard hours allowed:		
Variable overhead (38,000 units x 2 standard hours per unit x \$6 variable rate)	\$456,000	
Fixed overhead (80,000 budgeted hours x \$3 fixed rate)	<u>240,000</u>	<u>696,000</u>
Controllable variance		<u>\$ 4,000</u> unfav.
Budget allowance based on standard hours allowed (from above)		\$696,000
Standard overhead chargeable to actual production (38,000 units x 2 standard hours per unit x \$9 overhead rate)		<u>684,000</u>
Volume variance		<u>\$ 12,000</u> unfav.
Controllable variance		\$ 4,000 unfav.
Volume variance		<u>12,000</u> unfav.
Overall factory overhead variance		<u>\$ 16,000</u> unfav.

(2) Three-variance method:

Actual factory overhead	\$700,000	
Budget allowance based on actual hours worked:		
Variable overhead (77,500 actual hours x \$6 variable rate)	\$465,000	
Fixed overhead (80,000 budgeted hours x \$3 fixed rate)	<u>240,000</u>	<u>705,000</u>
Spending variance		<u>\$ (5,000)</u> fav.
Budget allowance based on actual hours worked (from above)		\$705,000
Budget allowance based on standard hours allowed (from above)		<u>696,000</u>
Variable efficiency variance		<u>\$ 9,000</u> unfav.
Budget allowance based on standard hours allowed (from above)		\$696,000
Standard overhead chargeable to actual production (38,000 units x 2 standard hours per unit x \$9 overhead rate)		<u>684,000</u>
Volume variance		<u>\$ 12,000</u> unfav.
Spending variance		\$ (5,000) fav.
Variable efficiency variance		9,000 unfav.
Volume variance		<u>12,000</u> unfav.
Overall factory overhead variance		<u>\$ 16,000</u> unfav.

E18-11

Materials price variance:

<u>Ingredients</u>	<u>Actual Quantity (Lbs.)</u>	<u>Standard Cost per Lb.</u>	<u>Standard Cost</u>	<u>Actual Cost</u>	<u>Materials Price Variance</u>
Cocoa beans.....	325,000	\$.60	\$ 195,000	\$201,500	\$ 6,500 unfav.
Milk.....	1,425,000	.50	712,500	684,000	(28,500) fav.
Sugar	250,000	.40	100,000	97,500	(2,500) fav.
			<u>\$1,007,500</u>	<u>\$983,000</u>	<u>\$(24,500) fav.</u>

Materials mix variance:

<u>Ingredients</u>	<u>Actual Quantity (Lbs.)</u>	<u>Standard Formula for Actual Quantity (Lbs.)*</u>	<u>Difference in Lbs.</u>	<u>Standard Cost per Lb.</u>	<u>Materials Mix Variance</u>
Cocoa beans.....	325,000	320,000	5,000	\$.60	\$ 3,000 unfav.
Milk.....	1,425,000	1,480,000	(55,000)	.50	(27,500) fav.
Sugar	250,000	200,000	50,000	.40	20,000 unfav.
	<u>2,000,000</u>	<u>2,000,000</u>	<u>0</u>		<u>\$ (4,500) fav.</u>

*Cocoa beans = $(800 + 5,000) \times 2,000,000$

Milk = $(3,700 + 5,000) \times 2,000,000$

Sugar = $(500 + 5,000) \times 2,000,000$

Materials yield variance:

Expected yield: 2,000,000 lbs. input + 5,000 lbs. =.....	400
Actual yield in one-ton batches.....	<u>387</u>
Unfavorable yield in batches	13
Standard cost per one-ton batch.....	<u>\$ 2,530</u>
Materials yield variance.....	<u>\$32,890 unfav.</u>

E18-12

(1) Materials purchase price variance:

<u>Ingredients</u>	<u>Actual Quantity Purchased in Liters</u>	<u>Standard Cost per Liter</u>	<u>Standard Cost</u>	<u>Actual Cost</u>	<u>Materials Purchases Price Variance</u>
Echol	25 000	\$.200	\$ 5,000	\$ 5,365	\$365 unfav.
Protex.....	13 000	.425	5,525	6,240	715 unfav.
Benz	40 000	.150	6,000	5,840	(160) fav.
CT-40.....	7 500	.300	2,250	2,220	(30) fav.
			<u>\$18,775</u>	<u>\$19,665</u>	<u>\$890 unfav.</u>

(2) Materials mix variance:

<u>Ingredients</u>	<u>Actual Quantity Used in Liters</u>	<u>Standard Formula for Actual Quantity in Liters*</u>	<u>Differ- ence in Liters</u>	<u>Standard Cost per Liter</u>	<u>Materials Mix Variance</u>
Echol	26 800	28 000	(1 200)	\$.200	\$(240.00) fav.
Protex.....	12 660	14 000	(1 340)	.425	(569.50) fav.
Benz	37 400	35 000	2 400	.150	360.00 unfav.
CT-40.....	7 140	7 000	140	.300	42.00 unfav.
	<u>84 000</u>	<u>84 000</u>	<u>0</u>		<u>\$(407.50) fav.</u>

*Echol = $(200 + 600) \times 84\,000$ liters
 Protex = $(100 + 600) \times 84\,000$ liters
 Benz = $(250 + 600) \times 84\,000$ liters
 CT-40 = $(50 + 600) \times 84\,000$ liters

Materials yield variance:

Expected yield: 84 000 liters input + 600 liters =	140
Actual yield in 500-liter batches.....	136
Unfavorable yield in batches	4
Standard cost per 500-liter batch	\$135
Materials yield variance.....	<u>\$540 unfav.</u>

E18-13

BENJAMIN PRODUCTS COMPANY
Department 2
Factory Overhead Variance Report
For Month Ending June 30

	(1) Budget Allowable Normal Capacity	(2) Budget Allowance Standard Hours	(3) Actual Cost	(4) Controllable Variance Unfav. (Fav.) (3) - (2)
Direct labor hours	6000	5100		
Capacity	<u>100%</u>	<u>85%</u>		
Variable factory overhead:				
Indirect labor	\$ 2,400	\$ 2,040	\$ 2,100	\$60
Manufacturing supplies	2,100	1,785	1,805	20
Repairs	800	680	650	(30)
Heat, power, and light	100	85	105	20
Total variable cost	<u>\$ 5,400</u>	<u>\$ 4,590</u>	<u>\$ 4,660</u>	
Fixed factory overhead:				
Supervision	\$ 6,000	\$ 6,000	\$ 6,200	200
Indirect labor	5,400	5,400	5,400	0
Manufacturing supplies	1,020	1,020	1,020	0
Maintenance	960	960	960	0
Heat, power, and light	120	120	120	0
Machinery depreciation	540	540	540	0
Insurance and taxes	360	360	372	12
Total fixed cost	<u>\$14,400</u>	<u>\$14,400</u>	<u>\$14,612</u>	
Total factory overhead	<u>\$19,800</u>	<u>\$18,990</u>	<u>\$19,272</u>	<u>\$282</u> unfav.
Standard factory overhead chargeable to work in process (5,100 standard hours x \$3.30 rate)		<u>16,830</u>		
Volume variance		<u>\$ 2,160</u>	unfav.	
Reconciliation of variances:				
Actual factory overhead		\$19,272		
Standard factory overhead chargeable to work in process		<u>16,830</u>		
Overall factory overhead variance		<u>\$ 2,442</u>	unfav.	
Controllable variance		\$ 282	unfav.	
Volume variance		<u>2,160</u>	unfav.	
Overall factory overhead variance		<u>\$ 2,442</u>	unfav.	

E18-14 APPENDIX

$$\frac{\$15,000 \text{ budgeted overhead}}{2,500 \text{ budgeted machine hours}} = \$6 \text{ overhead rate}$$

$$\frac{\$5,000 \text{ variable overhead}}{2,500 \text{ budgeted machine hours}} = \$2 \text{ variable rate}$$

Actual factory overhead.....	\$16,500
Standard overhead chargeable to actual production (2,400 standard hours allowed x \$6 overhead rate).....	<u>14,400</u>
Overall factory overhead variance	<u>\$ 2,100 unfav.</u>
Actual factory overhead.....	\$16,500
Budget allowance based on actual hours:	
Variable overhead (2,700 actual hours x \$2)...	\$ 5,400
Fixed overhead	<u>10,000</u>
Spending variance	<u>15,400</u>
	<u>\$ 1,100 unfav.</u>
Budget allowance based on actual hours (from above)	\$15,400
2,700 actual hours x \$6 factory overhead rate	<u>16,200</u>
Idle capacity variance	<u>\$ (800) fav.</u>
2,700 actual hours x \$6 factory overhead rate (from above)	\$16,200
Standard factory overhead chargeable to production (from above)	<u>14,400</u>
Efficiency variance	<u>\$ 1,800 unfav.</u>
Spending variance	\$ 1,100 unfav.
Idle capacity variance	(800) fav.
Efficiency variance	<u>1,800 unfav.</u>
Overall factory overhead variance	<u>\$ 2,100 unfav.</u>

E18-15 APPENDIX

$$\frac{\$16,800 \text{ budgeted overhead}}{1,200 \text{ budgeted labor hours}} = \$14 \text{ overhead rate}$$

$$\frac{\$4,800 \text{ variable overhead}}{1,200 \text{ budgeted labor hours}} = \$4 \text{ variable rate}$$

Actual factory overhead.....	\$15,800
Standard overhead chargeable to actual production (1,170 standard hours allowed x \$14 overhead rate).....	<u>16,380</u>
Overall factory overhead variance	<u>\$ (580) fav.</u>
Actual factory overhead.....	\$15,800
Budget allowance based on actual hours:	
Variable overhead (1,120 actual hours x \$4)...	\$ 4,480
Fixed overhead	<u>12,000</u>
Spending variance	<u>16,480</u>
	<u>\$ (680) fav.</u>
Budget allowance based on actual hours (from above)	\$16,480
1,120 actual hours x \$14 factory overhead rate	<u>15,680</u>
Idle capacity variance	<u>\$ 800 unfav.</u>
1,120 actual hours x \$4 variable factory overhead rate	\$ 4,480
1,170 standard hours x \$4 variable factory overhead rate	<u>4,680</u>
Variable efficiency variance	<u>\$ (200) fav.</u>
1,120 actual hours x \$10 fixed factory overhead rate	\$11,200
1,170 standard hours x \$10 fixed factory overhead rate	<u>11,700</u>
Fixed efficiency variance	<u>\$ (500) fav.</u>
Spending variance	\$ (680) fav.
Idle capacity variance	800 unfav.
Variable efficiency variance	(200) fav.
Fixed efficiency variance	<u>(500) fav.</u>
Overall factory overhead variance	<u>\$ (580) fav.</u>

PROBLEMS

P18-1

(1) Factory overhead per unit:

Variable (\$30 x 2/3)	\$20
Fixed (\$30 x 1/3)	<u>10</u>
	<u>\$30</u>

$$\frac{\text{Variable factory overhead per unit}}{\text{Direct labor hours per unit}} = \frac{\$20}{4} = \$5 \text{ variable overhead rate per direct labor hour}$$

Normal capacity direct labor hours (2,400) x Fixed factory overhead rate per direct labor hour (\$10 ÷ 4) = 2,400 x \$2.50 = \$6,000 fixed factory overhead based on normal monthly capacity.

(2)				
	<u>Yards</u>	x	<u>Unit Cost</u>	= <u>Amount</u>
Actual quantity purchased	18,000		\$1.38 actual	\$24,840
Actual quantity purchased	18,000		<u>1.35 standard</u>	<u>24,300</u>
Materials purchase price variance	18,000		<u>\$.03</u>	<u>\$ 540 unfav.</u>
	<u>Yards</u>	x	<u>Unit Cost</u>	= <u>Amount</u>
Actual quantity used	9,500		\$1.35 standard	\$12,825
Standard quantity allowed	<u>10,000</u>		<u>1.35 standard</u>	<u>13,500</u>
Materials quantity variance....	<u>(500)</u>		<u>1.35 standard</u>	<u>\$ (675) fav.</u>
	<u>Hours</u>	x	<u>Rate</u>	= <u>Amount</u>
Actual hours worked	2,100		\$9.15 actual	\$19,215
Actual hours worked	2,100		<u>9.00 standard</u>	<u>18,900</u>
Labor rate variance	2,100		<u>\$.15</u>	<u>\$ 315 unfav.</u>
	<u>Hours</u>	x	<u>Rate</u>	= <u>Amount</u>
Actual hours worked	2,100		\$9.00 standard	\$18,900
Standard hours allowed	<u>2,000</u>		<u>9.00 standard</u>	<u>18,000</u>
Labor efficiency variance	<u>100</u>		<u>9.00 standard</u>	<u>\$ 900 unfav.</u>
Actual factory overhead.....				\$16,650
Budget allowance based on standard hours allowed:				
Variable overhead (2,000 standard hours allowed				
x \$5 variable overhead rate).....			\$10,000	
Fixed overhead budgeted.....			<u>6,000</u>	<u>16,000</u>
Controllable variance.....				<u>\$ 650 unfav.</u>
Budget allowance based on standard hours allowed				\$16,000
Overhead charged to production (2,000 x \$7.50).....				<u>15,000</u>
Volume variance				<u>\$ 1,000 unfav.</u>

P18-2

(1)	Materials		Direct Labor	Factory Overhead
	A	B		
Units completed and transferred out this period	4,600	4,600	4,600	4,600
Less all units in beginning inventory	<u>500</u>	<u>500</u>	<u>500</u>	<u>500</u>
Equivalent units started and completed this period	4,100	4,100	4,100	4,100
Add equivalent units in spoiled units.....	200	0	140	200
Add equivalent units required to complete beginning inventory this period	0	500	150	250
Add equivalent units in ending inventory	<u>600</u>	<u>600</u>	<u>540</u>	<u>600</u>
Equivalent units of production this period.....	4,900	5,200	4,930	5,150
Standard quantity allowed per unit of product	<u>3 units</u>	<u>2 units</u>	<u>1/2 hr.</u>	<u>1 hr.</u>
Standard quantity allowed for current production	<u>14,700</u>	<u>10,400</u>	<u>2,465</u>	<u>5,150</u>

(2)	Quantity	x	Unit Cost	=	Amount
Actual material A purchased at actual cost	16,000		\$4.60 actual		\$73,600
Actual material A purchased at standard cost	16,000		<u>4.50 standard</u>		<u>72,000</u>
Material A purchase price variance	16,000		<u>\$.10</u>		<u>\$ 1,600 unfav.</u>

	Quantity	x	Unit Cost	=	Amount
Actual material A used at standard cost	14,800		\$4.50 standard		\$66,600
Standard quantity of material A allowed at standard cost	<u>14,700</u>		4.50 standard		<u>66,150</u>
Material A quantity variance ..	<u>100</u>		4.50 standard		<u>\$ 450 unfav.</u>

	Quantity	x	Unit Cost	=	Amount
Actual material B purchased at actual cost	12,000		\$1.95 actual		\$23,400
Actual material B purchased at standard cost	12,000		<u>2.00 standard</u>		<u>24,000</u>
Material B purchase price variance	12,000		<u>\$ (.05)</u>		<u>\$ (600) fav.</u>

P18-2 (Continued)

	<u>Quantity</u>	x	<u>Unit Cost</u>	=	<u>Amount</u>
Actual material B used at standard cost	11,000		\$2.00 standard		\$22,000
Standard quantity of material B allowed at standard cost	<u>10,400</u>		2.00 standard		<u>20,800</u>
Material B quantity variance ..	<u>600</u>		2.00 standard		<u>\$ 1,200</u> unfav.
	<u>Hours</u>	x	<u>Rate</u>	=	<u>Amount</u>
Actual labor hours worked at actual labor rate	2,550		\$10.20 actual		\$26,010
Actual labor hours worked at standard labor rate	<u>2,550</u>		<u>10.00</u> standard		<u>25,500</u>
Labor rate variance	<u>2,550</u>		<u>\$.20</u>		<u>\$ 510</u> unfav.
	<u>Hours</u>	x	<u>Rate</u>	=	<u>Amount</u>
Actual labor hours worked at standard labor rate	2,550		\$10.00 standard		\$25,500
Standard labor hours allowed at standard labor rate	<u>2,465</u>		10.00 standard		<u>24,650</u>
Labor efficiency variance	<u>85</u>		10.00 standard		<u>\$ 850</u> unfav.
Actual factory overhead					\$75,000
Standard overhead chargeable to actual production (5,150 standard hours allowed x \$15 overhead rate)					<u>77,250</u>
Overall factory overhead variance					<u>\$ (2,250)</u> fav.
Actual factory overhead					\$75,000
Budget allowance based on standard hours:					
Variable overhead (5,150 standard hours x \$5)			\$25,750		
Fixed overhead			<u>50,000</u>		<u>75,750</u>
Controllable variance					<u>\$ (750)</u> fav.
Budget allowance based on standard hours (from above)					\$75,750
Standard factory overhead chargeable to production (from above)					<u>77,250</u>
Volume variance					<u>\$ (1,500)</u> fav.
Controllable variance					\$ (750) fav.
Volume variance					<u>(1,500) fav.</u>
Overall factory overhead variance					<u>\$ (2,250)</u> fav.

P18-2 (Concluded)

(3)

Standard cost of units transferred to finished goods:
 (4,600 units x \$37.50 standard cost per unit of product)..... \$172,500

Standard cost of spoiled units charged to factory overhead:

Material A (200 units of product x 100% complete x 3 units each x \$4.50)	\$ 2,700
Material B (200 units of product x 0% complete x 2 units each x \$2.00).....	0
Direct labor (200 units x 70% complete x 1/2 hr. each x \$10.00)	700
Factory overhead (200 units x 100% complete x 1 hr. each x \$15.00)	3,000
Total cost of spoiled units.....	<u>\$ 6,400</u>

Work in process, ending inventory:

Material A (600 units of product x 100% complete x 3 units each x \$4.50)	\$ 8,100
Material B (600 units of product x 100% complete x 2 units each x \$2.00)	2,400
Direct labor (600 units x 90% complete x 1/2 hr. each x \$10.00)	2,700
Factory overhead (600 units x 100% complete x 1 hr. each x \$15.00).....	9,000
Total standard cost of work in process, ending inventory	<u>\$ 22,200</u>

P18-3

(1) January equivalent production:

	Material A	Material B	Conversion Costs
Transferred out	8,000	8,000	8,000
Less beginning inventory (all units)	<u>3,000</u>	<u>3,000</u>	<u>3,000</u>
Started and finished this period	5,000	5,000	5,000
Add beginning inventory (work this period).....	0	3,000	2,000
Add ending inventory (work this period)	5,000	0	2,000
Add abnormal spoilage	<u>1,000</u>	<u>1,000</u>	<u>1,000</u>
	<u>11,000</u> units	<u>9,000</u> units	<u>10,000</u> units

P18-3 (Continued)

(2)	<u>Gallons</u>	x	<u>Unit Cost</u>	=	<u>Amount</u>
Actual quantity of Material A used	50,000		\$1.00 actual		\$ 50,000
Actual quantity of Material A used	50,000		1.20 standard		60,000
Material A price usage variance	50,000		<u>\$ (.20)</u>		<u><u>\$ (10,000)</u></u> fav.

	<u>Gallons</u>	x	<u>Unit Cost</u>	=	<u>Amount</u>
Actual quantity of Material A used	50,000		\$1.20 standard		\$60,000
Standard quantity of Material A allowed.....	<u>44,000</u>		1.20 standard		<u>52,800</u>
Material A quantity variance ..	<u>6,000</u>		1.20 standard		<u><u>\$ 7,200</u></u> unfav.

	<u>Square Feet</u>	x	<u>Unit Cost</u>	=	<u>Amount</u>
Actual quantity of Material B used	18,000		\$.75 actual		\$13,500
Actual quantity of Material B used	18,000		.70 standard		12,600
Material B price usage variance	18,000		<u>\$.05</u>		<u><u>\$ 900</u></u> unfav.

	<u>Square Feet</u>	x	<u>Unit Cost</u>	=	<u>Amount</u>
Actual quantity of Material B used	18,000		\$.70 standard		\$12,600
Standard quantity of Material B allowed	<u>18,000</u>		.70 standard		<u>12,600</u>
Material B quantity variance ..	<u>0</u>		.70 standard		<u><u>0</u></u>

	<u>Hours</u>	x	<u>Rate</u>	=	<u>Amount</u>
Actual hours worked	10,200		\$12.00 actual		\$122,400
Actual hours worked	10,200		11.50 standard		117,300
Labor rate variance	10,200		<u>\$.50</u>		<u><u>\$ 5,100</u></u> unfav.

	<u>Hours</u>	x	<u>Rate</u>	=	<u>Amount</u>
Actual hours worked	10,200		\$11.50 standard		\$117,300
Standard hours allowed	<u>10,000</u>		11.50 standard		<u>115,000</u>
Labor efficiency variance	<u>200</u>		11.50 standard		<u><u>\$ 2,300</u></u> unfav.

P18-3 (Concluded)

Actual factory overhead		\$ 60,100
Budget allowance based on standard hours allowed:		
Variable overhead (10,000 equivalent units x 1 standard hour per unit x \$1.80 variable rate)	\$18,000	
Fixed overhead budgeted (7,800 labor hours at normal capacity x \$5 fixed rate).....	<u>39,000</u>	<u>57,000</u>
Controllable variance		<u>\$ 3,100 unfav.</u>
Budget allowance based on standard hours allowed (above).....		\$ 57,000
Standard overhead chargeable to actual production (10,000 standard hours allowed x \$6.80 overhead rate)	<u>68,000</u>	
Volume variance		<u>\$(11,000) fav.</u>

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**P18-4
(1)**

	Materials	Conversion Costs
Units completed and transferred out.....	<u>17,000</u>	<u>17,000</u>
Less beginning inventory (all units)	<u>4,000</u>	<u>4,000</u>
Units started and completed this period	13,000	13,000
Add beginning inventory (work this period)	0	3,200
Add ending inventory (work this period)	<u>2,150</u>	<u>860</u>
Add abnormal spoilage (work this period).....	<u>850</u>	<u>850</u>
Equivalent units of production this period.....	<u><u>16,000</u></u>	<u><u>17,910</u></u>

	Quantity	x	Unit Cost	=	Amount
(2) Actual materials purchased at actual cost	60 000 kg		\$3.95 actual		\$237,000
Actual materials purchased at standard cost	60 000		<u>4.00 standard</u>		<u>240,000</u>
Materials purchase price variance	60 000		<u>\$ (.05)</u>		<u>\$ (3,000) fav.</u>

	Quantity	x	Unit Cost	=	Amount
Actual materials used at standard cost	50 000 kg		\$4.00 standard		\$200,000 unfav.
Standard quantity allowed at standard cost (16,000 x 3 kg)	<u>48 000</u>		4.00 standard		<u>192,000</u>
Materials quantity variance....	<u><u>2 000 kg</u></u>		4.00 standard		<u><u>\$ 8,000 unfav.</u></u>

P18-4 (Concluded)

	<u>Hours</u>	x	<u>Rate</u>	=	<u>Amount</u>
Actual labor hours at actual rate.....	9,000		\$12.00 actual		\$108,000
Actual labor hours at standard rate.....	9,000		11.00 standard		99,000
Labor rate variance	9,000		<u>\$ 1.00</u>		<u>\$ 9,000</u> unfav.
	<u>Hours</u>	x	<u>Rate</u>	=	<u>Amount</u>
Actual labor hours at standard rate.....	9,000		\$11.00 standard		\$99,000
Standard labor hours allowed at standard rate (17,910 equivalent units x 1/2 hour per unit).....	<u>8,955</u>		11.00 standard		<u>98,505</u>
Labor efficiency variance	<u>45</u>		11.00 standard		<u>\$ 495</u> unfav.
Actual factory overhead.....					\$134,900
Budget allowance based on actual hours:					
Variable overhead (\$6 rate x 9,000 actual hours)			\$54,000		
Budgeted fixed factory overhead.....			<u>80,000</u>		<u>134,000</u>
Factory overhead spending variance					<u>\$ 900</u> unfav.
Budget allowance based on actual hours (computed above).					\$134,000
Budget allowance based on standard hours:					
Variable overhead (\$6 rate x 17,910 equivalent units x 1/2 standard hour per unit)			\$53,730		
Budgeted fixed factory overhead.....			<u>80,000</u>		<u>133,730</u>
Factory overhead variable efficiency variance					<u>\$ 270</u> unfav.
Budget allowance based on standard hours (computed above)					\$133,730
Factory overhead chargeable to production at standard (\$14 rate x 17,910 equivalent units x 1/2 standard hour)					<u>125,370</u>
Factory overhead volume variance					<u>\$ 8,360</u> unfav.

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P18-5

	<u>Materials</u>	<u>Conversion Costs</u>
(1)		
Units completed and transferred out this period.....	32,000	32,000
Less all units in beginning inventory	<u>5,000</u>	<u>5,000</u>
Equivalent units started and completed this period	27,000	27,000
Add equivalent units required to complete beginning inventory this period	0	3,000
Add equivalent units in ending inventory.....	<u>2,000</u>	<u>1,600</u>
Equivalent units of production this period.....	29,000	31,600
Standard quantity allowed per unit of product	<u>3 units</u>	<u>1/4 hr.</u>
Standard quantity allowed for current production....	<u>87,000</u>	<u>7,900 hrs.</u>

	<u>Quantity</u>	x	<u>Unit Cost</u>	=	<u>Amount</u>
(2)					
Actual materials purchased at actual cost	100,000		\$6.54 actual		\$654,000
Actual materials purchased at standard cost	100,000		<u>6.00</u> standard		<u>600,000</u>
Materials purchase price variance	100,000		<u>\$.54</u>		<u>\$ 54,000</u> unfav.

	<u>Quantity</u>	x	<u>Unit Cost</u>	=	<u>Amount</u>
Actual materials purchased at standard cost	100,000		\$6.00 standard		\$600,000
Actual materials issued at standard cost	<u>92,000</u>		6.00 standard		<u>552,000</u>
Materials inventory variance..	<u>8,000</u>		6.00 standard		<u>\$ 48,000</u> unfav.

	<u>Quantity</u>	x	<u>Unit Cost</u>	=	<u>Amount</u>
Actual materials issued at standard cost	92,000		\$6.00 standard		\$552,000
Standard quantity of materials at standard cost	<u>87,000</u>		6.00 standard		<u>522,000</u>
Materials quantity variance....	<u>5,000</u>		6.00 standard		<u>\$ 30,000</u> unfav.

	<u>Hours</u>	x	<u>Rate</u>	=	<u>Amount</u>
Actual labor hours worked at actual labor rate.....	8,000		\$10.60 actual		\$84,800
Actual labor hours worked at standard labor rate.....	8,000		<u>10.00</u> standard		<u>80,000</u>
Labor rate variance	8,000		<u>\$.60</u>		<u>\$ 4,800</u> unfav.

P18-5 (Concluded)

	<u>Hours</u>	x	<u>Rate</u>	=	<u>Amount</u>
Actual labor hours worked at standard labor rate.....	8,000		\$10.00 standard		\$80,000
Standard labor hours allowed at standard labor rate	<u>7,900</u>		10.00 standard		<u>79,000</u>
Labor efficiency variance	<u>100</u>		10.00 standard		<u>\$ 1,000</u> unfav.
Actual factory overhead.....					\$75,000
Standard overhead chargeable to actual production (7,900 standard hours allowed x \$10 overhead rate).....					<u>79,000</u>
Overall factory overhead variance					<u>\$ (4,000)</u> fav.
Actual factory overhead.....					\$75,000
Budget allowance based on actual hours:					
Variable overhead (8,000 actual hours x \$2)			\$16,000		
Fixed overhead (8,500 budgeted hours x \$8)			<u>68,000</u>		<u>84,000</u>
Spending variance					<u>\$ (9,000)</u> fav.
Budget allowance based on actual hours (from above)					\$84,000
Budget allowance based on standard hours:					
Variable overhead (7,900 standard hours x \$2).....			\$15,800		
Fixed overhead.....			<u>68,000</u>		<u>83,800</u>
Variable efficiency variance					<u>\$ 200</u> unfav.
Budget allowance based on standard hours (from above)					\$83,800
Standard factory overhead chargeable to production (from above)					<u>79,000</u>
Volume variance					<u>\$ 4,800</u> unfav.
Spending variance					\$ (9,000) fav.
Variable efficiency variance					200 unfav.
Volume variance					<u>4,800</u> unfav.
Overall factory overhead variance					<u>\$ (4,000)</u> fav.

P18-6

(1) Standard cost of production:

<u>Lot</u>	<u>Quantity (dozens)</u>	<u>Standard Cost per dozen</u>	<u>Total Standard Cost</u>
22	1,000	\$53.10	\$ 53,100
23	1,700	53.10	90,270
24	1,200 (direct materials)	26.40	31,680
	960 (direct labor and factory overhead)	26.70	25,632
			<u>\$200,682</u>

	<u>Yards</u>	x	<u>Unit Cost</u>	=	<u>Amount</u>
(2) Actual quantity purchased	95,000		\$1.12 actual		\$106,400
Actual quantity purchased	95,000		1.10 standard		<u>104,500</u>
Materials purchase price variance	95,000		<u>\$.02</u>		<u>\$ 1,900 unfav.</u>

(3) (a)	<u>Lot 22</u>	<u>Lot 23</u>	<u>Lot 24</u>
Actual quantity used	24,100	40,440	28,825
Standard quantity allowed:			
1,000 x 24 yards	24,000		
1,700 x 24 yards		40,800	
1,200 x 24 yards			28,800
	100	(360)	25
Standard cost per yard	x \$1.10	x \$1.10	x \$ 1.10
Materials quantity variance	<u>\$ 110 unfav.</u>	<u>\$(396) fav.</u>	<u>\$27.50 unfav.</u>

(b)	<u>Lot 22</u>	<u>Lot 23</u>	<u>Lot 24</u>
Actual hours worked	2,980	5,130	2,890
Standard hours allowed:			
1,000 x 3 hours	3,000		
1,700 x 3 hours		5,100	
960 x 3 hours			2,880
	(20)	30	10
Standard cost per hour	x \$4.90	x \$4.90	x \$4.90
Labor efficiency variance ..	<u>\$ (98) fav.</u>	<u>\$ 147 unfav.</u>	<u>\$ 49 unfav.</u>

(c)	<u>Lot 22</u>	<u>Lot 23</u>	<u>Lot 24</u>
Actual labor rate	\$5.00	\$5.00	\$5.00
Standard labor rate	4.90	4.90	4.90
	\$.10	\$.10	\$.10
Actual hours worked	x 2,980	x 5,130	x 2,890
Labor rate variance	<u>\$ 298 unfav.</u>	<u>\$ 513 unfav.</u>	<u>\$ 289 unfav.</u>

P18-7

CLAFFY MANUFACTURING COMPANY
Department 2
Factory Overhead Variance Report
For Month Ending February 28

	(1)	(2)	(3)	(4)	(5)	(6)
	Budget Allowance Normal Capacity	Budget Allowance Standard Hours	Budget Allowance Actual Hours	Actual Cost	Variable Efficiency Variance Unfav. (Fav.) (3) - (2)	Spending Variance Unfav. (Fav.) (4) - (3)
Processing time						
In hours	6,000	5,700	5,840			
Capacity	<u>100%</u>	<u>95%</u>	<u>97.33%</u>			
Variable factory overhead:						
Indirect labor...	\$ 2,000	\$ 1,900	\$ 1,947	\$ 1,920	\$ 47	\$(27)
Manufacturing						
supplies	2,400	2,280	2,336	2,325	56	(11)
Repairs	1,000	950	973	1,050	23	77
Heat, power, and						
light	<u>300</u>	<u>285</u>	<u>292</u>	<u>325</u>	7	33
Total variable						
cost	<u>\$ 5,700</u>	<u>\$ 5,415</u>	<u>\$ 5,548</u>	<u>\$ 5,620</u>		
Fixed factory overhead:						
Supervision	\$ 4,000	\$ 4,000	\$ 4,000	\$ 4,000	0	0
Indirect labor...	6,200	6,200	6,200	6,200	0	0
Manufacturing						
supplies	2,000	2,000	2,000	2,000	0	0
Maintenance...	1,100	1,100	1,100	1,080	0	(20)
Heat, power,						
and light	<u>1,400</u>	<u>1,400</u>	<u>1,400</u>	<u>1,400</u>	0	0
Machinery						
depreciation ..	4,500	4,500	4,500	4,500	0	0
Insurance and						
taxes	<u>900</u>	<u>900</u>	<u>900</u>	<u>970</u>	0	70
Total fixed						
cost	<u>\$20,100</u>	<u>\$20,100</u>	<u>\$20,100</u>	<u>\$20,150</u>		
Total factory						
overhead	<u>\$25,800</u>	<u>\$25,515</u>	<u>\$25,648</u>	<u>\$25,770</u>	<u>\$133</u>	<u>\$122</u>
Standard factory overhead					unfav.	unfav.
chargeable to work in						
process (5,700 standard						
hours x \$4.30 rate)		<u>24,510</u>				
Volume variance		<u>\$ 1,005</u>	unfav.			

COFFMAN MANUFACTURING COMPANY
Department X
Factory Overhead Variance Report
For Month Ending January 31

	(1) Budget Allowance Normal Capacity	(2) Budget Allowance Standard Hours	(3) Budget Allowance Actual Hours	(4) Actual Quantity of Input at Standard Unit Cost	(5) Actual Cost	(6) Variable Efficiency Variance (3) - (2)	(7) Spending Variance (5) - (3)	(8) Spending Quantity Variance (4) - (3)	(9) Spending Price Variance (5) - (4)
Machine hours.....	5,000	4,800	4,850						
Capacity utilized.....	100%	96%	93%						
Variable factory overhead:									
Indirect labor.....	\$ 3,500	\$ 3,360	\$ 3,255	\$ 3,300	\$ 3,400	\$(105)	\$145	\$ 45	\$100
Supplies.....	2,500	2,400	2,325	2,600	2,200	(75)	(125)	275	(400)
Machinery repairs.....	1,000	960	930	950	960	(30)	30	20	10
Electric power.....	5,000	4,800	4,650	4,700	4,740	(150)	90	50	40
Total variable overhead	\$12,000	\$11,520	\$11,160	\$11,550	\$11,300				
Fixed factory overhead:									
Supervision.....	\$ 3,000	\$ 3,000	\$ 3,000	\$ 3,000	\$ 3,100	0	100	0	100
Supplies.....	1,700	1,700	1,700	1,700	1,650	0	(50)	0	(50)
Machinery maintenance	3,000	3,000	3,000	3,200	3,200	0	200	200	0
Depreciation of machinery	6,500	6,500	6,500	6,500	6,500	0	0	0	0
Insurance.....	1,800	1,800	1,800	1,800	1,900	0	100	0	100
Property tax.....	1,000	1,000	1,000	1,000	1,100	0	100	0	100
Gas heating.....	600	600	600	700	845	0	245	100	145
Electricity (lighting).....	400	400	400	400	405	0	5	0	5
Total fixed overhead.....	\$18,000	\$18,000	\$18,000	\$18,300	\$18,700				
Total factory overhead....	\$30,000	\$29,520	\$29,160	\$29,850	\$30,000	\$(360)	\$840	\$690	\$150
Standard overhead chargeable to work in process (4,800 std. hrs. x \$6).....						Fav.	Unfav.	Unfav.	Unfav.
Volume variance.....		28,800							
		\$ 720 Unfav.							

P18-8 (Concluded)

Reconciliation of variances:

Actual factory overhead	\$30,000
Standard overhead chargeable to work in process	<u>28,800</u>
Overall factory overhead variance.....	<u>\$ 1,200 unfav.</u>

Spending variance:

Spending quantity variance	\$690 unfav.	
Spending price variance	<u>150 unfav.</u>	\$ 840 unfav.
Variable efficiency variance		(360) fav.
Volume variance		<u>720 unfav.</u>
Overall factory overhead variance.....		<u>\$ 1,200 unfav.</u>

P18-9 APPENDIX

Equivalent production for September:

	Materials	Conversion
Transferred out.....	42,000	42,000
Less beginning inventory.....	<u>10,000</u>	<u>10,000</u>
Started and finished this period.....	32,000	32,000
Add beginning inventory (work this period).....	0	5,000
Add ending inventory (work this period).....	<u>5,000</u>	<u>4,500</u>
Equivalent units of product	<u>37,000</u>	<u>41,500</u>

	Pieces	x	Unit Cost	=	Amount
Actual quantity used	76,000		\$.50 actual		\$38,000
Actual quantity used	76,000		<u>.48 standard</u>		<u>36,480</u>
Materials price usage variance	76,000		<u>\$.02</u>		<u>\$ 1,520 unfav.</u>

	Pieces	x	Unit Cost	=	Amount
Actual quantity used	76,000		.48 standard		\$36,480
Standard quantity allowed (37,000 x 2)	<u>74,000</u>		.48 standard		<u>35,520</u>
Materials quantity variance....	<u>2,000</u>		.48 standard		<u>\$ 960 unfav.</u>

	Hours	x	Rate	=	Amount
Actual hours worked	22,500		\$8.00 actual		\$180,000
Actual hours worked	22,500		<u>7.60 standard</u>		<u>171,000</u>
Labor rate variance	22,500		<u>\$.40</u>		<u>\$ 9,000 unfav.</u>

	Hours	x	Rate	=	Amount
Actual hours worked	22,500		\$7.60 standard		\$171,000
Standard hours allowed (41,500 x 1/2)	<u>20,750</u>		7.60 standard		<u>157,700</u>
Labor efficiency variance	<u>1,750</u>		7.60 standard		<u>\$ 13,300 unfav.</u>

P18-9 APPENDIX (Concluded)

Actual factory overhead.....		\$42,000
Budget allowance based on actual hours worked:		
Variable cost (22,500 actual hours x		
\$1.40 variable overhead rate)	\$31,500	
Fixed cost budgeted	8,000	39,500
Spending variance		<u>\$ 2,500*</u> unfav.

*The spending variance includes the difference between actual and budgeted fixed cost, \$200 (\$8,200 - \$8,000). This portion could be separately labeled as a fixed spending variance, leaving a balance of \$2,300 as the variable spending variance.

Budget allowance based on actual hours worked	\$39,500	
Actual hours (22,500) x standard overhead rate (\$1.80)	40,500	
Idle capacity variance	<u>\$ (1,000)</u>	fav.
Actual hours (22,500) x standard overhead rate (\$1.80)	\$40,500	
Standard hours (41,500 x 1/2) x standard overhead rate		
(\$1.80)	37,350	
Efficiency variance	<u>\$ 3,150</u>	unfav.

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P18-10 APPENDIX**Raw material:**

	<u>Gallons</u>	x	<u>Unit Cost</u>	=	<u>Amount</u>
Actual quantity purchased	600,000		\$1.917 actual		\$1,150,000
Actual quantity purchased	600,000		<u>2.000 standard</u>		<u>1,200,000</u>
Materials purchase price					
variance	600,000		<u>\$ (.083)</u>		<u>\$ (50,000)</u> fav.

Drums:

	<u>Drums</u>	x	<u>Unit Cost</u>	=	<u>Amount</u>
Actual quantity purchased	85,000		\$1 actual		\$ 85,000
Actual quantity purchased	85,000		<u>1 standard</u>		<u>85,000</u>
Materials purchase price					
variance	85,000		<u>0</u>		<u>0</u>

Raw material:

	<u>Gallons</u>	x	<u>Unit Cost</u>	=	<u>Amount</u>
Actual quantity used	700,000		\$2 standard		\$1,400,000
Standard quantity allowed	<u>600,000</u>		<u>2 standard</u>		<u>1,200,000</u>
Materials quantity variance....	<u>100,000</u>		<u>2 standard</u>		<u>\$ 200,000</u> unfav.

P18-10 APPENDIX (Continued)

Drums:

	<u>Drums</u>	x	<u>Rate</u>	=	<u>Amount</u>
Actual quantity used	60,000		\$1 standard		\$60,000
Standard quantity allowed	60,000		1 standard		60,000
Materials quantity variance....	<u>0</u>		1 standard		<u>0</u>

Direct labor:

	<u>Hours</u>	x	<u>Rate</u>	=	<u>Amount</u>
Actual hours worked	65,000		\$7.231 actual		\$470,000
Actual hours worked	65,000		7.000 standard		455,000
Labor rate variance	65,000		<u>\$.231</u>		<u>\$ 15,000</u> unfav.

	<u>Hours</u>	x	<u>Rate</u>	=	<u>Amount</u>
Actual hours worked	65,000		\$7 standard		\$455,000
Standard hours allowed	60,000		7 standard		420,000
Labor efficiency variance	<u>5,000</u>		7 standard		<u>\$ 35,000</u> unfav.

Factory overhead:

Actual factory overhead.....					\$666,500
Budget allowance based on actual hours worked:					
Variable overhead (65,000 actual hours x					
\$8 variable overhead rate)			\$390,000		
Fixed overhead budget			<u>275,000</u>		<u>665,000</u>
Spending variance					<u>\$ 1,500</u> unfav.

Budget allowance based on actual hours worked (see above)					\$665,000
Actual hours (65,000) x standard overhead rate (\$10)					<u>650,000</u>
Idle capacity variance					<u>\$ 15,000</u> unfav.

P18-10 APPENDIX (Concluded)

(or)

68,750 normal capacity hours x \$4 fixed overhead rate.....	\$275,000	
65,000 actual hours worked x \$4 fixed overhead rate.....	<u>260,000</u>	
Idle capacity variance (3,750 hours x \$4)	<u>\$ 15,000</u>	unfav.

Budget allowance based on actual hours worked (see above)	\$665,000	
Budget allowance based on standard hours allowed:		
Variable overhead (60,000 standard hours		
allowed x 6 variable overhead rate)	\$360,000	
Fixed overhead budgeted	<u>275,000</u>	<u>635,000</u>
Variable efficiency variance		<u>\$ 30,000</u> unfav.

(or)

65,000 actual hours x \$6 variable overhead rate	\$390,000	
60,000 standard hours allowed x \$6 variable overhead rate	<u>360,000</u>	
Variable efficiency variance (5,000 hours x \$6)	<u>\$ 30,000</u>	unfav.
65,000 actual hours x \$4 fixed overhead rate	\$260,000	
60,000 standard hours allowed x \$4 fixed overhead rate	<u>240,000</u>	
Fixed efficiency variance (5,000 hours x \$4).....	<u>\$ 20,000</u>	unfav.

CASES**C18-1**

- (1) (a) **The use of participative cost standards to motivate plant managers and department heads has several benefits. These benefits result from contact with executive management through the interchange of ideas, negotiation between the parties, and a final compromise in establishing the standard. This allows the plant managers and department heads to personally identify with these standards, which will increase their desire to achieve a goal they have accepted.**

In this case, however, the standard-setting process does not appear to be participative. Executive management appears to follow through with the interchange of ideas, but the negotiation and final compromise are missing. Executive management merely reviews recommendations before setting the standards, without discussing the standards further with plant management. As a consequence, plant managers may become frustrated with the standard-setting system and a negative impact upon motivation could result.

- (b) **The use of tight, but attainable, standards can have a positive motivation effect on department heads and plant managers. This is particularly true if they participated in setting the standards and are confident that good performance will be recognized and rewarded. However, if the standards are perceived as being unattainable, then the motivation will probably be negative because they feel there is no use in trying for an unreachable goal. The unfavorable variances being the norm seems to imply that the standards are too tight, and this could be part of the cause for the low motivation among first-line supervisors.**
- (2) **Under the present system, there is no motivation for department heads to control overhead costs because all overhead costs are allocated on the basis of actual units produced, and the actual production output in other departments can have a significant impact on the overhead cost charged to each department.**
- The use of standard, predetermined department factory overhead rates, applied on the basis of standard activity allowed for actual production, should provide useful cost control information and enhance cost control on the part of department heads.**

C18-2

- (1) (a) The characteristics that should be present in a standard cost system to encourage positive employee motivation include:

 - (1) participation in setting standards from all levels of the organization including purchasing, engineering, manufacturing, and accounting;
 - (2) the integration of organizational communication by translating the organizational goals and objectives into monetary terms for the employees;
 - (3) support of the standard cost system by executive management;
 - (4) standards that are perceived as achievable and accurate and apply to controllable costs.

(b) A standard cost system should be implemented to motivate employees positively by:

 - (1) communicating the corporate objectives of a standard cost system;
 - (2) soliciting improvement in standards from employees;
 - (3) using a standard cost system to provide a guide to action, not a straight jacket. (Although significant variances should be explained, employees should not feel that the standard is a mandate. Continuous improvement should be the goal.);
 - (4) not overemphasizing variances, although standard cost variances often are used for individual performance review and reward. (Employees should be encouraged to take actions that will benefit the company as a whole rather than simply to meet standard.)
- (2) (a) Management by exception focuses management's attention only on those items that deviate significantly from the standard. The assumption is that by foregoing a thorough, detailed analysis of all items, the manager has more time to concentrate on other managerial activities.

(b) The behavioral implications of management by exception include both positive and negative implications. On the positive side, this technique increases management efficiency by concentrating only on significant variances, allowing time for the manager to concentrate on other activities. On the negative side, managers tend only to focus on the negative variances rather than the positive ones, limiting their employee interactions to negative reinforcement or punishment. This technique may not indicate detrimental trends at an early stage, and fragmentation of efforts can occur from dealing only with the specific problems rather than global issues.

C18-2 (Concluded)

- (3) **Employee behavior could be affected adversely when standard cost variances are the sole basis for performance evaluation. Employees may subvert the system and attempt to build slack into the standard so that they can meet or exceed the standard. There can be a minimal level of motivation since exceptional performance is not rewarded. Employees may tend to engage in activities that are not in the best overall interest of the company just to meet standard. Overemphasis on price variances can result in a large number of low cost vendors, high levels of inventory, and poor quality materials and parts. Overemphasis on efficiency variances can result in long production runs, large work in process inventories, and attempts to control quality through inspection alone.**

C18-3

- (1) **Had Stevens not confined his initial remarks to telling the employees that production standards were too low, but rather explained why, the results of the conference would certainly have been more effective. Furthermore, he should have remained with the group and joined the discussion. He failed to establish two-way communication, to exchange ideas, to air differences of opinion, and to provide reasons why certain practices could or could not be followed. Had he remained with the group, Stevens could have stated that he had been thinking about the problem of production standards and, in his opinion, such and such should be done. Then he could have asked the group what it thought about following the outlined approach. The ensuing discussion should shape a suggested course of action representing the group's opinions as well as those of Stevens.**

It is poor practice for a manager to abdicate, as Stevens did in this incident. An important part of a manager's job is to provide effective leadership, to show the way by offering a plan, by giving reasons, and by taking into account suggestions offered by the members affected by the plan. Using this approach, the manager's ideas, the group's wishes, and the needs of the enterprise can be blended into an effective program.

It might be that the employees were correct, that standards should be reduced. For example, errors in calculating the standards are possible. The employees must be given the opportunity to present reasons for their recommendations.

Both facts and experience are important in determining the level of production standards adopted. Stevens should abstain from forcing any decision. It may take several weeks or months for events to demonstrate what standards should be established, for they will be influenced, among other things, by the verification of the employees' major beliefs, the correctness of Stevens' statements, the extent of modifications required, and the full comprehension of the situation by the employees.

C18-3 (Concluded)

The subject of raising production standards, in itself, is not a popular one among employees. One must be quite naive to believe that an employee will accept an increase in production standards without some explanation of the reason it is requested or required. The issue in this incident could be better identified as "How can the enterprise survive?" or "How to increase our production output" or "How to regain a strong competitive position for our company."

One might also raise the question of whether Stevens was adequately in touch with the attitudes and beliefs of the Department B employees toward their work, especially production standards. He does not appear to be. Better communication, improved supervision, and effective leadership apparently are in order.

- (2) Stevens should call another meeting with the production employees of Department B, indicating that he wishes to offer to the group additional pertinent information on production standards. Next, he should get together all data dealing with the company's production standards and fair profits on the owner's investment, the continuity of the enterprise, and other significant and applicable data. Preferably, the additional data should be in a visual form to increase their effectiveness. Also, it is advisable for Stevens to talk informally with leaders of Department B employees to discover why the group recommended lower production standards. He can use this information to shape his presentation at the forthcoming meeting.

The best approach for Stevens to follow at the meeting is to:

- (a) thank each member for his or her interest and past participation,
- (b) advise that additional information, vital to the modification of present production standards, will be presented, followed by a group discussion,
- (c) present the additional information in a forthright manner,
- (d) remain with the group and join in the discussion from which the decision on production standards will evolve.

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C18-4

- 1) **Standard direct cost of a ten-gallon batch of raspberry sherbert follows:**

Direct material:

Raspberries (7.5 qts* x \$.80 per qt.)	\$8.00	
Other ingredients (10 gal. x \$.45 per gal.)	<u>4.50</u>	\$10.50

Direct labor:

Sorting (((3 min. x 6 qts. raspberries) + 60 min.) x \$9 per hr.)	\$2.70	
Blending ((12 min. + 60 min.) x \$9 per hr.)	<u>1.80</u>	4.50
Packaging (40 qts.** x \$.38 per qt.)		<u>15.20</u>
Total direct standard cost per ten-gallon batch of sherbert ...		<u>\$30.20</u>

*6 qts x (5 qts. + 4 qts.) = 7.5 qts. required to obtain 6 acceptable qts.

**4 qts. per gal. x 10 gal. = 40 qts.

- (2) (a) For the most part, the purchasing manager is responsible for unfavorable materials price variances. Causes of unfavorable materials price variances at ColdKing are likely to include one or more of the following:
- (1) failure to correctly forecast price increases
 - (2) purchasing nonstandard or uneconomical lot sizes
 - (3) purchasing from suppliers other than those offering the most favorable prices
- (b) The production manager or foreman is usually held responsible for unfavorable labor efficiency variances. Causes of unfavorable labor efficiency variances could include one or more of the following:
- (1) poorly trained employees
 - (2) substandard or inefficient equipment or machinery
 - (3) inadequate supervision
 - (4) poor quality of materials (in particular, the raspberries that must be sorted by hand)

C18-5.**(1) Standard unit cost per cutting board****Direct material:**

Lumber (1.25 board feet x ((5 + 1) + 5) x \$3 per board foot) ..	\$4.50
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Footpads (4 pads x \$.05 per pad)20
---	------------

Total direct materials	<u>\$4.70</u>
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Direct labor:

Prepare and cut (12 + 60 hour per board x ((5 + 1) + 5 x \$8))	\$1.92
--	---------------

Assemble/finish (15 + 60 hour x \$8)	2.00
--	-------------

Total direct labor	<u>\$3.92</u>
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Total standard unit cost	<u><u>\$8.62</u></u>
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(2) The advantages of implementing a standard cost system include the following:

- (a) Standard costs are incorporated into the accounting system, making record keeping easier and facilitating cost analysis.
- (b) Standard costs provide the basis for building a company budget.
- (c) Standard costs serve as goals; they encourage cooperation and coordination among all elements of the corporation. The variance analysis associated with standard costs provides a feedback system to those responsible for controlling costs.

- (3)
 - (a) The role of purchasing manager in the development of standards includes establishing the standard cost for material required by the bill of materials, determining if the company should take advantage of price reductions available through economic order quantity, and obtaining data regarding the availability of materials.
 - (b) The role of industrial engineer in the development of standards includes preparing the bill of materials that specifies the types and quantities of material required; establishing, in conjunction with the manufacturing supervisor, any allowances for scrap, shrinkage, and waste; and participating in time studies and test runs to facilitate the establishment of time standards.
 - (c) The role of cost accountant in the development of standards includes reviewing all information regarding material and labor standards received from other departments, establishing the labor rate standards based on the type of labor required, determining application rates for indirect costs such as material handling and factory overhead, and converting physical standards such as hours and quantities to monetary equivalents.

C18-6

(1)

Actual quantities at individual standard materials costs:

Standard (expected) output from actual input (52,220 x .80 = 41,776) multiplied by \$1.30 weighted average of standard materials cost output

Standard (expected) output from actual input at weighted average of standard materials cost output.....	\$54,308.80
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Actual output quantity at weighted average of standard materials cost (40,000 x \$1.30)	<u>52,000.00</u>	
Materials yield variance.....	<u>\$ 2,308.80</u>	unfav.

<u>Material</u>	<u>Actual Quantity</u>	<u>Standard Formula</u> x	<u>Total Actual Quantity</u> =	<u>Actual Quantity Using Standard Formula</u>	<u>Quantity Variation</u>	<u>Standard Unit Cost</u> x	= <u>Materiale Mix Variance</u>
Maxan....	8,480 gals.	$\frac{100}{625}$	52,220 gals	8,355 gals.	125 gals.	\$2.00	\$250.00 unfav.
Salex.....	25,200	$\frac{300}{625}$	52,220	25,066	134	.75	100.50 unfav.
Crayln...	18,540	$\frac{225}{625}$	52,220	18,799	(259)	1.00	(259.00) fav.
	<u>52,220 gals.</u>			<u>52,220 gals.</u>	<u>0</u>		
Rounding difference							(.30) \$ 91.20 unfav.

C18-6 (Concluded)

- (2) Before LAR Chemical Company management can control costs, they need to know which costs are out of line, within whose area of responsibility has the cost variance appeared, what is the cause of the cost variance, and who has the responsibility to correct the cause of the variance.

Standard costs and the variances from them help management to begin to answer these issues. Specifically, the variances indicate where management should begin its investigation:

- (a) Price variations—the information to identify the causes of the price variances usually can be obtained in the Purchasing Department. A review of purchasing procedures and records would disclose whether the variances were caused by permanent changes in prices, poor purchasing practices, or poor production scheduling requiring incurrence of extra costs to expedite shipments. The information obtained will identify the department responsible for the extra cost and provide clues to improve the control.
- (b) Mix and yield variances—the information to identify the cause of these variances usually can be obtained in the production departments. A review of materials records and handling procedures would disclose whether the mix variance was caused by the use of wrong proportions, entering excess materials into the process because of carelessness, or adjustment of the mix to accommodate off-standard materials quality caused by the same factors. Thus, the yield variance would often be explained by the same information. Nonstandard proportions would often result in nonstandard yields and excess materials inputs. The information obtained would help identify the department responsible and provide clues to improve the control.

C18-7

(1)	(a)	Materials—quantity purchased	5,200 lbs.
		Unfavorable unit cost (\$2.10 - \$2)	x \$.10
		Materials purchase price variance.....	<u>\$ 520 unfav.</u>
(b)		Materials—quantity used	5,300 lbs.
		Materials—quantity required at standard (5,000	
		units produced x 1 lb. per unit).....	<u>5,000</u>
		Unfavorable quantity.....	300 lbs.
		Standard cost per lb.	x \$2
		Materials quantity variance	<u>\$ 600 unfav.</u>
(c)		Direct labor used	8,200 hrs.
		Unfavorable unit hourly rate (\$4.10 - \$4).....	x \$.10
		Direct labor rate variance	<u>\$ 820 unfav.</u>

C18-7 (Continued)

(d)	Direct labor used	8,200 hrs.
	Direct labor required at standard for 5,000 units produced.....	<u>8,000</u>
	Unfavorable direct labor use.....	200 hrs.
	Standard wage rate per direct labor hour.....	<u>x \$4</u>
	Direct labor efficiency variance	<u>\$800 unfav.</u>

- (e) Analysis by expenses of the factory overhead controllable variance for 5,000 units of production:

	Factory Overhead Charged	Factory Overhead Budgeted for One-Month Period and 5,000-Unit Output	Factory Overhead Controllable Variance Over (Under)
Variable factory overhead:			
Indirect labor	\$ 9,840	\$10,000	\$ (160)
Supplies—oil.....	3,300	2,500	800
Allocated variable service department cost.....	<u>3,200</u>	<u>2,500</u>	<u>700</u>
Total variable factory overhead	<u>\$16,340</u>	<u>\$15,000</u>	<u>\$1,340</u>
Fixed factory overhead:			
Supervision.....	\$ 2,475	\$ 2,250	\$ 225
Depreciation	3,750	3,750	0
Other fixed costs	<u>1,250</u>	<u>1,250</u>	<u>0</u>
Total fixed factory overhead	<u>\$ 7,475</u>	<u>\$ 7,250</u>	<u>\$ 225</u>
Total	<u>\$23,815</u>	<u>\$22,250</u>	<u>\$1,565</u>

- (2) Clearly indicating where the responsibilities for price and quantity variances lie and charging the variances to the departments with initial responsibility reduces the conflict but does not eliminate it.

The specific cause(s) of the variance needs to be determined before there can be certainty that the proper department is charged. For example, if materials were purchased at higher than standard prices because the Manufacturing Department required a rush order, then the price variance is the responsibility of the Manufacturing Department. If the materials provided by the Purchasing Department were of slightly lower quality than specifications required, due to careless purchasing, the excess quantity used by Manufacturing is the Purchasing Department's responsibility.

C18-7 (Continued)

Even if the variances are properly charged to the two departments, it can be argued that the Purchasing Department's variance is influenced by the excess quantity required by Manufacturing. In this case, the extra 300 pounds will increase the Purchasing Department's variance (accumulated over several periods) by \$30 (300 lbs. x \$.10). The \$30 is the joint responsibility of the two departments.

- (3) Generally, the Manufacturing Department manager cannot control the price of the overhead items. Therefore, the prices should not influence the data in the departmental report. Further, the allocation method for service department costs is not sufficiently explained to determine what part (if any) of this variation can be identified with the department. The fixed overhead items listed in this case normally are outside a department manager's control. Supplies and indirect labor remain.

Control can be exercised at the departmental level over the amount of items used. Therefore, emphasis should be placed on the quantities within the variances, with little or no emphasis on dollar values. The major use of the dollar values would be to establish the quantity level of each variance that would be economically worth management's attention.

C18-7 (Concluded)

TO: Department Manager—Manufacturing
FROM: Performance Analysis
RE: Controllable Factory Overhead Performance—November

	<u>Quantity</u>	<u>Percent Compared to Standard</u>
Indirect labor:		
Favorable indirect labor use (dollar value—\$400)	100 hrs.	4%
Supplies—oil:		
Unfavorable oil use (dollar value—\$500)	1,000 gals.	20%

Commentary:
The dollar value of the oil variation and its large percentage require identifying the cause and applying control procedures.

The indirect labor variation, although favorable, should be investigated to be sure that it does not represent unaccomplished activities affecting other aspects of the operations.

Computations:

Indirect labor:	
Hours used	2,400 hrs.
Standard hours for 5,000 units of output (5,000 x .5 hrs.)	<u>2,500</u>
Favorable indirect labor variation	<u>100 hrs.</u>
Dollar value at standard wage rates	<u>\$400</u>
Supplies—oil:	
Oil consumed	6,000 gals.
Standard quantity for 5,000 units of output	<u>5,000</u>
Unfavorable oil consumption	<u>1,000 gals.</u>
Dollar value at standard oil prices	<u>\$500</u>

- (4) The immediate reaction might be to dismiss the department manager. However, careful thought would require analysis of the situation to determine (a) if, on an overall basis, the department is being operated economically (if so, then dismissal may be undesirable); and (b) if the cause of such behavior is due to management reaction to unfavorable variances without regard to size, or to undue emphasis by management on individual variances to the exclusion of measurement of overall performance.
- If it is assumed that the manager is performing satisfactorily on an overall basis and should not be dismissed, then two possible solutions can be considered:
- (a) Revise reporting methods to emphasize overall performance.
 - (b) Revise reporting on labor to combine direct and indirect labor into one item for performance evaluation.

C18-8

- (1) (a) Revising the standards immediately would facilitate their use in a master budget. Use of revised standards would minimize production coordination problems and facilitate cash planning. Revised standards would facilitate more meaningful cost-volume-profit analysis and result in simpler, more meaningful variance analysis. Standards are often used in decision analysis such as make-or-buy, product pricing, or product discontinuance. The use of obsolete standards would impair the analysis.

- (b) Standard costs are carried through the accounting system in a standard cost system. Retaining the current standards and expanding the analysis of variances would eliminate the need to make changes in the accounting system.

Changing standards could have an adverse psychological impact on the persons using them. Retaining the current standards would preserve the well-known benchmarks and allow for consistency in reporting variances throughout the year.

Variances are often computed and ignored. Retaining the current standards and expanding the analysis of variances would force a diagnosis of the costs and would increase the likelihood that significant variances would be investigated.

- (2) (a) Changes in prime costs per unit due to the use of new direct material.

Changes due to direct material price:

$$((\text{new material price} - \text{old material price}) \times \text{new material quantity}) = (\$7.77 - \$7.00) \times 1 \text{ pound}).. \quad \$.77 \text{ unfav.}$$

Changes due to the effect of direct material quantity on direct material usage:

$$((\text{old material quantity} - \text{new material quantity}) \times \text{old material price}) = (1.25 - 1.00) \times \$7.00)..... \quad (1.75) \text{ fav.}$$

Changes due to the effect of direct material quantity on direct labor usage:

$$((\text{old labor time} - \text{new labor time}) \times \text{old labor rate}) = ((24 + 60) - (22 + 60)) \times \$12.60)..... \quad (.42) \text{ fav.}$$

Total changes in prime costs per unit due to the use of new direct material..... \$ (1.40) fav.

- (b) Changes in prime costs per unit due to the new labor contract:

$$((\text{new labor rate} - \text{old labor rate}) \times \text{new labor time}) = (\$14.40 - \$12.60) \times (22 + 60))..... \quad .66 \text{ unfav.}$$

Reduction of prime costs per unit (\$13.05 - \$13.79) \$ (.74) fav.

CHAPTER 19

DISCUSSION QUESTIONS

- Q19-1. When standard costs are not incorporated, they may be used for the purposes of pricing, budgeting, and controlling cost; but if they are not used for inventory costing, the advantages from the saving of clerical effort in accounting cannot be obtained.
- Q19-2. With actual cost methods, it is first necessary to select a cost flow method—lifo, fifo, average, etc. It is then necessary to keep detailed records of quantities and prices and to make fairly complex calculations of inventory costs. With a standard costing system, only quantities, not prices, must be taken into account, facilitating both record keeping and calculations. Standard costs also provide cost control.
- Q19-3. The number of variance accounts is determined by (a) the number and type of variances that are to appear in statements for management use, and (b) the need for easy disposal of variances at the end of the fiscal period, particularly when the variances are not treated uniformly in financial statements and for analyses.
- Q19-4. (a) The standard cost of products completed and products sold can be determined immediately without waiting for the actual cost to be calculated. With standard costs, monthly statements can be prepared more quickly.
- (b) A firm producing a great many different products finds it practically impossible to determine the actual cost of each product. The use of standard costs will facilitate the preparation of income statements by product lines.
- (c) Keeping finished goods stock records in quantities only will result in clerical saving, since this eliminates the necessity for recording the actual unit cost of each receipt and issue or shipment.
- Q19-5. The standard costing of inventories depends on (a) the types of standards employed, (b) the degree of success that the company has in keeping overall actual costs in line with standard costs, and (c) the concept held with regard to the most suitable kind of cost.
- Q19-6. (a) Deferral of variances is supported on the grounds that, if the standards in use are based on normal price, efficiency, and output levels, positive and negative variances can be expected to offset one another in the long run. Because variance account balances at any given point in time are due to recurring seasonal and business cycle fluctuations, and because periodic reporting requirements result in arbitrary cutoff dates, variance account balances at a particular cutoff date are not assignable to operating results of the period then ended. They will cancel out over time and therefore should be carried to the balance sheet.
- (b) Variances appearing as charges or credits on the income statement are regarded as appropriate charges or credits in the period in which they arise. They are considered the result of favorable or unfavorable departures from normal (standard) conditions and are disclosed separately from cost of goods sold at standard. This provides management with unobscured information for immediate corrective action.
- Inventory costs and cost of goods sold should not be distorted by variances that represent abnormal efficiencies or inefficiencies. The standard cost represents that amount which is reasonably necessary to produce finished products and should therefore be considered the best measure of the cost of goods manufactured and inventory cost, as long as the underlying operating conditions remain unchanged.
- (c) The argument for allocating variances between inventories and cost of goods sold is that standard costs are a useful tool for purposes of managerial control, but should not be substitutes for actual historical costs in the financial statements. Only actual historical costs should be used for financial reporting, even though they are greater or less than standard costs, and without regard to the reasons for their differences from standard costs. Standard cost variances are not gains or losses but costs (or reductions therein) of goods manufactured and should be allocated between inventories and cost of goods sold. To treat them as gains or losses in the period in which they arise distorts both the inventory and gross profit figures. This distortion will be even greater if the standards are lacking in accuracy or reliability. Further, to substitute standard costs for actual historical costs in the financial statements represents an unwarranted sacrifice of objectivity.

EXERCISES

E19-1

Price variance recorded at the time materials are received and placed in the storeroom:

Materials (20,000 x \$.42)	8,400	
Materials Purchase Price Variance (20,000 x \$.03)....	600	
Accounts Payable (20,000 x \$.45).....		9,000
Work in Process (8,200 x 2 x \$.42)	6,888	
Materials Quantity Variance (100 x \$.42)	42	
Materials (16,500 x \$.42)		6,930

Materials recorded at actual cost when received, and price variance determined at the time materials are issued to production:

Materials (20,000 x \$.45).....	9,000	
Accounts Payable		9,000
Work in Process (8,200 x 2 x \$.42)	6,888	
Materials Price Usage Variance (16,500 x \$.03).....	495	
Materials Quantity Variance (100 x \$.42).....	42	
Materials (16,500 x \$.45).....		7,425

Price variance determined when the materials are received, but not charged to production until the materials are actually placed in process:

Materials (20,000 x \$.42)	8,400	
Materials Purchase Price Variance (20,000 x \$.03)...	600	
Accounts Payable (20,000 x \$.45).....		9,000
Work in Process (8,200 x 2 x \$.42)	6,888	
Materials Quantity Variance (100 x \$.42).....	42	
Materials (16,500 x \$.42)		6,930
Materials Price Usage Variance (16,500 x \$.03)	495	
Materials Purchase Price Variance		495

E19-2

(1) Materials (12,000 AQ purchased x \$8 SP)	96,000	
Materials Purchase Price Variance.....	960	
Accounts Payable		96,960
Work in Process (12,800 SQ x \$8 SP)	102,400	
Materials Quantity Variance	1,600	
Materials (13,000 AQ issued x \$8 SP).....		104,000

E19-2 (Concluded)

(2)	<u>Average costing</u>	<u>Total Cost</u>	<u>Quantity</u>	<u>Unit Cost</u>
	Beginning inventory.....	\$ 15,880	2,000	\$7.94
	Purchases.....	96,960	12,000	8.08
	Available for use	<u>\$112,840</u>	<u>14,000</u>	8.06 average
	Materials.....		96,960	
	Accounts Payable			96,960
	Work in Process (12,800 SQ x \$8 SP)		102,400	
	Materials Quantity Variance ((13,000 - 12,800) x \$8 SP)		1,600	
	Materials Price Usage Variance (13,000 AQ x (\$8.06 AP - \$8 SP))		780	
	Materials (13,000 AQ x \$8.06 AP)			104,780
(3)	<u>Fifo inventory</u>			
	Work in Process (same as above)		102,400	
	Materials Quantity Variance (same as above)		1,600	
	Materials Price Usage Variance.....		760	
	Materials ((\$7.94 x 2,000 units) + (\$8.08 x 11,000 units))			104,760
(4)	<u>Lifo inventory</u>			
	Work in Process (same as above)		102,400	
	Materials Quantity Variance (same as above)		1,600	
	Materials Price Usage Variance.....		900	
	Materials ((\$8.08 x 12,000 units) + (\$7.94 x 1,000 units))			104,900

E19-3

Payroll.....	18,048	
Accrued Payroll.....		18,048
Work in Process (2,400 x 3/4 x \$9.50)	17,100	
Labor Efficiency Variance (120 x \$9.50)	1,140	
Labor Rate Variance (1,920 x \$.10).....		192
Payroll (1,920 x \$9.40)		18,048

E19-4

Work in Process		
(10,000 units x 2 SQ per unit x \$2 SP)	40,000	
Materials Price Variance		
(((\$2.10 AP - \$2 SP) x 21,000 AQ)	2,100	
Materials Quantity Variance		
(\$2 SP x (20,000 SQ - 21,000 AQ))	2,000	
Materials (21,000 AQ x \$2.10 AP)		44,100
Work in Process		
(10,000 units x 1/4 SH per unit x \$12 SR)	30,000	
Labor Rate Variance		
(((\$12.20 AR - \$12 SR) x 2,400 AH)	480	
Labor Efficiency Variance		
(\$12 SR x (2,400 AH - 2,500 SH))		1,200
Payroll (2,400 AH x \$12.20 AR)		29,280

E19-5

(1)	Work in Process (\$7 FO rate x 12,000 SH)	84,000	
	Applied Factory Overhead		84,000
(2)	Applied Factory Overhead	84,000	
	Factory Overhead Control		84,000
(3)	Volume Variance		
	(\$4.50 fix. rate x (15,000 BH - 12,000 SH))	13,500	
	Controllable Variance		6,500
	Factory Overhead Control		
	(\$91,000 actual - \$84,000 applied)		7,000

E19-6

(1)	Factory Overhead Control	56,000	
	Various Credits		56,000
(2)	Work in Process (11,000 SH x \$5 FO rate)	55,000	
	Applied Factory Overhead		55,000
(3)	Applied Factory Overhead	55,000	
	Factory Overhead Control		55,000
(4)	Controllable Variance	4,000	
	Volume Variance		
	(\$2 fix. rate x (10,000 BH - 11,000 SH))		2,000
	Factory Overhead Control		
	(\$57,000 actual - \$55,000 applied)		2,000

E19-7

(1)	Work in Process (4,800 SH x \$16 FO rate)..... Applied Factory Overhead	76,800	
(2)	Applied Factory Overhead	76,800	76,800
(3)	Variable Efficiency Variance (\$4 var. rate x (5,200 AH - 4,800 SH)) Volume Variance (\$12 fix. rate x (5,000 BH - 4800 SH)) Spending Variance Factory Overhead Control (\$78,200 actual - \$76,800 applied).....	1,600 2,400 1,400	2,600 1,400

E19-8

1)	Work in Process (7,000 SH x \$11 FO rate)..... Applied Factory Overhead	77,000	77,000
2)	Applied Factory Overhead	77,000	77,000
3)	Variable Efficiency Variance (\$8 var. rate x (7,600 AH - 7,000 SH)) Volume Variance (\$3 fix. rate x (8,000 BH - 7,000 SH)) Spending Variance Factory Overhead Control (\$86,500 actual - \$77,000 applied).....	4,800 3,000 1,700 9,500	

E19-9

Percentage of current-year labor cost element in finished goods and cost of goods sold:

	<u>Amount</u>	<u>%</u>
Finished goods, 19,000 units x \$4 labor.....	\$ 76,000	20
Cost of goods sold (from current production), (91,000 units - 15,000 units) x \$4 labor	304,000	80
	<u>\$380,000</u>	<u>100</u>

Allocation of current-year labor variances:

Finished goods (\$52,000 x 20%).....	\$10,400
Cost of goods sold (\$52,000 x 80%)	41,600
	<u>\$52,000</u>

End-of-year balances:

	<u>Finished Goods</u>	<u>Cost of Goods Sold</u>
Balance at standard	\$171,000	\$819,000
Current year's labor variances allocation.....	10,400	41,600
Last year's variances, all applicable to cost of goods sold on a fifo flow assumption		5,800
	<u>\$181,400</u>	<u>\$866,400</u>

E19-10

Percentage of units in inventories and cost of goods sold:

<u>Account</u>	<u>Materials</u>		<u>Direct Labor and Factory Overhead</u>	
	<u>Units</u>	<u>%</u>	<u>Units</u>	<u>%</u>
Work in Process	1,500	25%	500	10%
Finished Goods	1,200	20%	1,200	24%
Cost of Goods Sold	3,300	55%	3,300	66%
Total	<u>6,000</u>	<u>100%</u>	<u>5,000</u>	<u>100%</u>

Allocation of variances:

<u>Variance</u>	<u>Total Amount</u>	<u>Work in Process</u>	<u>Finished Goods</u>	<u>Cost of Goods Sold</u>
Materials purchase price.....	\$ (150.00)	\$ (37.50)	\$ (30.00)	\$ (82.50)
Materials quantity.....	500.00	125.00	100.00	275.00
Labor rate	600.00	60.00	144.00	396.00
Labor efficiency.....	1,200.00	120.00	288.00	792.00
Controllable	1,500.00	150.00	360.00	990.00
Volume.....	(1,800.00)	(180.00)	(432.00)	(1,188.00)
Total.....	<u>\$1,850.00</u>	<u>\$ 237.50</u>	<u>\$430.00</u>	<u>\$1,182.50</u>

E19-11 APPENDIX

Work in Process (\$4 FO rate x 3,450 units x 1.5 SH per unit)	20,700	
Applied Factory Overhead.....		20,700
Applied Factory Overhead	20,700	
Efficiency Variance (\$4 FO rate x (5,320 AH - 5,175 SH))	580	
Idle Capacity Variance (\$3 fix. rate x (6,000 BH - 5,320 AH))	2,040	
Spending Variance		1,970
Factory Overhead control		21,350

E19-12 APPENDIX

Work in Process (\$20 FO rate x 9,400 SH)	188,000	
Applied Factory Overhead.....		188,000
Applied Factory Overhead.....	188,000	
Variable Efficiency Variance		
(\$4.50 var. x (10,600 AH - 9,400 SH)).....	5,400	
Fixed Efficiency Variance		
(\$15.50 fix. x (10,600 AH - 9,400 SH))	18,600	
Spending Variance		7,200
Idle Capacity Variance		
(\$15.50 fix. x (10,000 BH - 10,600 AH))		9,300
Factory Overhead Control		195,500

PROBLEMS

P19-1

Materials (33,000 AQ purchased x \$2 SP)	66,000	
Materials Purchase Price Variance		1,320
Accounts Payable (33,000 AQ purchased x \$1.96 AP)		64,680
Work in Process (6,000 equivalent units x 6 SQ x \$2 SP)	72,000	
Materials Quantity Variance	8,000	
Materials (40,000 AQ issued x \$2 SP)		80,000
Work in Process (5,800 equivalent units x 1/4 SH x \$8 SR)...	11,600	
Labor Rate Variance (((\$8.20 AR - \$8 SR) x 1,500 AH).....	300	
Labor Efficiency Variance (\$8 SR x (1,500 AH - 1,450 SR))....	400	
Payroll (\$8.20 AR x 1,500 AH).....		12,300
Factory Overhead Control.....	65,000	
Various Credits.....		65,000
Work in Process		
(5,500 equivalent units x 3/4 SH x \$16 FO rate).....	66,000	
Applied Factory Overhead		66,000
Applied Factory Overhead	66,000	
Controllable Variance	500	
Volume Variance (\$12 fixed rate x (4,000 BH - 4,125 SH))		1,500
Factory Overhead Control		65,000
Finished Goods (5,200 units x \$26 standard cost).....	135,200	
Work in Process		135,200
Accounts Receivable (5,500 units x \$40 sales price)	220,000	
Sales.....		220,000
Cost of Goods Sold (5,500 units x \$26 standard cost).....	143,000	
Finished Goods.....		143,000

P19-2

	<u>Materials</u>	<u>Labor</u>	<u>Overhead</u>
Units completed and transferred out this period	2,400	2,400	2,400
Less all units in beginning inventory	<u>300</u>	<u>300</u>	<u>300</u>
Equivalent units started and completed this period	2,100	2,100	2,100
Add equivalent units required to complete beginning inventory	0	100	150
Add equivalent units in ending inventory	<u>200</u>	<u>100</u>	<u>50</u>
Equivalent units of production this period	2,300	2,300	2,300
Multiply by standard quantity of input per unit of product	<u>5 units</u>	<u>3/4 DLH</u>	<u>2 MH</u>
Standard quantity of input allowed for work produced during the period	<u>11,500</u>	<u>1,725</u>	<u>4,600</u>
Materials (11,000 AQ purchased x \$6 SP)		66,000	
Materials Purchase Price Variance		1,000	
Accounts Payable			67,000
Work in Process (\$6 SP x 11,500 SQ allowed)		69,000	
Materials Quantity Variance		3,000	
Materials (\$6 SP x 12,000 AQ issued)			72,000
Work in Process (\$12 SR x 1,725 SH allowed)		20,700	
Labor Rate Variance ((\$12.10 AR - \$12 SR) x 1,700 AH)		170	
Labor Efficiency Variance (\$12 SR x (1,700 AH - 1,725 SH))			300
Payroll			20,570
Factory Overhead Control		69,000	
Various Credits			69,000
Work in Process (\$14 FO rate x 4,600 SH allowed)		64,400	
Applied Factory Overhead			64,400
Applied Factory Overhead		64,400	
Variable Efficiency Variance (\$2.80 var. rate* x (4,900 AH - 4,600 SH))		840	
Volume Variance (\$11.20 fix rate** x (5,000 BH - 4,600 SH))		4,480	
Spending Variance			720
Factory Overhead Control			69,000

* \$14 FO rate x 20% variable = \$2.80 variable rate

** \$14 FO rate - \$2.80 variable rate = \$11.20 fixed rate

P19-3

	<u>Materials</u>	<u>Conversion Cost</u>
Units completed and transferred out this period	5,000	5,000
Less all units in beginning inventory	3,000	3,000
Equivalent units started and completed this period...	2,000	2,000
Add equivalent units required to complete beginning inventory	0	2,000
Add equivalent units in ending inventory	2,000	1,500
Equivalent units of production this period	4,000	5,500
Multiply by standard quantity of input per unit of product	6 units	1/2 hour
Standard quantity of input allowed for work produced during the period	<u>24,000</u>	<u>2,750</u>
Materials (\$.50 SP x 30,000 AQ purchased)	15,000	
Materials Purchase Price Variance	1,000	
Accounts Payable		16,000
Work in Process (\$.50 SP x 24,000 SQ allowed)	12,000	
Materials Quantity Variance	250	
Materials (\$.50 SP x 24,500 AQ issued)		12,250
Work in Process (\$10 SR x 2,750 SH allowed)	27,500	
Labor Rate Variance ((\$10.75 AR - \$10 SR) x 2,600 AH used)	1,950	
Labor Efficiency Variance (\$10 SR x (2,600 AH - 2,750 SH))		1,500
Payroll (\$10.75 AR x 2,600 AH used)		27,950
Work in Process (\$12 FO rate x 2,750 SH allowed)	33,000	
Applied Factory Overhead		33,000
Factory Overhead Control	31,000	
Various Credits		31,000
Applied Factory Overhead	33,000	
Controllable Variance	250	
Volume Variance (\$9 fixed rate x (2,500 BH - 2,750 SH))		2,250
Factory Overhead Control		31,000

P19-3 (Concluded)

Finished Goods Inventory (5,000 units x \$14 standard cost*)	70,000	
Work in Process		70,000
* Materials (6 units @ \$.50 each).....	\$ 3.00	
Labor (1/2 hour @ \$10 per hour).....	5.00	
Overhead: Variable (1/2 hour @ \$3 per hour).....	1.50	
Fixed (1/2 hour @ \$9 per hour)	4.50	
Total standard cost per unit of product	<u>\$14.00</u>	
Cost of Goods Sold (5,100 units x \$14 standard cost).....	71,400	
Finished Goods Inventory.....		71,400
Accounts Receivable (5,100 units x \$22 sales price)	112,200	
Sales.....		112,200

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P19-4

ENSLEY CORPORATION
Income Statement

For Year Ended December 31, 20A

Sales ((20,000 units + 110,000 units - 12,000 units) x \$25).....	\$2,950,000
Cost of goods sold at standard (118,000 units x \$17.60).....	<u>2,076,800</u>
Gross profit at standard	\$ 873,200
Add net manufacturing variance	90 ¹
Gross profit, adjusted to actual.....	\$ 873,290
Less marketing and administrative expenses	<u>680,500</u>
Operating income.....	<u>\$ 192,790</u>

¹Manufacturing variances:

	<u>Unfavorable</u>	<u>Favorable</u>
Materials:		
Purchase price		\$ 3,750
Quantity	\$15,000	
Labor:		
Rate	25,760	
Efficiency		44,000
Factory overhead:		
Controllable	8,000	
Volume		1,100
	<u>\$48,760</u>	<u>\$48,850</u>
		48,760
Net favorable variance		<u>\$ 90 fav.</u>

P19-4 (Continued)

Computation of manufacturing variances:Materials:

Actual quantity x average cost (250,000 lbs. x 1.485 per lb.)	\$371,250
Actual quantity x standard cost (250,000 lbs. x \$1.50 per lb.)	375,000
Materials purchase price variance	<u>\$ (3,750) fav.</u>
Transferred into production (240,000 lbs. x \$1.50)	\$360,000
Standard quantity for 115,000* equivalent production units (230,000 lbs. x \$1.50 per lb., or 115,000 units x \$3 per unit)	345,000
Materials quantity variance	<u>\$ 15,000 unfav.</u>

*Computation of equivalent production for materials:

	Pound Basis	Unit Basis
Transferred out of work in process	220,000	110,000
Beginning inventory (all completed)	20,000	10,000
Started and completed this period	200,000	100,000
Add ending inventory	30,000	15,000
Total	<u>230,000</u>	<u>115,000</u>

Labor:

Actual labor cost	\$1,313,760
Actual hours x standard labor rate (161,000 hours x \$8)	1,288,000
Labor rate variance	<u>\$ 25,760 unfav.</u>
Actual hours x standard labor rate	\$1,288,000
Standard hours x standard labor rate (166,500 hrs.** x \$8 per hour, or 111,000 units ** x \$12 per unit)	1,332,000
Labor efficiency variance	<u>\$ (44,000) fav.</u>

P19-4 (Concluded)

**** Computation of equivalent production for labor and factory overhead:**

	<u>Hour Basis</u>	<u>Unit Basis</u>
Transferred out of work in process	165,000	110,000
Beginning inventory—work in process	15,000	10,000
Started and completed this period	150,000	100,000
Add 3/5 to complete beginning inventory	9,000	6,000
Add 1/3 of ending inventory	7,500	5,000
Total	<u>166,500</u>	<u>111,000</u>

Factory overhead (two-variance method):

Actual factory overhead	\$295,500	
Budget allowance:		
Variable overhead (111,000 units x \$1.50) ...	\$166,500	
Fixed overhead	<u>121,000</u>	<u>287,500</u>
Controllable variance		<u>\$ 8,000</u> unfav.
Budget allowance	\$287,500	
Applied factory overhead (111,000 units x \$2.60)	<u>288,600</u>	
Volume variance		<u>\$ (1,100)</u> fav.

P19-5

KALMAN COMPANY
Interim Income Statement
For the Second Quarter, 20-

Sales (600,000 x \$30)	\$18,000,000
Cost of goods sold at standard (600,000 x \$18)	<u>10,800,000</u>
Gross profit at standard	\$ 7,200,000
Adjustments for standard cost variances:	
Materials price variance ¹	\$ 237,600
Labor efficiency variance ²	36,000
Overhead spending variance ³	135,000
Variable overhead efficiency variance ⁴	8,000
Overhead volume variance ⁵	<u>0</u>
Adjusted gross profit	<u>\$ 6,783,400</u>
Less commercial expenses:	
Marketing expenses (\$18,000,000 x 10%)	\$1,800,000
Administrative expenses (\$6,000,000 x 25%)	<u>1,500,000</u>
Income before income tax	\$ 3,483,400
Less income tax expense (\$3,483,400 x (\$3,750,000 / \$7,500,000))	<u>1,741,700</u>
Net income	<u>\$ 1,741,700</u>

P19-5, (Continued)

¹The materials price variance should be prorated between work in process, finished goods, and cost of goods sold as follows:

Ending balance of work in process	-	$\frac{\$72,000}{\$18 \text{ per unit}}$	-	4,000 units
Ending balance of finished goods	-	$\frac{\$900,000}{\$18 \text{ per unit}}$	-	<u>50,000 units</u>
Total units in ending inventories.....				<u>54,000 units</u>
Total units produced during second quarter.....				450,000
Total units in ending inventories.....				<u>54,000</u>
Units produced and sold during second quarter ...				<u>396,000</u>
Materials price variance charged to cost of goods sold	-	$\frac{396,000}{450,000}$	x 270,000 =	\$237,600

²Since the labor efficiency variance is not regarded as significant, all of it is charged against second quarter income.

³A portion of the overhead spending variance is attributable to the overtime premium paid. Since the overtime premium was incurred in order to meet sales forecasts for the entire year, the portion of the spending variance resulting from the overtime premium (\$9.00 labor per unit at regular rate x 50% = \$4.50/unit) should be prorated over the entire year in proportion to the sales of each quarter as follows:

Production in excess of capacity (Quarters 1 and 2 only):

Quarter 1 = 465,000 - 430,000 = 35,000 units

Quarter 2 = 450,000 - 430,000 = 20,000 units

Overtime premium resulting from excess production:

Quarter 1 = 35,000 units x \$4.50/unit = \$157,500

Quarter 2 = 20,000 units x \$4.50/unit = 90,000

Total overtime premium for first six months \$247,500

Proration of overtime premium portion of spending variance based on sales:

Quarter 2 = $\frac{\$600,000}{\$1,500,000}$ x \$247,500 total overtime premium = \$99,000

P19-5 (Concluded)

The overhead spending variance charged against second quarter income is calculated as follows:

Total overhead spending variance for second quarter.....	\$126,000
Amount resulting from second quarter overtime premium	<u>90,000</u>
Amount related to unexpected inefficiencies	\$ 36,000
Amount of overtime premium chargeable to second quarter on the basis of sales allocation determined above	<u>99,000</u>
Total spending variance charged against second quarter income	<u>\$135,000</u>

⁴Since factory overhead is charged to production on the basis of direct labor hours, an unfavorable variable overhead efficiency variance occurs because of the inefficient use of direct labor. The amount of the unfavorable overhead variable efficiency variance is determined as follows:

$$\frac{\text{Labor efficiency variance}}{\text{Labor cost per unit}} \times \text{Variable overhead per unit} = \frac{\$36,000}{\$9} \times \$2 = \$8,000$$

⁵The company policy is to report a volume variance on interim statements only if actual production differs from the planned production schedule. Since actual production is equal to budgeted production through the end of the second quarter, there is no volume variance to be charged against second quarter income.

P19-6

(1)	Material A	Material B	Labor	Factory Overhead
Units completed and transferred out	15,000	15,000	15,000	15,000
Less beginning inventory (all units)	<u>6,000</u>	<u>6,000</u>	<u>6,000</u>	<u>6,000</u>
Started and completed this period	9,000	9,000	9,000	9,000
Add work this period in inventories:				
Beginning inventory	0	2,000	3,000	2,000
Ending inventory	<u>5,000</u>	<u>2,500</u>	<u>1,250</u>	<u>2,500</u>
Equivalent units of Westco	14,000	13,500	13,250	13,500
Standard quantity per unit of Westco	x 1	x 6	x 1/2	x 1/3
Standard quantity allowed	<u>14,000</u>	<u>81,000</u>	<u>6,625</u>	<u>4,500</u>

Materials ((15,000 x \$14) + (80,000 x \$2))	370,000	
Materials Purchase Price Variance	65,000	
Accounts Payable ((15,000 x \$13) + (80,000 x \$3))....		435,000
Work in Process ((14,000 x \$14) + (81,000 x \$2)).....	358,000	
Materials Quantity Variance	5,400	
Materials ((14,200 x \$14) + (82,300 x \$2))		363,400

P19-6 (Concluded)

Work in Process (6,625 x \$10).....	66,250	
Labor Rate Variance (6,500 x (\$10 - \$11)).....	6,500	
Labor Efficiency Variance ((6,625 - 6,500) x \$10)		1,250
Payroll (6,500 x \$11)		71,500
Work in Process (4,500 x \$27).....	121,500	
Applied Factory Overhead.....		121,500
Applied Factory Overhead	121,500	
Volume Variance ((5,000 - 4,500) x \$24).....	12,000	
Spending Variance		11,200
Variable Efficiency Variance ((4,500 - 4,400) x \$3)....		300
Factory Overhead Control.....		122,000

(2)

Labor Efficiency Variance.....	1,250	
Spending Variance.....	11,200	
Variable Efficiency Variance	300	
Income Summary.....	76,150	
Materials Purchase Price Variance		65,000
Materials Quantity Variance.....		5,400
Labor Rate Variance.....		6,500
Volume Variance		12,000

(3)

PACIFIC MANUFACTURING COMPANY
Income Statement
For Year Ended December 31, 20A

Sales ((4,000 + 15,000 - 3,600) x \$60).....		\$924,000
Cost of goods sold (15,400 x \$40)		616,000
Gross profit at standard		<u>\$308,000</u>
Adjustments for standard cost variances:		
Materials purchase price variance.....	\$65,000	
Materials quantity variance	5,400	
Labor rate variance.....	6,500	
Labor efficiency variance.....	(1,250)	
Spending variance	(11,200)	
Variable efficiency variance	(300)	
Volume variance.....	<u>12,000</u>	<u>76,150</u>
Adjusted gross profit.....		\$231,850
Less commercial expenses		<u>120,000</u>
Income before income tax.....		\$111,850
Income tax expense (30% x \$111,850).....		<u>33,555</u>
Net income		<u><u>\$ 78,295</u></u>

P19-7

(1) Materials (40 000 liters AQ purchased x \$4 SP)	160,000	
Materials Purchase Price Variance		800
Accounts Payable		159,200
Work in Process (10,000 units x 3 liters SQ per unit x \$4 SP)	120,000	
Materials Quantity Variance	4,000	
Materials (31 000 liters AQ issued x \$4 SP)		124,000
Work in Process (10,000 units x 1/2 SH x \$7 SR)	35,000	
Labor Rate Variance ((\$7.42 AR - \$7 SR) x 4,800 AH)	2,016	
Labor Efficiency Variance (\$7 SR x (4,800 AH - 5,000 SH))		1,400
Payroll (\$7.42 AR x 4,800 AH)		35,616
Work in Process (10,000 units x 1/2 SH x \$15 FO rate) ...	75,000	
Applied Factory Overhead		75,000
Factory Overhead Control	81,500	
Various Credits	-	81,500
Finished Goods (10,000 units x \$23 standard cost)	230,000	
Work in Process		230,000
Cost of Goods Sold (8,000 units x \$23 standard cost)	184,000	
Finished Goods		184,000
Accounts Receivable (8,000 units x \$40 sales price)	320,000	
Sales		320,000
Marketing and Administrative Expenses	50,000	
Various Credits		50,000

P19-7 (Continued)

(2) Actual factory overhead		\$81,500
Budget allowance based on 4,800 actual hours:		
Variable overhead (\$6 variable rate x 4,800 AH)	\$28,800	
Fixed overhead	49,500	78,300
Spending variance		<u>\$ 3,200</u> unfav.
Budget allowance based on 4,800 actual hours (from above)		\$78,300
Budget allowance based on 5,000 standard hours:		
Variable overhead (\$6 variable rate x 5,000 SH)	\$30,000	
Fixed overhead	49,500	79,500
Variable efficiency variance		<u>\$ (1,200)</u> fav.
Budget allowance based on 5,000 standard hours (from above)		\$79,500
Applied factory overhead (\$15 FO rate x 5,000 SH)		75,000
Volume variance		<u>\$ 4,500</u> unfav.

(3)

GRINDLE CORPORATION
Income Statement
For November

Sales		\$320,000
Less cost of goods sold:		
Standard cost	\$184,000	
Net unfavorable variances (Schedule 1)	10,316	194,316
Gross profit		\$125,684
Marketing and administrative expenses		50,000
Income before taxes		<u>\$ 75,684</u>

P19-7 (Concluded)

Schedule 1
GRINDLE CORPORATION
Schedule of Variances
For November

Materials purchase price variance		\$ 800
Materials quantity variance	\$ 4,000	
Labor rate variance	2,016	
Labor efficiency variance		1,400
Factory overhead spending variance.....	3,200	
Factory overhead variable efficiency variance		1,200
Factory overhead volume variance	4,500	
	<u>\$13,716</u>	<u>\$3,400</u>
	(3,400)	
Net unfavorable variance.....	<u>\$10,316</u>	

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P19-8

(1)

	<u>Total</u>	<u>Allocated to Work in Process</u>	<u>Allocated to Cost of Goods Manufactured</u>		
			<u>Total</u>	<u>Finished Goods</u>	<u>Cost of Goods Sold</u>
Materials price usage variance	\$1,500	\$500	\$1,000	\$375	\$625
Materials quantity variance.....	660	220	440	165	275
Direct labor rate variance	250	50	200	75	125
Factory overhead spending variance	(300)	(60)	(240)	(90)	(150)
Total variances	\$2,110	\$710	\$1,400	\$525	\$875
Discounts lost on purchases.....	120	40	80	30	50
Total	<u>\$2,230</u>	<u>\$750</u>	<u>\$1,480</u>	<u>\$555</u>	<u>\$925</u>

	<u>Materials</u>		<u>Direct Labor</u>		<u>Factory Overhead</u>	
	<u>Pro- duction Units</u>	<u>%</u>	<u>Pro- duction Units</u>	<u>%</u>	<u>Pro- duction Units</u>	<u>%</u>
Work in Process:						
Materials (1,200 units x 100%).....	1,200	33 1/3				
Direct labor (1,200 units x 50%).....			600	20		
Factory overhead (1,200 units x 50%)					600	20
Finished goods (900 units x 100%)	900	25	900	30	900	30
Cost of goods sold (1,500 units x 100%)	1,500	41 2/3	1,500	50	1,500	50
Total	<u>3,600</u>	<u>100</u>	<u>3,000</u>	<u>100</u>	<u>3,000</u>	<u>100</u>

P19-8 (Concluded)

(2)

	<u>Materials</u>	<u>Direct Labor</u>	<u>Factory Overhead</u>	<u>Total</u>
Work in process at standard cost:				
Materials (1,200 units x \$7 x 100%) ...	\$ 8,400			
Direct labor (1,200 units x \$8 x 50%)..		\$ 4,800		
Factory overhead (1,200 units x \$2 x 50%)			\$1,200	\$14,400
Finished goods at standard cost:				
Materials (900 units x \$7)	6,300			
Direct labor (900 units x \$8)		7,200		
Factory overhead (900 units x \$2).....			1,800	15,300
Cost of goods sold at standard cost:				
Materials (1,500 units x \$7)	10,500			
Direct labor (1,500 units x \$8)		12,000		
Factory overhead (1,500 units x \$2)....			3,000	25,500
Total mfg. cost at standard cost...	\$25,200	\$24,000	\$6,000	\$55,200
Less work in process, Dec. 31, 19—...	<u>8,400</u>	<u>4,800</u>	<u>1,200</u>	<u>14,400</u>
Cost of goods manufactured at standard cost	\$16,800	\$19,200	\$4,800	\$40,800
Add: Variance allocation	1,440	200	(240)	1,400
Allocation of discounts lost on purchases.....	<u>80</u>			<u>80</u>
Cost of goods manufactured at actual cost.....	<u>\$18,320</u>	<u>\$19,400</u>	<u>\$4,560</u>	<u>\$42,280</u>
(3)				
	<u>Work in Process</u>	<u>Finished Goods</u>	<u>Total</u>	
Materials at standard cost	\$ 8,400	\$ 6,300	\$14,700	
Materials—price variance allocation.....	500	375	875	
—quantity variance allocation.....	220	165	385	
—allocation of discounts lost on purchases.....	<u>40</u>	<u>30</u>	<u>70</u>	
Total materials	\$ 9,160	\$ 6,870	\$16,030	
Direct labor at standard cost	\$ 4,800	\$ 7,200	\$12,000	
Direct labor—rate variance allocation.....	50	75	125	
Total direct labor.....	\$ 4,850	\$ 7,275	\$12,125	
Factory overhead at standard cost.....	\$ 1,200	\$ 1,800	\$ 3,000	
Factory overhead—spending variance allocation	<u>(60)</u>	<u>(90)</u>	<u>(150)</u>	
Total factory overhead	\$ 1,140	\$ 1,710	\$ 2,850	
Total inventories at actual cost	<u>\$15,150</u>	<u>\$15,855</u>	<u>\$31,005</u>	

P19-9 APPENDIX

	Cotton Cloth	Dyes	Conver- sion Cost
Units completed and transferred out this period.....	3,000	3,000	3,000
Less all units in beginning inventory	<u>1,000</u>	<u>1,000</u>	<u>1,000</u>
Equivalent units started and completed this period	2,000	2,000	2,000
Add equivalent units required to complete beginning inventory	0	0	750
Add equivalent units in ending inventory.....	<u>750</u>	<u>750</u>	<u>250</u>
Equivalent units of production this period.....	2,750	2,750	3,000
Multiply by standard quantity of input per unit of product	<u>2 yards</u>	<u>1 pint</u>	<u>1/2 hour</u>
Standard quantity of input allowed for work produced during the period.....	<u>5,500</u>	<u>2,750</u>	<u>1,500</u>
Materials—Cotton Cloth (5,000 yards AQ purchased x \$1 SP)	5,000		
Materials Purchase Price Variance—Cotton Cloth	500		
Accounts Payable (5,000 yards AQ purchased x \$1.10 AP)			5,500
Materials—Dyes (2,500 pints AQ purchased x \$.50 SP).....	1,250		
Materials Purchase Price Variance—Dyes			25
Accounts Payable (2,500 pints AQ purchased x \$.49 AP)			1,225
Work in Process (5,500 yards SQ allowed x \$1 SP)	5,500		
Materials Quantity Variance—Cotton Cloth	100		
Materials—Cotton Cloth (5,600 yards AQ issued x \$1 SP)			5,600
Work in Process (2,750 pints SQ allowed x \$.50 SP)	1,375		
Materials Quantity Variance—Dyes			25
Material—Dyes (2,700 pints AQ issued x \$.50 SP)			1,350
Payroll (1,550 AH x \$5.90 AR)	9,145		
Accrued Payroll (and employee withholding accounts)...			9,145
Work in Process (1,500 SH allowed x \$6 SR)	9,000		
Labor Efficiency Variance (\$6 SR x (1,550 AH - 1,500 SR))....	300		
Labor Rate Variance ((\$5.90 AR - \$6 SR) x 1,550 AH)			155
Payroll			9,145
Factory Overhead Control.....	16,100		
Various Credits.....			16,100
Work in Process (1,500 SH allowed x \$10 FO rate).....	15,000		
Applied Factory Overhead.....			15,000

P19-9 APPENDIX (Concluded)

Applied Factory Overhead	15,000	
Overhead Spending Variance	650	
Overhead Efficiency Variance (\$10 rate x (1,550 AH - 1,500 SH))	500	
Overhead Idle Capacity Variance (\$7 fixed rate x (1,600 BH - 1,550 AH))	350	
Factory Overhead Control		16,500
Finished Goods (3,000 units x \$10.50 standard cost)	31,500	
Work in Process		31,500
Accounts Receivable (3,100 units sold x \$14 sales price)	43,400	
Sales		43,400
Cost of Goods Sold (3,100 units x \$10.50 standard cost)	32,550	
Finished Goods		32,550
Cost of Goods Sold	2,195	
Materials Purchase Price Variance—Dyes	25	
Materials Quantity Variance—Dyes	25	
Labor Rate Variance	155	
Materials Purchase Price Variance—Cotton Cloth		500
Materials Quantity Variance—Cotton Cloth		100
Labor Efficiency Variance		300
Overhead Spending Variance		650
Overhead Efficiency Variance		500
Overhead Idle Capacity Variance		350

P19-10 APPENDIX

Materials (10 000 kg AQ purchased x \$2 SP)	20,000	
Materials Purchase Price Variance		500
Accounts Payable (10 000 kg AQ purchased x \$1.95 AP)		19,500
Work in Process (900 units x 9 kg SQ per unit x \$2 SP)	16,200	
Materials Quantity Variance	1,000	
Materials (8 600 kg AQ issued x \$2 SP)		17,200
Work in Process (900 units x 2 SH per unit x \$10.50 SR)	18,900	
Labor Rate Variance ((\$11.55 AR - \$10.50 SR) x 1,740 AH) ...	1,827	
Labor Efficiency Variance (\$10.50 SR x (1,740 AH - 1,800 SH))		630
Payroll (\$11.55 AR x 1,740 AH)		20,097

P19-10 APPENDIX (Concluded)

Factory Overhead Control.....	24,000	
 Various Credits.....		24,000
Work in Process (900 units x 2 SH x \$13 FO rate)	23,400	
 Applied Factory Overhead.....		23,400
Applied Factory Overhead	23,400	
Idle Capacity Variance (\$10 fixed rate x (2,000 BH - 1,740 AH))	2,600	
 Spending Variance		520
 Variable Efficiency Variance (\$3 var. rate x (1,740 AH - 1,800 SH))		180
 Fixed Efficiency Variance (\$10 fix. rate x (1,740 AH - 1,800 SH))		600
 Factory Overhead Control		24,700
Finished Goods (900 units x \$65 standard cost).....	58,500	
 Work in Process		58,500

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CASES

C19-1

- (1) The quotation implies that "actual" manufacturing costs form the preferable basis for inventory costing because they were incurred in producing the inventory.

The notion that actual costs are the only acceptable costs for inventory purposes has been challenged by advocates of standard costs. Accountants who advocate using standard costs for reporting purposes believe that standard costs are more representative of the true cost of the product than actual costs. They maintain that variances are measures of abnormal inefficiencies or abnormal efficiencies; therefore, variances cannot be inventoried and should be immediately recognized in determining net income of the period rather than prorated to inventories and cost of goods sold. Thus, the costs attached to the product are the costs that should have been incurred, not the costs that were incurred.

Many accountants believe that variances do not have to be inventoried as long as standards are currently attainable. But if standards are not up to date, or if they reflect theoretical performance rather than performance under reasonably efficient conditions, then, conceptually, the variances should be split between the portion that reflects departures from attainable standards and the portion that does not.

Most accountants agree that unfavorable variances resulting from the difference between standards based on theoretical performance and those based on normal performance should be treated as product costs and prorated to inventories and cost of goods sold. There is less agreement relating to variances resulting from the difference between actual performance and standards based on normal (attainable) performance. Standard cost advocates believe that these variances should be expensed because they represent abnormal conditions. Many other accountants believe that these variances represent part of the actual cost of producing the goods and, therefore, should be treated as product costs and prorated to inventories and cost of goods sold.

- (2) The three most appropriate alternative methods of variance disposition would require the following entries:

(a)	Cost of Goods Sold	500	
	Finished Goods Inventory	1,000	
	Variance		1,500
(b)	Cost of Goods Sold	1,500	
	Variance		1,500
(c)	Finished Goods Inventory	1,500	
	Variance		1,500

C19-1 (Concluded)

- (3) The first journal entry is in accordance with the discussion in part (1) as the most appropriate method of handling variances. Cost of Goods Sold is charged with the excess cost above what it should have taken to complete the project, based on a normal (attainable) standard. The costs (variances) resulting from the difference between the theoretical standard the normal standard should be prorated to cost of goods sold and inventories, based on the relative proportion of the associated cost contained in each. In the situation presented, the entire \$1,000 is charged to Finished Goods Inventory instead of being prorated to inventories and cost and goods sold because the production is included solely in finished goods inventory.

The second journal entry can be justified as an appropriate method for disposition of the variance primarily on practical considerations but has little theoretical justification. The practice of charging all variances to Cost of Goods Sold (or against current revenue) often has been justified on the grounds of simplicity, convenience, and immateriality.

The last entry would be appropriate where it is desired to adjust the standard cost inventory to actual costs. Many accountants would advocate this entry in the circumstances presented because the inventory would then be stated at actual costs of production. However, when this method of variance disposition is followed, the asset inventory will be carried on the financial statements at an amount that exceeds the cost that should have been incurred. Thus, inefficiencies in operations are being capitalized as assets in the financial statements when this method is applied.

CHAPTER 20

DISCUSSION QUESTIONS

- Q20-1. Direct costs are direct materials, direct labor, and other costs directly assignable to a product. Direct costing is a procedure by which only prime costs plus variable factory overhead are assigned to a product or inventory; all fixed costs are considered period costs.
- Q20-2. Product costs are associated with the manufacture of a product and include direct materials, direct labor, and factory overhead. These costs are charged against revenue as cost of goods sold, or shown on the balance sheet as inventories of work in process and finished goods. Period costs are associated with the passage of time and are included as expenses in the income statement. Under direct costing, fixed factory overhead is treated as a period cost rather than as a product cost.
- Q20-3. Under direct costing, only variable manufacturing costs are included in inventory. Under absorption costing (the current, generally accepted method of costing inventory for external reporting), all manufacturing costs, both variable and fixed, are included in inventory.
- Q20-4. It is argued that fixed manufacturing costs are the expenses of maintaining productive capacity. Such expenses are more closely associated with the passage of time than with production activity and should, therefore, be charged to period expense rather than to the product.
- Q20-5. The direct costing method is useful for internal reporting because it focuses attention on the fixed-variable cost relationship and the contribution margin concept. It facilitates managerial decision making, product pricing, and cost control. It allows certain calculations to be readily made, such as break-even points and contribution margins of products, sales territories, operating divisions, etc. The focus on the contribution margin (sales revenue less variable costs) enables management to emphasize profitability in making short-run business decisions. Fixed costs are not easily controllable in the short run and hence may not be particularly relevant for short-run business decisions.
- Q20-6. Arguments for the use of direct costing include the following:
- (a) For profit-planning and decision-making purposes, management requires cost-volume-profit relationship data that are more readily available from direct cost statements than from absorption cost statements.
 - (b) Since fixed factory overhead is absorbed as a period cost, fluctuations in production and differences between the number of units produced and the number sold do not affect the per unit product cost.
 - (c) Direct costing reports are more easily understood by management because the statements follow management's decision-making processes more closely than do absorption cost statements.
 - (d) Reporting the total fixed cost for the period in the income statement directs management's attention to the relationship of such cost to profits.
 - (e) The elimination of allocated joint fixed cost permits a more objective appraisal of income contributions according to products, sales areas, kinds of customers, etc. Cost-volume relationships are highlighted.
 - (f) The similarity of the underlying concepts of direct costing and flexible budgets facilitates the adoption and use of these methods for reporting and cost control.
 - (g) Direct costing provides a means of costing inventory that is similar to management's concept of inventory cost as the current out-of-pocket expenditures necessary to produce or replace the inventory.
 - (h) Clerical costs are lower under direct costing because the method is simpler and does not require involved allocations of fixed costs or special analyses of absorption data.
 - (i) The computation of product costs is simpler and more reliable under direct costing because a basis for allocating the fixed costs, which involves estimates and personal judgment, is eliminated.
- Q20-7. Arguments against the use of direct costing include the following:
- (a) Separation of costs into fixed and variable might be difficult, especially when such costs are semivariable in nature. Moreover, all costs—including fixed costs—are variable at some level of production and in the long run.
 - (b) Long-range pricing of products and other long-range policy decisions require a knowledge of complete manufacturing cost, which would require additional separate computations to allocate fixed overhead.
 - (c) The pricing of inventories by the direct costing method is not acceptable for income tax computation purposes.
 - (d) Direct costing has not been recognized as conforming with generally accepted accounting principles applied in the preparation of financial statements for stockholders and the general public.

- (e) Profits determined by direct costing are not "true and proper" because of the exclusion of fixed production costs that are part of total production costs and inventory. Production would not be possible without plant facilities, equipment, etc. To disregard these fixed costs violates the general principle of matching costs with revenue.
- (f) The elimination of fixed costs from inventory results in a lower figure and consequent reduction of reported working capital for financial analysis purposes.

Q20-8. Assuming that the quantity of ending inventory is larger than the quantity of beginning inventory and the LIFO method is used, operating income using direct costing would be smaller than operating income using absorption costing. Direct costing excludes fixed factory overhead from inventories because such costs are considered to be period costs which are expensed when incurred. In contrast, absorption costing includes fixed factory overhead in inventories because such costs are considered to be product costs, which are expensed only when the products are sold. When the quantity of inventory increases during a period, direct costing produces a lower dollar increase in inventory than absorption costing, because fixed costs are expensed rather than charged to inventory. Since a smaller amount of current period cost is charged against income under the absorption costing method when inventories increase, absorption costing income would be larger than direct costing income.

Q20-9. The break-even point is the point at which costs and revenue are in equilibrium, showing neither profit nor loss for the business.

Q20-10. The contribution margin is the result of subtracting variable cost from the sales figure. The contribution margin indicates the amount available for the recovery of fixed cost and for profit.

Q20-11. (a) $R(BE) = \frac{F}{1 - V}$

or (in words):

$$\text{Revenue at the break-even point} = \frac{\text{Total fixed cost}}{\text{Contribution margin per dollar of sales}}$$

(b) $Q(BE) = \frac{F}{P - C}$

or (in words):

$$\text{Units of sales at break-even point} = \frac{\text{Total fixed cost}}{\text{Contribution margin per unit of product}}$$

- Q20-12. (1) Dollars of revenue and costs.
 (2) Volume of output, expressed in units, percent of capacity, sales, or some other measure.

- (3) Total cost line.
- (4) Variable cost area.
- (5) Fixed cost area.
- (6) Break-even point.
- (7) Loss area.
- (8) Profit area.
- (9) Sales line.

Q20-13. An analysis of the expected behavior of a firm's expenses and revenue for the purpose of constructing a break-even chart is usually restricted to the output levels at which the firm is likely to operate. Assumptions about the level of fixed cost, the rate of variable cost, and sales prices are based on the operating conditions and managerial policies that will be in effect over the expected output levels. These expected output levels represent the firm's relevant range, and the cost-volume-profit relationships shown in a break-even chart are applicable only to output levels within this range. The behavior of fixed cost, variable cost, and sales prices at levels of output below or above the relevant range are likely to result in an entirely different set of cost-volume-profit relationships because of changed operating conditions or managerial policies. The fact that the cost and revenue lines on a break-even chart are typically extended past the upper and lower limits of the relevant range should not, therefore, be interpreted to mean that they are valid for these levels of output.

A break-even chart showing cost-volume-profit relationships for all levels of output could be developed. The shapes of the cost and revenue lines in such a chart could not, however, be expected to approximate straight-line (linear) patterns. By restricting the underlying cost and revenue behavior assumptions in break-even analyses to a relatively narrow output range (the range over which the firm is likely to operate), it is usually possible to assume linear behavior patterns without any significant distortions in cost-volume-profit relationships, thereby simplifying the analysis.

If the range over which a firm is likely to operate is quite wide, curvilinear functions may be employed; or it may be desirable to develop a number of break-even charts, each having its own relevant range, for which the underlying cost and revenue behavior assumptions are valid.

Q20-14. Weaknesses inherent in the preparation and use of break-even analysis are:

- (a) When more than one product is produced, the contribution margin of each product will probably differ. Accordingly, a break-even analysis for the whole operation will not indicate the contribution of each product to fixed cost and the volume required for each product.

- (b) Some costs are almost impossible to classify conclusively as being either fixed or variable.
- (c) General economic conditions and other external factors may affect the data used in the analysis.
- (d) In the final analysis, fixed cost is related to production and sales and, therefore, may decrease somewhat due to decreased production and sales—and vice versa.
- (e) Quite often costs increase sharply at certain points in production and sales levels and then level out until a certain greater stage of production and/or sales is reached, at which time the phenomenon is repeated as production and/or sales are again increased.
- (f) Performance must be constantly compared to the break-even analysis in order to determine whether the conditions that existed at the time of the calculations have held true, and whether any changes have been considered.

Q20-15. (a) With sales price per unit and total fixed cost remaining constant, the break-even point moves up rapidly as unit variable cost is increased; at the same time, the break-even point moves down as unit variable cost is decreased.

- (b) A decrease in fixed cost lowers the break-even point. An increase in fixed cost moves the break-even point higher.

Q20-16. The margin of safety is a selected sales figure less break-even sales. The margin of safety is a cushion against sales decreases. The greater the margin, the greater the cushion against suffering a loss.

Q20-17. Cost-volume-profit relationship is the relationship of profit to sales volume. This relationship is important to management because management tries at all times to keep volume, cost, price, and product mix in a ratio that will achieve a desired level of profit.

Q20-18. The Theory of Constraints is a specialized version of direct costing for use in short-run optimization decisions. A distinction between TOC and direct costing is that TOC focuses on only the purely variable costs and does not consider direct labor to be purely variable.

Q20-19. Most companies that classify costs into fixed and variable categories treat direct labor as variable, so in direct costing, direct labor is assigned to products as a variable or incremental cost of production. In the Theory of Constraints, direct labor is stipulated to be not purely variable and therefore is not treated as an incremental cost of output.

The difference between the contribution margin measure in direct costing and the throughput measure in TOC is that direct labor is one of the costs deducted from sales to calculate contribution margin, but direct labor is not a cost to be deducted from sales in calculating throughput.

There are many differences in emphasis between direct costing and the theory of constraints. For example, while direct costing is widely used as an accounting approach for internal reporting of income and product cost, TOC deals heavily with the improvement of constraints or bottlenecks in a production system.

Q20-20. Throughput is the rate at which a system generates money through sales. It is calculated as sales minus the purely variable costs, and often the only purely variable cost is the cost of materials.

Q20-21. Elevating a constraint means improving the constraint—improving the conditions at a bottleneck in the system. Its significance is greatest if the constraint is the tightest one in the system; there, any improvement will increase the total throughput of the entire system.

An improvement in product quality can help elevate a constraint because it can reduce the workload on a bottleneck resource. For example, removing defective units before rather than after they reach the bottleneck means there will be fewer units passing through the bottleneck. This has approximately the same effect on the bottleneck as increasing its capacity.

EXERCISES

E20-1

Operating income for 20A using direct costing:

Sales (90,000 x \$12).....		\$1,080,000
Variable cost of goods sold (90,000 x \$4)		<u>360,000</u>
Gross contribution margin		\$ 720,000
Variable marketing and administrative expenses (90,000 x \$20)		<u>18,000</u>
Contribution margin.....		\$ 702,000
Less fixed expenses:		
Factory overhead	\$200,000	
Marketing and administrative expenses	<u>140,000</u>	<u>340,000</u>
Operating income		<u>\$ 362,000</u>

E20-2

(1) Variable cost per unit:

\$7,000,000 total variable cost	
<u>60% manufacturing cost portion</u>	
<u>\$4,200,000 total variable manufacturing cost</u>	
<u>\$4,200,000 total variable manufacturing cost</u>	=
140,000 units actually produced	\$30 per unit

Fixed cost per unit:

\$11,200,000 total fixed cost	
<u>50% manufacturing cost portion</u>	
<u>\$ 5,600,000 total fixed factory overhead</u>	
<u>\$5,600,000 total fixed factory overhead</u>	=
160,000 units normal production volume	<u>35 per unit</u>

Full cost per unit at standard	\$65
Number of units sold during the year	x 100,000
Cost of goods sold at standard under absorption costing	<u>\$6,500,000</u>

(2)

Units actually produced during the year	140,000
Units sold during the year	<u>100,000</u>
Unit increase in inventory	40,000
Standard variable manufacturing cost per unit.....	x \$30
Ending inventory at standard direct cost	<u>\$1,200,000</u>

E20-2 (Concluded)

(3)	Normal production volume	160,000
	Units actually produced during the year	140,000
	Excess of budget over actual production	20,000
	Fixed factory overhead per unit.....	x \$35
	Factory overhead volume variance.....	<u>\$ 700,000</u>
(4)	Sales (100,000 units x \$180)	\$ 18,000,000
	Standard variable cost of goods sold (100,000 units x \$30 unit variable cost).....	3,000,000
	Gross contribution margin.....	\$ 15,000,000
	Variable selling expense (\$7,000,000 variable cost x 40%)	2,800,000
	Contribution margin	\$ 12,200,000
	Less fixed costs.....	11,200,000
	Operating income under direct costing.....	<u>\$ 1,000,000</u>

E20-3

(1)	Income statement using absorption costing:	
	Sales (9,000 x \$30)	\$ 270,000
	Cost of goods sold (9,000 x (\$10 + \$5))	135,000
	Gross profit.....	\$ 135,000
	Less commercial expenses	50,000
	Operating income	<u>\$ 85,000</u>
(2)	Income statement using direct costing:	
	Sales (9,000 x \$30)	\$ 270,000
	Variable cost of goods sold (9,000 x \$10)	90,000
	Contribution margin	\$ 180,000
	Less fixed expenses:	
	Factory overhead.....	\$40,000
	Commercial expenses.....	50,000
	Operating income	<u>\$ 90,000</u>
(3)	Computations explaining the difference in operating income:	
	Absorption costing operating income.....	\$ 85,000
	Direct costing operating income	90,000
	Difference.....	<u>\$ (5,000)</u>
	Units produced during the period.....	8,000
	Units sold during the period.....	9,000
	Unit decrease in finished goods inventory	(1,000)
	Fixed factory overhead charged to each unit of product under absorption costing	x \$5
	Difference.....	<u>\$ (5,000)</u>

E20-4

$$\frac{\$6,000}{1 - \$\frac{.80}{\$2.00}} = \frac{\$6,000}{1 - .40} = \frac{\$6,000}{.60} = \$10,000 \text{ break-even point in dollars}$$

$$\$10,000 \div \$2 = 5,000 \text{ break-even point in units}$$

(or)

$$\frac{\$6,000}{\$2.00 - \$\frac{.80}{\$2.00}} = \frac{\$6,000}{\$1.20} = 5,000 \text{ break-even point in units}$$

$$5,000 \text{ units} \times \$2 = \$10,000 \text{ break-even point in dollars}$$

E20-5

Materials	\$ 1.00
Direct labor	1.20
Variable factory overhead .....	.50
Variable marketing expense .....	.30
Total variable cost per unit	<u>\$ 3.00</u>
Sales price per unit	\$ 5.00
Variable cost per unit	<u>3.00</u>
Contribution margin per unit	<u>\$ 2.00</u>
Fixed factory overhead	\$15,000
Fixed marketing expense	5,000
Fixed administrative expense	<u>6,000</u>
Total fixed expense	<u>\$26,000</u>

(1) $\frac{\$26,000 \text{ total fixed cost}}{\$2 \text{ contribution margin}} = 13,000 \text{ units of sales to break even}$

(2) $13,000 \text{ units} \times \$5 \text{ per unit} = \$65,000 \text{ sales to break even}$

(3) $\frac{\$26,000 \text{ fixed cost} + \$10,000 \text{ profit}}{\$2 \text{ contribution margin}} = 18,000 \text{ units}$

(4) $18,000 \text{ units} \times \$5 \text{ per unit} = \$90,000 \text{ sales}$

E20-6

Planned sales	\$2,000,000
Break-even sales	<u>1,500,000</u>
Margin of safety	<u>\$ 500,000</u>

$$\frac{\$500,000 \text{ Margin of safety}}{\$2,000,000 \text{ Planned sales}} = 25\% \text{ Margin of safety ratio}$$

E20-7

- (1) $\frac{\$9,300}{.62} = \$15,000$ break-even sales
- (2) $\frac{\$15,000}{1 - .25} = \frac{\$15,000}{.75} = \$20,000$ actual sales
- (3) $PR = C/M \times M/S$; $PR = .62 \times .25 = .155$
 $\$20,000 \times .155 = \$3,100$ profit for the month

E20-8

- (1) $\frac{\$30,000}{.60} = \$50,000$ break-even sales
- (2) $\frac{\$50,000}{1 - .20} = \frac{\$50,000}{.80} = \$62,500$ sales for the year
 $PR = C/M \times M/S$; $PR = .20 \times .60 = .12$
 $\$62,500 \times .12 = \$7,500$ profit for the year
- (3)
- | | |
|---|-----------------|
| Sales | \$62,500 |
| Variable cost (\$62,500 x (1 - .60))..... | 25,000 |
| Contribution margin (\$62,500 x .60)..... | <u>\$37,500</u> |

E20-9

	Chip A	Chip B	Total
Sales:			
(100,000 x \$8)	\$800,000		
(200,000 x \$6)		\$1,200,000	\$2,000,000
Variable cost:			
(\$800,000 x 30%)	<u>240,000</u>		
(\$1,200,000 x 25%)		<u>300,000</u>	<u>540,000</u>
Contribution margin.....	<u>\$560,000</u>	<u>\$ 900,000</u>	<u>\$1,460,000</u>
Planned operating profit.....			<u>270,000</u>
Fixed cost			<u>\$1,190,000</u>

E20-10

	<u>Tables</u>	<u>Chairs</u>
Sales price per unit.....	\$110	\$35
Variable cost per unit.....	<u>50</u>	<u>20</u>
Contribution margin per unit	<u>\$ 60</u>	<u>\$15</u>
<u>\$720,000 fixed cost</u>	<u>\$1,500,000 sales</u>	
1 - (((\$50 + (4 x \$20)) + (\$110 + (4 x \$35))) = to break even		

or alternatively:

$$\frac{\$720,000 \text{ fixed cost}}{(\$60 + (4 \times \$15)) + (\$110 + (4 \times \$35))} = \$1,500,000 \text{ sales to break even}$$

$$\frac{\$1,500,000 \text{ sales}}{\$110 + (4 \times \$35)} = 6,000 \text{ hypothetical packages}$$

or alternatively:

$$\frac{\$720,000 \text{ fixed cost}}{\$60 + (4 \times \$15) \text{ CM}} = 6,000 \text{ hypothetical packages}$$

$$\begin{aligned} 6,000 \text{ packages} \times 1 \text{ table per package} &= 6,000 \text{ tables to break even} \\ 6,000 \text{ packages} \times 4 \text{ chairs per package} &= 24,000 \text{ chairs to break even} \\ 6,000 \text{ tables} \times \$110 \text{ per table} &= \$ 660,000 \\ 24,000 \text{ chairs} \times \$ 35 \text{ per chair} &= \underline{840,000} \\ \text{Total sales to break even,} &\underline{\underline{\$1,500,000}} \end{aligned}$$

E20-11

	<u>Product L</u>	<u>Product M</u>	
Sales price per unit	\$20	\$15	
Variable cost per unit	<u>12</u>	<u>10</u>	
Unit contribution margin.....	\$ 8	\$ 5	
Expected sales mix.....	<u>x 2</u>	<u>x 3</u>	
Contribution margin per hypothetical package	<u>\$16</u>	<u>\$15</u>	= \$31

E20-11 (Concluded)

(1)
$$\frac{\$372,000 \text{ fixed cost}}{\$31 \text{ contribution margin}} = 12,000 \text{ packages to break even}$$

12,000 packages	x	2 units of L	=	24,000 units of L
12,000 packages	x	3 units of M	=	36,000 units of M
24,000 units of L	x	\$20	=	\$ 480,000 sales of L
36,000 units of M	x	\$15	=	540,000 sales of M
Break-even sales				<u>\$ 1,020,000</u>

(2)
$$\frac{\$372,000 \text{ fixed cost} + \$93,000 \text{ profit}}{\$31 \text{ contribution margin}} = 15,000 \text{ packages to achieve profit}$$

15,000 packages	x	2 units of L	=	30,000 units of L
15,000 packages	x	3 units of M	=	45,000 units of M
30,000 units of L	x	\$20	=	\$ 600,000 sales of L
45,000 units of M	x	\$15	=	675,000 sales of M
Sales to achieve profit				<u>\$1,275,000</u>

E20-12

(1)	Variable manufacturing cost.....	\$210,000
	Fixed manufacturing cost.....	80,000
	Variable marketing expense	105,000
	Fixed marketing and administrative expenses	60,000
	Total costs to produce and sell 70,000 units.....	<u>\$455,000</u>

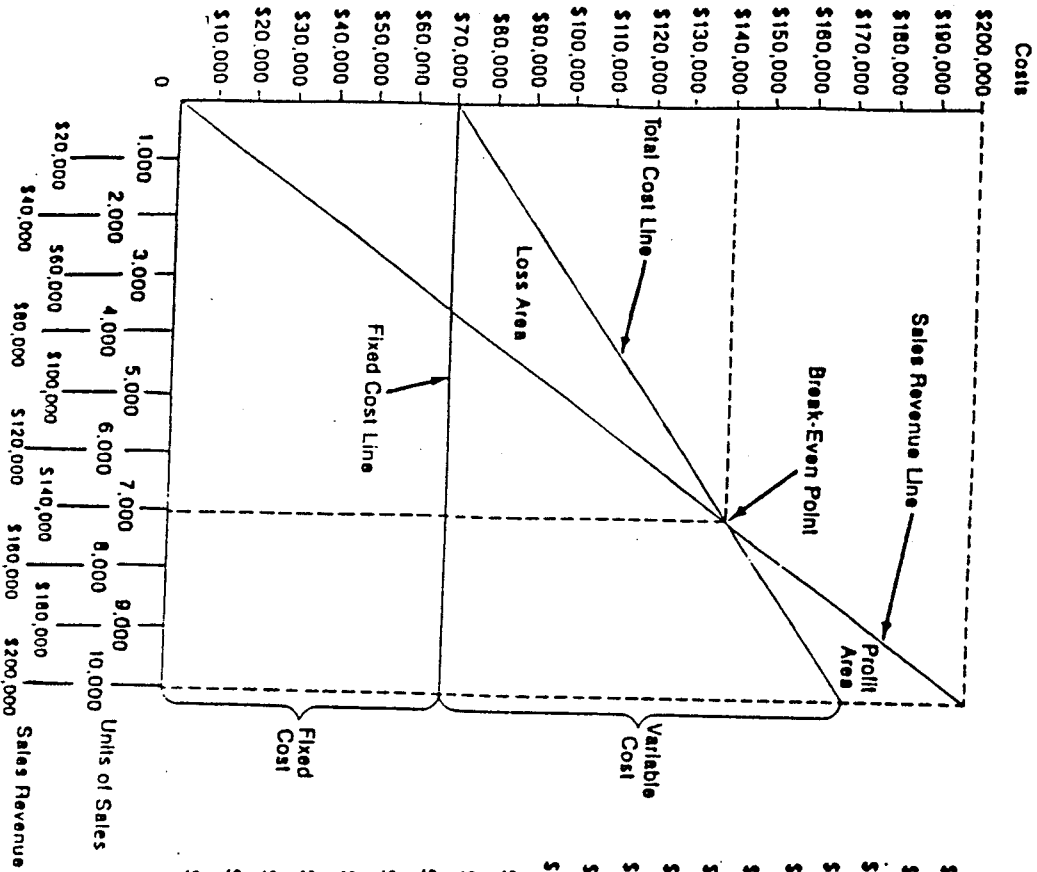
$$\frac{\$455,000 \text{ total cost}}{70,000 \text{ units}} = \$6.50 \text{ sales price per unit to break even}$$

(2)
$$\frac{(\$80,000 + \$60,000) \text{ fixed cost}}{\$8 - \$4.50 - (10\% \times \$8)} = 51,852 \text{ units}$$

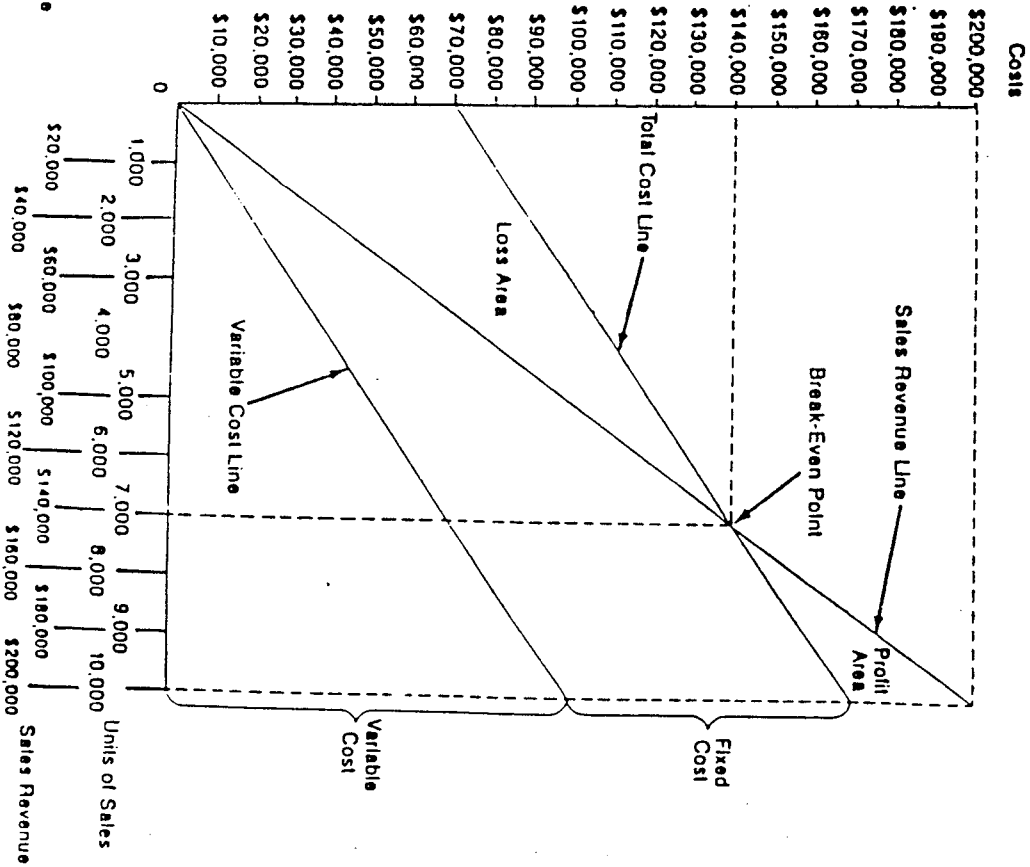
(3)
$$\frac{(\$124,000 + \$60,000) \text{ fixed cost}}{\$8 - \$4.50 - (15\% \times \$8)} = 80,000 \text{ units}$$

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E20-13 Break-even chart:



Alternative break-even chart:



E20-14

- (1) **throughput/unit = sales – materials cost = \$45 – (\$14 + \$1) = \$30**
- (2) **Maximum throughput per month is \$144,000. Total throughput for a period is the \$30/unit (from requirement 1) multiplied by the number of units shipped; units are limited by the lowest-capacity operation, which is Surface Prep's 4,800 units per month: 4,800 units/month x \$30/unit = \$144,000/month.**
- (3) **Surface Prep is the tightest constraint, with a 4,800-unit capacity.**

E20-15

- (1) **No, they should not acquire the equipment. Gloss Coat is not the tightest constraint, so increasing its capacity will not help.**
- (2) **Zero. Maximum monthly throughput will not increase.**
- (3) **Yes, an additional Surface Prep (SP) crew should be hired. The increase in overall throughput more than justifies the cost.**
- (4) **Maximum throughput will increase by about \$15,000 per month (500 units/month x \$30/unit). SP is the tightest constraint, so increasing its capacity will increase throughput of the entire system until SP's improvement causes another constraint to become the tightest. Gloss Coat, the second-tightest constraint, presently has capacity 500 units higher than SP's.**

E20-16

- (1) **Yes, an inspection should be created just prior to Surface Prep (SP). For each 1,000 shipped, 50 defectives enter SP—26, 14, and 10 arising in the three preceding operations, respectively. SP is the tightest constraint, so removing defectives prior to SP will increase total system throughput. At \$30 throughput per unit, the 50 added units (per thousand shipped) do justify the added inspection.**
- (2) **Removing all defectives just prior to SP will increase the number of good units entering SP by 50/1,000 or about 5%. With SP presently handling 4,800 units per month, a 5% increase in units shipped is $.05 \times 4,800 = 240$. Additional throughput will be $240 \text{ units/month} \times \$30/\text{unit} = \$7,200$ per month. Because the inspection will cost \$1,800 per month, the monthly advantage of the added inspection operation will be \$7,200 minus \$1,800, or \$5,400 per month.**

PROBLEMS

P20-1

MASTERPIECE TOOL CORPORATION
Product-Line Income Statement
(Contribution Margin Approach)

	<u>Total</u>	<u>Electronic Tools</u>	<u>Pneumatic Tools</u>	<u>Hand Tools</u>
Sales	\$3,000,000	\$1,500,000	\$1,000,000	\$500,000
Less variable cost of goods sold	<u>1,400,000</u>	<u>700,000</u>	<u>500,000</u>	<u>200,000</u>
Gross contribution margin	\$1,600,000	\$ 800,000	\$ 500,000	\$300,000
Less variable marketing expenses (packing and shipping)	<u>250,000</u>	<u>100,000</u>	<u>100,000</u>	<u>50,000</u>
Contribution margin	<u>\$1,350,000</u>	<u>\$ 700,000</u>	<u>\$ 400,000</u>	<u>\$250,000</u>
Less traceable fixed expenses:				
Manufacturing	\$ 250,000	\$ 100,000	\$ 100,000	\$ 50,000
Marketing (advertising)	<u>450,000</u>	<u>200,000</u>	<u>200,000</u>	<u>50,000</u>
Total traceable fixed expense	<u>\$ 700,000</u>	<u>\$ 300,000</u>	<u>\$ 300,000</u>	<u>\$100,000</u>
Product contribution	<u>\$ 650,000</u>	<u>\$ 400,000</u>	<u>\$ 100,000</u>	<u>\$150,000</u>
Less common fixed expenses:				
Manufacturing ¹	\$ 370,000			
Marketing ²	100,000			
Administration	<u>150,000</u>			
Total common fixed expenses	<u>\$ 550,000</u>			
Operating Income	<u>\$ 100,000</u>			

¹ \$1,950,000 absorption cost of goods sold - \$1,400,000 variable costs - \$250,000 traceable fixed cost

² \$800,000 total marketing costs - \$250,000 variable expense - \$450,000 advertising expense

P20-2
(1)

ROBERTS CORPORATION
Income Statement
For Year Ended 20—

Sales (52,000 x \$25)		\$1,300,000
Cost of goods sold:		
Standard full cost (52,000 x \$15)	\$780,000	
Net unfavorable variable cost variances ..	2,000	
Unfavorable volume variance*	5,000	787,000
Gross profit		\$ 513,000
Less commercial expenses:		
Variable expenses (52,000 x \$1)	\$ 52,000	
Fixed expenses	180,000	232,000
Operating income under absorption costing		\$ 281,000
*Units budgeted for production during the year	50,000	
Units actually produced during the year		49,000
		1,000
Fixed factory overhead charged to each unit	x	\$5
Unfavorable volume variance		\$ 5,000

(2)

ROBERTS CORPORATION
Income Statement
For Year Ended 20—

Sales (52,000 x \$25)		\$1,300,000
Cost of goods sold:		
Standard variable cost (52,000 x \$10)	\$520,000	
Net unfavorable variable cost variances ..	2,000	522,000
Gross contribution margin		\$ 778,000
Variable commercial expenses (52,000 x \$1)		52,000
Contribution margin		\$ 726,000
Less fixed costs:		
Factory overhead		
(50,000 units budgeted x \$5)	\$250,000	
Commercial expenses	180,000	430,000
Operating income under direct costing		\$ 296,000

(3)

Operating income under absorption costing	\$ 281,000
Operating income under direct costing	296,000
Difference	\$ (15,000)
Units produced during the year	49,000
Units sold during the year	52,000
Unit decrease in finished goods inventory	(3,000)
Fixed factory overhead charged to each unit under absorption costing	x \$5
Difference	\$ (15,000)

P20-3

(1)

PLACID CORPORATION
Income Statement
For Year Ended 20—

Sales (48,000 x \$16)		\$768,000
Cost of goods sold:		
Standard full cost (48,000 x \$9)	\$432,000	
Net unfavorable variable cost variances ..	1,000	
Favorable volume variance*	(3,000)	430,000
Gross profit.....		\$338,000
Less commercial expenses:		
Variable expenses (48,000 x \$1).....	\$48,000	
Fixed expenses.....	99,000	147,000
Operating income under absorption costing		\$191,000
*Units budgeted for production during the year	50,000	
Units actually produced during the year	51,000	
		(1,000)
Fixed factory overhead charged to each unit.....	x	\$3
Favorable volume variance		\$ (3,000)

(2)

PLACID CORPORATION
Income Statement
For Year Ended 20—

Sales (48,000 x \$16)		\$768,000
Cost of goods sold:		
Standard variable cost (48,000 x \$6).....	\$288,000	
Net unfavorable variable cost variances ..	1,000	289,000
Gross contribution margin.....		\$479,000
Variable commercial expenses (48,000 x \$1)		48,000
Contribution margin		\$431,000
Less fixed costs:		
Factory overhead		
(50,000 units budgeted x \$3).....	\$150,000	
Commercial expenses	99,000	249,000
Operating income under direct costing.....		\$182,000

(3)

Operating income under absorption costing	\$191,000	
Operating income under direct costing.....	182,000	
Difference.....	\$ 9,000	
Units produced during the year.....	51,000	
Units sold during the year	48,000	
Unit increase in finished goods inventory	3,000	
Fixed factory overhead charged to each unit under		
absorption costing.....	x	\$3
Difference.....		\$ 9,000

P20-4

(1) Absorption costing:

	Quarter	
	First	Second
Sales	\$200,000	\$260,000
Direct materials	\$ 30,000	\$ 20,000
Direct labor	60,000	40,000
Variable factory overhead	45,000	30,000
Fixed factory overhead	62,400	62,400
Cost of goods manufactured	\$197,400	\$152,400
Beginning inventory		65,800
Cost of goods available for sale	\$197,400	\$218,200
Ending inventory	65,800 ¹	30,480 ²
Cost of goods sold	\$131,600	\$187,720
Gross profit	\$ 68,400	\$ 72,280
Marketing and administrative expenses	25,000	28,000
Operating income	<u>\$ 43,400</u>	<u>\$ 44,280</u>

$$^1 \$1 + \$2 + \$1.50 + (\$62,400 \div 30,000) = \$6.58$$

$$\$6.58 \times 10,000 \text{ units} = \$65,800$$

$$^2 \$1 + \$2 + \$1.50 + (\$62,400 \div 20,000) = \$7.62$$

$$\$7.62 \times 4,000 \text{ units} = \$30,480$$

(2) Direct costing:

	Quarter	
	First	Second
Sales	\$200,000	\$260,000
Direct materials	\$ 30,000	\$ 20,000
Direct labor	60,000	40,000
Variable factory overhead	45,000	30,000
Variable cost of goods manufactured	\$135,000	\$ 90,000
Beginning inventory		45,000
Variable cost of goods available for sale	\$135,000	\$135,000
Ending inventory	45,000	18,000
Variable cost of goods sold	\$ 90,000	\$117,000
Gross contribution margin	\$110,000	\$143,000
Variable marketing and administrative expenses	10,000	13,000
Contribution margin	<u>\$100,000</u>	<u>\$130,000</u>
Less fixed expenses:		
Factory overhead	\$ 62,400	\$ 62,400
Marketing and administrative	15,000	15,000
Total fixed expense	<u>\$ 77,400</u>	<u>\$ 77,400</u>
Operating income	<u>\$ 22,600</u>	<u>\$ 52,600</u>

P20-4 (Concluded)

(3)

	Quarter	
	First	Second
Operating income under absorption costing	\$43,400	\$ 44,280
Operating income under direct costing	22,600	52,600
Difference	<u>\$20,800</u>	<u>\$ (8,320)</u>
Change in inventory under absorption costing:		
Ending inventory.....	\$65,800	\$ 30,480
Beginning inventory.....	0	65,800
Increase (decrease) in inventory.....	<u>\$65,800</u>	<u>\$(35,320)</u>
Change in inventory under direct costing:		
Ending inventory.....	\$45,000	\$ 18,000
Beginning inventory.....	0	45,000
Increase (decrease) in inventory.....	<u>\$45,000</u>	<u>\$(27,000)</u>
Difference between absorption and direct costing.....	<u>\$20,800</u>	<u>\$ (8,320)</u>

P20-5

(1)

	Capital Intensive	Labor Intensive
Sales price	\$30.00	\$30.00
Variable costs:		
Materials	\$5.00	\$5.60
Direct labor	6.00	7.20
Variable factory overhead.....	3.00	4.80
Variable marketing expenses	<u>2.00</u>	<u>2.00</u>
Contribution margin per unit.....	<u>\$14.00</u>	<u>\$10.40</u>

(a) Capital-intensive manufacturing method:

Fixed factory overhead.....	\$2,440,000
Fixed marketing expenses.....	500,000
Total fixed cost.....	<u>\$2,940,000</u>

\$2,940,000 fixed cost
\$14 contribution margin per unit = 210,000 units of sales to break even

(b) Labor-intensive manufacturing method:

Fixed factory overhead.....	\$1,320,000
Fixed marketing expenses	500,000
Total fixed cost.....	<u>\$1,820,000</u>

\$1,820,000 fixed cost
\$10.40 contribution margin per unit = 175,000 units of sales to break even

P20-5 (Concluded)

- (2) Kimbrell Company would be indifferent between the two alternative manufacturing methods at the volume of sales for which total cost was equal under both alternatives. Let Q equal the quantity of units of product manufactured and sold.

$$\begin{aligned}
 (\$16 \times Q) + \$2,940,000 &= (\$19.60 \times Q) + \$1,820,000 \\
 \$2,940,000 - \$1,820,000 &= (\$19.60 \times Q) - (\$16 \times Q) \\
 \$1,120,000 &= \$3.60 \times Q \\
 311,111 &= Q
 \end{aligned}$$

Total cost will be the same for both manufacturing methods at 311,111 units of sales.

P20-6

- (1) The number of units to break even at a per unit sales price of \$38.50:

Variable costs:

Direct materials	\$ 60,000
Direct labor	40,000
Variable factory overhead	20,000
Variable marketing and administrative expenses	10,000
	<u>\$130,000</u>

$$\frac{\$30,000 + \$15,000}{\$38.50 - \$26.00^*} = \frac{\$45,000}{\$12.50} = 3,600 \text{ break-even units}$$

*\$130,000 ÷ 5,000 units = \$26 variable cost per unit

- (2) Units that must be sold to produce an \$18,000 profit, at a \$40 per unit sales price:

$$\frac{\$45,000 + \$18,000}{\$40 - \$26} = \frac{\$63,000}{\$14} = 4,500 \text{ units}$$

- (3) The price Castleton must charge at a 5,000-unit sales level, in order to produce a profit equal to 20% of sales:

$$\begin{aligned}
 \text{Let } x &= \text{sales price per unit} \\
 5,000x &= 5,000(\$26) + \$45,000 + 5,000(.2x) \\
 4,000x &= \$175,000 \\
 x &= \$43.75 \text{ sales price per unit}
 \end{aligned}$$

P20-7

	B2	B4
Sales price per unit	<u>\$180.00</u>	<u>\$176.00*</u>
Less:		
Variable manufacturing cost per unit	\$121.00	\$ 96.00
Variable selling expense per unit		
(5% of sales price).....	<u>9.00</u>	<u>8.80</u>
Total variable cost per unit.....	<u>\$130.00</u>	<u>\$104.80</u>
Contribution margin per unit.....	<u>\$ 50.00</u>	<u>\$ 71.20</u>

*\$160 sales price per unit in 19A + (\$160 x 10% increase in 19B)

Total fixed factory overhead	
((20,000 B2's + 40,000 B4's) x \$25 per unit)	\$1,500,000
Total fixed selling and administrative expenses	<u>207,330</u>
Total fixed costs.....	<u>\$1,707,330</u>

$$\frac{\$1,707,330 \text{ fixed cost} + (\$135,000 \text{ profit} + (1 - .4))}{(2 \text{ B2's} \times \$50 \text{ CM each}) + (3 \text{ B4's} \times \$71.20 \text{ CM each})} =$$

$$\frac{\$1,707,330 \text{ fixed cost} + \$225,000 \text{ pretax profit}}{\$313.60 \text{ CM per package}} =$$

$$\frac{\$1,932,330}{\$313.60} = 6,162 \text{ packages}$$

6,162 packages x 2 units of B2 = 12,324 units of B2

6,162 packages x 3 units of B4 = 18,486 units of B4

P20-8

- (1) The 20A sales mix in units is 1:2 (70,000 tape recorders; 140,000 electronic calculators).

Let x = Number of tape recorders to break even

$2x$ = Number of electronic calculators to break even

At break even:

Sales = Variable cost + Fixed cost

$$\$15x + 2(\$22.50x) = \$8x + 2(\$9.50x) + \$1,320,000^1$$

$$\$15x + \$45x = \$8x + \$19x + \$1,320,000$$

$$\$60x = \$27x + \$1,320,000$$

$$\$33x = \$1,320,000$$

$$x = 40,000 \text{ tape recorders}$$

$$2x = 80,000 \text{ electronic calculators}$$

¹ Fixed costs:

Factory overhead.....	\$ 280,000
Marketing and administrative.....	<u>1,040,000</u>
Total.....	<u><u>\$1,320,000</u></u>

20-8 (Continued)

- 2) The following formula can be used to calculate the sales dollars required to earn an aftertax profit of 9% on sales, using 20B estimates:

$$S = VC(S) + FC + \frac{P(S)}{1 - T}$$

Where: S = Necessary sales dollars

VC = Variable cost stated as a percentage of sales dollars (S)

FC = Fixed costs

P = Desired profit stated as a percentage of sales dollars (S)

T = Income tax rate

$$S = .46S^1 + \$1,377,000^2 + \frac{.09(S)}{(1 - .55)}$$

$$S = .46S + \$1,377,000 + .2S$$

$$.34S = \$1,377,000$$

$$S = \$4,050,000$$

¹Variable cost rate for tape recorders and electronic calculators:

	Tape Recorders		Electronic Calculators	
	Per Unit	%	Per Unit	%
Sales price	<u>\$15.00</u>	100%	<u>\$20.00</u>	100.0%
Variable costs:				
Materials	\$ 3.60		\$ 3.60	
Direct labor	2.20		3.30	
Factory overhead.....	<u>2.00</u>		<u>2.00</u>	
Total variable cost	<u>\$ 7.80</u>	52%	<u>\$ 8.90</u>	44.5%
Contribution margin	<u>\$ 7.20</u>	48%	<u>\$11.10</u>	55.5%

Composite variable cost rate per dollar of sales:

$$(.20 \times \text{Tape recorder variable cost rate}) + (.80 \times \text{Calculator variable cost rate}) = .20 (.52) + .80 (.445) = .104 + .356 = .46$$

²Fixed costs:

Factory overhead	\$ 280,000
Marketing and administrative	1,040,000
Additional advertising	57,000
Total	<u>\$1,377,000</u>

P20-8 (Concluded)

- (3) Let: x = Number of tape recorders to break even
 $3x$ = Number of electronic calculators to break even

At break even:

Sales = Variable cost + Fixed cost

$$\$15x + 3(\$20x) = \$7.80x + 3(\$8.90x) + \$1,377,000$$

$$\$15x + \$60x = 7.80x + \$26.70x + \$1,377,000$$

$$\$75x = \$34.50x + \$1,377,000$$

$$\$40.50x = \$1,377,000$$

$$x = 34,000 \text{ tape recorders}$$

$$3x = 102,000 \text{ electronic calculators}$$

P20-9

- (1) (a) In order to break even, Almo must sell 500 units determined as follows:

$$Q(\text{BE}) = \frac{F}{P - C} = \frac{\$100,000}{\$400 - \$200} = 500 \text{ units}$$

where F = fixed cost, P = sales price per unit, and C = variable cost per unit.

- (b) To achieve an after-tax profit of \$240,000, Almo must sell 2,500 units determined as follows:

$$Q = \frac{F + \pi}{P - C} = \frac{\$100,000 + (\$240,000 + (1 - .40))}{\$400 - \$200} = \frac{\$100,000 + \$400,000}{\$200} = \frac{\$500,000}{\$200} = 2,500 \text{ units}$$

where P , F , and C are defined the same as in (1)(a), and π is the after-tax profit objective.

P20-9 (Concluded)

(2) Almo Company should choose alternative (a) because it will result in the largest after-tax profit.

Alternative (a):

$$\begin{aligned}\text{Revenue} &= (\$400 \text{ unit sales price} \times 350 \text{ units}) + ((\$400 - \$40 \text{ price reduction}) \times 2,700 \text{ units}) \\ &= \$140,000 + \$972,000 \\ &= \$1,112,000\end{aligned}$$

$$\begin{aligned}\text{Variable Cost} &= \$200 \text{ per unit} \times (350 \text{ units sold} + 2,700 \text{ units to be sold}) \\ &= \$810,000\end{aligned}$$

$$\begin{aligned}\text{After-tax Profit} &= (\text{Revenue} - \text{Variable Cost} - \text{Fixed Cost}) \times (1 - \text{Tax Rate}) \\ &= (\$1,112,000 - \$810,000 - \$100,000) \times (1 - .4) \\ &= \$402,000 \times .6 \\ &= \$241,200\end{aligned}$$

Alternative (b):

$$\begin{aligned}\text{Revenue} &= (\$400 \text{ unit sales price} \times 350 \text{ units}) + ((\$400 - \$30 \text{ price reduction}) \times 2,200 \text{ units}) \\ &= \$140,000 + \$814,000 \\ &= \$954,000\end{aligned}$$

$$\begin{aligned}\text{Variable Cost} &= (\$200 \text{ per unit} \times 350 \text{ units}) + ((\$200 - \$25 \text{ cost reduction}) \times 2,200 \text{ units}) \\ &= \$70,000 + \$385,000 \\ &= \$455,000\end{aligned}$$

$$\begin{aligned}\text{After-tax Profit} &= (\text{Revenue} - \text{Variable Cost} - \text{Fixed Cost}) \times (1 - \text{Tax Rate}) \\ &= (\$954,000 - \$455,000 - \$100,000) \times (1 - .4) \\ &= \$399,000 \times .6 \\ &= \$239,400\end{aligned}$$

Alternative (c):

$$\begin{aligned}\text{Revenue} &= (\$400 \text{ unit sales price} \times 350 \text{ units}) + (\$400 \times (1 - 5\% \text{ price reduction}) \times 2,000 \text{ units}) \\ &= \$140,000 + \$760,000 \\ &= \$900,000\end{aligned}$$

$$\begin{aligned}\text{Variable Cost} &= \$200 \text{ per unit} \times (350 \text{ units sold} + 2,000 \text{ units to be sold}) \\ &= \$470,000\end{aligned}$$

$$\begin{aligned}\text{After-tax Profit} &= (\text{Revenue} - \text{Variable Cost} - \text{Fixed Cost}) \times (1 - \text{Tax Rate}) \\ &= (\$900,000 - \$470,000 - (\$100,000 - \$10,000 \text{ cost reduction})) \times (1 - .4) \\ &= \$340,000 \times .6 \\ &= \$204,000\end{aligned}$$

P20-10

- (1) Estimated break-even point based on pro forma income statement:

Sales.....		\$10,000,000
Variable costs:		
Cost of goods sold.....	\$6,000,000	
Commissions paid to agents.....	<u>2,000,000</u>	<u>8,000,000</u>
Contribution margin.....		<u>\$ 2,000,000</u>

$$\text{Contribution margin ratio} = \frac{\$ 2,000,000}{\$10,000,000} = 20\% \text{ C/M}$$

$$\frac{\$100,000 \text{ fixed cost}}{20\% \text{ C/M}} = \$500,000 \text{ break-even point}$$

- (2) Estimated break-even point with the company employing its own salespersons:

Variable cost ratios:

Cost of goods sold to sales (\$6,000,000 + \$10,000,000).....	60%
Commissions on sales.....	<u>5%</u>
Total variable cost ratio	<u>65%</u>

$$\text{Contribution margin ratio} = 1 - 65\% \text{ variable cost ratio} = 35\%$$

Fixed costs:

Administrative.....	\$100,000
Sales manager	160,000
Salaries of salespersons (3 x \$30,000)	<u>90,000</u>
Total fixed costs.....	<u>\$350,000</u>

$$\frac{\$350,000 \text{ fixed cost}}{35\% \text{ C/M}} = \$1,000,000 \text{ break-even point}$$

P20-10 (Concluded)

- (3) **Estimated sales volume to yield net income projected in pro forma income statement with independent sales agents receiving 25% commission:**

Total income before income tax	\$1,900,000
Fixed cost.....	<u>100,000</u>
Total fixed cost and profit.....	<u><u>\$2,000,000</u></u>

Variable cost ratios:

Cost of goods sold to sales.....	60%
Commissions on sales	<u>25%</u>
Total variable cost ratio	<u><u>85%</u></u>

Contribution margin ratio = 1 - 85% variable cost ratio = 15%

$$\frac{\$2,000,000 \text{ fixed cost and profit}}{15\% \text{ C/M}} = \$13,333,333 \text{ sales}$$

- (4) **Estimated sales volume to yield an identical income regardless of whether the company employs its own salespersons or continues with independent sales agents and pays them a 25% commission:**

Total cost with agents = Total cost with company's
receiving 25% commission own sales force

(85% variable cost x sales) = (65% variable cost x sales)
+ \$100,000 fixed cost + \$350,000 fixed cost

20% x sales = \$250,000

sales = \$1,250,000

CASES

C20-1

- (1) Because Star Company uses absorption costing, income from operations is influenced by both sales volume and production volume. Sales volume was increased in the November 30 forecast, and at standard gross profit rates this would increase income from operations by \$5,600. However, during this same period, production volume was below the January 1 forecast, causing an unplanned volume variance of \$6,000. The volume variance and the increased marketing expenses (due to the 10% increase in sales) overshadowed the added profits from sales, as follows:

Increased sales.....		\$26,800	
Increased cost of goods sold at standard...		<u>21,200</u>	
Increased gross profit at standard.....			\$ 5,600
Less:			
Volume variance	\$6,000		
Increased marketing expense.....	<u>1,340</u>	<u>7,340</u>	
Decrease in income from operations.....			<u><u>\$ (1,740)</u></u>

C20-1 (Concluded)

- (2) **Star Company could adopt direct costing. Under direct costing, fixed manufacturing costs would be treated as period costs and would not be assigned to production. Consequently, earnings would not be affected by production volume, but only by sales volume. Statements prepared on a direct-costing basis are as follows:**

STAR COMPANY		
Forecasts of Operating Results for 20—		
	Forecasts as of	
	January 1	November 30
Sales.....	\$268,000	\$294,800
Variable costs:		
Manufacturing	\$182,000	\$200,200 *
Marketing	13,400	14,740
Total variable cost	\$195,400	\$214,940
Contribution margin	\$ 72,600	\$ 79,860
Fixed costs:		
Manufacturing	\$ 30,000	\$ 30,000
Administrative	26,800	26,800
Total fixed cost	\$ 56,800	\$ 56,800
Income from operations	\$ 15,800	\$ 23,060

*\$182,000 x 110% = \$200,200

Reconciliation of differences in income from operations:

January 1: No difference in absorption vs. direct costing because \$30,000 fixed factory overhead was expensed in both cases.

November 30:	Income from Operations
Direct costing.....	\$23,060
Absorption costing	14,060
Difference.....	\$ 9,000

Fixed factory overhead included in cost of goods sold at standard:

November 30 forecast (\$30,000 in January 1 forecast	
+ 10% sales volume increase).....	\$33,000
January 1 forecast	30,000
	\$ 3,000
Underapplied fixed factory overhead	6,000
Difference.....	\$ 9,000

C20-2

- (1) In absorption costing, as currently employed by RGB Corporation, fixed factory overhead is considered a product cost rather than a period cost. Fixed factory overhead is applied to production based on a normal capacity of 1,000,000 units. Thus, the fixed factory overhead is applied to products in the same manner as variable costs, even though it does not vary with production. In addition, if production and sales are not equal during the year, fixed factory overhead is deferred as part of inventory costs (when production exceeds sales) or released upon sales of the inventory (when sales exceed production).

During 20A, production exceeded sales, resulting in a portion of the fixed factory overhead being inventoried in finished goods rather than being expensed in 20A. This resulted in 20A operating income being larger than it would have been if all fixed factory overhead had been charged against 20A sales revenue. Then in 20B, sales exceeded production, resulting in more fixed factory overhead being charged against 20B sales revenue than was incurred in 20B. First, finished goods were sold out of inventory, which meant that the part of fixed factory overhead that was incurred in 20A and inventoried in 20A was charged against 20B sales revenue. Second, fixed factory overhead was underapplied in 20B because only 850,000 units were produced (150,000 units less than normal capacity used in determining the factory overhead rate). This resulted in an unfavorable volume variance that was charged to the cost of goods sold in 20B. Both of these occurrences increased the cost of goods sold and resulted in a reduction of gross profit and operating income in 20B.

C20-2 (Continued)

(2) (a)

RGB CORPORATION
Operating Income Statement
For the Years Ended November 30, 20A and 20B
(In thousands)

	20A	20B
Sales	\$9,000	\$11,200
Variable cost of goods sold:		
900,000 units at \$5.00	4,500	
300,000 units at \$5.00		\$1,500
700,000 units at \$5.50		3,850
		5,350
Contribution margin	\$4,500	\$ 5,850
Fixed expenses:		
Fixed factory overhead	\$3,000	\$3,300
Selling and administrative	1,500	1,500
	4,500	4,800
Operating Income	<u>0</u>	<u>\$ 1,050</u>

(b) Reconciliation:

	20A	20B
Operating income—		
absorption costing	\$ 900	\$ 645
Operating income—		
direct costing	0	1,050
Difference	<u>\$ 900</u>	<u>\$ (405)</u>
Difference accounted for as follows:		
Inventory change under absorption costing:		
Ending inventory:		
300,000 units at \$8.00	\$2,400	
150,000 units at \$8.80		\$1,320
Beginning inventory:	0	\$2,400
300,000 units at \$8.00		2,400
		\$ (1,080)
Inventory change under direct costing:		
Ending inventory:		
300,000 units at \$5.00	\$1,500	
150,000 units at \$5.50		\$ 825
Beginning inventory:	0	1,500
300,000 units at \$5.00		1,500
		(875)
Difference	<u>\$ 900</u>	<u>\$ (405)</u>

C20-2 (Concluded)

- (3) The advantages of direct costing for internal reporting include the following:
- (a) Direct costing aids in forecasting and in evaluating reported income for internal management decision-making purposes, because fixed costs are not arbitrarily allocated between accounting periods (or among different products, sales territories, operating divisions, etc.).
 - (b) Fixed costs are reported at incurred values (and not absorbed values), increasing opportunity for more effective control of these costs.
 - (c) Profits vary directly with sales volume and are unaffected by changes in inventory levels.
 - (d) Analysis of the cost-volume-profit relationship is facilitated, and management is able to determine the break-even point and total profit for a given volume of production and sales.

The disadvantages of direct costing for internal reporting include the following:

- (a) Management may fail to consider properly the fixed cost element in long-range pricing decisions.
- (b) Direct costing lacks acceptability for external financial reporting or as a basis for computing taxable income. As a consequence, additional record-keeping costs must be incurred to use direct costing.
- (c) The separation of costs into fixed and variable elements is a costly process. In addition, the distinction between fixed and variable cost is not precise and not reliable at all levels of activity.

C20-3

- (1) Daly would determine the number of units of Product Y that it would have to sell to attain a 20% profit on sales, by dividing total fixed costs plus desired profit (i.e., 20% of sales price per unit multiplied by the units to attain a 20% profit) by unit contribution margin (i.e., sales price per unit less variable cost per unit).
- (2) If variable cost per unit increases as a percentage of the sales price, Daly would have to sell more units of Product Y to break even. Because the unit contribution margin (i.e., sales price per unit less variable cost per unit) would be lower, Daly would have to sell more units to cover the fixed cost in order to break even.

C20-3 (Concluded)

- (3) **The limitations of break-even and cost-volume-profit analysis in managerial decision making follow:**
- (a) **The analysis is fundamentally a static analysis, and, in most cases, changes can be determined only by recomputing results. If a break-even chart is used, changes can be shown only by drawing a new chart or series of charts.**
 - (b) **The amount of fixed and variable cost, as well as the slope of the sales line, is meaningful in a defined range of activity and must be redefined for activity outside the relevant range.**
 - (c) **The analysis is highly dependent upon a meaningful separation of fixed and variable costs, which may be difficult to obtain in actual practice.**
 - (d) **The analysis is based on a single mix of products. If the mix is expected to change, the results must be recomputed.**
 - (e) **The analysis assumes that production technology (i.e., labor productivity, level of automation, and product specifications) will be unchanged. If changes in production technology are expected to occur, the analyst must consider the expected effects on costs.**
 - (f) **The analysis assumes that selling prices, input prices, and other market conditions will not change. Expected changes must be incorporated into the analysis. If a range of possible changes can occur, a different result must be determined for each possible combination.**

CHAPTER 21

DISCUSSION QUESTIONS

- Q21-1. Differential cost is the difference in the cost of alternative choices. The economist calls such costs marginal, and the engineer calls them incremental.
- Q21-2. Marginal cost (or differential cost) is the cost incurred by increasing the present output. The cost, therefore, would not have been incurred if the additional units had not been made. Marginal costing (or direct costing), on the other hand, is a costing approach in which only variable manufacturing costs are charged to products, and thus to inventory, while fixed manufacturing costs are treated as period costs and are charged off without becoming part of inventory costs.
- Q21-3. Incremental costs are important in decision making, because the least costly or most profitable alternative cannot be determined unless incremental costs are known. Incremental costs are the costs that must be incurred in order to complete an activity that is being considered. These costs must be known in order to compare each available alternative.
- Q21-4. Differential costs do not correspond to any possible accounting category, because they are oriented toward the future rather than the past and they treat product costs on a differential rather than a total cost basis. Furthermore, certain costs relevant for differential cost analysis (e.g., opportunity cost and imputed cost) are not recorded in the accounts. Conversely, certain costs recorded in the accounts (e.g., fixed costs that will remain unchanged) are irrelevant for differential cost analysis. The differential cost concept is a concept for cost analysis and not cost accumulation purposes.
- Q21-5. The flexible budget is useful in differential cost analyses, because the increments between each different level of output represent the cost that must be incurred if additional business is undertaken. As long as fixed costs remain constant under all rates of output, variable costs are always the differential costs. If fixed costs change in the flexible budget, differential costs will include the incremental element of fixed cost reflected in the flexible budget.
- Q21-6. Historical costs are usually irrelevant because they have been created by a past decision that cannot be changed by a future decision. Historical costs obtained from accounting records often include arbitrarily allocated fixed cost that may not be relevant to differential cost analysis.
- Q21-7. Variable cost is important because it can always be identified as a differential cost. However, differential costs may also include additional fixed costs.
- Q21-8. Sunk costs are irrecoverable costs that are not relevant to future decisions.
- Q21-9. A fixed cost would be relevant in deciding between alternatives if the fixed expenditure is an out-of-pocket cost required in order to undertake an alternative (e.g., the cost of renting equipment needed to provide sufficient capacity in deciding whether or not to accept an offer); or if a fixed expenditure can be avoided by undertaking an alternative (e.g., supervisory salaries that will be discontinued in the event of a plant closing).
- Q21-10. Opportunity costs are the measurable value of an opportunity bypassed by rejecting an alternative use of resources.
- Q21-11. Appendix Linear programming is a mathematical technique designed to assist decision makers in determining the allocation of resources that would be required to maximize or minimize the objective function; i.e., it is a tool that can be used by business managers to determine the mix of inputs necessary to maximize contribution margin or minimize cost. Linear programming is an algorithm that maximizes or minimizes a function of several variables subject to one or more constraints. The function being optimized and the constraints are assumed to be linear with respect to production activity.
- Q21-12. Appendix The unit costs used in linear programming problems are the traceable variable costs. Costs must be traceable to the product and variable with respect to production quantity in order to affect changes in total production cost and total contribution margin when changes in production quantity and mix occur.
- Q21-13. Appendix (a) The area bounded by the lines AB, BC, CD, and DA is called the solution space because it represents those quantities and combinations of standard and deluxe models that can be produced, given the available capacity of the grinding and polishing machines.

- (b) Triangle BCF represents those combinations of standard and deluxe models that could be produced by the polishing machines but not by the grinding machines. Triangle CDE represents the level of production that the grinding machines could attain, but not the polishing machines.
- (c) Point C denotes the optimum solution because any other level of attainable production will result in a smaller total contribution margin. It can be identified by computing the total contribution margin available from the production and sale of the combination of standard and deluxe models—denoted by each corner point—and choosing the corner point with the largest total contribution margin. Alternatively, a series of CM lines can be constructed, which have a slope equal to -1 multiplied by the unit contribution margin available from the product

identified by the horizontal axis, divided by the unit contribution margin available from the product identified by the vertical axis. The profit line farthest from the origin, point A, represents the greatest total contribution margin, and in this case, it passes through point C.

Q21-14. Appendix The simplex method is an iterative process that finds the optimum solution to a linear programming problem. The simplex method, which is based on matrix algebra, is a systematic way of evaluating each corner point in the feasible area. The process begins at the zero level of production and systematically moves from one corner point to another until the optimal solution is found. Each move provides the largest per unit improvement in the objective function. The process continues until the objective function can no longer be improved.

EXERCISES

E21-1

Sales ($\$1.80 \times 5\,000\text{ kg}$)		\$9,000
Cost to manufacture:		
Direct materials ($(\$0.60 + \$0.01) \times 5\,000\text{ kg}$).....	\$3,050	
Direct labor ($\$0.50 \times 5\,000\text{ kg}$)	2,500	
Factory overhead:		
Indirect labor ($\$0.20 \times 5\,000\text{ kg}$)	1,000	
Power ($(\$600 + 30,000) \times 5\,000\text{ kg}$)	100	
Supplies ($\$0.02 \times 5\,000\text{ kg}$)	100	
Maintenance and repair ($\$0.027 \times 5\,000\text{ kg}$)	135	
Depreciation ($\$3,000 \div 24\text{ months}$)	125	
Insurance ($\$0.007 \times 5\,000\text{ kg}$)	35	
Payroll taxes	160	
Cost of goods produced and sold.....		<u>7,205</u>
Gross profit contribution		\$1,795
Administrative expense		<u>150</u>
Profit contribution from accepting new business		<u>\$1,645</u>

E21-2

(1) Estimated cost of the additional 100,000 units:

Materials ($(\$150,000 / 150,000\text{ units}) \times 100,000\text{ units}$)	\$100,000
Direct labor ($(\$112,500 / 150,000\text{ units}) \times 100,000\text{ units}$)	75,000
Variable factory overhead	
($(\$75,000 / 150,000\text{ units}) \times 100,000\text{ units}$) or	
($\$125,000$ at 100% capacity - $\$75,000$ at 60% capacity)	50,000
Fixed factory overhead	
($\$125,000$ at 100% capacity - $\$100,000$ at 60% capacity)	<u>25,000</u>
Total differential cost of manufacturing the additional 100,000 units	<u>\$250,000</u>

(2) Total cost of producing 250,000 units in January:

	Budget for 150,000 Units	Differential Cost for 100,000 Units	Total Cost for 250,000 Units
Materials.....	\$150,000	\$100,000	\$250,000
Direct labor.....	112,500	75,000	187,500
Factory overhead:			
Variable.....	75,000	50,000	125,000
Fixed	100,000	25,000	125,000
Total cost.....	<u>\$437,500</u>	<u>\$250,000</u>	<u>\$687,500</u>

E21-2 (Concluded)

- (3) Sales price required to achieve a 20% mark up on production cost:

Production cost per unit (\$687,500 ÷ 250,000 units)	\$2.75
Plus 20% mark up on cost (\$2.75 x 20%)	<u>.55</u>
Sales price required to achieve 20% mark up on cost	<u><u>\$3.30</u></u>

E21-3

Revenue from the special sale (15,000 units x \$12.50 each) ..		\$187,500
Less differential costs:		
Direct materials ((\$20,000 ÷ 10,000 units) x 15,000 units)	\$30,000	
Direct labor ((\$35,000 ÷ 10,000 units) x 15,000 units)	52,500	
Additional overtime premium on special order	10,000	
Variable factory overhead ((\$10,000 ÷ 10,000 units) x 15,000 units)	15,000	
Additional fixed overhead from equipment rental	7,000	
Variable marketing expenses ((\$20,000 ÷ 10,000 units) x 15,000 units)	<u>30,000</u>	<u>144,500</u>
Addition to annual company profit resulting from special sale		<u><u>\$ 43,000</u></u>

E21-4

No, Huntington should not accept Lufkin's offer because it would be \$5,000 cheaper to make the part.

Cost if purchased from Lufkin (10,000 x \$18)		\$180,000
Cost if manufactured by Huntington:		
Direct materials.....	\$20,000	
Direct labor	55,000	
Variable factory overhead	45,000	
Rent from third party forgone if part manufactured	15,000	
Additional fixed factory overhead eliminated if part purchased from Lufkin (10,000 x \$3)....	30,000	165,000
Savings if part manufactured by Huntington.....		<u>\$ 15,000</u>

This solution assumes that a more profitable use of the facilities does not exist than that derived from the saving of \$15,000. Otherwise, it would be preferable to buy Part M-1 from Lufkin and use Huntington's facilities for the more profitable activity.

E21-5

The company should purchase the pistons from the outside supplier because it would cost \$6,000 less than manufacturing them at the Tucson plant.

The differential cost of manufacturing pistons at the Tucson plant:

Direct materials.....	\$160,000
Direct labor	80,000
Variable factory overhead (20% x \$240,000)....	48,000
Incremental fixed cost for machinery rental	30,000
Incremental fixed cost for additional supervisor	40,000
Total differential cost to manufacture 80,000 pistons.....	\$358,000
Cost to purchase 80,000 pistons from Wichita Machine Works (\$4.40 per piston x 80,000 pistons).....	352,000
Cost savings available from purchasing the pistons from the Wichita Machine Works rather than manufacturing them at the Tucson plant .	<u>\$ 6,000</u>

E21-6

- (1) Yes, the sales manager's proposal to drop Tift from the product line and increase the production of Mift should be accepted because it will increase the company's income by \$4,000, determined as follows:

Contribution margin from sale of Tift:

Revenue from sale of Tift (\$6 x 7,000 units).....	\$42,000	
Less variable cost of manufacturing Tift:		
Materials (\$2 x 7,000 units)	\$14,000	
Labor (\$1 x 7,000 units).....	7,000	
Variable factory overhead		
(\$1 x 7,000 units).....	<u>7,000</u>	<u>28,000</u>
Gross contribution margin from sale of Tift	\$14,000	
Less variable marketing expense from sale of		
Tift (\$1 x 7,000 units).....	<u>7,000</u>	<u>\$ 7,000</u>

Contribution margin from sale of 4,000 additional units of Mift:

Revenue from sale of additional Mift		
(\$10 x 4,000 units).....	\$40,000	
Less variable cost of manufacturing additional Mift:		
Materials (\$2 x 4,000 units)	\$ 8,000	
Labor (\$2 x 4,000 units).....	8,000	
Variable factory overhead		
(\$1 x 4,000 units).....	<u>4,000</u>	<u>20,000</u>
Gross contribution margin from		
sale of additional Mift.....	\$20,000	
Less variable marketing expense from sale of		
additional Mift (\$1 x 4,000 units).....	<u>4,000</u>	<u>16,000</u>
Additional contribution margin from converting capacity to		
to production of 4,000 additional units of Mift.....	\$ 9,000	
Additional advertising expense required to sell 4,000		
additional units of Mift	<u>5,000</u>	
Additional income from dropping Tift from product line and		
converting capacity to production of 4,000 additional units		
of Mift.....	<u>\$ 4,000</u>	

E21-6 (Concluded)

- (2) Montreal should consider whether dropping Tift from the product line will result in decreased sales of Mift and Lift in the long run. For example, if the three products are complementary, customers may prefer to maintain only those sources of supply from which the full product line is available. The present ability to sell more Mift by dropping Tift may be a short-run condition. If this is a concern, the cost of resuming Tift production at a later date should also be considered.

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E21-7

	Silver Polish per Jar
Sales price.....	\$4.00
Grit 337 per jar (one fourth of \$1.60)	\$.40
Other ingredients, labor, and variable factory overhead	2.50
Variable marketing cost.....	.30
Total variable cost	<u>\$3.20</u>
Contribution margin	\$.80
Opportunity cost from further processing rather than selling Grit 337 (1/4 x (\$2.00 - \$1.60)).....	.10
Net contribution margin per unit.....	<u>\$.70</u>

\$5,600 avoidable fixed cost + \$.70 = 8,000, the minimum number of jars of silver polish that must be sold to justify further processing of Grit 337.

E21-8

$$\begin{aligned}
 (1) \quad \text{Direct labor hours (DLH)} &= \frac{1,000,000 \text{ doses to be packaged}}{1,000 \text{ doses per DLH}} \\
 &= 1,000 \text{ DLH}
 \end{aligned}$$

Direct labor (\$5 x 1,000 hours)	\$5,000
Variable factory overhead (\$2 x 1,000 DLH).....	2,000
Administrative expense	1,000
Total traceable out-of-pocket costs.....	<u>\$8,000</u>

$$\text{Minimum price per dose} = \frac{\text{Total traceable out-of-pocket costs}}{1,000,000 \text{ doses}}$$

$$= \frac{\$8,000}{1,000,000} = \$0.008$$

E21-8 (Concluded)

$$\begin{aligned}
 (2) \quad \text{Maximum allowable return before taxes} &= \frac{\text{Maximum return after taxes}}{(1 - \text{Tax Rate})} \\
 &= \frac{.09}{1 - .40} = \frac{.09}{.60} = .15 \text{ or } 15\%
 \end{aligned}$$

Total traceable out-of-pocket costs (from requirement (1))	\$ 8,000
Fixed factory overhead (\$5 x 1,000 DLH)	5,000
Total full cost	<u>\$13,000</u>
Maximum allowable return (15% x \$13,000)	<u>1,950</u>
Total bid price	<u><u>\$14,950</u></u>

$$\begin{aligned}
 \text{Bid price per dose} &= \frac{\text{Total bid price}}{1,000,000 \text{ doses}} \\
 &= \frac{\$14,950}{1,000,000} = \$0.01495
 \end{aligned}$$

- (3) The factors that Hall Company should consider before deciding whether or not to submit a bid at the maximum allowable price include whether Hall has excess capacity, whether there are available jobs on which earnings might be greater, whether the maximum bid of \$.015 contributes toward covering the fixed costs, and whether this job could lead to more profitable business with Wyant in the future.
- (4) The competitive environment of the industry should have been considered by Wyant Memorial Hospital to determine whether or not a lower price could be obtained through competitive bidding. The hospital should also have considered that cost-plus pricing is not usually viewed uniformly by prospective bidders, is difficult to compute for products produced in "mass" quantity, and is better suited for products that are unique and high priced.

E21-9**Franchise fee collections per day:**

Average gross revenues per franchise per day	\$	500
Number of franchises	x	420
Total gross revenue		<u>\$210,000</u>
Franchise fee	x	.25
Average daily franchise fee collections		<u>\$ 52,500</u>

First proposal (i.e., use local messenger service to collect and mail checks only):

Average daily franchise fee collections	\$	52,500
Days saved	x	2
Total float saved		<u>\$105,000</u>
Before-tax opportunity cost	x	15%
Average annual savings		<u>\$ 15,750</u>
Less cost of messenger service		<u>20,000</u>
Annual reduction in income if proposal implemented		<u>\$ (4,250)</u>

Second proposal (i.e., use local messenger service with a lock-box arrangement):

Average daily franchise fee collections	\$	52,500
Days saved	x	5
Total float saved		<u>\$262,500</u>
Before-tax opportunity cost	x	15%
Average annual savings		<u>\$ 39,375</u>
Less costs:		
Messenger service	\$20,000	
Compensating balance (\$15,000 x 15%)	<u>2,250</u>	<u>22,250</u>
Annual increase in income if proposal implemented		<u>\$ 17,125</u>

E21-10**Silk-screen method:**

Prepare screen (1 1/2 hours x 20,000 circuit boards x \$6.50).....	\$195,000	
Screen patterns (1/3 hour x 20,000 circuit boards x \$6.50).....	<u>43,333</u>	
Total cost.....		\$238,333

AZ-17 process:

Labor (1/2 hour x 20,000 circuit boards x \$6.50)	\$ 65,000	
Monthly cost for materials and equipment rental and operation (\$4,000 x 12)	<u>48,000</u>	
Total cost.....		<u>113,000</u>

Annual savings from changing from silk-screen method to the new AZ-17 process	<u><u>\$125,333</u></u>
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E21-11 APPENDIX

Let MA = marking board assembled in automated assembly department
 ML = marking board assembled in labor assembly department
 TA = tack board assembled in automated assembly department
 TL = tack board assembled in labor assembly department

	<u>MA</u>	<u>ML</u>	<u>TA</u>	<u>TL</u>
Sales price per unit	<u>\$60.00</u>	<u>\$60.00</u>	<u>\$45.00</u>	<u>\$45.00</u>
Less variable costs:				
Direct materials:				
Base	\$ 6.00	\$ 6.00	\$ 6.00	\$ 6.00
Covering	14.50	14.50	7.75	7.75
Frame	8.25	8.25	8.25	8.25
Direct labor:				
Cutting Department.....	2.00	2.00	2.00	2.00
Assembly Department .....	.60	3.00	.60	3.00
Variable factory overhead:				
Cutting Department.....	2.45	2.45	2.45	2.45
Assembly Department	3.30	2.25	3.30	2.25
Variable marketing expenses	3.00	3.00	3.00	3.00
Total variable costs per unit	<u>\$40.10</u>	<u>\$41.45</u>	<u>\$33.35</u>	<u>\$34.70</u>
Contribution margin per unit.....	<u>\$19.90</u>	<u>\$18.55</u>	<u>\$11.65</u>	<u>\$10.30</u>

Objective function:

$$\text{Maximize CM} = \$19.90 \text{ MA} + \$18.55 \text{ ML} + \$11.65 \text{ TA} + \$10.30 \text{ TL}$$

Subject to:

$$\begin{aligned}
 .20 \text{ MA} + .20 \text{ ML} + .20 \text{ TA} + .20 \text{ TL} &\leq 30,000 \text{ DLH in Cutting} \\
 .05 \text{ MA} + .25 \text{ ML} + .05 \text{ TA} + .25 \text{ TL} &\leq 40,000 \text{ DLH in Assembly} \\
 .15 \text{ MA} + .15 \text{ ML} + .15 \text{ TA} + .15 \text{ TL} &\leq 25,000 \text{ MH in Cutting} \\
 0 \text{ MA} + .02 \text{ ML} + 0 \text{ TA} + .02 \text{ TL} &\leq 1,500 \text{ MH in Labor Assembly} \\
 .05 \text{ MA} + 0 \text{ ML} + .05 \text{ TA} + 0 \text{ TL} &\leq 5,000 \text{ MH in Automated Assembly} \\
 1 \text{ MA} + 1 \text{ ML} + 0 \text{ TA} + 0 \text{ TL} &\geq 30,000 \text{ units sales contract} \\
 0 \text{ MA} + 0 \text{ ML} + 1 \text{ TA} + 1 \text{ TL} &\geq 30,000 \text{ units sales contract}
 \end{aligned}$$

E21-12 APPENDIX

Let L = the number of legal pads
 R = the number of regular pads

Objective function:

$$\text{Maximize CM} = \$18L + \$12R$$

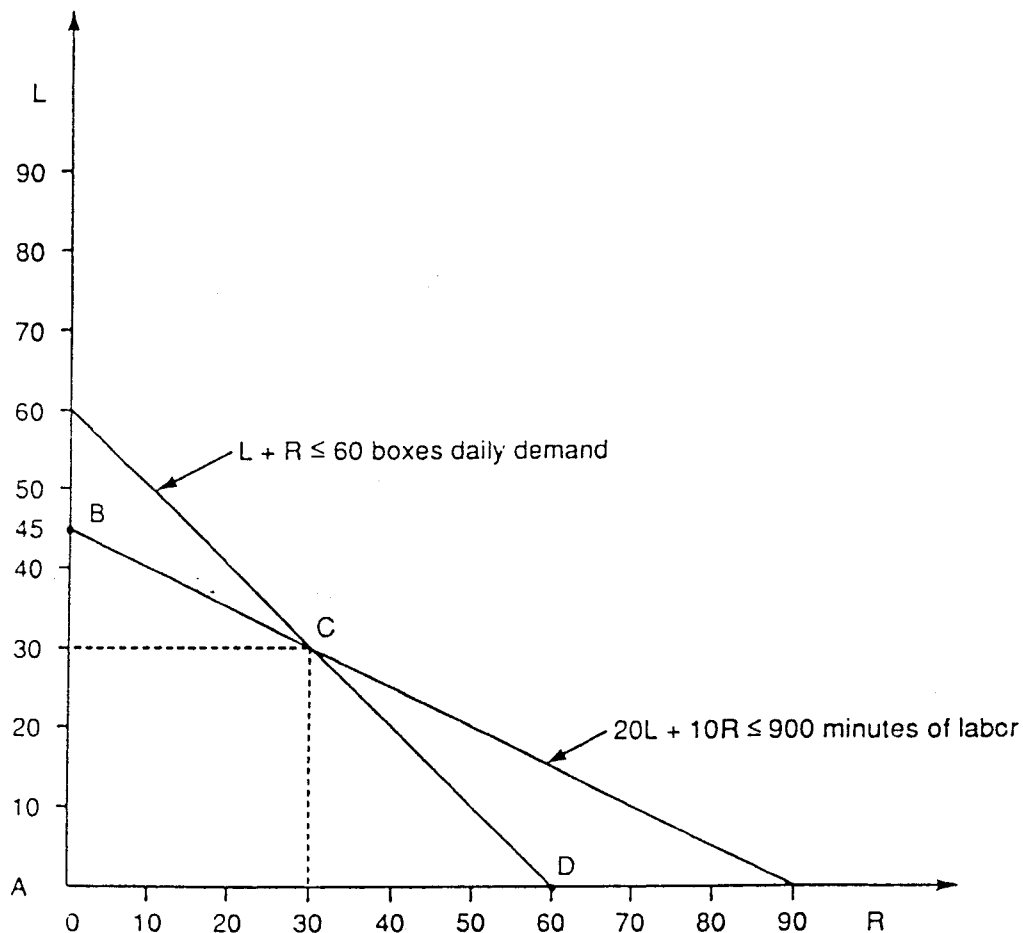
Subject to:

$$20L + 10R \leq 900 \text{ minutes labor}$$

(2 people x 7.5 hour x 60 minutes)

$$L + R \leq 60 \text{ boxes daily maximum demand}$$

(300 boxes per week + 5 work days)



A	=	(L = 0, R = 0)	=	(\$18)(0) + (\$12)(0)	=	\$0 CM
B	=	(L = 45, R = 0)	=	(\$18)(45) + (\$12)(0)	=	\$810 CM
C	=	(L = 30, R = 30)	=	(\$18)(30) + (\$12)(30)	=	\$900 CM ← Maximum CM
D	=	(L = 0, R = 60)	=	(\$18)(0) + (\$12)(60)	=	\$720 CM

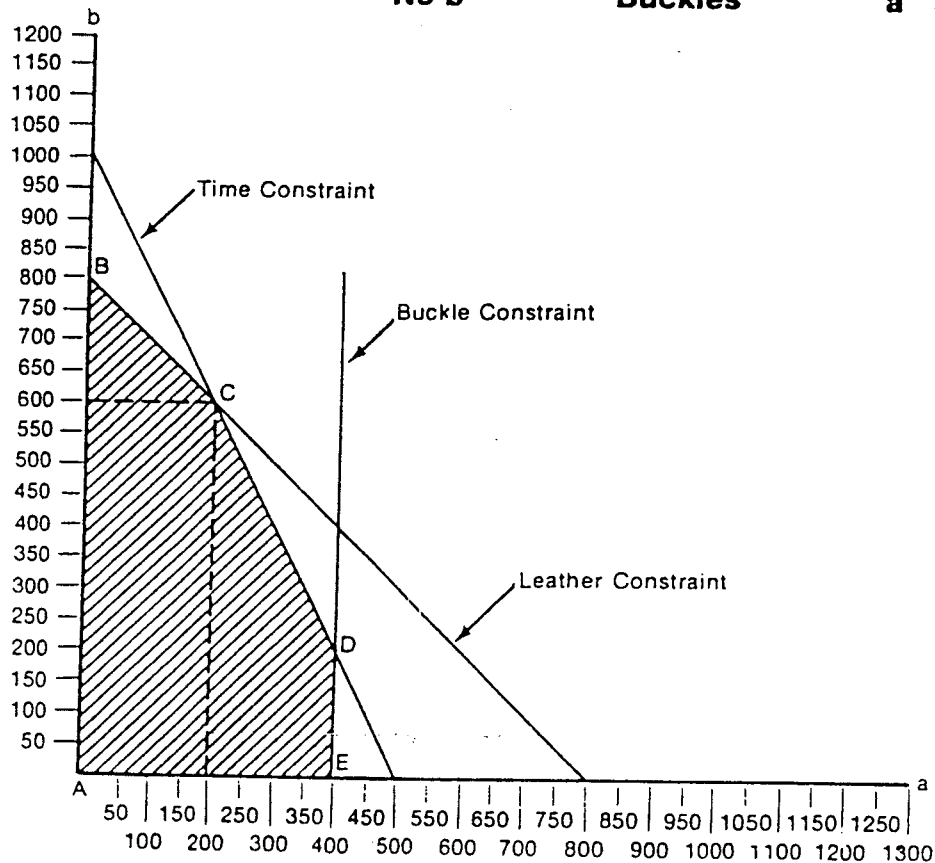
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E21-13 APPENDIX**Graphic method:****Objective function: Maximize $CM = 4a + 3b$**

Constraints:

$2a + b \leq 1,000$	Time
$a + b \leq 800$	Leather
$a \leq 400$	Buckles

When: $a = 0$ $b = 1,000$ Time $b = 800$ Leather No b Buckles	When: $b = 0$: $a = 500$ $a = 800$ $a = 400$
--	---

**Trying values at each of the corner points,**

$$A = (a = 0, b = 0); \quad 4(0) + 3(0) = \$ 0 \text{ CM}$$

$$B = (a = 0, b = 800); \quad 4(0) + 3(800) = \$2,400 \text{ CM}$$

$$C = (a = 200, b = 600); \quad 4(200) + 3(600) = \$2,600 \text{ CM} \leftarrow$$

$$D = (a = 400, b = 200); \quad 4(400) + 3(200) = \$2,200 \text{ CM}$$

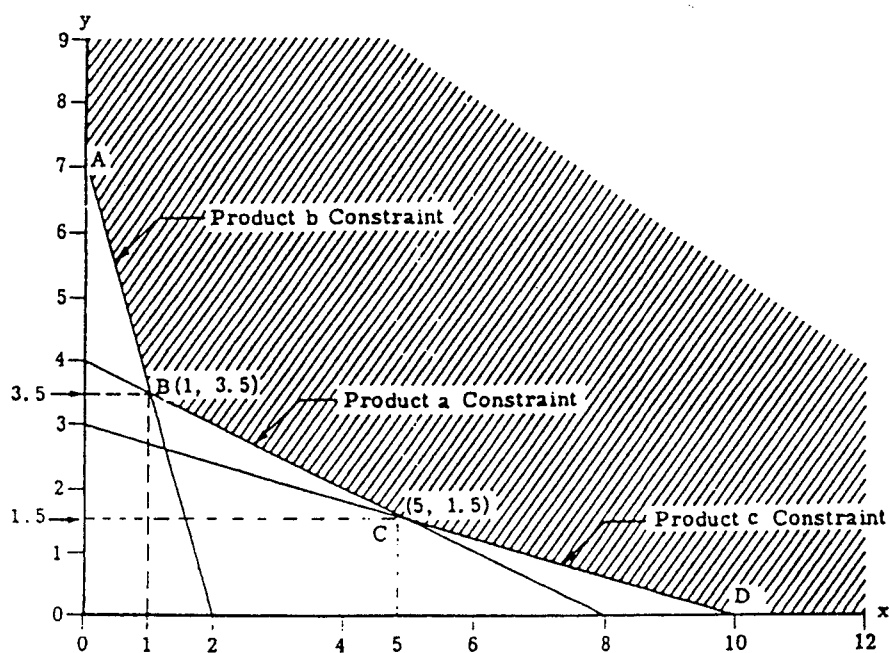
$$E = (a = 400, b = 0); \quad 4(400) + 3(0) = \$1,600 \text{ CM}$$

Optimum combination would be 200 a and 600 b

$$200 (4) + 600 (3) = \$2,600 \text{ CM}$$

E21-14 APPENDIX**Graphic method:****Cost function is: Minimize $C = \$3x + \$4y$**

Subject to constraints:

$$\begin{aligned} 4x + 8y &\geq 32 \\ 7x + 2y &\geq 14 \\ 1.5x + 5y &\geq 15 \end{aligned}$$
**Possible solutions:**

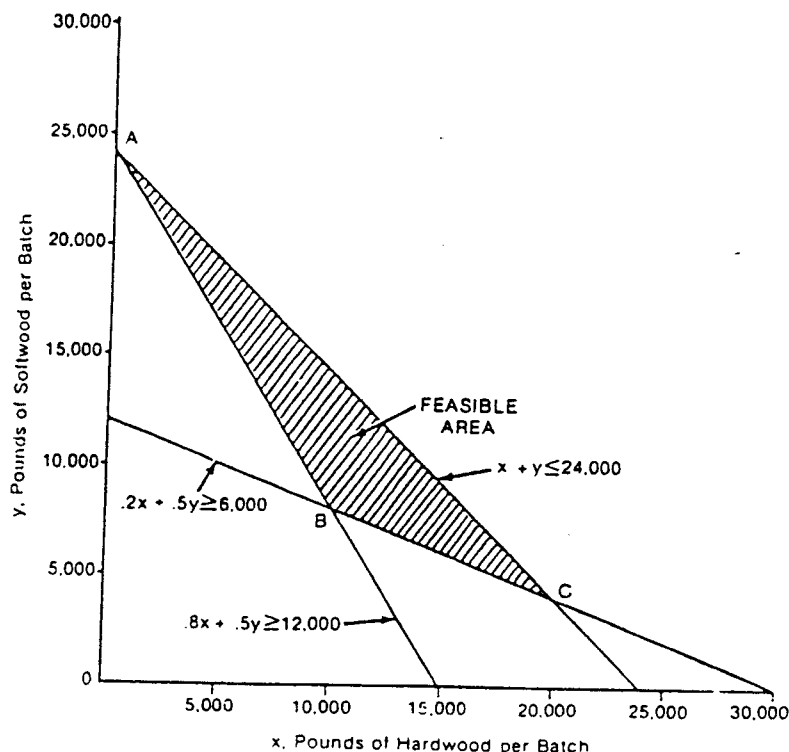
Points	x	y	3x	4y	3x + 4y
A	0	7	0	28	\$28
B	1	3.5	3	14	17
C	5	1.5	15	6	21
D	10	0	30	0	30

→ Optimum solution: Use 1 ton of x and 3.5 tons of y for a minimum total cost of \$17.

E21-15 APPENDIX

Let x = pounds of hardwood per batch Subject to: $x + y \leq 24,000$
 y = pounds of softwood per batch $.8x + .5y \geq 12,000$
 $.2x + .5y \geq 6,000$

Minimize: $C = .50X + .40Y$



Corner point B values:

$$.2x + .5y = 6,000$$

$$.8x + .5y = 12,000$$

$$.6x = 6,000$$

$$x = 10,000$$

Substitute:

$$.2(10,000) + .5y = 6,000$$

$$.5y = 4,000$$

$$y = 8,000$$

Corner point C values:

$$.2x + .5y = 6,000$$

$$x + y = 24,000$$

$$\text{Multiply by 2: } .4x + y = 12,000$$

$$x + y = 24,000$$

$$.6x = 12,000$$

$$x = 20,000$$

Substitute:

$$.2(20,000) + .5y = 6,000$$

$$.5y = 2,000$$

$$y = 4,000$$

Trying values at each of the corner points:

$$A = (x = 0, y = 24,000); \$.50(0) + \$.40(24,000) = \$ 9,600 C$$

$$B = (x = 10,000, y = 8,000); \$.50(10,000) + \$.40(8,000) = \$ 8,200 C \leftarrow$$

$$C = (x = 20,000, y = 4,000); \$.50(20,000) + \$.40(4,000) = \$ 11,600 C$$

Optimal solution: 10,000 pounds of hardwood per batch and 8,000 pounds of softwood per batch results in a cost equal to the \$8,200 standard per batch

PROBLEMS

P21-1

- (1) The differential cost analysis for the Glasgow Industries' order for 120,000 valves follows:

Incremental revenue (\$18 per unit × 120,000 units)		\$2,160,000
Incremental costs:		
Variable costs:		
Direct materials (\$5 per unit × 120,000 units)	\$ 600,000	
Direct labor (\$6 per unit × 120,000 units)	720,000	
Variable overhead (\$6 × 1/2 hour per unit × 120,000 units)	360,000	
Shipping expense (\$1 per unit × 120,000 units)	<u>120,000</u>	
Total variable costs	\$1,800,000	
Fixed costs:		
Supervisory and clerical costs (120,000 + 30,000 per month × \$12,000 per month)	<u>48,000</u>	<u>1,848,000</u>
Increment to pretax profit as a result of accepting the offer		<u>\$ 312,000</u>

- (2) The minimum unit sales price that Sommers could accept without reducing net income must cover all differential costs (i.e., the variable costs plus the out-of-pocket fixed costs). Therefore, the minimum sales price per unit would be:

Variable cost per unit:	
Direct materials	\$ 5.00
Direct labor	6.00
Variable overhead (\$6 per hour × 1/2 hour per unit)	3.00
Shipping expense	1.00
Additional fixed cost per unit:	
Supervisory and clerical costs (\$12,000 total cost + 30,000 units)	<u>.40</u>
Minimum unit sales price	<u>\$15.40</u>

P21-1 (Concluded)

- (3) Sommers Company management should consider the following factors before accepting the Glasgow Industries order:
- The effect of the special order on Sommers' sales to other customers at the regular sales price.
 - The possibility of establishing contacts in the international marketplace as a result of the sales to Glasgow Industries, which could lead to market expansion.
 - The wear and tear on machinery that might increase maintenance and repairs and result in a premature replacement of the machinery.
 - Possible retaliation by competitors who may learn of Sommers' deep price-cutting action, including risk of a price war that would disrupt regular selling prices.

P21-2

(1) Impact on net income if APA accepts bid:			
Submitted bid.....			\$165,000
Less sales commission			<u>16,500</u>
Net sales			\$148,500
Variable costs:			
Direct materials.....	\$29,200		
Direct labor	56,000		
Variable factory overhead (30% of direct labor)*		16,800	<u>102,000</u>
Contribution margin			\$ 46,500
Income tax (40%).....			<u>18,600</u>
Increase in net income.....			<u>\$ 27,900</u>

*The factory overhead rate is 50% of direct labor dollars. Based on the experience for the fiscal year ended September 30, the rate due to the variable factory overhead cost is 30% (\$2,250 ÷ \$7,500).

(2) Framar would realize a positive contribution margin of \$12,300 before income tax, increasing net income by \$7,380, if the \$127,000 counteroffer is accepted:			
Counteroffer.....			\$127,000
Sales commission			<u>12,700</u>
Net sales			\$114,300
Variable manufacturing costs (from requirement (1))			<u>102,000</u>
Contribution margin			\$ 12,300
Income tax (40%).....			<u>4,920</u>
Increase in net income.....			<u>\$ 7,380</u>

P21-2 (Concluded)

- (3) The lowest price that Framar could quote on this machinery without reducing its net income is \$113,333 (\$102,000 + .9). This bid would cover exactly the sum of the variable manufacturing costs (\$102,000) and the 10% sales commission, thereby resulting in no increase in contribution margin and no income tax.
- (4) If Framar Inc. accepted all of its work at prices similar to the \$127,000 counteroffer, a loss situation could result. The analyses for requirements (1), (2), and (3) were short-run decisions in situations in which Framar had excess capacity. Consequently, the analyses concentrated on covering only the differential variable cost. However, when all orders are considered, Framar must cover both its variable and its fixed costs. A bid for all work similar to the one for \$127,000 would not cover Framar's fixed cost.

Calculations restating the most recent entire fiscal year on the \$127,000 price/variable cost relationship are as follows (000s omitted):

Sales (\$15,750 x 1.245)*	\$19,609
Less commission	<u>1,961</u>
	\$17,648

Expenses (per income statement for year ended 9/30):

Variable cost.....	\$15,750	
Fixed cost	<u>2,250</u>	<u>18,000</u>
		<u>\$ (352)</u>

*Annual variable costs:

Direct materials.....	\$ 6,000
Direct labor	7,500
Variable factory overhead	<u>2,250</u>
	<u>\$15,750</u>

$$\text{Markup on variable costs} = \frac{\$127,000}{\$102,000} = 1.245$$

P21-3

(1) An analysis comparing costs of each alternative:

(a) Schedule overtime hours:

	Overtime Hours Required	
May.....	1,000	
June	2,000	
July.....	2,000	
August	2,500	
September.....	2,500	
October	2,000	
	<u>12,000</u>	
Inefficiency (5%).....	600	
Total overtime hours.....	<u>12,600</u>	
Additional labor costs (12,600 x \$6 x 1.5)		\$113,400
Related fringe benefits (\$113,400 x .10)		<u>11,340</u>
Differential cost if overtime is scheduled		<u>\$124,740</u>

(b) Hire temporary workers:

Extra hours required	12,000
Inefficiency factor (25%)	<u>3,000</u>
Total hours required	15,000
Hourly rate for temporary workers.....	x \$6
Differential cost if temporary workers hired	<u>\$ 90,000</u>

There are no fringe benefit costs with temporary workers.

P21-3 (Continued)

- (c) Expand labor force and schedule level production of 10,000 units per month: If the labor force is expanded so that level production can be scheduled, Valbec will produce 10,000 doll house units per month, requiring 5,000 direct labor hours. This means that 12,000 additional regular direct labor hours will be required during 20A with no scheduled overtime or need for temporary workers, as shown below:

	<u>Requirements</u>	
	<u>Month</u>	<u>Annual</u>
Forecast production in units.....	<u>10,000</u>	<u>120,000</u>
Direct labor hours required	<u>5,000</u>	<u>60,000</u>
Former direct labor constraint in hours.....	<u>4,000</u>	<u>48,000</u>
Additional regular hours in 20A	<u>1,000</u>	<u>12,000</u>
Direct labor costs:		
Regular time (12,000 x \$6).....	\$72,000	
Related fringe benefits (\$72,000 x .20)...	<u>14,400</u>	<u>\$86,400</u>
Additional inventory carrying costs (refer to the schedule of inventory levels below):		
Average monthly inventory with overtime or temporary workers	13,846	
Average monthly inventory with level production	<u>16,231</u>	
Difference	2,385	
Estimated annual cost of carrying inventory per unit	x \$1	<u>2,385</u>
Differential costs if level production is used.....		<u>\$88,785</u>

P21-3 (Concluded)

Last Day of Month	Schedule of Inventory Levels				
	Use Overtime or Temporary Workers*	Level Production			
	Beginning*	Production	Sales	Ending*	
December.....	8,000			8,000	
January	8,000	8,000	10,000	8,000	10,000
February.....	8,000	10,000	10,000	8,000	12,000
March	8,000	12,000	10,000	8,000	14,000
April.....	8,000	14,000	10,000	8,000	16,000
May.....	10,000	16,000	10,000	8,000	18,000
June	12,000	18,000	10,000	10,000	18,000
July.....	12,000	18,000	10,000	12,000	16,000
August.....	13,000	16,000	10,000	12,000	14,000
September.....	13,000	14,000	10,000	13,000	11,000
October	12,000	11,000	10,000	13,000	8,000
November.....	8,000	8,000	10,000	12,000	6,000
December.....	8,000	6,000	10,000	8,000	8,000
	<u>128,000</u>				<u>159,000</u>
Average per month excluding safety stock (divide by 13)	9,846				12,231
Safety stock	<u>4,000</u>				<u>4,000</u>
Average monthly inventory	<u>13,846 units</u>				<u>16,231 units</u>

*Excludes safety stock of 4,000 doll house units.

Alternative (c) affords the lowest estimated differential cost.

- (2) There are several noncost factors, or factors that are difficult to cost, that Valbec should consider in conjunction with the cost analysis of the three alternative courses of action. Relevant factors include:
- Consider the degree to which Valbec's regular labor force is willing to work overtime.
 - The labor force may plan on overtime pay as part of their normal work situation. If wages should be reduced because overtime is not scheduled, due to the use of temporary workers or an expanded labor force, then the morale of the labor force could deteriorate, laborers might seek work elsewhere, laborers might seek base pay increases, or the labor force might decrease its efficiency.
 - Overtime does provide a certain degree of flexibility, should sales volume and patterns not occur according to the forecasted plan.
 - If the labor force is to be expanded, Valbec must be sure there is an adequate supply of skilled workers.

P21-4

Group I production costs:

Materials ($\$3.27 \times 25$)	\$.131
Labor ($(\$9.48 \times 2.5) + 25$) .....	.948
Variable factory overhead ($\$.948 \times 150\%$)	1.422
Total variable unit cost	<u>\$ 2.501</u>
Total variable cost ($\$2.501 \times (3 + 2) \times 2,000$)	\$25,010
Additional fixed factory overhead	7,040
	<u>\$32,050</u>

Group II production costs:

Materials ($\$3.60 \times 20$)	\$.180
Labor ($(\$12.16 \times 2) + 20$)	1.216
Variable factory overhead ($\$1.216 \times 150\%$)	1.824
	<u>\$ 3.220</u>
Total variable cost ($\$3.220 \times (2 + 2 + 4) \times 2,000$)	\$51,520
Additional fixed factory overhead	6,000
	<u>\$57,520</u>

Sales ($\$58 \times 2,000$)	<u>\$116,000</u>
-------------------------------------	------------------

Group I costs:

Outside suppliers:

Dissection knives ($\$3.20 \times 3 \times 2,000$)	\$19,200
Scalpels ($\$3.30 \times 2 \times 2,000$)	13,200

\$32,400

Group I production costs (computed above)	\$32,050	} \$ 32,050
---	----------	-------------

Group II costs:

Outside suppliers:

Scissors ($\$3.00 \times 2 \times 2,000$)	\$12,000
Tweezers ($\$2.97 \times 2 \times 2,000$)	11,880
Clamps ($\$3.28 \times 4 \times 2,000$)	26,240

\$50,120

Group II production costs (computed above)	\$57,520	} 50,120
---	----------	----------

Glass slides ($\$.03 \times 100 \times 2,000$)	6,000
Cover slips ($\$.01 \times 400 \times 2,000$)	8,000
Cases ($\$6 \times 2,000$)	12,000
Set assembly costs ($\$3 \times 2,000$)	6,000
Total production costs	<u>\$114,170</u>
Operating profit contribution	<u>\$ 1,830</u>

P21-4 (Concluded)

Production of Group I components is less costly than purchasing from outsiders, and purchasing Group II components from outsiders is less costly than producing them. However, the estimated operating profit contribution is only marginally positive (\$1,830 or 1.6% of the estimated sales figure) and any necessary additional marketing cost related to the dissection instrument sets would further reduce the expected profit contribution.

Present annual fixed factory overhead is excluded from the differential cost analysis, because these costs will be incurred whether or not the sets are marketed.

Based on the information assembled by the study team, the proposal has little merit.

P21-5

- (1) The lowest price Chemco should bid for a one-time special order of 25,000 pounds (25 lots) would be \$34,750, which is equal to the variable costs of the order, determined as follows:

Direct materials:

On a one-time-only special order, chemicals used in manufacturing the firm's main product have a relevant cost of their expected future cost, represented by the current market price per pound. Chemicals not used in current production have a relevant cost of their value to the firm.

CW-3 (400 pounds per lot x 25 lots) = 10,000 pounds.

Substitute CN-5 on a one-for-one basis to its total of 5,500 pounds. The relevant cost is the salvage value .. \$ 500

The remaining 4,500 pounds would be CW-3 at the relevant cost of \$.90 per pound, its expected future cost 4,050

JX-6 (300 pounds per lot x 25 lots x \$.60 per pound) 4,500

MZ-8 (200 pounds per lot x 25 lots x \$1.60 per pound) 8,000

BE-7 (100 pounds per lot x 25 lots x (\$.65 cost per pound - \$.10 handling per pound))..... 1,375

Total direct materials cost \$18,425

Direct labor:

(60 DLH per lot x 25 lots) = 1,500 DLH

Because only 800 DLH can be scheduled during regular time this month, overtime would have to be used for the remaining 700 hours; therefore, overtime is a relevant cost for this order.

1,500 DLH x \$7.00 per DLH at regular time rate..... \$10,500

700 DLH x \$3.50 overtime premium per DLH..... 2,450

Total direct labor cost \$12,950

Factory overhead:

This special order will not increase fixed factory overhead cost, and it is not an order for a continuing project that should contribute to the recovery of fixed factory overhead. Therefore, the fixed factory overhead is not relevant, and the relevant factory overhead charge is the variable factory overhead rate.

1,500 DLH x \$2.25 variable factory overhead rate..... \$ 3,375

Total differential cost of manufacturing this special order and the minimum bid price for the order \$34,750

P21-5 (Concluded)

- (2) Calculation of the price for recurring orders of 25,000 pounds (25 lots) follows:

Direct materials:

Because of the possibility of future orders, all raw materials must be charged at their expected future cost, represented by the current market price per pound.

CW-3 (400 pounds per lot x 25 lots x \$.90 per pound)	\$ 9,000
JX-6 (300 pounds per lot x 25 lots x \$.60 per pound)	4,500
MZ-8 (200 pounds per lot x 25 lots x \$1.60 per pound)	8,000
BE-7 (100 pounds per lot x 25 lots x \$.65 per pound)	1,625
Total direct materials cost	<u>\$23,125</u>

Direct labor:

60% of the production of a batch (900 DLH) can be done on regular time; the remaining 600 DLH directly cause overtime to be incurred and are, thus, a relevant cost of this new product.

1,500 DLH x \$7.00 regular rate per DLH	\$10,500
600 DLH x \$3.50 overtime premium per DLH	2,100
Total direct labor cost	<u>\$12,600</u>

Factory overhead:

All new products should contribute to the recovery of fixed factory overhead as well as cover all variable costs. Therefore, the overhead charge would be the full overhead rate.

1,500 DLH x \$6.00 per DLH	\$ 9,000
Full manufacturing cost	<u>\$44,725</u>
Markup of 40% on cost (\$44,725 x .40)	17,890
Full manufacturing cost plus 40% markup	<u>\$62,615</u>

P21-6

	<u>Present Capacity</u>	<u>Additional Capacity</u>	<u>Total</u>
Sales:			
50,000 x \$10.....	\$500,000		
25,000 x \$10.....		<u>\$250,000</u>	<u>\$750,000</u>
Variable expenses:			
Direct materials:			
50,000 x \$2.....	\$100,000		
25,000 x (\$2 x .94)		\$ 47,000	
50,000 x (\$2 x .06)		(6,000)	\$141,000
Direct labor (\$4 x 1.05)	\$4.20		
Factory overhead.....	1.30		
	<u>\$5.50</u>		
50,000 x \$5.50.....	275,000		
25,000 x \$5.50.....		137,500	412,500
Marketing expense	12,000	6,000	18,000
Total variable expense.....	<u>\$387,000</u>	<u>\$184,500</u>	<u>\$571,500</u>
Contribution margin.....	<u>\$113,000</u>	<u>\$ 65,500</u>	<u>\$178,500</u>
Fixed expenses:			
Factory overhead.....	\$ 72,500	\$ 15,000	\$ 87,500
Marketing expense	11,000		
Increase in advertising (\$11,000 x .10 x .25)		275	11,275
Additional plant depreciation:			
\$260,000 ÷ 25 yrs. = \$10,400			
\$ 84,000 ÷ 20 yrs. = 4,200			
	<u>\$14,600</u>		
\$14,600 x .95* =		13,870	13,870
Total fixed expense.....	<u>\$ 83,500</u>	<u>\$ 29,145</u>	<u>\$112,645</u>
Operating income	<u>\$ 29,500</u>	<u>\$ 36,355</u>	<u>\$ 65,855</u>

*5% allocated to inventories.

The expected operating income from additional capacity (\$36,355) should be evaluated as to whether or not it is a satisfactory return on the additional capital investment of \$344,000 (\$260,000 + \$84,000) (See Chapters 23 and 24).

P21-7

(1)

MARX CORPORATION
Boston Plant
Computation of Number of Units of Xoff Required To Cover
Fixed Factory Overhead and Fixed Regional Promotional Costs

	Total (000s omitted)	Per Unit
Sales	\$2,200	\$20
Variable factory costs:		
Direct materials	\$ 550	\$ 5
Direct labor	660	6
Variable factory overhead	440	4
Total variable cost	\$1,650	\$15
Contribution margin	\$ 550	\$ 5

Units required to cover fixed factory overhead and fixed regular promotional costs:

$$\frac{(\$700,000 + \$100,000)}{\$5 \text{ contribution margin}} = 160,000 \text{ units of Xoff}$$

(2)

MARX CORPORATION
Schedule of Budgeted Contribution Margin and Operating Income
If Boston Operations Are Expanded Under Plan A

	(000s omitted)		
	Total	Boston	Chicago
Sales	\$7,400	\$3,400	\$4,000
Variable factory costs:			
Direct materials	\$1,850	\$ 850	\$1,000
Direct labor	2,020	1,020	1,000
Variable factory overhead	1,380	680	700
Total variable cost	\$5,250	\$2,550	\$2,700
Contribution margin	\$2,150	\$ 850	\$1,300
Fixed costs:			
Fixed factory overhead	\$1,600	\$ 700	\$ 900
Regional promotional cost	320	220	100
Total fixed cost	\$1,920	\$ 920	\$1,000
Plant operating income	\$ 230	\$ (70)	\$ 300
Allocated home office cost	310	142*	168**
Operating income (loss)	\$ (80)	\$ (212)	\$ 132

* \$3,400 Boston sales
\$7,400 Total sales

x \$310 Home office cost = \$142

** \$4,000 Chicago sales
\$7,400 Total sales

x \$310 Home office cost = \$168

P21-7 (Continued)

MARX CORPORATION
Schedule of Budgeted Contribution Margin and Operating Income
If Boston Plant Is Closed and Chicago Operations Are Expanded
Under Plan B

	<u>Chicago Operations</u> (000s omitted)
Sales.....	<u>\$6,200</u>
Variable factory costs:	
Direct materials.....	\$1,550
Direct labor	1,550
Variable factory overhead.....	<u>1,085</u>
Total variable factory cost.....	<u>\$4,185</u>
Contribution margin	<u>\$2,015</u>
Fixed costs:	
Fixed factory overhead.....	\$ 950
Regional promotional cost.....	<u>200</u>
Total fixed cost.....	<u>\$1,150</u>
Plant operating income	\$ 865
Allocated home office cost.....	<u>310</u>
Operating income.....	<u><u>\$ 555</u></u>

P21-7 (Concluded)

MARX CORPORATION
Schedule of Budgeted Contribution and Operating Income
If Boston Plant Is Closed and Royalty Agreement Is Contracted
Under Plan C

	(000s omitted)		
	<u>Total</u>	<u>Boston</u>	<u>Chicago</u>
Revenues:			
Sales	\$4,000		\$4,000
Royalties	275	\$275	
Total revenues	<u>\$4,275</u>	<u>\$275</u>	<u>\$4,000</u>
Variable factory costs:			
Direct materials	\$1,000		\$1,000
Direct labor	1,000		1,000
Variable factory overhead	700		700
Total variable factory cost	<u>\$2,700</u>		<u>\$2,700</u>
Contribution margin	<u>\$1,575</u>	<u>\$275</u>	<u>\$1,300</u>
Fixed costs:			
Fixed factory overhead	\$ 950	\$ 50	\$ 900
Regional promotional cost	200	100	100
Total fixed cost	<u>\$1,150</u>	<u>\$150</u>	<u>\$1,000</u>
Plant operating income and royalties	\$ 425	\$125	\$ 300
Allocated home office cost	310		310
Operating income (loss)	<u>\$ 115</u>	<u>\$125</u>	<u>\$ (10)</u>

P21-8

Source: *Management Accounting Campus Report* (Montvale, N.J.: Institute of Management Accountants (formerly National Association of Accountants), Spring, 1987), pp. 4-5. Copyright Spring, 1987, by Institute of Management Accountants (formerly National Association of Accountants). All rights reserved. Reprinted by permission.

Lex Glass Company should implement the proposed plan to purchase silica in the discount quantity. The annual savings from implementation of the plan would be \$48,150, determined as follows:

Annual cost with quantity discount plan:

Interest expense to finance carrying inventory:

Average level of inventory in tons:			
Lex Glass's requirements	10,000		
Requirements of other manufacturers			
((300,000 + 12 months + 2) average +			
(300,000 + 12 months + 2)			
minimum).....	25,000	35,000	
Price per ton with discount.....		x \$1.80	
Total average cost of inventory		\$63,000	
Rate of interest to carry inventory		x 5%	\$ 3,150
Cost of purchasing inventory (420,000 tons x \$1.80).....			756,000
Additional costs to carry additional inventory:			
Labor		\$20,000	
Administrative expenses		10,000	
Lost revenue from rental of warehouse			
required to store additional inventory		10,000	40,000
			\$799,150
Less revenue from the sale of silica to other			
manufacturers (300,000 tons x \$2 per ton)			600,000
Annual cost of quantity discount plan.....			\$199,150

Annual cost without quantity discount plan:

Interest expense to finance inventory:

Average level of inventory in tons	10,000		
Price per ton without discount.....	x \$2.00		
Total average cost of inventory	\$ 20,000		
Rate of interest to carry inventory	x5%		
Interest expense	\$ 1,000		
Cost of purchasing silica (120,000 tons x \$2)	240,000	241,000	

Annual cost savings available by implementing quantity discount plan..... \$ (41,850)

P21-9

(1)

	Colored Paper		Glossy Paper	
	Bulk	First Class	First Class	Late First Class
Gross revenue potential.....	\$2,000,000	\$2,200,000	\$2,500,000	\$2,200,000
Brochure and mailing costs:				
Design	\$ 1,000	\$ 1,000	\$ 3,000	\$ 3,000
Typesetting	800	800	2,000	2,000
Paper cost ¹	16,000	16,000	36,000	36,000
Printing cost ²	20,000	20,000	80,000	80,000
Postage ³	80,000	520,000	520,000	520,000
Handling ⁴	20,000	20,000	40,000	40,000
Total cost.....	\$ 137,800	\$ 577,800	\$ 681,000	\$ 681,000
Net revenue potential	\$1,862,200	\$1,622,200	\$1,819,000	\$1,519,000

¹Paper cost:

²Postage:

Plain: \$.005/unit x 2,000,000 units = \$10,000
Colored: \$.008/unit x 2,000,000 units = \$16,000
Glossy: \$.018/unit x 2,000,000 units = \$36,000

Bulk: \$.04/unit x 2,000,000 units = \$80,000
First class: \$.26/unit x 2,000,000 units = \$520,000

³Printing cost:

⁴Handling:

Plain: \$.003/unit x 2,000,000 units = \$6,000
Colored: \$.010/unit x 2,000,000 units = \$20,000
Glossy: \$.040/unit x 2,000,000 units = \$80,000

Plain and colored: \$.01/unit x 2,000,000 units = \$20,000
Glossy: \$.02/unit x 2,000,000 units = \$40,000

P21-9 (Concluded)**(2) Net revenue potential:**

The colored paper brochure provides the most net revenue if it can be mailed at bulk mail rates; however, there is a risk of earning only the third best revenue if it must be mailed first class. The glossy paper, if it can be mailed on time, produces the second largest amount of net revenue; however, the ranking slips to the fourth best net revenue if it is mailed late. The plain paper bulk mail brochure has a substantially lower net revenue than any of the other alternatives.

Image as a well-run organization:

The image would be based upon comparison of two things related to the mail campaign—the quality of the brochure (appearance) and the arrival of the brochure immediately following the radio and television coverage. The glossy brochure, if it arrives on time, would probably convey the best image; however, there is some risk that it would not arrive on a timely basis. The colored paper brochure would be the next best in terms of quality, but the bulk mail alternative raises some risk of a timely receipt of the brochures by the potential donors. The plain paper brochure would be the poorest quality, and because it is to be sent bulk mail, it runs the additional risk of not being delivered on a timely basis.

Image as a fiscally responsible organization:

The image of fiscal responsibility will be based on a comparison of potential donors' perceptions regarding the cost of the brochure and cost of the mailing. The glossy brochure mailed first class may be perceived as an extravagance by the potential donors. At the other extreme, the potential donors may conclude that the plain paper bulk mail alternative is an indication that the organization is unwilling to devote adequate financial resources to the fund-raising efforts.

The foundation staff must weigh the consequences of each of the alternatives and the risks associated with them on the three criteria to select a specific alternative. The staff has good information on net revenue potential, but needs to obtain information on the effects of the quality of the brochure, the timeliness of the mailing, and the type of mailing on potential donors' opinions as to what is a well-run and fiscally responsible organization.

P21-10

(1)

JUSTA CORPORATION
Quarterly Income Statement

	<u>Total</u>	<u>Local</u>	<u>Regional</u>
Sales	\$1,300,000	\$1,000,000	\$300,000
Variable expenses:			
Manufacturing (Schedule A)....	\$ 820,000	\$ 630,000	\$190,000
Marketing (Schedule B).....	31,000	24,000	7,000
Total variable expense	\$ 851,000	\$ 654,000	\$197,000
Contribution margin.....	\$ 449,000	\$ 346,000	\$103,000
Separable fixed marketing expense	74,000	36,000	38,000
Net market contribution.....	\$ 375,000	\$ 310,000	\$ 65,000
Common fixed expenses:			
Manufacturing (\$1,010,000 - \$820,000).....	\$ 190,000		
Administrative.....	52,000		
Total common fixed expense	\$ 242,000		
Operating income	\$ 133,000		

Schedule A—Variable Manufacturing Expenses

(1) Product	(2) %	(3) Local Sales	(4) Local Variable Expenses (2) x (3)	(5) Regional Sales	(6) Regional Variable Expenses (2) x (5)	(7) Total Variable Expenses (4) + (6)
A	80	\$400,000	\$240,000	\$100,000	\$ 80,000	\$300,000
B	70	300,000	210,000	100,000	70,000	280,000
C	80	300,000	180,000	100,000	80,000	240,000
Total.....			<u>\$630,000</u>		<u>\$190,000</u>	<u>\$820,000</u>

Schedule B—Variable Marketing Expenses

(1) Product	(2) %	(3) Local Sales	(4) Local Variable Expenses (2) x (3)	(5) Regional Sales	(6) Regional Variable Expenses (2) x (5)	(7) Total Variable Expenses (4) + (6)
A	3	\$400,000	\$12,000	\$100,000	\$3,000	\$15,000
B	2	300,000	6,000	100,000	2,000	8,000
C	2	300,000	6,000	100,000	2,000	8,000
Total.....			<u>\$24,000</u>		<u>\$7,000</u>	<u>\$31,000</u>

Separable fixed marketing expense computation:

	<u>Local</u>	<u>Regional</u>
Total marketing expense.....	\$60,000	\$45,000
Less variable (Schedule B).....	24,000	7,000
Fixed marketing expense.....	<u>\$36,000</u>	<u>\$38,000</u>

P21-10 (Concluded)

- (2) **No. The regional market should not be dropped. The regional market sales are adequate to cover variable expense and separable fixed expense of the regional market and contribute \$65,000 toward the recovery of the \$242,000 common fixed expense and operating income.**

If the regional market is dropped, the local market contribution margin must absorb its own separable fixed marketing expense plus all common fixed expense as shown below:

Contribution margin	\$ 346,000
Separable fixed marketing expense	<u>36,000</u>
Net market contribution	\$ 310,000
Total common fixed expense	<u>242,000</u>
Operating income	<u>\$ 68,000</u>

Thus the corporation operating income declines from \$133,000 to \$68,000. This \$65,000 reduction is the amount of the contribution loss from the regional market.

(3)

JUSTA CORPORATION
Quarterly Income Statement

	Total	Product A	Product B	Product C
Sales	<u>\$1,300,000</u>	<u>\$500,000</u>	<u>\$400,000</u>	<u>\$400,000</u>
Variable expense:				
Manufacturing				
(Schedule A)*	\$ 820,000	\$300,000	\$280,000	\$240,000
Marketing				
(Schedule B)*	<u>31,000</u>	<u>15,000</u>	<u>8,000</u>	<u>8,000</u>
Total variable expense ...	<u>\$ 851,000</u>	<u>\$315,000</u>	<u>\$288,000</u>	<u>\$248,000</u>
Contribution margin	<u>\$ 449,000</u>	<u>\$185,000</u>	<u>\$112,000</u>	<u>\$152,000</u>
Fixed expenses:				
Manufacturing	\$ 190,000			
Marketing	74,000			
Administrative	<u>52,000</u>			
Total fixed expense	<u>\$ 316,000</u>			
Operating income	<u>\$ 133,000</u>			

*Schedules A & B are in the requirement (1) solution.

- (4) **When the new product replaces Product C, the minimum contribution margin per quarter must be at least \$162,000 (the present contribution margin of Product C + \$10,000 of new fixed expense) in order for Justa Corporation to be no worse off financially than it is currently. This contribution margin will still provide operating income of \$133,000.**

CASES

C21-1

- (1) \$21 per unit, a total of \$210,000 for 10,000 units, is the lowest price the company could accept without reducing budgeted income of the coming quarter. At any lower price, the special order would add more to costs than it adds to revenues, reducing the coming quarter's budgeted operating income. The price is calculated to equal the relevant costs of filling the special order. First, calculate the following per-unit variable costs of *regular* units:

Budgeted manufacturing costs for the quarter. . .	\$5,400,000
Less: Budgeted fixed cost (3 mo. x \$1,400,000)	<u>4,200,000</u>
Budgeted variable manufacturing costs	\$1,200,000
Budgeted volume of regular business.	÷ 100,000 units
Budgeted variable manuf. cost per <i>regular</i> unit	<u>\$ 12.00</u>
Budgeted selling & admin. costs for the quarter	\$3,200,000
Less: Budgeted fixed cost (3 mo. x \$900,000)	<u>2,700,000</u>
Budgeted variable S & A costs for the quarter	\$ 500,000
Budgeted volume of regular business.	÷ 100,000 units
Budgeted variable S & A cost per <i>regular</i> unit	<u>\$ 5.00</u>
Regular sales commission (5% of \$90 price). . . .	<u>4.50</u>
Budgeted S & A cost per unit, excl. commission	<u>\$.50</u>

The case states how much to add to the regular direct material and direct labor cost. Two other adjustments must be calculated: (1) The saw is needed for only two months. At a rental of \$5,500 per month, its cost totals \$11,000 for the special order, or \$1.10 per unit. (2) Variable overhead per special unit is triple that of a regular unit, and the case states that this applies to total variable overhead and to the variable overhead of the cut-off operation. The *total* variable overhead cost of a regular unit is \$2.50, and variable overhead of the regular cut-off operation is a part of that total, so the entire \$2.50 is tripled for the special order (and no separate adjustment is needed specifically for the cut-off operation). The \$2.50 is included already in the budgeted costs of regular units, so the adjustment needed to cost the special order is an *additional* \$5.00 per unit $[(3 \times \$2.50) - \$2.50]$, or a total adjustment of \$50,000 for the special order.

Sufficient capacity must be available for the special order. (Otherwise, accepting it would require canceling some regular order(s), and an opportunity cost equal to the lost contribution margin on cancelled orders would be a relevant cost of the special order.) Grinding-machine capacity is limited to 60,000 regular units per month, so the quarter's capacity is 180,000 regular units, and the budgeted volume of 100,000 regular units leaves available capacity equivalent to 80,000 regular units. Each special-order unit uses triple the grinding time of a regular unit, so 10,000 special units require the equivalent of 30,000 regular units' grinding time, well within the 80,000 regular units of available capacity.

C21-1 (Concluded)

	Special Order Relevant Cost Analysis	
	<u>Total</u>	<u>per unit</u>
Units	<u>10,000</u>	<u>1</u>
Relevant costs of special order:		
Regular manufacturing costs....	\$120,000	\$12.00
Regular selling & administrative costs, excluding commission ..	5,000	.50
Additional costs of special order:		
Direct material.....	20,000	2.00
Direct labor.....	-	-
Variable overhead.....	50,000	5.00
Saw rental (2 mo. x \$5,500)	11,000	1.10
Metallurgist's fee	<u>4,000</u>	<u>.40</u>
Relevant costs of special order..	<u>\$210,000</u>	<u>\$21.00</u>

The relevant cost of \$21 per special unit, although considerably higher than that of a regular unit, is far below the regular selling price of \$90. This is because the company's costs are predominately fixed costs, presumably due to high levels of automation. The company will try to negotiate as high a price as possible, but the \$21 figure should be regarded as an absolute minimum.

(2) Nonquantitative factors to consider include the following:

(a) Effects on regular sales

Is the customer who placed the special order a new customer? If so, will they become a regular customer provided the special order is successful? Will that customer always demand large price discounts? Will (or does) the customer use a large quantity of the regular product and pay the full regular price for it?

Will regular customers learn of the special, low price? If so, will they demand large price discounts on their future orders?

Will this special, low price start a price war that can erode regular prices?

(b) Effects on employees and community

Will the special materials and equipment affect levels of safety, environmental pollution, and noise in the company's plant?

Will employees and managers gain valuable new skills and knowledge by producing the special order? (The case states that this is the company's first opportunity to produce and sell this particular type of product.)

Will the special order's affect on total production volume enable the company to avoid laying off valued employees in the coming quarter?

(c) Strategic effects (market share, growth, innovation, etc.)

Does the special order product represent a new or fast-growing market?

Are there learning-curve effects or other advantages to be gained from adding the new type of product sooner rather than later?

Are prices and profit margins on this type of product expected to improve, or is it a mature product likely to decline soon?

C21-2

- (1) Continuing to obtain covers from its own Denver Cover Plant would allow Big-Auto to maintain its current level of control over the quality of the covers and the timing of their delivery. Keeping the Denver Cover Plant open also allows Big-Auto more flexibility than purchasing the covering from outside suppliers. Big-Auto could more easily alter the coverings' design and change the quantities produced, especially if long-term contracts are required with outside suppliers. Big-Auto should also consider the economic impact that closing Denver Cover will have on the community and how this might affect Big-Auto's other operations in the region. In addition, relations with the workforce at other plants could be affected by news of a closing and layoffs at Denver Cover.

(2) (a) The following recurring annual budgeted costs can be avoided by closing the Denver Cover Plant:

Materials.....		\$12,000,000	
Direct labor.....			13,000,000
Indirect costs:			
Supervision	\$3,000,000		
Indirect labor		4,000,000	
Differential pension expense			
(\$4,000,000 - \$3,000,000)		1,000,000	8,000,000
			<u>\$33,000,000</u>

(b) The following recurring annual budgeted costs are not relevant to the decision to close the Denver Cover Plant:

Depreciation—equipment.....	\$ 5,000,000
Depreciation—building	3,000,000
Continuing pension expenses	3,000,000
Plant manager and staff	2,000,000
Corporate allocation.....	6,000,000
	<u>\$19,000,000</u>

The depreciation amounts are not relevant to the decision because they represent portions of sunk costs that are being written off during 20A. Three-fourths of the annual pension expense (\$3,000,000) is not relevant because it would continue whether or not the plant is closed. The amount for plant manager and staff is not relevant because Vosilo and his staff would continue with Big-Auto and administer the three remaining plants. The corporate allocation is not relevant because this represents non-avoidable costs, incurred outside Denver Cover, that are assigned to the plant.

C21-2 (Concluded)

- (c) The following nonrecurring costs would arise due to the closing of the Denver Cover Plant:

Termination charges on cancelled material orders	
(\$12,000,000 x 15%).....	\$1,800,000
Employment assistance.....	<u>1,000,000</u>
	<u>\$2,800,000</u>

These two costs are relevant to the decision because they are incurred only if the Denver Cover Plant is closed. Consequently, they can be avoided if the plant is not closed.

- (d) Items not specifically mentioned in the case that should be considered by Big-Auto before making a decision include:
- (i) The disposal value or alternate uses of the plant.
 - (ii) Any income tax implications; including the income tax rates applicable to gain or loss on the sales of plant and machinery, cost of losing depreciation tax shields, any depreciation and investment tax credit recapture, etc.
 - (iii) Outside supplier's prices in future years.
 - (iv) Cost to manufacture coverings at the Denver Cover Plant in future years.

C21-3

- (1) Factors Calco should consider, before entering the consumer products market, follow:
- (a) the product's contribution margin and break-even point
 - (b) consumer demand for the product in the short run and long run
 - (c) the company's ability to produce the quantity needed in the short and long run
 - (d) the company's lack of experience in the consumer market and the need for different marketing techniques for products sold in the consumer markets
 - (e) quality of the competition
 - (f) the impact of the decision on employees, and the effect of the diversion of Calco management effort on total business

- (2) Alteration of financial forecasts for use in deciding between the alternatives:

	Calco's Marketing Department	Jasco
Income before income tax.....	\$ 225,000	\$ 190,000
Add fixed manufacturing cost:		
100,000-unit level	750,000	
120,000-unit level		900,000
Add share of current Marketing Department's management costs	100,000	
Operating margin	<u>\$1,075,000</u>	<u>\$1,090,000</u>

Instead of a difference of \$35,000 income (\$225,000 - \$190,000) favoring Calco, the new calculation shows a \$15,000 operating margin (\$1,075,000 - \$1,090,000) favoring Jasco. The financial difference is slight, adding significance to the reliability of the financial estimates as well as to the relevance of nonquantitative factors.

- (3) One can only speculate about the reliability of the two proposals. The fact that Jasco has experience in the consumer market is significant in predicting success or failure of the project, but not necessarily for the estimates for the expected benefits of the marketing program or the associated costs. It should be remembered that the Jasco people recently lost their jobs and may be trying especially hard to look good.

Similarly, Calco's Marketing Department may be biased in its estimates in an effort to avoid elimination of existing employee positions.

Manufacturing costs are the same because Calco will manufacture the product. The sales price differs and an explanation of the 5% (\$5 per \$100 of sales) difference in the sales commission rate is not given. Calco's inclusion of assigned Marketing Department management costs is perhaps an attempt to hedge its estimates.

C21-3 (Concluded)

- (4) **Significant nonquantitative factors that Calco's management should consider include:**
- (a) **impact of the decision of Calco's present work force; i.e., morale loss of remaining employees if layoffs happen versus the ability of retained employees to work effectively in the new market,**
 - (b) **abilities and expectations of employees from Jasco, if Jasco is selected,**
 - (c) **the possible diversion of Calco top management effort from its regular line of business, if it does not hire experienced talent.**

No single item may in itself be important enough to warrant selection of one alternative over another. The information presented in the case is limited and does not give an indication that any one nonquantitative factor is more important than any other. However, any one of the factors could be sufficiently significant. For instance, the impact of eliminating Calco's Marketing Department positions, if Jasco is acquired, is perhaps the biggest single nonquantitative factor for consideration. Since these new employees displace existing Calco employees, the management process could be hampered by serious human relations problems.

C21-4

- (1) (a) **The product-line income statement for Precision Gauge Corporation is presented on a full costing basis and, consequently, is not suitable for analysis and decision making. The fact that the statement does not distinguish between variable and fixed costs hinders any analysis of the impact of volume changes on profits. In addition, the statement does not distinguish between costs that are directly related (traceable) to a product line from those that are shared among all products.**
- (b) **An alternative income statement format that would be more suitable for analysis and decision making would incorporate the contribution approach to costing. Expenses would be classified in terms of variability and controllability; such as, variable manufacturing, variable selling and administrative, direct fixed controllable by segment (discretionary), direct fixed controllable by others (committed), and common fixed. The common fixed costs would not be assigned to the product lines because such an allocation would be arbitrary. The contribution approach is more suitable for analysis and decision making because there is a meaningful segregation of costs.**

C21-4 (Continued)

- (2) (a) The suggested discontinuance of the T-gauges would be cost effective, but the suggestions relating to D-gauges and P-gauges would not be cost effective. These conclusions are based on the following quarterly differential cost analysis.

	<u>D-gauge</u>	<u>P-gauge</u>	<u>T-gauge</u>
Unit sales price.....	<u>\$90</u>	<u>\$200</u>	<u>\$180</u>
Unit variable costs:			
Direct materials	\$17	\$ 31	\$ 50
Direct labor	20	40	60
Variable factory overhead	30	45	60
Selling expenses	<u>4</u>	<u>10</u>	<u>10</u>
Total variable costs	<u>\$71</u>	<u>\$126</u>	<u>\$180</u>
Unit contribution margin	\$19	\$ 74	\$ 0
Increase (decrease) in units suggested:			
D-gauge (\$900,000 sales + \$90 price) x .50	x (5,000)		
P-gauge (\$1,600,000 sales + \$200 price) x .15		x 1,200	
T-gauge (\$900,000 sales + \$180 price) x 1.0			x (5,000)
Increase (decrease) in total contribution margin	\$ (95,000)	\$ 88,800	\$ 0
Decrease (increase) in fixed costs:			
D-gauge, \$100,000 - \$20,000	80,000		
P-gauge		(100,000)	
T-gauge			<u>40,000</u>
Increase (decrease) in segment contribution	<u>\$ (15,000)</u>	<u>\$ (11,200)</u>	<u>\$ 40,000</u>

- (b) Yes. The president was correct in eliminating the T-gauges. The T-gauge sales price covers only its variable cost and does not contribute anything to the recovery of fixed factory overhead or promotion costs. Thus, the T-gauge has a zero contribution margin.

C21-4 (Concluded)

- (c) Yes. The president was correct in promoting the P-gauge line rather than the D-gauge line because the unit contribution margin and contribution margin per labor dollar is greater for the P-gauge line than the D-gauge line, determined as follows:

	<u>D-gauge</u>	<u>P-gauge</u>
Unit contribution margin (see (a)).....	\$19.00	\$74.00
Contribution margin per labor dollar:		
\$19 contribution margin + \$20 labor .....	.95	
\$74 contribution margin + \$40 labor		1.85

However, the president's decisions regarding promotion expense do not seem well conceived. The decreased promotion on the D-gauge line and the increased promotion on the P-gauge line do not produce sufficient contribution margin to offset the promotion costs.

- (d) No. The proposed course of action does not make effective use of Precision's capacity. The 15% increase in production volume on the P-gauge line will not require all of the capacity that has been released by discontinuing the T-gauge line and reducing the D-gauge line by 50%.
- (3) Yes. The non-quantitative factors that Precision should consider before it decides whether to drop the T-gauge line include:
- (a) Customer relations—the sale of D-gauges and P-gauges may be related to the sale of T-gauges (i.e., Precision may need a complete line of gauges desired by many customers in order to maintain sales demand for D-gauges and P-gauges).
 - (b) Labor relations—reducing employment may create labor (personnel) problems.

C21-5 APPENDIX

- (1) Let x = rolls of commercial carpet
 y = rolls of residential carpet

Heavy duty fiber constraint: $80x + 40y = 42,000$ lbs.

Regular fiber constraint: $20x + 40y = 24,000$ lbs.

Solving by simultaneous equations:

$$80x + 40y = 42,000$$

$$20x + 40y = 24,000$$

$$\hline 60x = 18,000$$

$$x = 300 \text{ rolls of commercial carpet}$$

$$80(300) + 40y = 42,000$$

$$24,000 + 40y = 42,000$$

$$40y = 18,000$$

$$y = 450 \text{ rolls of residential carpet}$$

- (2) Leastan cannot manufacture these quantities of commercial and residential carpeting, because the direct labor constraint will be exceeded:

Labor constraint: $15x + 15y = 10,500$

Using the requirement (1) solution:

$15(300) + 15(450) = 11,250$, which exceeds the direct labor hour constraint of 10,500 by 750 hours.

- (3) Linear programming is a mathematical model for solving two or more unknowns in two or more equations. Linear programming is used to determine a mix of products that will maximize the contribution margin or minimize costs by identifying the inputs, outputs, and their related assumptions and limitations (constraints) and combining them in the model. Linear programming can be used to allocate limited facilities and resources among their many alternative uses in such a way that optimum benefit is derived from their utilization.

C21-5 APPENDIX (Concluded)

(4)	Commercial	Residential
Sales price per unit.....	<u>\$1,000</u>	<u>\$800</u>
Less variable cost per unit:		
Heavy duty fiber.....	\$ 240	\$120
Regular fiber.....	40	80
Direct labor.....	150	150
Variable factory overhead.....	90	90
.....	<u>\$ 520</u>	<u>\$440</u>
Contribution margin per unit	<u><u>\$ 480</u></u>	<u><u>\$360</u></u>

Let x = rolls of commercial carpet
 y = rolls of residential carpet
 c = pounds of scrap of heavy duty fiber
 d = pounds of scrap of regular fiber

Objective function:

Maximize $CM = 480x + 360y + .25c + .25d$

Constraints:

$80x + 40y + c = 42,000$ pounds of heavy duty fiber
 $20x + 40y + d = 24,000$ pounds of regular fiber
 $15x + 15y \leq 10,500$ direct labor hours

C21-6 APPENDIX

- (1) The linear programming model starts with an objective or goal to be achieved subject to a set of limiting factors, called constraints. The linear programming model allows the user to optimize (maximize or minimize) the objective function subject to the constraints. The central assumption in all linear programming models is linearity. The linearity assumption means that the objective function and the constraints in the model can be expressed in the form of linear equations. The constraints can be in the form of strict equalities, upper bounds (less than or equal to constraints), and lower bounds (greater than or equal to constraints).
- (2) Linear programming methods are applied mainly to allocation problems, i.e., allocating scarce resources among alternative uses according to some objective. The scarce resources for a business firm may include personnel, material, equipment, or capital. The objective function may take the form of profit maximization or some other measure of desired benefit. In this particular case, linear programming is appropriate because the firm of Miller, Lombardi, and York has an objective in the form of profit maximization subject to restricted resources, i.e., staff available in the short run is restricted in each area.
- (3) The following data would be needed to develop the linear programming model for Miller, Lombardi, and York:
 - (a) Total management hours available in each category of service provided.
 - (b) Total hours available for each category of service provided by each type of staff person, i.e., experienced and without experience.
 - (c) Number of microcomputers and hours available.
 - (d) Billing rates for management and staff.
- (4) R. Oliva should consider the following alternative objectives before making the staff allocations:
 - (a) Maximize the computer hours available.
 - (b) Minimize total variable costs consistent with maintaining a high level of professional service.
 - (c) Nonquantitative objectives such as the preferences of individuals in management to be in specific areas of service.

CHAPTER 22

DISCUSSION QUESTIONS

- Q22-1. Effective planning and control of capital expenditures are important because:
- financial risk is increased by long-term commitments;
 - the magnitude of capital expenditures is substantial and the penalties for unwise decisions are usually severe;
 - decisions made in this area provide the supporting structure for operating activities of the firm.
- Q22-2. Examples of opportunities and temptations for unethical behavior in the capital budgeting area include:
- pressure applied to the cost/managerial accountant by superiors or associates to circumvent the capital expenditure approval process, in order to get a pet project approved;
 - pressure to write off or devalue assets below their true value in order to justify replacement;
 - exaggerating the expected economic benefits of a pet project in order to increase the likelihood of getting it approved.
- Q22-3. The cost/managerial accountant has an obligation to the company to make sure that the company's legitimate policies and procedures are not circumvented and to make sure that the data used in the evaluation of capital expenditure proposals are as reliable and realistic as possible. If an ethical violation occurs, the cost/managerial accountant should first discuss the perceived problem with his or her immediate supervisor (in order to clarify the significance of the problem and identify possible courses of action) and then with the individual or individuals involved. If the individual involved is the accountant's immediate supervisor, the cost/managerial accountant should consult the next higher level of management. If the problem cannot be resolved through discussion, the cost/managerial accountant is obligated to provide a full disclosure of all the details to the executives responsible for evaluating and approving capital expenditures.
- Q22-4. The economic life of a project is the period during which it produces earnings. It need not, and probably will not, be equal to the physical life of the related asset(s). Its length depends primarily upon the obsolescence of the product or manufacturing process involved or the nature of the product itself. Managers usually find it quite difficult to estimate economic life because it depends upon future events over which they may have little or no control.
- Q22-5. Cash outflows that might be expected for a capital expenditure include:
- purchase price of one or more assets (or a down payment if property is purchased on installment);
 - construction period interest and taxes if the property is being constructed;
 - machinery and equipment setup cost, particularly if machinery being evaluated utilizes a more advanced technology than that currently in use;
 - computer software development cost if a computer aided design, computer aided manufacturing, or fully computer integrated manufacturing system is being purchased;
 - increased annual maintenance and/or power costs resulting from more complicated or technologically advanced machinery or equipment;
 - lease payments, if some or all of the assets being acquired in the project are leased;
 - increased working capital requirements (inventory, cash on hand, receivables, payables, etc.) may increase as a result of increased business generated by the capital project.
- Q22-6. Cash inflows that might be expected from a capital expenditure include:
- revenues from additional business generated by the project;
 - cost savings created by the capital expenditure that result in a reduction of cash outflows (e.g., maintenance savings, labor savings, reduced inventory requirements resulting from reduced setup times, etc.);
 - retention of market share that might have been lost if the capital expenditure were not made (particularly in the case of advanced technologies that improve product quality, reduce costs, provide manufacturing flexibility, etc. that can provide a competitive advantage to the firm with the technology);
 - salvage from the sale of the property at the end of the economic life of the capital project.
- Q22-7. Some nonquantifiable benefits from investing in advanced manufacturing technologies, such as CIM, FMS, and robotics, include:
- improved product quality (ability to meet closer production tolerances and at the same time reduce the variability in production output);

- (b) decreased machine setup and shorter manufacturing cycle times (which provide the company with the ability to adjust output quantity and variety quickly to meet rapidly changing customer demands).

Q22-8. Tax depreciation is quite likely to differ from book depreciation because the cost recovery period used for tax purposes is usually shorter than the economic life of the asset used for financial accounting purposes. Also, an accelerated method of depreciation is typically used for tax purposes, whereas the straight-line method is more often used for book purposes.

Q22-9. Book depreciation should not be considered in estimating the future cash flows from a project because book depreciation has no effect on the amount or timing of cash flows.

Q22-10. Tax depreciation should be considered in estimating the future cash flows from a project because tax depreciation reduces taxable income and, therefore, tax liability. Tax depreciation results in a tax savings, i.e., a reduction of tax liability that is a cash outflow. The timing of cash flows is affected by the tax depreciation method and the recovery period used.

Q22-11. Financial accounting data are not entirely suitable for use in evaluating capital expenditure proposals because:

- (a) Financial accounting uses the accrual basis. Capital expenditure decisions generally rely on estimates of cash flows, rather than revenues and expenses determined on the accrual basis.

- (b) Financial accounting is designed to measure periodic earnings. Capital expenditure evaluation is concerned with the life of a given project, which seldom corresponds to usual accounting periods.

(c) Financial accounting measures the results of operations of a company or a segment of a company. Although this entity sometimes corresponds with a capital expenditure project, it is usually composed of many intermingled capital expenditure projects.

(d) Financial accounting capitalizes expenditures if the expenditure is deemed to have a future value or benefit to the company. Capitalization is an attempt to match expenditures with revenues generated by those expenditures. When future value or benefit cannot be reliably measured, financial accounting treats the expenditure as a period expense rather than as an asset acquisition.

Q22-12. Benefits of following up project results include:

- (a) comparison of actual with projected results to insure that a project is meeting expected performance, or taking corrective action or terminating a project that is not achieving expected performance;
- (b) evaluation of accuracy of projections from different departments;
- (c) improvement of future capital project estimates;
- (d) motivation of personnel arising from knowledge that follow-up will occur.

EXERCISES

E22-1

Year	Estimated Demand in Units	Unit Sales Price	Unit Variable Cost	Unit Contribution Margin	Net Pretax Cash Inflows From Sales
1	12,000	\$25	\$15	\$10	\$120,000
2	12,000	25	15	10	120,000
3	12,000	25	15	10	120,000
4	12,000	25	15	10	120,000
5	12,000	25	15	10	120,000
Total net pretax cash inflows from sales					\$600,000
Initial cash outflow (cost of asset)					\$550,000
Less pretax estimated salvage value					(125,000)
Excess of net pretax cash inflows over cost					<u>\$175,000</u>

E22-2

Year	Estimated Demand in Units	Unit Sales Price	Unit Variable Cost	Unit Contribution Margin	Net Pretax Cash Inflows From Sales
1	6,000	\$12	\$9	\$3	\$ 18,000
2	8,000	12	9	3	24,000
3	10,000	12	9	3	30,000
4	10,000	12	9	3	30,000
5	10,000	12	9	3	30,000
6	10,000	12	9	3	30,000
7	10,000	12	9	3	30,000
8	8,000	12	9	3	24,000
9	6,000	12	9	3	18,000
10	4,000	12	9	3	12,000
Total net pretax cash inflows from sales					\$246,000
Initial cash outflow (cost of machine)					\$150,000
Less pretax estimated salvage value					(15,000)
Excess of net pretax cash inflows over cost					<u>\$111,000</u>

E22-3

Year	Estimated Net Pretax Cash Inflows	6% Annual Price-level Adjustment	Price-level Adjusted Net Cash Inflows
1	\$15,000	$(1 + .06)^1 = 1.060$	\$ 15,900
2	20,000	$(1 + .06)^2 = 1.124$	22,480
3	20,000	$(1 + .06)^3 = 1.191$	23,820
4	20,000	$(1 + .06)^4 = 1.262$	25,240
5	15,000	$(1 + .06)^5 = 1.338$	20,070
6	10,000	$(1 + .06)^6 = 1.419$	14,190
Total price-level adjusted net pretax cash inflows from operations.....			\$121,700
Plus cash inflow from salvage \$5,000			
Price-level adjustment.....			1.419
Total price-level adjusted net pretax cash inflows			\$128,795
Less initial cash outflow.....			75,000
Excess of net pretax cash inflows over initial cash outflow			\$ 53,795

E22-4

Year	Estimated Net Pretax Cash Inflows	9% Annual Price-level Adjustment	Price-level Adjusted Net Cash Inflows
1	\$20,000	$(1 + .09)^1 = 1.090$	\$ 21,800
2	30,000	$(1 + .09)^2 = 1.188$	35,640
3	40,000	$(1 + .09)^3 = 1.295$	51,800
4	60,000	$(1 + .09)^4 = 1.412$	84,720
5	60,000	$(1 + .09)^5 = 1.539$	92,340
6	60,000	$(1 + .09)^6 = 1.677$	100,620
7	60,000	$(1 + .09)^7 = 1.828$	109,680
8	60,000	$(1 + .09)^8 = 1.993$	119,580
9	40,000	$(1 + .09)^9 = 2.172$	86,880
10	20,000	$(1 + .09)^{10} = 2.367$	47,340
Total price-level adjusted net pretax cash inflows from operations.....			\$750,400
Plus cash inflow from salvage \$10,000			
Price-level adjustment.....			2.367
Total price-level adjusted net pretax cash inflows			\$774,070
Less initial cash outflow.....			250,000
Excess of net pretax cash inflows over initial cash outflow			\$524,070

E22-6

Year	(1) Estimated Inflation- Adjusted Net Cash Inflows	(2) Tax Depre- ciation*	(3) Taxable Income (Loss) (1) - (2)	(4) Tax Liability With 40% Tax Rate 40% x (3)	(5) Net After-tax Cash Inflows (1) - (4)
1	\$30,000	\$40,000	\$(10,000)	\$ (4,000)	\$ 34,000
2	40,000	64,000	(24,000)	(9,600)	49,600
3	50,000	38,400	11,600	4,640	45,360
4	60,000	23,000	37,000	14,800	45,200
5	70,000	23,000	47,000	18,800	51,200
6	80,000	11,600	68,400	27,360	52,640
7	60,000	0	60,000	24,000	36,000
Total net after-tax cash inflows.....					\$314,000
Less initial cash outflow to purchase system.....					200,000
Excess of net after-tax cash inflows over initial cash outflow.....					<u>\$114,000</u>

Year	MACRS 5-year Recovery Rate	Depreciable Basis	Tax Depreciation
1	.200	\$200,000	\$ 40,000
2	.320	200,000	64,000
3	.192	200,000	38,400
4	.115	200,000	23,000
5	.115	200,000	23,000
6	.058	200,000	11,600
	<u>1.000</u>		<u>\$200,000</u>

E22-7

Year	(1) Estimated Periodic Net Cash Inflows	(2) Tax Depre- ciation *	(3) Taxable Income (Loss) (1) - (2)	(4) Tax Liability With 40% Tax Rate 40% x (3)	(5) Net After-tax Cash Inflows (1) - (4)
1	\$10,000	\$14,300	\$ (4,300)	\$(1,720)	\$ 11,720
2	15,000	24,500	(9,500)	(3,800)	18,800
3	20,000	17,500	2,500	1,000	19,000
4	25,000	12,500	12,500	5,000	20,000
5	25,000	8,900	16,100	6,440	18,560
6	25,000	8,900	16,100	6,440	18,560
7	25,000	8,900	16,100	6,440	18,560
8	20,000	4,500	15,500	6,200	13,800
9	15,000	0	15,000	6,000	9,000
10	10,000	0	10,000	4,000	6,000
Total net after-tax cash inflows					\$154,000
After-tax cash inflow from salvage at end of economic life:					
Pretax cash inflow from salvage.....				\$10,000	
Less tax payable on sale at 40% tax rate				4,000	6,000
Total net after-tax cash inflows					\$160,000
Less initial cash outflow to purchase system.....					100,000
Excess of net after-tax cash inflows over initial cash outflow					<u>\$ 60,000</u>

Year	MACRS 7-year Recovery Rate	Depreciable Basis	Tax Depreciation
1	.143	\$100,000	\$ 14,300
2	.245	100,000	24,500
3	.175	100,000	17,500
4	.125	100,000	12,500
5	.089	100,000	8,900
6	.089	100,000	8,900
7	.089	100,000	8,900
8	.045	100,000	4,500
	<u>1.000</u>		<u>\$100,000</u>

PROBLEMS

P22-1

	(1)	(2)	(3)
	Periodic Cash Inflows	8% Price-Level Adjustment	Inflation- Adjusted Estimated Cash Inflows (1) x (2)
Year			
1	\$ 20,000	$(1+.08) = 1.080$	\$ 21,600
2	22,000	$(1+.08)^2 = 1.166$	25,652
3	24,000	$(1+.08)^3 = 1.260$	30,240
4	18,000	$(1+.08)^4 = 1.360$	24,480
5	15,000	$(1+.08)^5 = 1.469$	22,035
6	10,000	$(1+.08)^6 = 1.587$	15,870
	<u>\$109,000</u>		<u>\$139,877</u>

	(1)	(2)	(3)
	Depre- ciable Basis of Property	5-Year Property Recovery Percentage	Tax Depre- ciation (1) x (2)
Year			
1	\$60,000	.200	\$12,000
2	60,000	.320	19,200
3	60,000	.192	11,520
4	60,000	.115	6,900
5	60,000	.115	6,900
6	60,000	.058	3,480
			<u>\$60,000</u>

P22-2

Cost of new machine.....	\$18,000
Trade-in allowance for old machine	9,000
Net cash outflow at beginning of project	\$ 9,000
Tax basis of old machine traded in.....	8,000
Tax basis of new machine	<u>\$17,000</u>
Annual cost of operating old machine.....	\$20,000
Annual cost of operating new machine	16,000
Annual cost savings with new machine.....	<u>\$ 4,000</u>

	(1)	(2)	(3)
	Original Tax Basis of Old Machine	5-Year Property Recovery Rate	Tax Depre- ciation on Old Machine (1) x (2)
Year			
1	\$10,000	.320	\$3,200
2	10,000	.192	1,920
3	10,000	.115	1,150
4	10,000	.115	1,150
5	10,000	.058	580
			<u>\$8,000</u>

Note that year 1 is actually the second year the old property is depreciated. Therefore, the recovery rate for the second year is used to compute the amount of depreciation on the old property in the first year of the capital expenditure proposal.

	(1)	(2)	(3)
	Original Tax Basis of New Machine	5-Year Property Recovery Rate	Tax Depre- ciation on New Machine (1) x (2)
Year			
1	\$17,000	.200	\$ 3,400
2	17,000	.320	5,440
3	17,000	.192	3,264
4	17,000	.115	1,955
5	17,000	.115	1,955
6	17,000	.058	986
			<u>\$17,000</u>

P22-3

(1) Cost to purchase valve stem from outside supplier (\$20 per unit x 80,000 units per year)	<u>\$1,600,000</u>
Incremental cost of manufacturing valve stem:	
Direct materials (\$4.50 x 80,000 units)	\$ 360,000
Direct labor ((\$3.70 - \$.80) per unit x 80,000 units)	232,000
Variable factory overhead ((\$1.70 - \$.80) per unit x 80,000 units)	<u>72,000</u>
Total incremental costs	<u>\$ 664,000</u>
Total annual costs savings to make rather than buy	<u><u>\$ 936,000</u></u>

Year	(1) Tax Basis of New Tools	(2) 3-Year Property Recovery Rate	(3) Tax Depreciation on New Tools (1) x (2)
1	\$2,500,000	.333	\$ 832,500
2	2,500,000	.444	1,110,000
3	2,500,000	.148	370,000
4	2,500,000	.075	187,500
			<u><u>\$2,500,000</u></u>

P22-4

Year	(1) Estimated Annual Revenues	(2) Estimated Operating Expenses	(3) Unadjusted Cash Inflows (1) - (2)	(4) Annual 6% Inflation Adjustment $(1 + .06)^1$ $(1 + .06)^2$ $(1 + .06)^3$ $(1 + .06)^4$ $(1 + .06)^5$ $(1 + .06)^6$ $(1 + .06)^7$ $(1 + .06)^8$ $(1 + .06)^9$ $(1 + .06)^{10}$	(5) Inflation- Adjusted Cash Inflows (3) x (4)	(6) Annual Fixed Lease Rentals	(7) Pretax Annual Cash Inflows (5) - (6)
1	\$100,000	\$40,000	\$60,000	= 1.060	\$ 63,600	\$20,000	\$ 43,600
2	120,000	50,000	70,000	= 1.124	78,680	20,000	58,680
3	140,000	60,000	80,000	= 1.191	95,280	20,000	75,280
4	140,000	60,000	80,000	= 1.262	100,960	20,000	80,960
5	140,000	60,000	80,000	= 1.338	107,040	20,000	87,040
6	140,000	60,000	80,000	= 1.419	113,520	20,000	93,520
7	140,000	60,000	80,000	= 1.504	120,320	20,000	100,320
8	140,000	60,000	80,000	= 1.594	127,520	20,000	107,520
9	120,000	60,000	60,000	= 1.689	101,340	20,000	81,340
10	100,000	60,000	40,000	= 1.791	71,640	20,000	51,640
							<u>\$779,900</u>

Year	(1) Tax Basis for Depreciable Property	(2) 7-Year Property Recovery Rate	(3) Tax Depreciation Available (1) x (2)
1	\$200,000	.143	\$ 28,600
2	200,000	.245	49,000
3	200,000	.175	35,000
4	200,000	.125	25,000
5	200,000	.089	17,800
6	200,000	.089	17,800
7	200,000	.089	17,800
8	200,000	.045	9,000
			<u>\$200,000</u>

P22-5

(1)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Year	Estimated Demand	Unit Sales Price	Unit Variable Cost	Contribution Margin Per Unit (2) - (3)	Net Cash Inflow From Sales (1) x (4)	Cost Savings From Reduced Maintenance	Periodic Net Cash Inflows (5) + (6)
1	1,000	\$11	\$5	\$6	\$ 6,000	\$1,500	\$ 7,500
2	1,000	11	5	6	6,000	1,200	7,200
3	1,000	11	5	6	6,000	900	6,900
4	1,000	11	5	6	6,000	600	6,600
5	1,000	11	5	6	6,000	300	6,300
6	1,000	11	5	6	6,000	0	6,000
7	1,000	11	5	6	6,000	0	6,000
Total periodic cash inflows					<u>\$42,000</u>	<u>\$4,500</u>	<u>\$46,500</u>

P22-5 (Continued)

	(1)	(2)	(3)
	Periodic	Annual 10%	Adjusted
	Net Cash	Price-Level	Estimate of
	Inflows	Adjustment	Net Cash
Year			Inflows
			(1) x (2)
1	\$ 7,500	$(1+.10) = 1.100$	\$ 8,250
2	7,200	$(1+.10)^2 = 1.210$	8,712
3	6,900	$(1+.10)^3 = 1.331$	9,184
4	6,600	$(1+.10)^4 = 1.464$	9,662
5	6,300	$(1+.10)^5 = 1.611$	10,149
6	6,000	$(1+.10)^6 = 1.772$	10,632
7	6,000	$(1+.10)^7 = 1.949$	11,694
	<u>\$46,500</u>		<u>\$68,283</u>

	(1)	(2)	(3)
	Depre-	5-Year	Tax
	ciable	Property	Depre-
	Basis of	Recovery	ciation
	Machine	Percentage	(1) x (2)
Recovery Year			
1	\$40,000	.200	\$ 8,000
2	40,000	.320	12,800
3	40,000	.192	7,680
4	40,000	.115	4,600
5	40,000	.115	4,600
6	40,000	.058	2,320
			<u>\$40,000</u>

P22-5 (Concluded)

Year	(1) Adjusted Estimate of Net Cash Inflows	(2) Tax Depreciation	(3) Taxable Income (Loss) (1) - (2)	(4) Federal and State Income Tax Rate	(5) Income Tax Payment (Reduction) (3) x (4)	(6) Net After-tax Cash Inflows (1) - (5)
1	\$ 8,250	\$ 8,000	\$ 250	40%	\$ 100	\$ 8,150
2	8,712	12,800	(4,088)	40%	(1,635)	10,347
3	9,184	7,680	1,504	40%	602	8,582
4	9,662	4,600	5,062	40%	2,025	7,637
5	10,149	4,600	5,549	40%	2,220	7,929
6	10,632	2,320	8,312	40%	3,325	7,307
7	11,694	0	11,694	40%	4,678	7,016
Total after-tax cash inflow from sales and cost savings						\$56,968
After-tax cash inflow from salvage at end of economic life:						
Cash inflow from salvage (adjusted for expected 10% Inflation)* ..						\$11,694
Tax payable on salvage sale						4,678
Total net after-tax cash inflows from the capital expenditure.....						<u>7,016</u>
						<u>\$63,984</u>

*\$6,000 estimated salvage value x 1.949 inflation adjustment (10% for 7 years)

**The cash inflow from the salvage sale at the end of the project would be fully taxable because the tax basis of the machine would be zero (i.e., the machine was fully depreciated). Thus, the tax on the cash inflow from salvage would be \$4,678 (\$11,694 x 40%).

(2) Total after-tax cash inflows from the capital expenditure.....	\$63,984
Less original investment cash outflow.....	40,000
Excess of total after-tax cash inflows over initial investment.....	<u>\$23,984</u>

P22-6

Year	(1) Unadjusted Cash Inflows	(2) Annual 10% Price-Level Adjustment	(3) Inflation- Adjusted Cash Inflows (1) x (2)
1	\$15,000	$(1 + .10) = 1.100$	\$16,500
2	20,000	$(1 + .10)^2 = 1.210$	24,200
3	25,000	$(1 + .10)^3 = 1.331$	33,275
4	25,000	$(1 + .10)^4 = 1.464$	36,600
5	25,000	$(1 + .10)^5 = 1.611$	40,275
6	25,000	$(1 + .10)^6 = 1.772$	44,300
7	25,000	$(1 + .10)^7 = 1.949$	48,725
8	20,000	$(1 + .10)^8 = 2.144$	42,880
9	15,000	$(1 + .10)^9 = 2.358$	35,370
10	10,000	$(1 + .10)^{10} = 2.594$	25,940

Year	(1) Tax Basis of Depreciable Property	(2) 7-Year Property Recovery Rate	(3) Tax Depreciation Available (1) x (2)
1	\$100,000	.143	\$ 14,300
2	100,000	.245	24,500
3	100,000	.175	17,500
4	100,000	.125	12,500
5	100,000	.089	8,900
6	100,000	.089	8,900
7	100,000	.089	8,900
8	100,000	.045	4,500
			<u>\$100,000</u>

P22-6 (Concluded)

Year	(1) Inflation- Adjusted Annual Cash Inflows	(2) Tax Depreciation Available	(3) Increase (Decrease) in Taxable Income (1) - (2)	(4) Income Tax Rate	(5) Increase (Decrease) in Income Taxes (3) x (4)	(6) After-tax Cash Inflows (1) - (5)
1	\$16,500	\$14,300	\$ 2,200	40%	\$ 880	\$ 15,620
2	24,200	24,500	(300)	40%	(120)	24,320
3	33,275	17,500	15,775	40%	6,310	26,965
4	36,600	12,500	24,100	40%	9,640	26,960
5	40,275	8,900	31,375	40%	12,550	27,725
6	44,300	8,900	35,400	40%	14,160	30,140
7	48,725	8,900	39,825	40%	15,930	32,795
8	42,880	4,500	38,380	40%	15,352	27,528
9	35,370	0	35,370	40%	14,148	21,222
10	25,940	0	25,940	40%	10,376	15,564
Total periodic after-tax cash inflows.....						\$248,839
After-tax cash inflow from salvage:						
Inflation-adjusted cash inflow from salvage (\$2,000 x 2.594)						
Tax payable on salvage (\$5,188 x 40%)					\$5,188	
Total after-tax cash inflows from project					2,075	3,113
Less Initial investment cash outflow.....						\$251,952
Excess of total after-tax cash inflows over Initial investment.....						100,000
						<u>\$151,952</u>

P22-7

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Savings from Reduced Labor	Savings from Reduced Machine Setup Time	Savings from Reduced Inventory	Total Periodic Savings from CIM (1) + (2) + (3)	Additional Maintenance Cost with CIM	Net Periodic Savings with CIM (4) - (5)	Annual 8% Inflation Adjustment	Inflation-Adjusted Periodic Savings (6) x (7)
Year							
1	\$15,000	\$20,000	\$ 60,000	\$10,000	\$50,000	(1+.06) = 1.060	\$ 53,000
2	25,000	25,000	80,000	10,000	70,000	(1+.06) ² = 1.124	78,680
3	35,000	30,000	100,000	10,000	90,000	(1+.06) ³ = 1.191	107,190
4	35,000	30,000	100,000	10,000	90,000	(1+.06) ⁴ = 1.262	113,580
5	35,000	30,000	100,000	10,000	90,000	(1+.06) ⁵ = 1.338	120,420
6	35,000	30,000	100,000	10,000	90,000	(1+.06) ⁶ = 1.419	127,710

Year	(1)	(2)	(3)	(4)	(5)	(6)
	Inflation-Adjusted Periodic Savings with CIM	Tax Depreciation and Amortization*	Taxable Income (Loss) (1) - (2)	Effective Tax Rate	Tax Liability (Refund) (3) x (4)	Periodic Net After-tax Cash Inflows (1) - (5)
1	\$ 53,000	\$240,000	\$(187,000)	40%	\$ (74,800)	\$ 127,800
2	78,680	360,000	(281,320)	40%	(112,528)	191,208
3	107,190	232,000	(124,810)	40%	(49,924)	157,114
4	113,580	155,000	(41,420)	40%	(16,568)	130,148
5	120,420	155,000	(34,580)	40%	(13,832)	134,252
6	127,710	58,000	69,710	40%	27,884	99,826
						<u>\$ 840,348</u>
Total annual after-tax savings from investment in CIM						
Less initial investment:						
	Equipment cost.....					\$1,000,000
	Software cost.....					<u>200,000</u>
	Excess of cost of CIM system over after-tax savings.....					<u>\$ (359,652)</u>

P22-7 (Continued)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Year	Recovery Property Tax Basis	Rate for MACRS 5-year Property	Tax Depreciation (1) x (2)	Software Tax Basis	5-year Straight-line Amortization Rate	Tax Amorti- zation (4) x (5)	Total Tax Amortization and Depreciation (3) + (6)
1	\$1,000,000	.200	\$ 200,000	\$200,000	.200	\$ 40,000	\$ 240,000
2	1,000,000	.320	320,000	200,000	.200	40,000	360,000
3	1,000,000	.192	192,000	200,000	.200	40,000	232,000
4	1,000,000	.115	115,000	200,000	.200	40,000	155,000
5	1,000,000	.115	115,000	200,000	.200	40,000	155,000
6	1,000,000	.058	58,000	200,000	.000	0	58,000
			<u>\$1,000,000</u>			<u>\$200,000</u>	<u>\$1,200,000</u>

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Year	Inflation- Adjusted Periodic Savings with CIM from Part (1)	Inflation- Adjusted Lost Periodic Contribution Margin Saved with CIM**	Net Periodic Savings with CIM (1) + (2)	Tax Depre- ciation and Amor- tization*	Taxable Income (Loss) (3) - (4)	Effective Tax Rate	Tax Liability (Refund) (5) x (6)	Periodic Net After-tax Cash Inflows (3) - (7)
1	\$ 53,000	\$212,000	\$265,000	\$240,000	\$ 25,000	40%	\$ 10,000	\$ 255,000
2	78,680	224,800	303,480	360,000	(56,520)	40%	(22,608)	326,088
3	107,190	238,200	345,390	232,000	113,390	40%	45,356	300,034
4	113,580	252,400	365,980	155,000	210,980	40%	84,392	281,588
5	120,420	267,600	388,020	155,000	233,020	40%	93,208	294,812
6	127,710	283,800	411,510	58,000	353,510	40%	141,404	270,106
								<u>\$1,727,628</u>
								<u>1,200,000</u>
								<u>\$ 527,628</u>

Total annual after-tax savings from investment in CIM
 Less initial investment for equipment and software (from above).....
 Excess of after-tax savings over cost of CIM system with new information

P22-7 (Concluded)

**	(1)	(2)	(3)
	Lost Periodic Contribution Margin Saved with CIM	Annual 6% Inflation Adjustment	Inflation- Adjusted Lost Periodic Contribution Margin Saved with CIM (1) x (2)
<u>Year</u>			
1	\$200,000	$(1 + .06) = 1.060$	\$212,000
2	200,000	$(1 + .06)^2 = 1.124$	224,800
3	200,000	$(1 + .06)^3 = 1.191$	238,200
4	200,000	$(1 + .06)^4 = 1.262$	252,400
5	200,000	$(1 + .06)^5 = 1.338$	267,600
6	200,000	$(1 + .06)^6 = 1.419$	283,800

CASES**C22-1**

Some of the factors that affect the decision of whether or not to delay the investment in new cleaning equipment are given below. Each factor can have two sides (i.e., delay versus no delay) depending upon the circumstances involved.

- (a) Unemployment, inflation rate, and business conditions in general.
 - Business outlook improving—do not delay.
 - Business outlook deteriorating—delay.
 - All of these factors affect the climate for business and should be considered.
- (b) Difficulty associated with acquisition and installation of equipment and training of operators.
 - Great difficulty—do not delay.
 - Little difficulty—delay.
 - The greater the lead time involved, the sooner the equipment should be acquired so that it is ready when needed.
- (c) Extent of operating efficiency improvements.
 - Great—do not delay.
 - Little—delay.
 - The greater the efficiency, the less it should be delayed because costs will be saved even though volume does not increase.
- (d) Inflation rate in cost of equipment.
 - Cost of equipment not expected to increase drastically—delay.
 - Cost of equipment expected to increase drastically—do not delay.
 - Company wants to minimize its initial cost outlay.
- (e) Dependability of present equipment and likelihood of breakdowns.
 - Dependability is good—delay.
 - Dependability is not good—do not delay.
 - Company could defer, or have to go ahead with investment due to condition of present equipment.
- (f) Chance for technological advances in equipment.
 - Good—delay.
 - No chance—do not delay.
 - If there is a chance that technological advances will develop in the design of the equipment, the company might want to take advantage of the new design.
- (g) Ability to obtain market advantage by providing better quality service at same or lower price.
 - Good—do not delay.
 - Poor/neutral—delay.
 - Better service means more customers or justifies higher rates.

C22-1 (Concluded)

- (h) Competitors' plans for obtaining similar equipment and achieving market advantage.

High probability—do not delay.

Low probability—delay.

Company wants to maintain competitive advantage or meet competition.

- (i) Ability to predict timing and increased volume of demand from new or existing customers.

Good—better quality of decision; could defer switch longer.

Low—less reliable criteria for decision.

The better a company is able to predict new business, the more certain it can be of its decision and, possibly, the longer it can wait to make a change.

C22-2

Knight is probably correct in her assessment that the proposed capital investment framework grants too much freedom to the divisions. Neoglobe's long-run performance depends on its capital investments. While divisions must have some responsibility for capital investments for the proposed organization structure to be effective, corporate management must maintain adequate control to direct the future course of the firm. Under the proposed framework, division management controls a substantial portion of the capital budget, and in some years, few funds would be available for investment by corporate management. The present proposal would reduce corporate management's ability to diminish a product line, and it also would impair management's ability to have adequate funds available for investment in new businesses.

Capital investment procedures should involve both division and corporate managements in such a way that division management still should be able to influence the future direction of the firm. Such procedures might include classification of capital projects into groups, some of which could be approved by division management without corporate management study.

An alternative to the Neoglobe capital investment program might have the following features:

- (a) All proposed investment projects would be classified according to their nature—replacement, cost savings, expansion.
- (b) Replacement and cost savings projects could be adopted by division management alone, without approval of corporate management, provided an individual project did not exceed a specified dollar limit and the total of such projects did not exceed another specified dollar limit. The dollar limits would reflect the nature and size of each division's operations.
- (c) All expansion projects, or other projects that exceed the dollar limit, would be submitted to corporate management for evaluation and approval.

C22-3

The process of planning for and evaluating long-term commitments of resources is normally referred to as capital expenditure planning, evaluating, and control, or capital budgeting. The capital budget is distinct in that it focuses on the long-term effect of resources committed. Its primary objectives are to provide management with (1) a formal process to chart its future course, (2) a means of ranking and selecting among alternative resource commitments to maximize return on investment, and (3) a program for ongoing evaluation of extant resource commitments.

Any significant resource commitment is viewed as a project. Hence, the capital budget is composed of projects, some of which are in process and some of which are proposed. Each project affects significant periods of time in the ongoing life of a company. A project often involves the evaluation of alternatives and the purchase of such assets as property, plant, and equipment. It should also consider, however, any proposal or program that requires a significant resource commitment over an extended period, such as the development of new products, opening new markets, and the design and development of major computer programs.

Once resources have been committed to a particular project, the project requires ongoing evaluation; i.e., are the project's objectives being met? If not, it needs to be evaluated in terms of whether the project should be retained as is, modified if possible, or abandoned.

McAngus can make significant use of capital expenditure planning, evaluating, and control. At the division level, projects will need to be defined in terms of those elements of the plant, or operation of the division, over which the manager has control. On the basis of the facts given, the division manager has authority to operate his or her plant essentially as if it were an independent company. Hence, anything affecting operations, which has required or will require significant resource commitment over a significant period of time, should form an integral part of that division's capital budget. At the top management level, the president may view each division as a project, particularly for evaluation purposes. The other described activities of top management (investigating and evaluating such things as new markets, etc.) are projects in the capital budgeting sense. These and other new proposals may be defined, analyzed, and evaluated using a variety of available techniques.

C22-4

- (1) Arnett's revision of the first proposal described in the case can certainly be considered a violation of the *Standards of Ethical Conduct*. Arnett discarded the reasonable projections and estimates after being questioned and pressured by Earle, and used figures that have only a remote chance of occurring. By doing this, Arnett violated the standard of objectivity (which requires that the management accountant communicate information fairly and *objectively* and *disclose fully* relevant information that

C22-4 (Concluded)

could reasonably be expected to influence an intended user's understanding of the report presented). By altering the analysis, Arnett also violated the standard of integrity (which requires that the management accountant (1) refrain from engaging in an activity that would *prejudice* his or her ability to carry out the required duties ethically, and (2) communicate *unfavorable* as well as favorable information, professional judgments, and opinions). Arnett also violated the standard of competence (which requires that the management accountant prepare complete and clear reports and recommendations after appropriate analysis of relevant and reliable information).

- (2) Based on the facts in the case, Earle was certainly in violation of the *Standards of Ethical Conduct* as a result of pressuring a subordinate to prepare a proposal with data that were false and misleading. Earle has violated the standards of competence (failed to perform professional duties in accordance with ... technical standards; and failed to prepare complete and clear reports and reliable information), integrity (engaged in an activity that would prejudice his or her ability to carry out required duties ethically, actively or passively subverted the attainment of the organization's legitimate and ethical objectives, failed to communicate unfavorable as well as favorable information and professional judgments or opinions, and supported activity that would discredit the profession), and objectivity (failed to communicate information fairly and objectively and did not disclose fully all relevant information that could reasonably be expected to influence an intended user's understanding of the report presented).
- (3) The elements of the projection and estimation process that are compromised because of a predetermined, misleading outcome include:
 - (a) the quality of the base data,
 - (b) the quality of the assumptions used,
 - (c) the probability of the projection occurring, and
 - (d) the credibility of the people submitting the projection.
- (4) The internal controls Fore Corporation could implement to prevent unethical behavior include:
 - (a) approval of all formal capital expenditure proposals by the controller and/or the board of directors,
 - (b) designating a non-accounting/finance manager to coordinate capital expenditure requests and/or segregating duties during the preparation and approval of capital expenditure requests,
 - (c) requiring all capital expenditure proposals be reviewed by senior operating management, which includes the controller, before the proposals are submitted for approval, and
 - (d) requiring the internal audit staff to review all capital expenditure proposals or contracting with external auditors to review the proposal if the corporation does not have sufficient personnel.

C22-5

- (1) Referring to the specific standards in the IMA's *Standards of Ethical Conduct for Practitioners of Management Accounting and Financial Management*, the conduct of H. Dodge and G. Watson is unethical as discussed below:

- (a) H. Dodge's first revision of the proposal for the warehouse conversion was unethical because Dodge's actions violate the following standards:

Competence. Although the estimates used in the analysis are based on management's judgment, Dodge's action in changing reasonable estimates to remote assumptions is unethical. Management accountants have the responsibility to prepare complete and clear reports and recommendations after appropriate analyses of relevant and reliable information.

Integrity. Dodge has the responsibility to avoid conflicts of interest, refrain from subverting the attainment of the organization's legitimate and ethical objectives (profitability), and refrain from engaging in or supporting any activity that would discredit the profession.

Objectivity. Dodge has the responsibility to communicate information fairly and objectively and to disclose fully all relevant information that can influence an intended user's understanding.

- (b) G. Watson's conduct in giving H. Dodge specific instructions on preparing the second revision of the proposal is unethical because Watson's conduct violates the following specific standards:

Competence. Watson has the responsibility to perform his professional duties in accordance with relevant technical standards, such as using conservatism and realistic estimates in the net present value analysis. Management accountants should prepare complete and clear reports and recommendations after appropriate analyses of relevant and reliable information.

Confidentiality. Watson should refrain from using or appearing to use confidential information acquired in the course of his work for unethical advantage for personal gain (saving on commuting time and costs).

Integrity. Watson has the responsibility to advise all parties of any potential conflict of interest. Watson should refuse any favor (the warehouse reducing his commuting time) that would appear to influence his actions. Watson should communicate unfavorable as well as favorable information and professional judgments and opinions.

Objectivity. Watson has the responsibility to disclose fully all relevant information that can influence an intended user's understanding of the analysis.

C22-5 (Concluded)

- (2) Steps recommended by the *Standards of Ethical Conduct for Practitioners of Management Accounting and Financial Management* that H. Dodge should follow in attempting to resolve this situation are as follows:
- (a) Dodge should first investigate and see if Evans Company has an established policy for resolving conflict, and if such a policy exists, Dodge should follow it.
 - (b) Since it appears that G. Watson, Dodge's superior, is involved, there is no need to confront Watson or discuss this issue with Watson any further. Dodge should present the situation to the next higher level, the vice president of finance, for resolution.
 - (c) If Dodge does not receive any satisfaction, Dodge should continue to successively higher levels, including the audit committee and the board of directors, if necessary.
 - (d) Dodge should clarify the concepts of the issue at hand in a confidential discussion with an objective advisor, i.e., a peer.
 - (e) If the situation is still unresolved after exhausting all levels of internal review, Dodge will have no recourse but to resign and submit an informative memorandum to an appropriate representative of the organization.
 - (f) Unless legally bound (which does not appear to be the case in this situation), it is inappropriate to communicate this situation to authorities or individuals outside the organization.
 - (g) Dodge may consult with personal legal counsel.

C22-6

- (1) By referring to the IMA's *Standards of Ethical Conduct* and taking into consideration the specific standards of competence, confidentiality, integrity, and objectivity, L. Forrest should evaluate B. Rolland's directives as follows:

Competence. Forrest has a responsibility to present complete and clear reports and recommendations after appropriate analysis of relevant and reliable information. Rolland does not wish the report to be complete or clear, and has provided some information that is not totally reliable.

Confidentiality. Forrest should not disclose confidential information outside of the organization; but it also appears that Rolland wants to refrain from disclosing information to the board of directors that it should know about.

Integrity. Rolland is engaging in activities that could prejudice him from carrying out his duties ethically. In evaluating Rolland's directive as it affects Forrest, Forrest has an obligation to communicate unfavorable as well as favorable information and professional judgments or opinions.

C22-6 (Concluded)

Objectivity. The responsibility to communicate information fairly and objectively, as well as to disclose fully all relevant information that could reasonably be expected to influence reports and recommendations presented, is being hampered. The board of directors will not have the full scope of information they should have when they are presented with the analysis.

- (2) By referring to the *Standards of Ethical Conduct*, L. Forrest should take the following steps to resolve this situation:
- (a) Forrest should first investigate and see if IDI has an established policy for resolution of ethical conflicts and, if so, follow those procedures.
 - (b) If this policy does not resolve the ethical conflict, the next step would be for Forrest to discuss the situation with his supervisor, Rolland, and see if he can obtain resolution. One possible solution may be to present a "base case" and sensitivity analysis of the investment. Forrest should make it clear to Rolland that he has a problem and is seeking guidance.
 - (c) If Forrest cannot obtain a satisfactory resolution with Rolland, Forrest could take the situation up to the next layer of management, and inform Rolland that is being done. If this is not satisfactory, Forrest should progress to the next level, and eventually to all higher levels of management until the issue is resolved (i.e., the president, audit committee, or board of directors).
 - (d) Since Rolland has instructed him not to discuss the situation with anyone else at IDI, Forrest may want to have a confidential discussion with an objective advisor to clarify relevant concepts and obtain an understanding of possible courses of action. Forrest may want to talk to a close professional friend or the IMA "Ethics Hotline" for this purpose.
 - (e) If Forrest cannot satisfactorily resolve the situation within the organization, he may resign from the company and submit an informative memo to an appropriate person in IDI (i.e., the president, audit committee, or board of directors).
 - (f) Forrest may consult with personal legal counsel.

CHAPTER 23

DISCUSSION QUESTIONS

- Q23-1. The weighted average cost of capital is computed by the following steps:
- Calculate each component of capital as a percentage of total capital.
 - Calculate the after-tax cost of each individual capital component.
 - For each capital component, multiply (a) by (b) and sum the results.
- Q23-2. Using the cost of a specific source of funds may lead to faulty decisions. For example, when debt is used, low-return projects would be acceptable while better investments would have to be ruled out in a following period, when common stock shares are sold to obtain funds.
- Q23-3. There are two problem areas associated with estimating the firm's weighted average cost of capital—the proportions of each source of funds and the cost of each source of funds. The proportions that are expected over the investment horizon should be used. Since these amounts are typically unknown, the proportions desired by management in the long run are usually used. With respect to costs, the market prices of each source of funds should be used. Since the market price varies over time as creditor and investor expectations change, current market prices adjusted for changes expected by management are commonly used.
CGA-Canada (adapted). Reprint with permission.
- Q23-4. The payback (or payout) period method measures the length of time required by a project to recover the initial investment outlay.
- Q23-5. In computing the accounting rate of return on original investment, the denominator is the original investment, whereas in computing the accounting rate of return on average investment, the denominator is the average investment.
- Q23-6. The present value concept states that a dollar received today is worth more than a dollar to be received at a future date because of the earnings the "today" dollar can generate in the interim. It is important in capital budgeting because of the relatively long periods between the investment of funds and the return of those funds as earnings (i.e., dollars returned a long time in the future are worth considerably less than those invested today).
- Q23-7. The basic difference between the payback method and the net present value method concerns the recognition of the time value of money. The payback method, which ignores the time value of money and all cash flows beyond the payback period for the project, is the measure of the time it will take to recover the initial capital investment in net cash inflows.
- The net present value method does consider the time value of money. This method involves comparing the present value of all future cash inflows and outflows of a given project, using some minimum desired rate of return. A positive result implies that the project's rate of return exceeds this minimum rate, whereas a negative result indicates that the project's rate of return is less than this minimum rate.
- Q23-8. In the net present value method, the discount rate is known; whereas, in the internal rate of return method, the discount rate is not known. In the internal rate of return method, the discount rate is the one that will result in a net present value of zero.
- Q23-9. The net present value method assumes that earnings are reinvested at a rate of return equal to the firm's cost of capital, whereas the internal rate of return method assumes that earnings are reinvested at the rate of return of the particular project being considered. The firm's cost of capital rate is more realistic. If an investment proposal is predicted to be extremely profitable (e.g., having an internal rate of return of 50%), it is unlikely that similar proposals are available. However, a firm should ordinarily have several investment opportunities at or near the rate of its cost of capital.
CGA-Canada (adapted). Reprint with permission.
- Q23-10. Setting the discount rate at something in excess of the cost of capital in order to compensate for risk and uncertainty associated with a capital expenditure proposal is conceptually unsound, because the reinvestment potential of cash flows is overstated. Cash received in early periods has more value than cash received in later periods, because only the cash received in the early periods can be reinvested. As a consequence, the use of a rate in excess of the reinvestment rate in the net present value method will result in an overstatement of the value of cash received early in the life of the capital expenditure project. A better approach would be to compute the terminal value of the cash flows using the reinvestment rate (i.e., compute the value of all cash flows at the end of the life of the project), and then discount the total to present value at a risk-adjusted discount rate. An even better approach is to explicitly consider uncertainty by using probability analysis, as discussed in Chapter 24.

EXERCISES

E23-1

<u>Funds—Source</u>	<u>Proportion of Funds</u>	<u>After-tax Cost</u>	<u>Weighted Cost</u>
Bonds (10% x (1 - 45% tax rate))	30%	5.5%	1.65%
Preferred stock	20%	12.5% *	2.50%
Common stock and retained earnings ...	50%	15.0% **	7.50%
	<u>100%</u>		<u>11.65%</u>

* (12% x \$100 par value for preferred stock) + \$96 market value

** (\$75,000 + 50,000 shares of common stock) + \$10 market price per share

E23-2

Weighted average cost of capital before bond retirement and sale-leaseback transaction:

	(1)	(2)	(3)	(4)	(5)
<u>Capital Component</u>	<u>Amount</u>	<u>Percent of Total</u>	<u>Pretax Cost</u>	<u>After-tax Cost</u>	<u>Weighted Cost (2) x (4)</u>
Bonds	\$ 5,000,000	50%	8.0%	4.8%	2.4%
Preferred stock	1,000,000	10%	9.0%	9.0%	.9%
Common stock and retained earnings ...	4,000,000	40%	12.5%	12.5%	5.0%
	<u>\$10,000,000</u>	<u>100%</u>			<u>8.3%</u>

Weighted average cost of capital after bond retirement and sale-leaseback transaction:

	(1)	(2)	(3)	(4)	(5)
<u>Capital Component</u>	<u>Amount</u>	<u>Percent of Total</u>	<u>Pretax Cost</u>	<u>After-tax Cost</u>	<u>Weighted Cost (2) x (4)</u>
Lease	\$ 1,000,000	10%	10.0%	6.0%	.60%
Bonds	4,000,000	40%	8.0%	4.8%	1.92%
Preferred stock	1,000,000	10%	9.0%	9.0%	.90%
Common stock and retained earnings ...	4,000,000	40%	12.5%	12.5%	5.00%
	<u>\$10,000,000</u>	<u>100%</u>			<u>8.42%</u>

E23-3

(1)	Annual cash inflow before income tax.....	\$15,000	\$15,000
	Less depreciation (the same for financial accounting and income tax purposes (\$40,000 cost + 8 years))	5,000	
	Annual taxable income	\$10,000	
	Annual income tax (\$10,000 taxable income x 40%) ..	4,000	4,000
	Annual income after taxes.....	<u>\$ 6,000</u>	
	Annual after-tax cash inflow.....		<u><u>\$11,000</u></u>

$$\frac{\$40,000 \text{ initial cash outflow}}{\$11,000 \text{ annual cash inflow}} = 3.636 \text{ years to payback}$$

$$(2) \quad \frac{\$6,000 \text{ average annual income}}{\$40,000 \text{ original investment}} = .15 \text{ or } 15\% \text{ rate of return on original investment}$$

E23-4

(1)	$\frac{\$34,000 \text{ initial cash outflow}}{\$10,000 \text{ annual cash inflow}} = 3.4 \text{ years to payback}$	
(2)	Present value of annual cash inflows for six years (\$10,000 annual cash inflow x 3.784)	\$37,840
	Less initial cash outflow to acquire investment.....	<u>34,000</u>
	Net present value of investment	<u><u>3,840</u></u>
(3)	Cash desired at end of six years	\$34,000
	Present value of \$1 compounded annually at 15%	x .432
	Investment required	<u><u>\$14,688</u></u>

E23-5

(1)	Present value of annual cash inflows for 10 years (\$20,000 annual cash inflow x 5.216)	\$ 104,320
	Present value of salvage value at end of 10-year life (\$10,000 cash inflow from salvage x .270)	<u>2,700</u>
	Present value of all cash inflows.....	\$107,020
	Less initial cash outflow to purchase press.....	<u>(100,500)</u>
	Net present value of investment	<u><u>\$ 6,520</u></u>
(2)	Present value index = $\frac{\$6,520 \text{ net present value}}{\$100,500 \text{ initial investment}} = .065 \text{ or } 6.5\%$	

E23-6

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	MACRS Recovery Rate	Straight- Line Rate	Cost Recovery Under MACRS	Straight- Line Depre- ciation	Differ- ence (3) - (4)	Income Tax Savings (5) x 40%	Present Value of \$1 @ 14%	Present Value of Tax Savings (6) x (7)
Year								
1	0.200	0.100	\$ 20,000	\$ 10,000	\$10,000	\$4,000	0.877	\$3,508
2	0.320	0.200	32,000	20,000	12,000	4,800	0.769	3,691
3	0.192	0.200	19,200	20,000	(800)	(320)	0.675	(216)
4	0.115	0.200	11,500	20,000	(8,500)	(3,400)	0.592	(2,013)
5	0.115	0.200	11,500	20,000	(8,500)	(3,400)	0.519	(1,785)
6	0.058	0.100	5,800	10,000	(4,200)	(1,680)	0.456	(768)
			<u>\$100,000</u>	<u>\$100,000</u>	<u>0</u>	<u>0</u>		<u>\$2,439</u>

E23-7

(1)	Year	Unadjusted Estimate of Cash Inflows	Inflation Adjustment	Inflation- Adjusted Estimate of Cash Inflows
	1	\$20,000	1.10000*	\$22,000.00
	2	18,000	1.21000	21,780.00
	3	16,000	1.33100	21,296.00
	4	10,000	1.46410	14,641.00
	5	10,000	1.61051	16,105.10
		<u>\$74,000</u>		<u>\$95,822.10</u>

* $(1 + .10)^n$ where n = number of periods

(2)	Year	Unadjusted Cash Flows	Adjusted Cash Flows	PV of \$1 @ 15%	PV of Unadjusted Cash Flows	PV of Adjusted Cash Flows
	0	\$(58,000)	\$(58,000)	1.000	\$(58,000)	\$(58,000)
	1	20,000	22,000	.870	17,400	19,140
	2	18,000	21,780	.756	13,608	16,466
	3	16,000	21,296	.658	10,528	14,013
	4	10,000	14,641	.572	5,720	8,375
	5	10,000	16,105	.497	4,970	8,004
					<u>\$ (5,774)</u>	<u>\$ 7,998</u>
		Net present value of investment.....				

E23-8

Year	(1) Tax Basis Of New Airplane	(2) 7-Year Property Recovery Rate	(3) Tax Depreciation on New Airplane (1) x (2)
1	\$500,000	0.143	\$ 71,500
2	500,000	0.245	122,500
3	500,000	0.175	87,500
4	500,000	0.125	62,500
5	500,000	0.089	44,500
6	500,000	0.089	44,500
7	500,000	0.089	44,500
8	500,000	0.045	22,500
			<u>\$500,000</u>

Year	(1) Annual Pretax Cash Inflows	(2) Tax Depre- ciation Deduction	(3) Increase (Decrease) in Taxable Income (1) - (2)	(4) Income Tax Rate	(5) Increase (Decrease) in Income Tax (3) x (4)	(6) After-tax Cash Inflows (1) - (5)	(7) Present Value of \$1 @ 15%	(8) Present Value of After-tax Cash Inflows (6) x (7)
1	\$130,000	\$ 71,500	\$ 58,500	40%	\$23,400	\$106,000	0.870	\$ 92,742
2	130,000	122,500	7,500	40%	3,000	127,000	0.756	96,012
3	130,000	87,500	42,500	40%	17,000	113,000	0.658	74,354
4	130,000	62,500	67,500	40%	27,000	103,000	0.572	58,916
5	130,000	44,500	85,500	40%	34,200	95,800	0.497	47,613
6	130,000	44,500	85,500	40%	34,200	95,800	0.432	41,386
7	130,000	44,500	85,500	40%	34,200	95,800	0.376	36,021
8	130,000	22,500	107,500	40%	43,000	87,000	0.327	28,449
9	130,000	0	130,000	40%	52,000	78,000	0.284	22,152
10	130,000	0	130,000	40%	52,000	78,000	0.247	19,266

Present value of periodic after-tax cash inflows	\$516,911
Plus present value of after-tax salvage (\$100,000 x (1 - 40%) x .247).....	14,820
Present value of cash inflows over useful life of new airplane.....	\$531,731
Less initial cash outflow (cost of new airplane).....	500,000
Net present value of investment.....	<u>\$ 31,731</u>

E23-9

Cost of new machine	\$38,000
Trade-in allowance for old machine	18,000
Net cash outflow at beginning of project	\$20,000
Tax basis of old machine traded in	18,000
Tax basis of new machine	<u>\$36,000</u>
Annual cost of operating old machine	\$40,000
Annual cost of operating new machine	34,000
Annual cost savings with new machine	<u>\$ 6,000</u>

<u>Year</u>	(1) Original Tax Basis Of Old Machine	(2) 5-Year Property Recovery Rate	(3) Tax Depreciation on Old Machine (1) x (2)
1	\$20,000	0.320 *	\$ 6,400
2	20,000	0.192	3,840
3	20,000	0.115	2,300
4	20,000	0.115	2,300
5	20,000	0.058	1,160
			<u>\$16,000</u>

*Note that year 1 is actually the second year the old property is depreciated. Therefore, the recovery rate for the second year is used to compute the amount of depreciation on the old property in the first year of the capital expenditure proposal.

<u>Year</u>	(1) Original Tax Basis Of New Machine	(2) 5-Year Property Recovery Rate	(3) Tax Depreciation on New Machine (1) x (2)
1	\$36,000	0.200	\$ 7,200
2	36,000	0.320	11,520
3	36,000	0.192	6,912
4	36,000	0.115	4,140
5	36,000	0.115	4,140
6	36,000	0.058	2,088
			<u>\$36,000</u>

E23-9 (Concluded)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Allowable Tax Depreciation		Additional Tax Depreciation with New Machine	Annual Cost Savings With New Machine	Increase (Decrease) in Taxable Income	Income Tax Rate	Increase (Decrease) in Income Tax	Net Cash Inflow
Year	New Machine	Old Machine	(1) - (2)	Machine	(4) - (3)		(5) x (6)	(4) - (7)
1	\$ 7,200	\$6,400	\$ 800	\$8,000	\$ 5,200	40%	\$2,080	\$ 3,920
2	11,520	3,840	7,680	8,000	(1,680)	40%	(672)	8,672
3	6,912	2,300	4,612	8,000	1,388	40%	555	5,445
4	4,140	2,300	1,840	8,000	4,160	40%	1,664	4,336
5	4,140	1,160	2,980	8,000	3,020	40%	1,208	4,792
6	2,088	0	2,088	8,000	3,912	40%	1,565	4,435
Total Increase in periodic cash inflow								\$29,600
Less initial cash outlay for new machine								20,000
Increase in cash inflows over initial cash outlay for new machine								<u>\$ 9,600</u>

	(1)	(2)	(3)	(4)	(5)
Year	Net After-tax Cash Inflow (Outflow)	Present Value of \$1 @ 12%	Present Value of Cash Flows @ 12%	Present Value of \$1 @ 14%	Present Value of Cash Flows @ 14%
0	\$(20,000)	1.000	\$(20,000)	1.000	\$(20,000)
1	3,920	0.893	3,501	0.877	3,438
2	8,672	0.797	5,318	0.769	5,131
3	5,445	0.712	3,877	0.675	3,675
4	4,336	0.636	2,758	0.592	2,567
5	4,792	0.567	2,717	0.519	2,487
6	4,435	0.507	2,249	0.456	2,022
			<u>\$ 420</u>		<u>\$ (680)</u>

$$\text{Internal rate of return} = 12\% + \left(2\% \times \left(\frac{\$420}{\$420 + \$680} \right) \right) = 12.76\%$$

Recommendation: The investment may be acceptable because the internal rate of return exceeds the company's cost of capital; however, the internal rate of return on this project should be compared with the internal rate of return for other projects to determine if this is the best use of available funds.

E23-10

(1) Project A

Year	Cash Inflow (Outflow)	PV of \$1 @ 15%	PV of Cash Flow
0	\$(15,000)	1.000	\$(15,000)
1-5	5,000	3.352	16,760
Net present value.....			<u>\$ 1,760</u>

Project B

Year	Cash Inflow (Outflow)	PV of \$1 @ 15%	PV of Cash Flow
0	\$(15,000)	1.000	\$(15,000)
5	35,000	.497	17,395
Net present value.....			<u>\$ 2,395</u>

(2) Project A

Year	Cash Inflow (Outflow)	PV of \$1 @ 18%	PV of Cash Flow	PV of \$1 @ 20%	PV of Cash Flow
0	\$(15,000)	1.000	\$(15,000)	1.000	\$(15,000)
1-5	5,000	3.127	15,635	2.991	14,955
			<u>\$ 635</u>		<u>\$ (45)</u>

$$\text{Internal rate of return} = 18\% + \left(2\% \times \left(\frac{\$635}{\$635 + \$45} \right) \right) = 18\% + (2\% \times .934) = 19.87\%$$

Project B

Year	Cash Inflow (Outflow)	PV of \$1 @ 18%	PV of Cash Flow	PV of \$1 @ 20%	PV of Cash Flow
0	\$(15,000)	1.000	\$(15,000)	1.000	\$(15,000)
5	35,000	.437	15,295	.402	14,070
			<u>\$ 295</u>		<u>\$ (930)</u>

$$\text{Internal rate of return} = 18\% + \left(2\% \times \left(\frac{\$295}{\$295 + \$930} \right) \right) = 18\% + (2\% \times .241) = 18.48\%$$

- (3) Using the internal rate of return method, Project A is superior to Project B. Using the net present value method, Project B is more attractive than A. The decision hinges on assumptions made about reinvestment of cash inflow. Theory suggests resorting to the net present value method because the cost of capital reinvestment assumption implicit in this method is considered more realistic than the internal rate of return method, where a reinvestment at the project's internal rate is assumed.

PROBLEMS

P23-1

(1)	Alternative Plan	Source of Financing	After-tax Cost	Portion of Total Required	Weighted Average Cost
	(a)	Debt	$12\% \times (1 - 40\% \text{ tax rate})$	<u>\$10,000,000</u>	<u>7.20%</u>
				\$10,000,000	
	(b)	Debt	$12\% \times (1 - 40\% \text{ tax rate})$	<u>\$ 5,000,000</u>	3.60%
				\$10,000,000	
		Preferred stock	9% $(1 - 4\% \text{ issue cost})$	<u>\$ 5,000,000</u>	4.69%
				\$10,000,000	
					<u>8.29%</u>
	(c)	Common stock	$\frac{\$2.10 \text{ earnings per share}}{(\$20 \times (1 - 5\% \text{ issue cost}))}$	<u>\$10,000,000</u>	11.05%
				\$10,000,000	

(2)	Source of Financing	After-tax Cost	Portion of Current Total	Weighted Average Cost
	Debt	$10\% \times (1 - 40\% \text{ tax rate})$	<u>\$20,000,000</u>	1.33%
			\$90,000,000	
	Preferred stock	9%	<u>\$10,000,000</u>	1.00%
			\$90,000,000	
	Common stock	$\frac{\$2.10 \text{ earnings per share}}{\$20 \text{ market price per share}}$	<u>\$60,000,000 *</u>	7.00%
			\$90,000,000	
				<u>9.33%</u>

*3,000,000 shares outstanding x \$20 market price per share

P23-1 (Concluded)

(3)					Weighted
Alternative	Source of	After-tax Cost	Portion of	Average	Cost
Plan	Financing		Total Required	Cost	
(a)	Marginal cost	7.20%	\$ 10,000,000	.72%	
	(from part (1))		\$100,000,000		
	Current cost	9.33%	\$ 90,000,000	8.40%	
	(from part (2))		\$100,000,000		
	Total cost			<u>9.12%</u>	
(b)	Marginal cost	8.29%	\$ 10,000,000	.83%	
	(from part (1))		\$100,000,000		
	Current cost	9.33%	\$ 90,000,000	8.40%	
	(from part (2))		\$100,000,000		
	Total cost			<u>9.23%</u>	
(c)	Marginal cost	11.05%	\$ 10,000,000	1.11%	
	(from part (1))		\$100,000,000		
	Current cost	9.33%	\$ 90,000,000	8.40%	
	(from part (2))		\$100,000,000		
	Total cost			<u>9.51%</u>	

P23-2

Appraised value of the property, excluding storage tank and water well.....	\$190,000
Replacement cost of storage tank	<u>250,000</u>
	<u>\$440,000</u>

Differential cost of water resulting from loss of well:

Year	Water from City of Darnett at 8% Annual Increase	Water from City of Grant Well		Difference	Present Value of \$1 at 10%	Present Value
		At 8% Annual Increase	Main- tenance and Repair			
20A	\$ 72,720	\$ 35,200		\$ 37,520	.909	\$ 34,106
20B	78,538	38,016		40,522	.826	33,471
20C	84,821	41,057		43,764	.751	32,867
20D	91,606	44,342		47,264	.683	32,281
20E	98,935	47,889	\$20,000	31,046	.621	19,280
20F	106,850	51,720	20,000	35,130	.564	19,813
20G	115,398	55,858	20,000	39,540	.513	20,284
20H	124,629	60,327	20,000	44,302	.467	20,689
	<u>\$773,497</u>	<u>\$374,409</u>	<u>\$80,000</u>	<u>\$319,088</u>		<u>\$212,791</u>
Estimated land value						<u>\$652,791</u>

The City of Grant must also consider the offsetting increase in property and sales taxes arising from the ongoing economic health of this part of the total business activity that occurs within the city. This consideration may cause the negotiated land price to be reduced. Of course, the uncertainty of the various estimates must be recognized.

P23-3

(1)

Year	PV of \$1 @12%	Project 1 Aftertax Cash Flows	PV of Project 1 Cash Flows	Project 2 Aftertax Cash Flows	PV of Project 2 Cash Flows
0	1.000	\$(120,000)	\$(120,000)	\$(120,000)	\$(120,000)
1	.893	10,000	8,930	50,000	44,650
2	.797	20,000	15,940	45,000	35,865
3	.712	30,000	21,360	35,000	24,920
4	.636	60,000	38,160	25,000	15,900
5	.567	90,000	51,030	20,000	11,340
Net present value			<u>\$ 15,420</u>		<u>\$ 12,675</u>

P23-3 (Continued)

(2)	Project 1				
Year	After-tax Cash Flows	PV of \$1 @ 14%	PV of Cash Flows	PV of \$1 @ 16%	PV of Cash Flows
0	\$(120,000)	1.000	\$(120,000)	1.000	\$(120,000)
1	10,000	.877	8,770	.862	8,620
2	20,000	.769	15,380	.743	14,860
3	30,000	.675	20,250	.641	19,230
4	60,000	.592	35,520	.552	33,120
5	90,000	.519	46,710	.476	42,840
Net present value			<u>\$ 6,630</u>		<u>\$ (1,330)</u>

$$\text{Project 1 internal rate of return} = 14\% + \left(2\% \times \frac{\$6,630}{(\$6,630 + \$1,330)} \right) = 15.67\%$$

	Project 2				
Year	After-tax Cash Flows	PV of \$1 @ 16%	PV of Cash Flows	PV of \$1 @ 18%	PV of Cash Flows
0	\$(120,000)	1.000	\$(120,000)	1.000	\$(120,000)
1	50,000	.862	43,100	.847	42,350
2	45,000	.743	33,435	.718	32,310
3	35,000	.641	22,435	.609	21,315
4	25,000	.552	13,800	.516	12,900
5	20,000	.476	9,520	.437	8,740
Net present value			<u>\$ 2,290</u>		<u>\$ (2,385)</u>

$$\text{Project 2 internal rate of return} = 16\% + \left(2\% \times \frac{\$2,290}{(\$2,290 + \$2,385)} \right) = 16.98\%$$

P23-3 (Concluded)

- (3) The net present value of Project 1 is greater than the net present value of Project 2 (\$15,420 compared to \$12,675); however, the internal rate of return for Project 1 is less than the internal rate of return for Project 2 (15.67% compared to 16.98%). As a result, it is not altogether clear which project is the more profitable. The difference in rankings occurs because of the difference in the pattern of cash flows; i.e., the cash inflows for Project 1 are smaller in early years and larger in later years than those of Project 2. The internal rate of return for Project 2 is substantially larger than the company's weighted average cost of capital. It may not be possible for the cash flows received in early years to be reinvested at a rate of return equal to the internal rate of return of Project 2; consequently, cash flows received from Project 2 may not be as valuable to the firm as indicated by the internal rate of return. On the other hand, the weighted average cost of capital is a realistic earnings rate expected by the company over the investment horizon. Assuming that there is no difference in the riskiness of the expected cash flows for the two projects, it may be safer to rely on the net present value ranking than the internal rate of return. This would mean that Project 1 should be selected.

P23-4

(1)

Year	After-tax Cash Inflow	Recovery of Initial Outlay		Payback Years Required
		Needed	Balance	
1	\$300,000	\$2,200,000	\$1,900,000	1.00
2	350,000	1,900,000	1,550,000	1.00
3	400,000	1,550,000	1,150,000	1.00
4	450,000	1,150,000	700,000	1.00
5	500,000	700,000	200,000	1.00
6	550,000	200,000	0	.36
Total payback in years				<u>5.36</u>

(2)

Net aftertax cash inflows	\$5,250,000
Less depreciation	<u>2,200,000</u>
Net income over economic life of asset.....	<u>\$3,050,000</u>

$$\begin{aligned}
 \text{Accounting rate of return on original investment} &= \left(\frac{\text{Net income}}{\text{Economic life}} \right) + \text{Original investment} \\
 &= \left(\frac{\$3,050,000}{10 \text{ years}} \right) + \$2,200,000 = 13.9\%
 \end{aligned}$$

P23-4 (Concluded)

$$\begin{aligned}
 (3) \quad \text{Accounting rate of return on average investment} &= \left(\frac{\text{Net income}}{\text{Economic life}} \right) + \text{Average investment} \\
 &= \left(\frac{\$3,050,000}{10 \text{ years}} \right) + \left(\frac{\$2,200,000}{2} \right) = 27.7\%
 \end{aligned}$$

Year	Cash Inflow (Outflow)	PV of \$1 @ 14%	PV of Cash Flow
0	\$(2,200,000)	1.000	\$(2,200,000)
1	300,000	.877	263,100
2	350,000	.769	269,150
3	400,000	.675	270,000
4	450,000	.592	266,400
5	500,000	.519	259,500
6	550,000	.456	250,800
7	600,000	.400	240,000
8	650,000	.351	228,150
9	700,000	.308	215,600
10	750,000	.270	202,500
Net present value			<u>\$ 265,200</u>

Year	Cash Inflow (Outflow)	PV of \$1 @ 16%	PV of Cash Flow	PV of \$1 @ 18%	PV of Cash Flow
0	\$(2,200,000)	1.000	\$(2,200,000)	1.000	\$(2,200,000)
1	300,000	.862	258,600	.847	254,100
2	350,000	.743	260,050	.718	251,300
3	400,000	.641	256,400	.609	243,600
4	450,000	.552	248,400	.516	232,200
5	500,000	.476	238,000	.437	218,500
6	550,000	.410	225,500	.370	203,500
7	600,000	.354	212,400	.314	188,400
8	650,000	.305	198,250	.266	172,900
9	700,000	.263	184,100	.225	157,500
10	750,000	.227	170,250	.191	143,250
			<u>\$ 51,950</u>		<u>\$ (134,750)</u>

$$\text{Internal rate of return} = 16\% + \left(2\% \times \frac{\$51,950}{(\$51,950 + \$134,750)} \right) = 16\% + (2\% \times .278) = 16.6\%$$

P23-5

(1) Machine 1

$$\begin{array}{l} \text{Total payback} \\ \text{in years} \end{array} = \frac{\text{Initial outlay}}{\text{Uniform cash inflows}} = \frac{\$500,000}{\$125,000} = 4 \text{ years}$$

Machine 2

Year	After-tax Cash Inflow	Recovery of Initial Outlay		Payback Years Required
		Needed	Balance	
1	\$ 50,000	\$600,000	\$550,000	1.00
2	75,000	550,000	475,000	1.00
3	100,000	475,000	375,000	1.00
4	125,000	375,000	250,000	1.00
5	150,000	250,000	100,000	1.00
6	200,000	100,000	0	.50
Total payback in years				<u>5.50</u>

(2) Machine 1

Net after-tax cash inflows	\$1,000,000
Less depreciation	<u>500,000</u>
Net income over economic life of Machine 1	<u>\$ 500,000</u>

$$\begin{array}{l} \text{Accounting rate of return} \\ \text{on original investment} \end{array} = \left(\frac{\text{Net income}}{\text{Economic life}} \right) + \text{Original investment}$$

$$= \left(\frac{\$500,000}{8 \text{ years}} \right) + \$500,000 = 12.5\%$$

Machine 2

Net after-tax cash inflows	\$1,400,000
Less depreciation	<u>600,000</u>
Net income over economic life of Machine 2	<u>\$ 800,000</u>

$$\begin{array}{l} \text{Accounting rate of return} \\ \text{on original investment} \end{array} = \left(\frac{\$800,000}{8 \text{ years}} \right) + \$600,000 = 16.7\%$$

P23-5 (Continued)**(3) Machine 1**

$$\begin{aligned} \text{Accounting rate of return on average investment} &= \left(\frac{\text{Net income}}{\text{Economic life}} \right) + \text{Average investment} \\ &= \left(\frac{\$500,000}{8 \text{ years}} \right) + \left(\frac{\$500,000}{2} \right) = 25\% \end{aligned}$$

Machine 2

$$\text{Accounting rate of return on average investment} = \left(\frac{\$800,000}{8 \text{ years}} \right) + \left(\frac{\$600,000}{2} \right) = 33.3\%$$

(4) Machine 1

Year	Cash Inflow (Outflow)	PV of \$1 @ 15%	PV of Cash Flows
0	\$(500,000)	1.000	\$(500,000)
1-8	125,000	4.487 *	560,875
Net present value of Machine 1.....			<u>\$ 60,875</u>

*Present value of \$1 received annually for 8 years from Table 23-2 of the text.

Machine 2

Year	Cash Inflow (Outflow)	PV of \$1 @ 15%	PV of Cash Flows
0	\$(600,000)	1.000	\$(600,000)
1	50,000	.870	43,500
2	75,000	.756	56,700
3	100,000	.658	65,800
4	125,000	.572	71,500
5	150,000	.497	74,550
6	200,000	.432	86,400
7	300,000	.376	112,800
8	400,000	.327	130,800
Net present value of Machine 2.....			<u>\$ 42,050</u>

$$\begin{aligned} \text{Net present value index for Machine 1} &= \frac{\text{Net present value}}{\text{Initial cash outlay}} \\ &= \frac{\$60,875}{\$500,000} = .122 \end{aligned}$$

$$\begin{aligned} \text{Net present value index for Machine 2} &= \frac{\$42,050}{\$600,000} = .070 \end{aligned}$$

P23-5 (Concluded)

(5) Machine 1

Year	Cash Inflow (Outflow)	PV of \$1 @ 18%	PV of Cash Flows	PV of \$1 @ 20%	PV of Cash Flows
0	\$(500,000)	1.000	\$(500,000)	1.000	\$(500,000)
1-8	125,000	4.078	509,750	3.837	479,625
			<u>\$ 9,750</u>		<u>\$ (20,375)</u>

$$\begin{aligned} \text{Internal rate of return} &= 18\% + \left(2\% \times \left(\frac{\$9,750}{\$9,750 + \$20,375} \right) \right) \\ &= 18\% + (2\% \times .324) = 18.6\% \end{aligned}$$

Machine 2

Year	Cash Inflow (Outflow)	PV of \$1 @ 16%	PV of Cash Flows	PV of \$1 @ 18%	PV of Cash Flows
0	\$(600,000)	1.000	\$(600,000)	1.000	\$(600,000)
1	50,000	.862	43,100	.847	42,350
2	75,000	.743	55,725	.718	53,850
3	100,000	.641	64,100	.609	60,900
4	125,000	.552	69,000	.516	64,500
5	150,000	.476	71,400	.437	65,550
6	200,000	.410	82,000	.370	74,000
7	300,000	.354	106,200	.314	94,200
8	400,000	.305	122,000	.266	106,400
			<u>\$ 13,525</u>		<u>\$ (38,250)</u>

$$\begin{aligned} \text{Internal rate of return} &= 16\% + \left(2\% \times \left(\frac{\$13,525}{\$13,525 + \$38,250} \right) \right) \\ &= 16\% + (2\% \times .261) = 16.5\% \end{aligned}$$

P23-6

(1) Year	(2) Cash Savings from Reduced Maintenance	(3) Cash Flow from Increased Capacity	(4) Total Cash Flow (2) + (3)	(5) Tax Depreciation*	(6) Taxable Income (Loss) (4) - (5)	(7) Taxes (6) x 40%	(8) After-tax Cash Flow (4) - (7)
1	\$1,500	\$ 6,300	\$ 7,800	\$10,800	\$ (3,000)	\$(1,200)	\$ 9,000
2	1,200	7,280	8,480	17,280	(8,800)	(3,520)	12,000
3	900	17,188	18,088	10,368	7,720	3,088	15,000
4	600	25,260	25,860	6,210	19,650	7,860	18,000
5	300	25,560	25,860	6,210	19,650	7,860	18,000
6	0	22,912	22,912	3,132	19,780	7,912	15,000
7	0	22,500	22,500	0	22,500	9,000	13,500
							<u>\$100,500</u>

Cash inflow from salvage at end of economic life, net of tax

(\$6,000 salvage x (1 - .40 tax rate))..... 3,600Total after-tax cash inflows \$104,100

*The tax depreciation is determined by multiplying the depreciable basis of \$54,000 (i.e., the cash purchase price plus the tax basis of zero) by the MACRS percentages provided in Exhibit 22-4 of the text for the five-year property class.

(1) Year	After-tax Cash Inflow	Recovery of Initial Outlay		Payback Years Required
		Needed	Balance	
1	\$ 9,000	\$54,000	\$45,000	1
2	12,000	45,000	33,000	1
3	15,000	33,000	18,000	1
4	18,000	18,000	0	1
	Total payback in years			<u>4</u>

(2)	Net after-tax cash inflows (excluding salvage).....	\$100,500
	Less financial accounting depreciation	
	(\$54,000 cash + \$4,000 book value - \$6,000 salvage) ..	<u>52,000</u>
		\$ 48,500
	Less tax on salvage (\$6,000 salvage x .40 tax rate)	<u>2,400</u>
	Net income over the life of the property	<u>\$ 46,100</u>

P23-6 (Concluded)

Accounting rate of return on original investment $- \left(\frac{\text{Net income}}{\text{Economic life}} \right) + \text{Original investment}$

$$- \left(\frac{\$46,100}{7 \text{ years}} \right) + \$58,000 = 11.35\%$$

Accounting rate of return on average investment $- \left(\frac{\text{Net income}}{\text{Economic life}} \right) + \text{Average investment}$

$$- \left(\frac{\$46,100}{7 \text{ years}} \right) + \left(\frac{\$58,000 + \$6,000}{2} \right) = 20.58\%$$

(3)	Year	Cash Inflow (Outflow)	PV of \$1 @ 12%	PV of Cash Flows
	0	\$(54,000)	1.000	\$(54,000)
	1	9,000	.893	8,037
	2	12,000	.797	9,564
	3	15,000	.712	10,680
	4	18,000	.636	11,448
	5	18,000	.567	10,206
	6	15,000	.507	7,605
	7	17,100 *	.452	7,729
Net present value				<u>\$ 11,269</u>

*\$13,500 cash inflow in year 7 plus \$3,600 after-tax salvage.

$$\text{Net present value index} = \frac{\$11,269}{\$54,000} = .209$$

(4)	Year	Cash Inflow (Outflow)	PV of \$1 @ 16%	PV of Cash Flows	PV of \$1 @ 18%	PV of Cash Flows
	0	\$(54,000)	1.000	\$(54,000)	1.000	\$(54,000)
	1	9,000	.862	7,758	.847	7,623
	2	12,000	.743	8,916	.718	8,616
	3	15,000	.641	9,615	.609	9,135
	4	18,000	.552	9,936	.516	9,288
	5	18,000	.476	8,568	.437	7,866
	6	15,000	.410	6,150	.370	5,550
	7	17,100 *	.354	6,053	.314	5,369
				<u>\$ 2,996</u>		<u>\$ (553)</u>

*\$13,500 cash inflow in year 7 plus \$3,600 after-tax salvage.

$$\text{Internal rate of return} = 16\% + \left(2\% \times \frac{\$2,996}{(\$2,996 + \$553)} \right) = 17.688\%$$

P23-7

	(1)	(2)	(3)
	Periodic Net Cash Inflows	Annual 7% Price-Level Adjustment	Adjusted Estimate of Net Cash Inflows (1) x (2)
Year			
1	\$ 20,000	$(1 + .07) = 1.070$	\$ 21,400
2	25,000	$(1 + .07)^2 = 1.145$	28,625
3	30,000	$(1 + .07)^3 = 1.225$	36,750
4	30,000	$(1 + .07)^4 = 1.311$	39,330
5	30,000	$(1 + .07)^5 = 1.403$	42,090
6	30,000	$(1 + .07)^6 = 1.501$	45,030
7	25,000	$(1 + .07)^7 = 1.606$	40,150
8	20,000	$(1 + .07)^8 = 1.718$	34,360
9	15,000	$(1 + .07)^9 = 1.838$	27,570
10	10,000	$(1 + .07)^{10} = 1.967$	19,670
	<u>\$235,000</u>		<u>\$334,975</u>

	(1)	(2)	(3)
	Depreciable Basis of Machine	7-Year Property Recovery Percentage	Tax Depreciation (1) x (2)
Recovery Year			
1	\$100,000	0.143	\$ 14,300
2	100,000	0.245	24,500
3	100,000	0.175	17,500
4	100,000	0.125	12,500
5	100,000	0.089	8,900
6	100,000	0.089	8,900
7	100,000	0.089	8,900
8	100,000	0.045	4,500
			<u>\$100,000</u>

P23-7 (Continued)

Year	(1) Adjusted Estimate of Net Cash Inflows	(2) Tax Depre- ciation	(3) Taxable Income (Loss) (1) - (2)	(4) Federal and State Income Tax Rate	(5) Income Tax Payment (Reduction) (3) x (4)	(6) Net After-tax Cash Inflows (1) - (5)
1	\$21,400	\$14,300	\$ 7,100	40%	\$ 2,840	\$ 18,560
2	28,625	24,500	4,125	40%	1,650	26,975
3	36,750	17,500	19,250	40%	7,700	29,050
4	39,330	12,500	26,830	40%	10,732	28,598
5	42,090	8,900	33,190	40%	13,276	28,814
6	45,030	8,900	36,130	40%	14,452	30,578
7	40,150	8,900	31,250	40%	12,500	27,650
8	34,360	4,500	29,860	40%	11,944	22,416
9	27,570	0	27,570	40%	11,028	16,542
10	19,670	0	19,670	40%	7,868	11,802
Total inflation-adjusted after-tax cash inflows						<u>\$240,985</u>

(1) Payback period:

Year	Net After-tax Cash Inflow	Recovery of Initial Cash Outlay		Years Required Until Payback
		Needed	Balance	
1	\$18,560	\$100,000	\$81,440	1.0
2	26,975	81,440	54,465	1.0
3	29,050	54,465	25,415	1.0
4	28,598	25,415	0	0.9
Total payback period in years				<u>3.9</u>

(2) Accounting rate of return on original investment:

Total inflation-adjusted after-tax cash inflow	\$240,985
Less financial accounting depreciation	100,000
Net income over economic life of project	<u>\$140,985</u>

$$\text{Average annual return} = \frac{\text{Net income}}{\text{Economic life}} = \frac{\$140,985}{10 \text{ years}} = \$14,099$$

$$\text{Accounting rate of return on original investment} = \frac{\text{Average annual return}}{\text{Original investment}} = \frac{\$14,099}{\$100,000} = .1410 \text{ or } 14.10\%$$

P23-7 (Continued)**(3) Accounting rate of return on average investment:**

$$\begin{array}{l} \text{Accounting rate} \\ \text{of return} \\ \text{on average} \\ \text{investment} \end{array} = \frac{\text{Average annual return}}{\text{Original investment} + 2} = \frac{\$14,099}{\$50,000} = .2820 \text{ or } 28.20\%$$

(4) Net present value and net present value index:

Year	(1) Net After-tax Cash (Outflow) Inflow	(2) Present Value of \$1 @ 15%	(3) Present Value of Net Cash Flow (1) x (2)
0	\$(100,000)	1.000	\$ (100,000)
1	18,560	0.870	16,147
2	26,975	0.756	20,393
3	29,050	0.658	19,115
4	28,598	0.572	16,358
5	28,814	0.497	14,321
6	30,578	0.432	13,210
7	27,650	0.376	10,396
8	22,416	0.327	7,330
9	16,542	0.284	4,698
10	11,802	0.247	2,915
Net present value			<u>\$ 24,883</u>

$$\begin{array}{l} \text{Net present} \\ \text{value index} \end{array} = \frac{\text{Net present value}}{\text{Required investment}} = \frac{\$24,883}{\$100,000} = .249$$

(5) Present value payback in years:

Year	Present Value of After-tax Cash Inflow	Recovery of Initial Cash Outlay		Years Required for Present Value Payback
		Needed	Balance	
1	\$16,147	\$100,000	\$83,853	1.00
2	20,393	83,853	63,460	1.00
3	19,115	63,460	44,345	1.00
4	16,358	44,345	27,987	1.00
5	14,321	27,987	13,666	1.00
6	13,210	13,666	456	1.00
7	10,396	456	0	0.04
Total payback period in years.....				<u>6.04</u>

P23-7 (Concluded)

(6) Internal rate of return:

	(1)	(2)	(3)	(4)	(5)
	Net Aftertax Cash (Outflow) Inflow	Present Value of \$1 @ 20%	Present Value of Cash Flow Discounted @ 20% (1) x (2)	Present Value of \$1 @ 22%	Present Value of Cash Flow Discounted @ 22% (1) x (4)
Year					
0	\$(100,000)	1.000	\$(100,000)	1.000	\$(100,000)
1	18,560	0.833	15,460	0.820	15,219
2	26,975	0.694	18,721	0.672	18,127
3	29,050	0.579	16,820	0.551	16,007
4	28,598	0.482	13,784	0.451	12,898
5	28,814	0.402	11,583	0.370	10,661
6	30,578	0.335	10,244	0.303	9,265
7	27,650	0.279	7,714	0.249	6,885
8	22,416	0.233	5,223	0.204	4,573
9	16,542	0.194	3,209	0.167	2,763
10	11,802	0.162	1,912	0.137	1,617
			<u>\$ 4,670</u>		<u>\$ (1,985)</u>

$$\text{Internal rate of return} = 20\% + \left(2\% \times \left(\frac{\$4,670}{\$4,670 + \$1,985} \right) \right) = .2140 \text{ or } 21.4\%$$

P23-8

(1)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
			Reduced	Lost	Total	Additional	Net Periodic
	Reduced	Reduced	Inventory	Contribution	Periodic	Maintenance	Savings
	Labor	Machine	Carrying	Margin	Savings from	Cost with	with CIM
Year	Cost	Setup Time	Cost	Avoided	CIM System	CIM System	System
					(1)+(2)+(3)+(4)		(5) - (6)
1	\$15,000	\$40,000	\$25,000	\$200,000	\$280,000	\$25,000	\$255,000
2	25,000	50,000	35,000	300,000	410,000	25,000	385,000
3	30,000	60,000	40,000	400,000	530,000	25,000	505,000
4	30,000	60,000	40,000	500,000	630,000	25,000	605,000
5	30,000	60,000	40,000	600,000	730,000	25,000	705,000
6	30,000	60,000	40,000	700,000	830,000	25,000	805,000

P23-8 (Continued)

	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Year	Net Periodic Savings with CIM	Tax Depre- ciation and Amorti- zation*	Taxable Income (Loss) (7) - (8)	Effective Tax Rate	Tax Liability (Refund) (9) x (10)	Periodic Net After-tax Cash Inflows (7) - (11)	Index for Antici- pated 8% Rate of Inflation	Inflation- Adjusted Periodic Net After- tax Cash Inflows (12) x (13)
1	\$255,000	\$440,000	\$(185,000)	40%	\$ (74,000)	\$329,000	1.080	\$ 355,320
2	385,000	680,000	(295,000)	40%	(118,000)	503,000	1.168	586,498
3	505,000	424,000	81,000	40%	32,400	472,600	1.260	595,476
4	605,000	270,000	335,000	40%	134,000	471,000	1.360	640,560
5	705,000	270,000	435,000	40%	174,000	531,000	1.469	780,039
6	805,000	116,000	689,000	40%	275,600	529,400	1.587	840,158
Total annual inflation-adjusted after-tax savings from investment in CIM system								\$3,798,051
Cash inflow from salvage of equipment and machinery (\$100,000 salvage x 1.587 adj. x (1 - 40% tax rate)).....								95,220
Total inflation adjusted after-tax cash inflows from investment in CIM system....								\$3,893,271
Less initial investment (\$2,000,000 in equipment plus \$200,000 in software).....								2,200,000
Excess of cost of CIM system over inflation-adjusted after-tax savings								<u>\$1,693,271</u>

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Year	Recovery Property Tax Basis	Rate for MACRS 5-year Property	Tax Depre- ciation (1) x (2)	Software Tax Basis	5-year Straight-line Amortization Rate	Tax Amorti- zation (4) x (5)	Total Tax Amorti- zation and Depreciation (3) + (6)
1	\$2,000,000	0.200	\$ 400,000	\$200,000	0.200	\$ 40,000	\$ 440,000
2	2,000,000	0.320	640,000	200,000	0.200	40,000	680,000
3	2,000,000	0.192	384,000	200,000	0.200	40,000	424,000
4	2,000,000	0.115	230,000	200,000	0.200	40,000	270,000
5	2,000,000	0.115	230,000	200,000	0.200	40,000	270,000
6	2,000,000	0.058	116,000	200,000	0.000	0	116,000
			<u>\$2,000,000</u>			<u>\$200,000</u>	<u>\$2,200,000</u>

P23-8 (Concluded)

(2)				
	Inflation- Adjusted Periodic Net After-tax Cash Inflows	Needed	Balance	Payback Years Required
Year				
1	\$355,320	\$2,200,000	\$1,844,680	1.00
2	586,498	1,844,680	1,258,182	1.00
3	595,476	1,258,182	662,706	1.00
4	640,560	662,706	22,146	1.00
5	780,039	22,146	0	0.03
Total payback in years				<u>4.03</u>

(3)				
	Inflation- Adjusted Periodic Net After-tax Cash Inflows	Present Value of \$1 @ 14%	Present Value of Cash Inflows	
Year				
0	\$(2,200,000)	1.000	\$(2,200,000)	
1	355,320	0.877	311,616	
2	586,498	0.769	451,017	
3	595,476	0.675	401,946	
4	640,560	0.592	379,212	
5	780,039	0.519	404,840	
6	935,378 *	0.456	426,532	
Net present value of investment			<u>\$ 175,163</u>	

*\$840,158 after-tax cash inflow for year 6 plus \$95,220 after-tax salvage value at the end of year 6.

P23-9**Purchase alternative:**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Cash	MACRS	Income	Increase	Income	Increase	Net
Year	Inflows	Depreci- ation Rate	Tax Depreci- ation*	In Taxable Income (1) - (3)	Tax Rate	In Income Tax (4) x (5)	After-tax Cash Inflows (1) - (6)
1	\$800,000	.143	\$286,000	\$314,000	.40	\$125,600	\$ 474,400
2	600,000	.245	490,000	110,000	.40	44,000	556,000
3	600,000	.175	350,000	250,000	.40	100,000	500,000
4	600,000	.125	250,000	350,000	.40	140,000	460,000
5	600,000	.089	178,000	422,000	.40	168,800	431,200
6	600,000	.089	178,000	422,000	.40	168,800	431,200
7	600,000	.089	178,000	422,000	.40	168,800	431,200
8	600,000	.045	90,000	510,000	.40	204,000	396,000
9	600,000	.000	0	600,000	.40	240,000	360,000
10	600,000	.000	0	600,000	.40	240,000	360,000
11	600,000	.000	0	600,000	.40	240,000	360,000
12	600,000	.000	0	600,000	.40	240,000	360,000
13	600,000	.000	0	600,000	.40	240,000	360,000
14	600,000	.000	0	600,000	.40	240,000	360,000
15	600,000	.000	0	600,000	.40	240,000	360,000
							<u>\$6,200,000</u>
After-tax cash inflow from salvage at end of economic life.....							<u>120,000</u> **
Total after-tax cash inflow from the purchase alternative.....							<u>\$6,320,000</u>
Less initial cash outflow							<u>2,000,000</u>
Total after-tax cash inflow over economic life of project							<u><u>\$4,320,000</u></u>

*The depreciation is determined by multiplying the depreciable basis of \$2,000,000 by the MACRS cost recovery percentages provided in Exhibit 22-4 of the text for seven-year property.

**The salvage received at the end of the economic life of the asset would be fully taxable because the tax basis of the property would be zero. The after-tax cash inflow would be \$120,000, i.e., (\$200,000 salvage value x (1 - .40 tax rate)).

P23-9 (Concluded)

Year	Net After-tax Cash Flow	PV of \$1 @ 14%	PV of Cash Flow
0	\$(2,000,000)	1.000	\$(2,000,000)
1	474,400	.877	416,049
2	556,000	.769	427,564
3	500,000	.675	337,500
4	460,000	.592	272,320
5	431,200	.519	223,793
6	431,200	.456	196,627
7	431,200	.400	172,480
8	396,000	.351	138,996
9	360,000	.308	110,880
10	360,000	.270	97,200
11	360,000	.237	85,320
12	360,000	.208	74,880
13	360,000	.182	65,520
14	360,000	.160	57,600
15	360,000	.140	50,400
Net present value			<u>\$ 727,129</u>

Lease alternative:

Annual cash inflow before lease payment.....	\$600,000
Annual lease payment.....	<u>320,000</u>
Annual pretax cash inflow and increase in taxable income	\$280,000
Annual increase in income tax expense (\$280,000 x 40%)	<u>112,000</u>
Annual after-tax cash inflow from lease alternative.....	<u>\$168,000</u>

Year	Cash Inflow	PV of Annuity \$1 @ 14%	PV of Cash Flows
1-15	\$168,000	6.142	\$1,031,856

The lease alternative appears to be preferable because the net present value of the estimated after-tax cash flows is greater than for the purchase alternative (\$1,031,856 versus \$727,129).

P23-10

(1)

	General-Purpose Equipment		Self- Constructed Equipment
	Lease	Purchase	
Recurring cash flows from operations:			
Estimated sales volume in units.....	40,000	40,000	40,000
Unit contribution margin.....	\$ 1.55	\$ 1.55	\$ 1.90
Estimated total contribution margin	<u>\$62,000</u>	<u>\$62,000</u>	<u>\$76,000</u>
Less fixed costs:			
Supervision.....	\$16,000	\$16,000	\$17,000
Property taxes and insurance.....	0	3,000	5,000
Maintenance.....	0	3,000	2,000
Total fixed cost	<u>\$16,000</u>	<u>\$22,000</u>	<u>\$24,000</u>
Annual cash inflows before tax	<u>\$46,000</u>	<u>\$40,000</u>	<u>\$52,000</u>

Lease equipment alternative:

Annual cash inflow before tax.....	\$46,000
Annual lease payment	40,000
Annual increase in taxable income.....	\$ 6,000
Annual increase in income tax (\$6,000 x 40%).....	2,400
Annual aftertax cash inflow.....	\$ 3,600
PV of \$1 received annually for 6 years @ 14%	x 3.889
Net present value of lease alternative.....	<u>\$14,000</u>

P23-10 (Continued)

Purchase equipment alternative:

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Pretax Cash Inflows	Income Tax Depreci- ation*	Taxable Income (1) - (2)	Income Tax at 40% Tax Rate (3) x 40%	Net After-tax Cash Inflows (1) - (4)	PV of \$1 @ 14%	PV of Net After-tax Cash Inflows (5) x (6)
Year							
1	\$40,000	\$25,000	\$15,000	\$ 6,000	\$34,000	.877	\$ 29,818
2	40,000	40,000	0	0	40,000	.769	30,760
3	40,000	24,000	16,000	6,400	33,600	.675	22,680
4	40,000	14,375	25,625	10,250	29,750	.592	17,612
5	40,000	14,375	25,625	10,250	29,750	.519	15,440
6	80,000 **	7,250	72,750	29,100	50,900	.456	23,210
Present value of net cash inflows.....							\$139,520 **
Less initial cash outflow							125,000
Net present value of purchase alternative.....							<u>\$ 14,520</u>

*Tax depreciation is determined by multiplying the depreciable basis of the equipment under the purchase alternative (\$125,000) by the MACRS depreciation rates provided in Exhibit 22-4 of the text.

**Includes salvage value of \$40,000, all of which would be taxable, since the equipment would be fully depreciated for income tax purposes at the end of the sixth year. The total after-tax cash flow from operations of \$50,900 shown in column (5) is composed of after-tax cash inflow from operations of \$26,900 (\$40,000 - ((\$40,000 - \$7,250) x .40 tax rate)) and the after-tax cash flow from salvage of \$24,000 (\$40,000 x (1 - .40 tax rate)).

P23-10 (Continued)

Self-constructed equipment alternative:

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Pretax Cash Inflows	Income Tax Depreci- ation*	Taxable Income (1) - (2)	Income Tax at 40% Tax Rate (3) x 40%	Net After-tax Cash Inflows (1) - (4)	PV of \$1 @ 14%	PV of Net After-tax Cash Inflows (5) x (6)
Year							
1	\$52,000	\$36,000	\$16,000	\$ 6,400	\$45,600	.877	\$ 39,991
2	52,000	57,600	(5,600)	(2,240)	54,240	.769	41,711
3	52,000	34,560	17,440	6,976	45,024	.675	30,391
4	52,000	20,700	31,300	12,520	39,480	.592	23,372
5	52,000	20,700	31,300	12,520	39,480	.519	20,490
6	82,000 **	10,440	71,560	28,624	53,376	.456	24,339
Present value of net cash inflows							\$180,294
Less initial cash outflow							165,000 ***
Net present value of purchase alternative							<u>\$ 15,294</u>

* Tax depreciation is determined by multiplying the depreciable basis of the equipment under the self-construction alternative (\$180,000, which is the full construction cost including allocated fixed cost) by the MACRS depreciation rates provided in Exhibit 22-4 of the text.

** Includes salvage value of \$30,000, all of which would be taxable, since the equipment would be fully depreciated for income tax purposes at the end of the sixth year. The total after-tax cash flow from operations of \$53,376 shown in column (5) is composed of after-tax cash inflow from operations of \$35,376 (\$52,000 - ((\$52,000 - \$10,440) x .40 tax rate)) and the after-tax cash flow from salvage of \$18,000 (\$30,000 x (1 - .40 tax rate)).

*** Because Egelston Corporation is operating at normal capacity and the construction of the new equipment will not interfere with regular activities, the company should not incur any additional fixed factory overhead. Therefore, the \$15,000 of fixed factory overhead is not included in the differential cost of the self-constructed asset. The initial cash outlay would be \$180,000 full cost less \$15,000 of allocated fixed factory overhead, or \$165,000.

P23-10 (Concluded)

- (2) Egelston Corporation should consider any proposal that is expected to have an earnings rate in excess of the firm's cost of capital. If a proposal has a positive net present value, that proposal's expected earnings will yield a rate of return that exceeds the firm's cost of capital. In this case, the purchase of general-purpose equipment, the construction of special-purpose equipment, and the lease of general-purpose equipment are all acceptable to Egelston Corporation, because the net present value of all three proposals is positive.

Egelston Corporation should attempt to maximize the earnings that can be obtained from the funds available for capital investments. When comparing a set of mutually exclusive alternatives, the alternative with the largest net present value will result in a maximization of stockholder wealth. Accordingly, construction of special-purpose equipment appears to be the most attractive alternative. However, the net present value should be related to any required investment by calculating a net present value index as follows:

Construction of special-purpose equipment:

$$\frac{\text{Net present value}}{\text{Required investment}} = \frac{\$15,294}{\$165,000} = .0927$$

Purchase of special-purpose equipment:

$$\frac{\text{Net present value}}{\text{Required investment}} = \frac{\$14,520}{\$125,000} = .1162$$

Purchase of general-purpose equipment promises a larger net present value index and would be preferable, provided that the investment difference of \$40,000 (\$165,000 - \$125,000) can be used to earn a net present value greater than \$774 (\$15,294 - \$14,520).

CASES

C23-1

- (1)
 - (a) The payback method measures the number of years required for the aftertax cash inflows to fully recover the initial cash investment in a project. The payback method emphasizes an organization's financial liquidity and the riskiness of the capital project in terms of investment recovery. Since long-term forecasts contain more uncertainty than short-term forecasts (i.e., it is easier to predict what will happen next year than what will happen 10 years from now), the least risky projects will have the shortest payback period.
 - (b) The net present value method recognizes the time value of money by discounting the after-tax cash flows for a project over its life to time zero using the firm's weighted average cost of capital. The net present value is the difference between the present value of the after-tax cash inflows, measured over the life of the capital project, and the cash outflow required to undertake the capital project. Projects that have a positive net present value are acceptable, while those that have a negative net present value are unacceptable.
 - (c) The internal rate of return method (also called the discounted cash flow rate of return method) incorporates the time value of money by determining the compound interest rate for a capital project that would result in a net present value of zero. A proposal would be acceptable if the internal rate of return exceeds the weighted average cost of capital, and unacceptable if it is less.
- (2) In order to maximize the value of the company, Caledonia Division should use the net present value method or the internal rate of return method to decide which capital projects should be included in the capital budget submitted to Quible Industries. Both of these methods would identify Projects A, B, D, E, and F as acceptable (each has a positive net present value and an internal rate of return in excess of the company's hurdle rate), and Project C as unacceptable (the net present value is negative and the internal rate of return is less than the company's hurdle rate). However, Projects A and D are mutually exclusive (meaning that ultimately only one of the two can be pursued). The selection between the two depends upon the criteria used to rank the projects, i.e., the capital expenditure evaluation method employed in the selection process. If the net present value method is used, Caledonia would select Project D because it has a higher net present value than Project A (\$74,374 for D compared to \$69,683 for A). On the other hand, if the internal rate of return method is used, Caledonia would select Project A because it has a higher internal rate of return than Project D (35% for A compared to 22% for D).

C23-1 (Concluded)

- (3) In order to maximize the value of the company in this capital rationing situation, the net present value should be used to select the projects to be included in the capital budget because the cash inflows are assumed to be reinvested at the hurdle rate (the company has a demonstrated earning rate equal to its weighted average cost of capital). The internal rate of return should not be used, because it violates the reinvestment rate assumption and may be unreliable as a basis for maximizing the value of the company in a capital rationing situation. Using the net present value method, the most profitable combination of projects within the \$450,000 budget constraint would be to include Projects A, B, and F because this combination yields the greatest total net present value (net present value of \$162,929 for an initial investment of \$436,000). (Note that the combination of A, D, and F is not possible because A and D are mutually exclusive projects, and that the combination of B, D, and F is not possible because it would require a combined investment in excess of \$450,000.)

C23-2

- (1) The 18.2% rate of return on the investment differs from the 24% internal rate of return because the methods used to measure the returns are different.

The return on investment (18.2%) calculation is based on accrual accounting concepts. If the reduced operating expenses—less depreciation—remain constant as planned, the numerator in the ROI fraction will not change over the life of the investment. The denominator in the fraction, the investment base, decreases each year by the amount of the annual depreciation. Consequently, the rate of return calculated will increase each year over the life of the investment.

The internal rate of return calculation (24%) is based on discounted cash flow concepts. The cash flows expected to be received over the life of the investment, discounted to the acquisition date at 24%, exactly equaled the initial cost of the machine. This measure of return on investment provides a percentage that is constant for each year of life of the investment. This rate can be computed for each year's actual operating results if the annual savings in operating expenses are constant and the new equipment is depreciated using the effective interest method based on an interest rate of 24%. The method would be essentially the same as that employed in amortizing leaseholds and bonds. The depreciation charge each year would have to be such that the numerator and the denominator of the ROI computation would change at the same rate in order to keep the annual return on investment ratio constant.

C23-2 (Concluded)

- (2) Recap Corporation can restructure the data from the cash flow analysis to make it consistent with the accounting reports (which contain straight-line depreciation) received by the department manager. Once the investment is accepted on the basis of its internal rate of return, the data can be converted into the format consistent with the accounting basis used for reporting. Annual contribution from the new investment would be calculated by subtracting the straight-line depreciation from the net cash operating savings. The accounting book value for each of the years of the investment life would also be calculated. The annual contribution would be divided by the investment base (book value) for each year to obtain the rates of return. This would then present the manager with the different rates of return for each of the years of the investment's life. Thus, the rates would be more comparable with the actual return on investment rates experienced each year.

Alternatively, rather than computing an annual rate of return, it may be more expedient to compare actual net cash operating savings each year with those forecast in the capital expenditure analysis. If actual periodic savings equal those forecast, the internal rate of return would be equal to the 24% budgeted.

CHAPTER 4

DISCUSSION QUESTIONS

- Q4-1. The five parts are:
- (a) Direct materials section
 - (b) Direct labor section
 - (c) Factory overhead
 - (d) Work in process inventories
 - (e) Finished goods inventories
- Q4-2. The balance sheet is a statement of financial position; the income statement is a statement of activity. The income statement is complementary to the balance sheet, accounting in particular for the change in the proprietary equity as a result of operations during the year. In that respect, the income statement is essentially nothing more than a major section of the retained earnings account. Therefore, the revenue and expense accounts in the income statement have been termed "explanatory" accounts, explaining the ebb and flow of revenues and expenses that lead to the new income (or loss) and to the new retained earnings balance in the balance sheet.
- Q4-3. The ordinary balance sheet and income statement are intended to provide information as to financial position and results of operation of a business, in accordance with several assumptions that are made in preparing the statements. From the standpoint of the criticisms made, the most important of these assumptions are that cost less appropriate amortization of cost measures unexpired cost, and that a business may be assumed to be going to continue operations indefinitely into the future. Accounting statements are usually prepared on the theory that a sale or some other definite event is essential before revenue is recognized. Basically, the asset side of a balance sheet contains a presentation of the amounts of cost incurred, which can be presumed to benefit future periods. An income statement presents the amount of revenue recognized as having been realized during the period, less the portion of all costs incurred that does not appear to be fairly deferrable to future periods.

The income statement is primarily a measure of what has been earned, and not a measure of "earning power." For plant assets, the balance sheet is primarily a measure of accountability for expenditures, showing acquisition costs less costs allocated to past operations. This measure of accountability may be quite different from "true value."

To increase its usefulness as one element in judging earning power, the income statement is prepared with a distinction between operating and nonoperating items. For the same reason, certain items may be eliminated from the income

statement and shown in the statement of retained earnings. However, the effect of nonrecurring and nonoperating transactions is not entirely eliminated.

Information revealed by a series of income statements is more significant in judging earning power than information revealed by one income statement. The income of a business may follow or even exaggerate the ups and downs of the business cycle and, therefore, the income of any one year will not represent earning power.

Changes in law or local zoning ordinances may result in a marked change in the earning power of a business. Likewise, changes in public taste, development of new products, appearance of new competition, acquisition of subsidiaries, changes in management and the like, all may change earning power and yet not be clearly reflected, if reflected at all, in one income statement.

The accounting use of historical, rather than current, dollars in measuring depreciation and cost of goods sold may result in distorting any view of earning power obtained from a single income statement.

In regard to plant assets, it can be said that their value to a going concern is usually dependent upon the earning power of the business. Such a value is not necessarily the same as liquidation value, cost, cost less amortization, replacement value, or any other kind of value. The phrase "true value" has no definite connotation.

- Q4-4. *Actual* describes the way costs are measured, i.e., at actual historical amounts; *full absorption* describes which elements of cost are allocated to inventory accounts, i.e., all elements of manufacturing cost are fully allocated to inventories; *process* describes how cost information is accumulated, i.e., costs are accumulated for each process or department in the factory.
- Q4-5. Prime costing systems allocate only the prime costs, direct material and direct labor, to inventory accounts. Direct costing systems, also called variable costing systems, allocate the variable manufacturing costs, direct material, direct labor, and variable factory overhead to the inventory accounts. Absorption costing systems allocate to inventories part or all of fixed factory overhead, in addition to all variable manufacturing costs.
- Q4-6. Actual costing measures product costs at actual historical amounts, while standard costing measures product costs by using predetermined amounts of resources to be consumed and predetermined prices of those resources.

- Q4-7. Process costing accumulates costs for each process or department in the factory and maintains detailed records and calculations of the costs of work in process. Job order costing accumulates costs for each job, lot, batch, or contract and maintains detailed records and calculations of the costs of work in process. Backflush costing accumulates costs by working backwards through the available information after production is completed (i.e., at the end of the accounting period) and maintains no detailed records of the costs of work in process.
- Q4-8. Actual costing is more common than standard costing in defense-related industries, while standard costing is somewhat more common elsewhere.
- Q4-9. Super-full absorption or super absorption refers to the income tax requirement that some purchasing and storage costs be allocated to inventory accounts.
- Q4-10. Job order costing would be common in repair shops, building construction, and printing; and in service businesses such as medical, legal, architectural, construction engineering, accounting, and consulting firms, as mentioned in the text. Other examples include shipbuilding, bridge building, tool and die manufacturing, art and antique restoration, and contract research.
- Q4-11. As mentioned in the text, process costing would be common in the milling, brewing, chemical, and textile industries; in simple assembly operations; and in service businesses serving large numbers of customers simultaneously, such as airlines. Other examples include petroleum refining, basic food processing, and manufacture of low-cost consumer products such as toys, disposable pens, razors, and lighters.
- Q4-12. Aspects common to job order and process costing are:
- (a) They can be used by service organizations.
 - (b) They require considerable detail to calculate the cost of work in process.
 - (c) The work in process account in the general ledger is supported by subsidiary records.
- Q4-13. A blended costing method uses job order costing to accumulate some element(s) of cost and process costing to accumulate others.
- Q4-14. Flexible manufacturing systems consist of an integrated collection of automated production processes, automated materials movement, and computerized system controls to utilize facilities in efficiently manufacturing a highly flexible variety of products.
- Q4-15. The advantages of a flexible manufacturing system over the other systems include short (near-zero) setup times, the absence of a learning curve, lower lead times to shipment, lower direct labor cost per unit, lower direct labor cost in total, and lower work in process inventories.
- Q4-16. The initial cost of creating a flexible manufacturing system is much higher than that of other manufacturing systems.
- Q4-17. Manufacturing settings suited for backflush costing are distinguished by very fast processing speeds, which removes both the incentive and the opportunity to track the detailed costs of work in process.

EXERCISES

E4-1 Calculation of cost of goods sold (in thousands):

Total manufacturing cost	\$110
Add work in process inventory, beginning	80
	<u>\$190</u>
Less work in process inventory, ending	90
Cost of goods manufactured	\$100
Add finished goods inventory, beginning	150
Cost of goods available for sale	<u>\$250</u>
Less finished goods inventory, ending	60
Cost of goods sold	<u>\$190</u>

E4-2 Calculation of cost of goods sold (in thousands):

Direct materials used	\$ 90
Direct labor	60
Factory overhead	80
Total manufacturing cost	<u>\$230</u>
Add work in process inventory, beginning	250
	<u>\$480</u>
Less work in process inventory, ending	210
Cost of goods manufactured	\$270
Add finished goods inventory, beginning	340
Cost of goods available for sale	<u>\$610</u>
Less finished goods inventory, ending	270
Cost of goods sold	<u>\$340</u>

E4-4 (Concluded)**(2) Cost of goods manufactured:**

Stores, April 30	\$ 10,250
Purchases	105,000
	<u>\$115,250</u>
Less: Stores, May 31	12,700
Direct materials consumed	\$102,550
Direct labor used (4,250 x \$22)	93,500
Factory overhead	<u>77,390</u>
Total manufacturing cost	\$273,440
Add work in process, beginning inventory	61,420
	<u>\$334,860</u>
Less work in process, ending inventory	52,800
Cost of goods manufactured	<u><u>\$282,060</u></u>

(3) Ending balance of finished goods:

Finished goods, April 30	+	Cost of goods manufactured	-	Finished goods, May 31	=	Cost of goods sold
\$45,602	+	\$282,060	-	X	=	\$280,000
				X	=	\$ 47,662

Therefore, the finished goods ending balances is \$47,662.

E4-5	(a)	Materials	35,000	
		Accounts Payable		35,000
(b)		Work in Process	33,000	
		Factory Overhead Control	2,000	
		Materials		35,000
(c)		Payroll	40,000	
		Accrued Payroll		40,000
(d)		Accrued Payroll	40,000	
		Cash		40,000
(e)		Work in Process	32,000	
		Factory Overhead control	8,000	
		Payroll		40,000
(f)		Factory Overhead Control	4,000	
		Cash		4,000

E4-5 (Concluded)

(g)	Factory Overhead Control	18,000	
	Accounts Payable		18,000
(h)	Factory Overhead Control	4,130	
	Accumulated Depreciation.....		2,100
	Prepaid Expenses		780
	Accrued Property Taxes		1,250
(i)	Work in Process	36,130	
	Factory Overhead Control		36,130
(j)	Finished Goods.....	92,000	
	Work in Process		92,000
(k)	Accounts Receivable.....	80,000	
	Sales		80,000
	Cash	40,000	
	Accounts Receivable.....		40,000
	Cost of Goods Sold.....	60,000	
	Finished Goods		60,000

E4-6	(a)	Materials	13,500	
		Accounts Payable		13,500
	(b)	Work in Process	17,500	
		Materials		17,500
	(c)	Factory Overhead Control	1,800	
		Materials		1,800
	(d)	Payroll	27,000	
		Accrued Payroll.....		27,000
		Work in Process	17,000	
		Factory Overhead Control	2,000	
		Marketing Expenses Control	5,000	
		Administrative Expenses Control	3,000	
		Payroll		27,000
	(e)	Factory Overhead Control	2,508	
		Cash.....		2,508
	(f)	Factory Overhead Control	8,500	
		Accounts Payable		8,500
	(g)	Work in Process	14,808	
		Factory Overhead Control.....		14,808
	(h)	Finished Goods.....	60,100	
		Work in Process		60,100

E4-6 (Concluded)

(i)	Accounts Receivable.....	80,000	
	Sales		80,000
	Cost of Goods Sold*	60,000	
	Finished Goods		60,000
	* \$15,000 + \$60,100 - \$15,100 = \$60,000		

E4-7

WALLACE INDUSTRIES
Cost of Goods Manufactured Statement
For May
(in thousands of dollars)

Direct materials:			
	Direct materials, April 30, 20A.....	\$ 28	
	Purchases	\$510	
	Freight in	15	525
	Direct materials available for use		\$553
	Less direct materials, May 31, 20A ...		23
	Direct materials consumed		\$ 530
	Direct labor.....		260
Factory overhead:			
	Indirect factory labor	\$ 90	
	Utilities (\$135 x 80%).....	108	
	Property tax	60	
	Insurance (\$20 x 60%)	12	
	Depreciation (\$20 + \$30).....	50	
	Total factory overhead.....		320
	Total manufacturing cost.....		\$1,110
	Add work in process, April 30, 20A...		150
			\$1,260
	Less work in process, May 31, 20A ...		210
	Cost of goods manufactured		<u>\$1,050</u>

E4-8

CINNABAR COMPANY
Statement of Cost of Goods Sold
For Year Ended December 31

Raw materials:			
Purchases	\$400,000		
Less discounts on raw materials purchased	<u>4,200</u>	\$395,800	
Less raw materials on hand, December 31, 20A.....		<u>24,000</u>	
Cost of raw materials consumed			\$371,800
Direct labor			180,000
Factory overhead:			
Factory maintenance.....		\$38,400	
Factory supplies used		22,400	
Power and heat—factory.....		19,400	
Insurance expense—factory building and equipment		4,800	
Depreciation—factory building and equipment.....		17,500	
Factory superintendence		100,000	
Indirect factory labor.....		<u>20,000</u>	
Total factory overhead			222,500
Total manufacturing costs.....			<u>\$774,300</u>
Add work in process, January 1, 20A			84,000
			<u>\$858,300</u>
Less work in process, December 31, 20A			<u>30,000</u>
Cost of goods manufactured			<u>\$828,300</u>
Add finished goods, January 1, 20A.			37,500
Cost of goods available for sale			<u>\$865,800</u>
Less finished goods, December 31, 20A			<u>70,000</u>
Cost of goods sold			<u><u>\$795,800</u></u>

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PROBLEMS

P4-1

(1)

BRIDGEWELL COMPANY
Cost of Goods Sold Statement
For Month Ended July 31
(in thousands)

Direct materials consumed	\$16
Direct labor	24
Factory overhead	<u>20</u>
Total manufacturing cost (a)	\$60
Add work in process inventory, July 1	<u>15</u>
	\$75
Less work in process inventory, July 31	<u>25</u>
Cost of goods manufactured	\$50
Add finished goods inventory, July 1 (b)	<u>20</u>
Cost of goods available for sale	\$70
Less finished goods inventory, July 31 (c)	<u>15</u>
Cost of goods sold	<u>\$55</u>

Calculations:

(a)	Cost of goods manufactured	\$50
	Add work in process, ending	<u>25</u>
		\$75
	Less work in process, beginning	<u>15</u>
	Equals total manufacturing cost	<u>\$60</u>
(b)	Cost of goods available for sale	\$70
	Less cost of goods manufactured	<u>50</u>
	Equals finished goods, beginning	<u>\$20</u>
(c)	Cost of goods available for sale	\$70
	Less cost of goods sold	<u>55</u>
	Equals finished goods, ending	<u>\$15</u>

P4-1 (Concluded)

(2)	(a)	Materials	25,000	
		Accounts Payable		25,000
(b)		Work in Process	16,000	
		Factory Overhead Control	2,000	
		Materials		18,000
(c)		Payroll (\$24,000 + \$5,000)	29,000	
		Accrued Payroll		29,000
(d)		Work in Process	24,000	
		Factory Overhead Control	5,000	
		Payroll		29,000
(e)		Finished Goods	50,000	
		Work in Process		50,000
(f)		Accounts Receivable	105,000	
		Sales (\$60,000 + (75% of \$60,000))		105,000
		Cost of Goods Sold	55,000	
		Finished Goods		55,000

Chapter 4

P4-2
(1)

SCOTTSBURG COMPANY
Cost of Goods Sold Statement
For Month Ended June 30
(in thousands)

Direct materials:			
Materials inventory, June 1		\$15	
Purchases		33	
Materials available for use		\$48	
Less: Indirect materials used	\$ 1		
Materials inventory, June 30	19	20	
Direct materials consumed			\$ 2
Direct labor (Note (a))			4
Factory overhead:			
Indirect materials	\$ 1		
Indirect labor (a)	7		
Depreciation	17		
Insurance	2		
General factory overhead	13		4
Total manufacturing cost (b)			\$11
Add work in process inventory, June 1			4
			\$15
Less work in process inventory, June 30			3
Cost of goods manufactured			\$12
Add finished goods inventory, June 1 (c)			7
Cost of goods available for sale			\$19
Less finished goods inventory, June 30 (d)			3
Cost of goods sold			\$15
Calculations:			
(a)	indirect labor + direct labor	= \$49	
	indirect labor + (indirect labor x 6)	= \$49	
	indirect labor x 7 = \$49		
	indirect labor = \$7		
	direct labor = 6 x \$7 = \$42		
(b)	Cost of goods manufactured	\$120	
	Add work in process, ending	30	
		\$150	
	Less work in process, beginning	40	
	Equals total manufacturing cost.	\$110	
(c)	Cost of goods available for sale	\$190	
	Less cost of goods manufactured	120	
	Equals finished goods, beginning	\$ 70	

P4-2 (Concluded)

(d)		Cost of goods available for sale	\$190	
		Less cost of goods sold.....	<u>155</u>	
		Equals finished goods, ending	<u>\$ 35</u>	
(2)	(a)	Materials	33,000	
		Accounts Payable		33,000
	(b)	Work in Process	28,000	
		Factory Overhead Control	1,000	
		Materials.....		29,000
	(c)	Payroll	49,000	
		Accrued Payroll.....		49,000
	(d)	Work in Process	42,000	
		Factory Overhead Control	7,000	
		Payroll.....		49,000
	(e)	Finished Goods.....	120,000	
		Work in Process		120,000
	(f)	Accounts Receivable	210,000	
		Sales (\$140,000 + (50% of \$140,000)) ...		210,000
		Cost of Goods Sold.....	155,000	
		Finished Goods		155,000

P4-3

(1)

MADEIRA COMPANY
Schedule of Cost of Goods Manufactured
For Month Ended March 31

Work in process, March 1		\$ 40,000
Production costs:		
Direct materials	\$104,000 **	
Direct labor	160,000 ***	
Factory overhead	80,000 ***	344,000
		<u>\$384,000</u>
Less work in process, March 31		36,000
Cost of goods manufactured.....		<u><u>\$348,000 *</u></u>

* Cost of goods sold (\$345,000) + ending finished goods inventory (\$105,000) – beginning finished goods inventory (\$102,000) = \$348,000.

** Purchases of materials during March (\$110,000) + beginning materials inventory (\$20,000) – ending materials inventory (\$26,000) = \$104,000.

*** Production costs for March (\$344,000) – direct materials (\$104,000) = direct labor and factory overhead (\$240,000).

Let x = direct labor
 1.5x = \$240,000
 x = \$160,000 direct labor
 .5x = \$80,000 factory overhead

(2)	Prime cost:	
	Direct materials (requirement (1))	\$104,000
	Direct labor (requirement (1))	160,000
		<u><u>\$264,000</u></u>
(3)	Conversion cost:	
	Direct labor (requirement (1))	\$160,000
	Factory overhead (requirement (1))	80,000
		<u><u>\$240,000</u></u>

P4-4

Company A:		
Sales		\$4,000,000
Cost of goods sold:		
Finished goods inventory, January 1.....	\$ 600,000	
Cost of goods manufactured.....	<u>3,800,000</u>	
Cost of goods available for sale.....	\$4,400,000	
Finished goods inventory, December 31	<u>1,200,000</u>	
Cost of goods sold		<u>3,200,000</u>
Gross profit (20% of sales).....		<u>\$ 800,000</u>

Company B:		
Cost of goods available for sale.....	\$1,510,000	
Less finished goods ending inventory.....	<u>210,000</u>	
Cost of goods sold	<u>\$1,300,000</u>	

Company C:		
Sales		\$ 429,000
Cost of goods sold:		
Cost of goods manufactured.....	\$ 340,000	
Add beginning finished goods inventory	<u>45,000</u>	
Cost of goods available for sale.....	\$ 385,000	
Less ending finished goods inventory....	<u>52,000</u>	
Cost of goods sold		<u>333,000</u>
Gross profit		<u>\$ 96,000</u>

P4-5

Finished Goods		Work in Process	
Beg.	34,000	Beg.	7,000
(4)	348,000	M	50,000
	380,000	L(2)	200,000
End. 30,000		FOH	100,000
			357,000
		End. 11,000	
Materials and Supplies		Accrued Payroll	
Beg.	20,000	(8)	259,000
	65,000	Beg.	13,000
(1)	50,000		55,000
	85,000		200,000
End. 15,000			268,000
			End. 9,000

P4-5 (Concluded)

Accounts Receivable				Accounts Payable			
Beg.	54,000	(7)	532,000	(6)	77,000	Beg.	18,000
	500,000						65,000
	554,000						83,000
	End. 22,000						End. 6,000
Factory Overhead Control				Sales			
	20,000	(3)	100,000				500,000
	55,000						
	10,000						
	2,000						
	13,000						
	100,000						
Payroll				Cost of Goods Sold			
	55,000		55,000	(5)	350,000		
	200,000		200,000				
	255,000		255,000				

- (1) Materials issued to production, \$50,000
- (2) Direct labor, \$200,000
- (3) Total factory overhead, \$100,000
- (4) Cost of goods manufactured, \$346,000
- (5) Cost of goods sold, \$350,000
- (6) Payment of accounts payable, \$77,000
- (7) Collection of accounts receivable, \$532,000
- (8) Payment of payroll, \$259,000

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P4-6

Work in Process		84,000	
Materials			84,000
Cost of goods sold	\$140,000		
Add finished goods inventory increase ..	<u>17,000</u>		
Cost of goods manufactured.....	\$157,000		
Add work in process inventory increase	<u>2,000</u>		
Total manufacturing cost	\$159,000		
Less : Factory overhead.....	\$35,000		
Direct labor.....	<u>40,000</u>	<u>75,000</u>	
Materials used in manufacturing	<u>\$ 84,000</u>		
Materials		91,000	
Accounts Payable			91,000
Materials used in manufacturing			
(from above)	\$ 84,000		
Add materials inventory increase	<u>7,000</u>		
Materials purchased	<u>\$ 91,000</u>		
Payroll		40,000	
Accrued Payroll.....			40,000
Work in Process		40,000	
Payroll			40,000
Factory Overhead Control		35,000	
Various Credits.....			35,000
Work in Process		35,000	
Factory Overhead Control			35,000
Finished Goods (12,000 + 84,000 + 40,000 + 35,000 - 14,000)		157,000	
Work in Process			157,000
Cost of Goods Sold (28,000 + 157,000 - 45,000)		140,000	
Finished Goods			140,000

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P4-7

(1) and (2)

(a) Materials.....	92,000	
Accounts Payable.....		92,000
(b) Factory Overhead Control.....	26,530	
Accounts Payable.....		26,530
(c) Payroll.....	86,000	
Accrued Payroll		86,000
Work in Process.....	60,500	
Factory Overhead Control.....	12,500	
Marketing Expenses Control	8,000	
Administrative Expenses Control	5,000	
Payroll		86,000
Accrued Payroll (86,000 + 2,250).....	88,250	
Cash		88,250
(d) Work in Process.....	82,500	
Factory Overhead Control.....	8,300	
Materials		90,800
(e) Work in Process.....	47,330	
Factory Overhead Control		47,330
(f) Finished Goods.....	188,000	
Work in Process		188,000
(g) Accounts Receivable	241,150	
Sales.....		241,150
Cost of Goods Sold	185,500	
Finished Goods.....		185,500
(h) Cash	208,662	
Sales Discounts	4,258	
Accounts Receivable		212,920
(i) Marketing Expenses Control	18,000	
Administrative Expenses Control	12,000	
Accounts Payable.....		30,000
(j) Accounts Payable	104,000	
Cash		104,000

P4-7 (Continued)

Cash

1/1 Bal.	20,000	(c)	88,250
(h)	208,662	(i)	104,000
	228,662		192,250
	36,412		

Materials

1/1 Bal.	10,000	(d)	90,800
(a)	92,000		
	102,000		
	11,200		

Accounts Receivable

1/1 Bal.	25,000	(h)	212,920
(g)	241,150		
	266,150		
	53,230		

Machinery

1/1 Bal.	40,000
----------	--------

Finished Goods

1/1 Bal.	9,500	(g)	185,500
(f)	188,000		
	197,500		
	12,000		

Accumulated Depreciation

1/1 Bal.	10,000
----------	--------

Work in Process

1/1 Bal.	4,500	(f)	188,000
(c)	60,500		
(d)	82,500		
(e)	47,330		
	194,830		
	6,830		

Accounts Payable

(j)	104,000	1/1 Bal.	15,500
		(a)	92,000
		(b)	26,530
		(i)	30,000
			164,030
			60,030

Accrued Payroll

(c)	88,250	1/1 Bal.	2,250
		(c)	86,000

Retained Earnings

1/1 Bal.	21,250
----------	--------

Sales

(g)	241,150
-----	---------

Cost of Goods Sold

(g)	185,500
-----	---------

Sales Discounts

(h)	4,258
-----	-------

Payroll

(c)	86,000	(c)	86,000
-----	--------	-----	--------

P4-7 (Concluded)

Common Stock		Factory Overhead Control	
	1/1 Bal. 60,000	(b) 26,530	(e) 47,330
		(c) 12,500	
		(d) 8,300	
		47,330	
Administrative Expenses Control		Marketing Expenses Control	
(c) 5,000		(c) 8,000	
(i) 12,000		(i) 18,000	
17,000		26,000	

(3)

HOPKINS & WHITE COMPANY
Trial Balance
January 31

Cash.....	\$ 36,412	
Accounts Receivable.....	53,230	
Finished Goods	12,000	
Work in Process	6,830	
Materials	11,200	
Machinery	40,000	
Accounts Payable		\$ 60,030
Accumulated Depreciation.....		10,000
Common Stock.....		60,000
Retained Earnings.....		21,250
Sales		241,150
Sales Discounts	4,258	
Cost of Goods Sold	185,500	
Marketing Expenses Control.....	26,000	
Administrative Expenses Control.....	17,000	
	<u>\$392,430</u>	<u>\$392,430</u>

Chapter 25

DISCUSSION QUESTIONS

- Q25-1. Percentage of profit to sales is a measure of current operating activities. Revenue production, cost incurrence, and cost control are embodied in this ratio. The capital-employed turnover rate is a measure of the amount of asset investment relative to the activity level of the company. This rate highlights the success of achieving sales volume with minimum asset investment and measures the sales-generation activity and overall asset management.
- Q25-2. Capital employed consists of noncurrent assets (investments in buildings, machinery, and equipment) as well as current assets. Some firms do not use current assets but prefer working capital; that is, the net balance of current assets and current liabilities.
- Q25-3. Two major objectives that management may have in mind when setting up a system for measuring the return on divisional capital employed are:
- to secure a summary measure of the profitability of operations, products, and facilities connected with each division;
 - to obtain information as to the success of division managers in conducting their portions of the company's activities.
- Q25-4. Dysfunctional actions that management could take to improve short-term return on capital employed at the expense of long-run profitability include:
- Defer or reduce preventive maintenance, which reduces current expense but shortens the life of assets, thereby increasing future cost.
 - Reduce expenditure on research and development, which reduces current expense but makes the company less competitive in the future.
 - Reduce or avoid employee training and development, which reduces current expense but makes the company less competitive in the future.
 - Sell and then rent needed assets, which gets them off the balance sheet but may cost the company more in the long run.
 - Defer, reduce, or avoid modernization of facilities, especially substantial investments in automated manufacturing facilities, which keeps asset cost on the balance sheet low but makes the company less competitive in the future.
- Q25-5. Use of the rate-of-return-on-capital-employed has the following five claimed advantages:
- It focuses management's attention on earning the best profit possible on the capital (total assets) available.
 - It ties together the many phases of financial planning, sales objectives, cost control, and the profit goal.
 - It aids in detecting the strengths and weaknesses with respect to the use or nonuse of individual assets.
 - It serves as a yardstick in measuring performance and provides a basis for evaluating improvement over time and among divisions.
 - It develops a keener sense of responsibility and team effort in divisional managers by enabling them to measure and evaluate their own activities in the light of the budget and with respect to the results achieved by other divisional managers.
- Q25-6. The five frequently encountered limitations of using the rate-of-return-on-capital-employed follow:
- It may not be reasonable to expect the same return on capital employed from each division if the divisions sell their respective products in markets that differ widely with respect to product development, competition, and consumer demand. Lack of agreement on the optimum rate of return might discourage managers who believe the rate is set at an unfair level.
 - Valuations of assets of different vintages in different divisions might give rise to comparison difficulties and misunderstandings.
 - Proper allocation of common costs and assets requires detailed information about the budgeted and actual use of common facilities. The cost of keeping track of such details may be high.
 - For the sake of making the current period rate of return on capital employed "look good," managers may be influenced to make decisions that are not in the best long-run interests of the firm. This problem is especially likely if managers expect to be in positions for only a short time before being reassigned, thus, personally avoiding responsibility for long-run consequences.
 - A single measure of performance, such as return on capital employed, may result in a fixation on improving the components of the one measure to the neglect of needed attention to other desirable activities. Product research and development, managerial development, progressive personnel policies, good employee

morale, and good customer and public relations are just as important in earning a greater profit and assuring continuous growth.

Q25-7. Multiple performance measures are used to overcome the limitations of a single financial measure. Multiple performance measures provide central management with a more comprehensive picture of divisional performance by considering a wider range of management responsibilities, nonfinancial activities as well as financial performance. Multiple performance measures can be designed to provide an incentive to divisional managers to engage in activities that have long-term benefit to the company but which may have a negative impact on short-run profit. Examples include basic research, new product development, quality improvement, production innovation, employee development, and new market development. In addition, multiple measures mitigate the problem of trying to evaluate divisional performance on the basis of a single profit measure that may be computed on different bases in each division.

Q25-8. Common forms of management incentive compensation plans include:

- (a) Cash bonuses, which are usually paid in a lump sum at the end of the period and are based on a combination of corporate performance, individual performance, and the management level.
- (b) Stock bonuses, which are determined in essentially the same way as cash bonuses.
- (c) Deferred compensation, which is paid in cash and/or stock that does not vest until a future period. In some cases, the manager is required to invest annually and the company matches the contribution.
- (d) Stock options, which give the manager a right to purchase stock at a set price within a set period. The incentive is to help the company increase the market price of its stock as much as possible within the option period.
- (e) Stock appreciation rights, which are similar to stock options except that the manager is not required to purchase stock, but instead receives an amount equal to its appreciation at the end of a set period.
- (f) Performance shares, which are stock awards paid to the manager only after some long-run goal has been achieved.

Cash and stock bonuses are based on one period results and therefore provide a short-term incentive. In contrast, stock options, stock

appreciation rights, and performance shares are valuable only if the company improves in the long-run. Since actions that result in short-term improvements can have a negative long-term impact, long-term incentives probably are more effective.

Q25-9. The basic methods used in pricing intracompany transfers are:

- (a) transfer pricing based on cost
- (b) market-based transfer pricing
- (c) cost-plus transfer pricing
- (d) negotiated transfer pricing
- (e) arbitrary transfer pricing

Q25-10. A market-based transfer price provides an incentive for divisional management to minimize costs in order to maximize divisional profits. In contrast, a cost-plus transfer price provides no incentive for divisional management to be cost efficient. In fact, if the profit markup is a percentage of cost, there is substantial incentive to be inefficient in order to increase total divisional profit.

Q25-11. (a) Negotiated transfer pricing:

(1) Advantage: The profit-center managers have control over the transfer prices and can be held responsible for their resulting impact on profits.

(2) Disadvantage: Individual managers, in their endeavor to maximize profits of their own divisions, may make decisions detrimental to the overall profit of the firm.

(b) Arbitrary transfer pricing:

(1) Advantage: It is possible for executive management to set transfer prices that will guide profit-center managers to make decisions that will maximize total firm profits.

(2) Disadvantage: The profit-center managers do not have authority in an area affecting the profit performance for which they will be evaluated.

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Q25-12. Under the dual transfer pricing approach, the producing (selling) division includes a profit in computing its revenue from intracompany sales while the consuming (buying) division is assigned only variable costs of the producing division, plus an equitable portion of fixed costs. The producing division thus uses a transfer price that better measures performance, while the consuming division has available a price more useful for decision-making purposes. The producing division's profit would be eliminated in preparing company-wide financial statements.

EXERCISES

E25-1

- (1) Capital-employed turnover rate $= \frac{\text{Sales}}{\text{Capital employed}} = \frac{\$1,600,000}{\$2,000,000} = .8$
- (2) Percentage of profit to sales $= \frac{\text{Profit}}{\text{Sales}} = \frac{\$200,000}{\$1,600,000} = .125$
- (3) Rate of return on capital employed $= \text{Capital-employed turnover rate} \times \text{Percentage of profit to sales} = .8 \times .125 = .10$

E25-2

(1)	Total corporate assets at beginning of the year	\$ 66,000,000
	Total corporate assets at the end of the year	70,000,000
		<u>\$136,000,000</u>
		+ 2
	Average total corporate assets employed during the year	\$ 68,000,000
	Assets used by corporate headquarters and not allocated to operating divisions	5,000,000
	Average assets used by operating divisions during the year	<u>\$ 63,000,000</u>

Division	(1) Total Average Assets Used By All Divisions	(2) Percentage Used By Division	(3) Capital Employed (1) x (2)
Recreational Products....	\$63,000,000	25%	\$15,750,000
Household Products	63,000,000	40	25,200,000
Commercial Tools.....	63,000,000	35	22,050,000
Total		<u>100%</u>	<u>\$63,000,000</u>

Division	(1) Sales	(2) Capital Employed	(3) Capital-Employed Turnover Rate (1) ÷ (2)
Recreational Products....	\$15,750,000	\$15,750,000	1.000
Household Products	20,160,000	25,200,000	.800
Commercial Tools.....	15,435,000	22,050,000	.700
Overall Corporation.....	51,345,000	68,000,000	.755

E25-2 (Concluded)

(2)	(1)	(2)	(3) Percentage of Profit to Sales <u>(1) ÷ (2)</u>
<u>Division</u>	<u>Profit</u>	<u>Sales</u>	
Recreational Products....	\$4,725,000	\$15,750,000	.300
Household Products	4,032,000	20,160,000	.200
Commercial Tools	3,858,750	15,435,000	.250
Overall Corporation	9,860,000	51,345,000	.192

(3)	(1) Capital-Employed Turnover <u>Rate</u>	(2) Percentage of Profit to Sales <u>to Sales</u>	(3) Rate of Return on Capital Employed <u>(1) x (2)</u>
<u>Division</u>			
Recreational Products....	1.000	.300	.300
Household Products .....	.800	.200	.160
Commercial Tools .....	.700	.250	.175
Overall Corporation .....	.755	.192	.145

or alternatively

	(1)	(2)	(3) Rate of Return on Capital Employed <u>(1) ÷ (2)</u>
<u>Division</u>	<u>Profit</u>	<u>Capital Employed</u>	
Recreational Products....	\$4,725,000	\$15,750,000	.300
Household Products	4,032,000	25,200,000	.160
Commercial Tools	3,858,750	22,050,000	.175
Overall Corporation	9,860,000	68,000,000	.145

E25-3

- (1) The company must seek to minimize total cost. Since there is no other market for the 64,000 tons, and since the variable cost of \$4.50 per ton is less than the outside price of \$5, the coke-producing profit center's supply should be used at least in the short run. In the long run, the \$4.50 variable cost may change, and the fixed cost must be covered while realizing a reasonable return on capital employed. However, the \$5 outside price may also change when the contract is renegotiated. In determining the transfer price for profit-center profit computations, the blast furnace manager has a sound basis for a renegotiation of the transfer price so that it is competitive with the \$5 external price that is available.

(2) Present:	<u>Revenue</u>	<u>Costs</u>	
Sales (16,000 tons (20% x 80,000 tons) x \$6*)	\$ 96,000		
Variable cost (80,000 tons x \$4.50).....		\$360,000	
Fixed cost.....		40,000	
Total	<u>\$ 96,000</u>	<u>\$400,000</u>	= <u>\$(304,000)</u>

*Sales price – marketing costs

Proposed:

Sales (80,000 tons x \$6)	\$480,000		
Variable costs:			
Production... \$3.00			
Marketing .... .50			
<u>\$3.50 x 80,000 tons</u>		\$280,000	
Fixed costs:			
Present..... \$40,000			
Proposed..... 60,000		100,000	
Purchase of coke for blast furnace (64,000 tons x \$5) ..		320,000	
Total	<u>\$480,000</u>	<u>\$700,000</u>	= <u>\$(220,000)</u>

By making the additional investment, the company would be better off by \$84,000 (\$304,000 – \$220,000). The cost of capital committed to this investment should be considered by management in making a decision on this proposal. (See Chapter 23.)

E25-4

- (1) Ace Division should take on the new customer because its gross profit would be increased by \$600,000. Ace's cost to manufacture would be the same per unit and in total whether they are sold to Duece Division or to the outside customer (since the quantity is the same). Therefore, any increase in sales revenue would immediately be translated into increased profit for Ace Division.

Sales revenue from new customer (\$75 x 20,000 units)	\$1,500,000
Sales revenue from Duece Division	900,000
Increase in revenue and income from outside sales.....	<u>\$ 600,000</u>

- (2)
- | | |
|---|-------------------|
| Initial amount from new negotiated transfer price (\$75 x 20,000 units)..... | \$1,500,000 |
| Less manufacturing costs: Variable cost..... | \$900,000 |
| Fixed cost | 300,000 |
| | <u>1,200,000</u> |
| Gross profit from transfer | \$ 300,000 |
| Loss avoided on original transfer price..... | (300,000) |
| Additional gross profit from proposed transfer price..... | <u>\$ 600,000</u> |
| Initial unit transfer price | \$75 |
| Less 1/2 of average additional gross profit (1/2 x (600,000 ÷ 20,000 units))..... | <u>15</u> |
| Actual transfer price after splitting the additional gross profit | <u>\$60</u> |

E25-5

No, because making blades would save Dana Company \$2,500, determined as follows:

Outside supplier cost (\$1.25 x 10,000 units).....	\$12,500
Variable cost to manufacture by Blade Division	<u>10,000</u>
Savings to Dana if the Lawn Products Division purchases from the Blade Division	<u>\$ 2,500</u>

PROBLEMS

P25-1

(1)	<u>Springy</u>	<u>Leapy</u>	<u>Total</u>
Sales	\$420,000	\$292,500	\$712,500
Variable cost: 280,000 units x \$.90..	\$252,000		
150,000 units x \$1.35		\$202,500	\$454,500
Fixed cost.....	130,000	45,000	175,000
Total cost.....	\$382,000	\$247,500	\$629,500
Income before income tax.....	\$ 38,000	\$ 45,000	\$ 83,000
Capital employed: Variable	\$ 42,000	\$ 58,500	\$100,500
Fixed	148,000	91,500	239,500
Total capital employed.....	\$190,000	\$150,000	\$340,000
	\$ 38,000	\$ 45,000	\$ 83,000
	\$190,000	\$150,000	\$340,000
Return on capital employed	20%	30%	24.4%

(2)	(a) Increase Springy production and increase Leapy price by \$.15 per unit:			
		<u>Springy</u>	<u>Leapy</u>	<u>Total</u>
	Sales.....	\$487,500	\$210,000	\$697,500
	Variable cost:			
	325,000 units x \$.90.....	\$292,500		
	100,000 units x \$1.35.....		\$135,000	\$427,500
	Fixed cost.....	144,500	40,000	184,500
	Total cost.....	\$437,000	\$175,000	\$612,000
	Income before income tax.....	\$ 50,500	\$ 35,000	\$ 85,500
	Capital employed: Variable	\$ 48,750	\$ 42,000	\$ 90,750
	Fixed.....	158,000	81,500	239,500
	Total capital employed.....	\$206,750	\$123,500	\$330,250
		\$ 50,500	\$ 35,000	\$ 85,500
		\$206,750	\$123,500	\$330,250
	Return on capital employed	24.4%	28.3%	25.9%

5-1 (Concluded)

(b) Increase Springy production and continue present Leapy price:

	<u>Springy</u>	<u>Leapy</u>	<u>Total</u>
Sales.....	\$487,500	\$195,000	\$682,500
Variable cost:			
325,000 units x \$.90.....	\$292,500		
100,000 units x \$1.35.....		\$135,000	\$427,500
Fixed cost.....	144,500	31,000	175,500
Total cost.....	\$437,000	\$166,000	\$603,000
Income before income tax.....	\$ 50,500	\$ 29,000	\$ 79,500
Capital employed: Variable	\$ 48,750	\$ 39,000	\$ 87,750
Fixed.....	158,000	81,500	239,500
Total capital employed.....	\$206,750	\$120,500	\$327,250
	<u>\$ 50,500</u>	<u>\$ 29,000</u>	<u>\$ 79,500</u>
	<u>\$206,750</u>	<u>\$120,500</u>	<u>\$327,250</u>
Return on capital employed	24.4%	24.1%	24.3%

(c) Increase Springy production and increase Leapy price by \$.05 per unit:

	<u>Springy</u>	<u>Leapy</u>	<u>Total</u>
Sales.....	\$487,500	\$200,000	\$687,500
Variable cost:			
325,000 units x \$.90.....	\$292,500		
100,000 units x \$1.35.....		\$135,000	\$427,500
Fixed cost.....	144,500	32,500	177,000
Total cost.....	\$437,000	\$167,500	\$604,500
Income before income tax.....	\$ 50,500	\$ 32,500	\$ 83,000
Capital employed: Variable	\$ 48,750	\$ 40,000	\$ 88,750
Fixed.....	158,000	81,500	239,500
Total capital employed.....	\$206,750	\$121,500	\$328,250
	<u>\$ 50,500</u>	<u>\$ 32,500</u>	<u>\$ 83,000</u>
	<u>\$206,750</u>	<u>\$121,500</u>	<u>\$328,250</u>
Return on capital employed	24.4%	26.7%	25.3%

Note: Excluding nonallocable data understates costs and capital employed. As an alternate solution, the nonallocable fixed cost (\$28,000) and capital employed (\$25,000) might be included in the total figures, thus highlighting the nonadditive difficulty that can arise when full allocation is not made to segments.

P25-2

(1) Contribution margin of sales increase	
(2,400 x (\$380 - \$70 - \$37 - \$30 - \$45 - \$18))	\$432,000
Loss in contribution margin on original volume, arising from decrease in sales price (15,000 x \$20)	<u>300,000</u>
Estimated increase in contribution margin and in income before income tax if sales price is reduced 5%	<u>\$132,000</u>
(2) Contribution margin from sales to WindAir	
(17,400 x (\$50 - \$10.50 - \$8 - \$10))	\$374,100
Loss in contribution margin from loss of sales to outsiders:	
Total unit capacity	75,000
Sales to WindAir	17,400
Balance	57,600
Projected sales to outsiders	64,000
Lost sales to outsiders	<u>6,400</u>
(6,400 x (\$100 - \$12 - \$8 - \$10 - \$6))	<u>409,600</u>
Estimated decrease in Compressor Division contribution margin and in income before income tax if WindAir's needs are supplied	<u>\$ 35,500</u>

The Compressor Division would find it desirable, from its own viewpoint, to accept orders from WindAir above the 64,000-unit outside customer demand level, up to its 75,000-unit capacity, because there would be a positive contribution margin of \$21.50 per unit.

(3) Cost savings by using units from Compressor Division:	
Outside purchase price	\$ 70.00
Compressor Division's variable cost to produce (\$10.50 + \$8 + \$10)	<u>28.50</u>
Savings per unit	\$ 41.50
Number of compressors	x 17,400
Total cost savings	<u>\$722,100</u>
Less Compressor Division's lost sales to outsiders (6,400 x \$64 (see requirement 2))	<u>409,600</u>
Increase in income before income tax for National Industries	<u>\$312,500</u>

The decision should be based on what is best for the total firm. It would be in the best interests of National Industries for the Compressor Division to sell the units to the WindAir Division. The net advantage to National Industries is \$312,500, as shown in the above calculations.

Since each division is evaluated based on its profits and return on division investment, the expectations for the two divisions should be adjusted because of the effect of this decision on individual divisional performance.

P-5-4

- (1) Based on variable manufacturing cost to produce the cushioned seat and the Office Division's opportunity cost, the transfer price is \$1,869 for a 100-unit lot or \$18.69 per seat, computed as follows:

Variable cost.....	\$1,329
Opportunity cost.....	540
Transfer price	<u>\$1,869</u>

This transfer price was derived as follows:

Variable Cost:

Cushioned Material:

Padding	\$2.40	
Vinyl	4.00	
Total cushion material.....	\$6.40	
Cost increase (10%).....	x1.10	
Cost of cushioned seat.....		\$ 7.04
Cushion fabrication labor cost		
(\$7.50 x .5 DLH).....		3.75
Variable factory overhead*		
(\$5.00 per DLH x .5 DLH).....		2.50
Total variable cost per cushioned seat.....		<u>\$13.29</u>
Total variable cost per 100-unit lot.....		<u>\$1,329</u>

***Variable overhead for 300,000 hours:**

Supplies.....	\$ 420,000
Indirect labor	375,000
Power	180,000
Employee benefits:	
20% of direct labor and indirect labor (excluding	
20% of supervisors' salary which is a fixed cost)	
(\$575,000 - (20% x \$250,000))	525,000
Total variable overhead at 300,000 direct labor hours	<u>\$1,500,000</u>

Variable overhead per DLH

(\$1,500,000 ÷ 300,000 DLH).....	<u>\$5.00 per DLH</u>
----------------------------------	-----------------------

P25-4 (Concluded)

Opportunity cost:

Labor hour constraint:

Labor hours to make a 100-unit lot of deluxe office stools (1.50 DLH x 100 units)	150 hours
Less labor hours to make a 100-unit lot of cushioned seats (.5 DLH x 100 units)	50 hours
Labor hours available for economy office stool ...	<u>100 hours</u>
Labor hours required to make one economy office stool	<u>.8 hour</u>
Use of extra labor devoted to economy office stool production (100 hours ÷ .8 hour)	<u>125 stools</u>

	Deluxe Office Stool	Economy Office Stool
Selling price per unit	<u>\$58.50</u>	<u>\$41.60</u>
Less manufacturing costs:		
Materials	\$14.55	\$15.76
Labor: (\$7.50 x 1.5 DLH)	11.25	
(\$7.50 x .8 DLH)		6.00
Variable factory overhead:		
(\$5.00 per DLH x 1.5 DLH)	7.50	
(\$5.00 per DLH x .8 DLH)		4.00
Total cost per unit	<u>\$33.30</u>	<u>\$25.76</u>
Contribution margin per unit	<u>\$25.20</u>	<u>\$15.84</u>
Units produced	x 100	x 125
Total contribution margin	<u>\$2,520</u>	<u>\$1,980</u>
Opportunity cost of shifting production to the economy office stool (\$2,520 - \$1,980)	<u>\$ 540</u>	

- (2) Variable manufacturing cost plus opportunity cost would be the best transfer price system to use because it would allow the supplying division to be indifferent between selling the product internally to another division or selling the product in the external market. This transfer price method assures that the supplying division's contribution to profit would be the same under either alternative. The sum of the variable manufacturing cost and the opportunity cost represents the effort put forth by supplying division to the overall well-being of the company.

An appropriate transfer price must attempt to fulfill the company objectives of autonomy, incentive, and goal congruence. While no one transfer price can necessarily satisfy each of these objectives fully in all situations, the variable manufacturing cost plus opportunity cost transfer price should be the most appropriate method for meeting these objectives in most situations.

j-5

- (1) In order to maximize short-run contribution margin, the Cole Division should accept the contract from Wales Company. This conclusion is supported by the following calculations:

Cole Division transfer to Diamond Division

Transfer price (3,000 units x \$1,500 each)	\$4,500,000	
Variable cost:		
Purchase from Bayside Division		
(3,000 units x \$600 each)	\$1,800,000	
Variable processing cost in Cole Division		
(3,000 units x \$500 each)	<u>1,500,000</u>	<u>3,300,000</u>
Contribution margin		<u><u>\$1,200,000</u></u>

Cole Division sales to Wales Company

Sales price (3,500 units x \$1,250 each)	\$4,375,000	
Variable cost:		
Purchase from Bayside Division		
(3,500 units x \$500 each)	\$1,750,000	
Variable processing cost in Cole Division		
(3,500 units x \$400 each)	<u>1,400,000</u>	<u>3,150,000</u>
Contribution margin		<u><u>\$1,225,000</u></u>

Conclusion:

Contribution margin from transfer to Diamond Division	\$1,200,000	
Contribution margin from sales to Wales Company	<u>1,225,000</u>	
Difference in favor of Wales Company contract		<u><u>\$ 25,000</u></u>

P25-5 (Concluded)

- (2) Cole Division's decision to accept the contract from Wales Company is in the best interest of Robert Products Inc. because the decision increases the overall corporation's contribution margin. This conclusion is supported by the following calculations:

Revenues and cost savings to Robert Products Inc.:

Sales by Cole Division to Wales Company

(3,500 units x \$1,250 each) \$4,375,000

Sales by Bayside Division to London

Company (3,000 units x \$400 each) 1,200,000

Cost savings (variable costs avoided by not accepting the Diamond Division order):

Bayside Division's savings

(3,000 units x \$300 each) 900,000

Cole Division's savings

(3,000 units x \$500 each) 1,500,000 \$7,975,000

Expenditures incurred by Roberts Products Inc.:

Variable cost incurred for the Wales

Company order:

Cole Division (3,500 units x \$400 each) \$1,400,000

Bayside Division (3,500 units x \$250

each) 875,000

Variable cost incurred for Diamond Division purchase from London Company

(3,000 units x \$1,500 each) 4,500,000

Variable cost incurred for London Company order from the Bayside Division

(3,000 units x \$200 each) 600,000 7,375,000

Positive overall contribution margin for Robert

Products Inc. \$ 600,000

CASES**C25-1**

- (1)** The return on capital employed has definite limitations for evaluating the performance of the Dexter Plant. Too many factors used to compute the return are not within the control of plant management. A significant portion of the "return" side of the measure is determined by the action of higher level management—sales and allocated costs. The plant management appears to have effective control over only a part of the costs incurred at the plant level, and the same is true for the asset base. Corporate and division assets are allocated to the plant. In addition, it appears that specific assets may be charged to the plant even though the decision was made at a higher level.
- (2)** The case states that recommendations for promotions and salary increases for plant managers are influenced by the comparison of the budgeted return on capital employed to the actual return. It appears that this plant manager is reacting in direct response to this measurement system. Two events have occurred outside his control (the sales decline and extra land charges), which will reduce his return on capital employed measure. He has responded by influencing those components of the measure that he controls and that will improve this measure. The reduced costs—training, maintenance, repair, and certain labor—would not affect sales volume in the short run. It is also likely that reduction of inventory levels will not influence the sales in the short run. Through these actions he has improved his return for 20A, but it may well be at the expense of 20B, or later years.

C25-2

- (1)** The shortcomings, or possible inconsistencies, of using rate of return on capital employed as the sole criterion to evaluate divisional management performance include the following:
 - (a)** Rate of return on capital employed tends to emphasize short-run performance at the expense of long-run profitability. In order to improve short-run profits, managers may make decisions that are not in the best interest of the company over the long run.
 - (b)** Rate of return on capital employed is not consistent with cash flow models used for capital expenditure analysis and, therefore, may not be comparable for divisions that use different accounting methods or that have assets purchased in different periods.
 - (c)** Rate of return on capital employed may not be controllable to the same extent by all division managers, i.e., the divisions may sell in different markets with different degrees of product development, competition, and consumer demand.

C25-2 (Concluded)

- (d) The use of a single measure of performance, such as rate of return on capital employed, may result in a fixation on improving the components of the one measure to the neglect of needed attention to other desirable activities—research and development, employee development, and improvement of market position.
- (2) The advantages of using multiple measures in evaluating divisional management performance include the following:
 - (a) Multiple performance measures provide a more comprehensive picture of performance by considering a wider range of management responsibilities.
 - (b) Multiple performance measures emphasize nonquantitative as well as quantitative aspects of performance, thereby providing an incentive for divisional managers to engage in desirable activities, such as, research and development, employee development, and improvement of market position, as well as to seek profitability.
 - (c) Multiple performance measures will mitigate the problem of trying to compare divisional performance with a single measure that may be computed on different bases in each division.
 - (d) Multiple performance measures include long-term as well as short-term incentives, thereby emphasizing total performance rather than just short-term profit maximization.
- (3) The problems or disadvantages of implementing a system of multiple performance measures include the following:
 - (a) The measurement criteria are not all equally quantifiable and, therefore, it may be difficult to compare the overall performance of one division with another.
 - (b) Central management may have difficulty applying the criteria on a consistent basis. Some criteria may be subjectively more heavily weighted than other criteria at different points in time, and some criteria may be in conflict with other criteria.
 - (c) A multiple performance measurement system may be confusing to division managers, thereby resulting in diffusion of effort and instability in performance.

(-3

(1)	(a)	Average operating assets employed:	
		Balance at 12/31/20F.....	\$12,600,000
		Balance at 12/31/20E (\$12,600,000 / 1.05).....	12,000,000
		Beginning plus ending balances	<u>\$24,600,000</u>
		Average balance (\$24,600,000 + 2).....	<u>\$12,300,000</u>

$$\begin{aligned}
 \text{Rate of return on capital employed} &= \frac{\text{Income from operations before taxes}}{\text{Average operating assets employed}} \\
 &= \frac{\$2,460,000}{\$12,300,000} \\
 &= 20\%
 \end{aligned}$$

(b)	Income from operations before taxes	\$ 2,460,000
	Minimum return:	
	Average operating assets employed	\$12,300,000
	Charge for invested capital	x 15%
		<u>1,845,000</u>
	Residual income	<u>\$ 615,000</u>

Yes. Presser's management probably would have accepted the investment if residual income were used. The investment opportunity would have lowered Presser's 20F rate of return on capital employed because the expected return (16%) was lower than the division's historical returns (19.3% to 22.1%) as well as its actual 20F rate (20%). Management rejected the investment because bonuses are based in part on the rate of return performance measure. If residual income were used as a performance measure (and as a basis for bonuses), management would accept any and all investments that would increase residual income (i.e., a dollar amount rather than a percentage), including the investment opportunity it had in 20F.

- (3) Presser must control all items related to profit (revenues and expenses) and investment if it is to be evaluated fairly as an investment center by either the rate of return on capital employed or the residual income performance measures. Presser must control all elements of the business except the cost of invested capital, which is controlled by Lawton Industries.

C25-4

(1)

	(\$000 omitted)		
	Marine	Airline	Plastics
Divisional profit.....	\$ 5,100	\$1,050	\$ 9,360
Add corporate headquarters allocation	3,450	1,185	570
Adjusted divisional profit.....	<u>\$ 8,550</u>	<u>\$2,235</u>	<u>\$ 9,930</u>
Divisional capital employed	\$20,400	\$5,000	\$36,000
Deduct corporate headquarters allocation	970	252	941
Adjusted divisional capital employed	<u>\$19,430</u>	<u>\$4,748</u>	<u>\$35,059</u>
Adjusted divisional rate of return on capital employed	<u>44%</u>	<u>47%</u>	<u>28%</u>
Adjusted divisional profit.....	\$ 8,550	\$2,235	\$ 9,930
Less 20% of adjusted divisional capital employed (minimum level of income) ..	3,886	950	7,012
Residual income	<u>\$ 4,664</u>	<u>\$1,285</u>	<u>\$ 2,918</u>

(2)

All three divisions have a reported rate of return on capital employed in excess of the 20% target rate. However, Marine Division management apparently turned down its investment opportunity because the investment had a lower rate of return than the division (24% for the investment versus 25% for the division), which if accepted would have lowered the division's rate for the year, thereby lowering the annual bonus. Similarly, Airline Division management appears to have avoided fleet replacement for the same reason (i.e., fleet replacement return is 16% versus 21% for the division for the year). Plastic Division's management has achieved the maximum bonus allowable under the current bonus system and therefore had no incentive to increase profit (which may have been viewed as something that could simply increase next year's budget). The revised figures indicate that all three divisions are performing well; however, Marine Division's residual income is greater than the other two divisions combined.

(3)

Airline Division is making an adjusted profit of \$2,235,000 and residual income of \$1,285,000. The adjusted rate of return on capital employed is 47%, which suggests that the target rate should be revised in order to properly evaluate it. Nevertheless, since the division is achieving more than double the present target rate of 20% and more than either of the other two divisions, it appears to be a very good investment. However, fleet replacement should be examined along with the computation of a new adjusted rate of return on capital employed and residual income. Assuming that the \$25,000,000 capital investment does not include any corporate headquarters allocation and that the old fixed assets have a book value equal to market value, the recomputation follows:

-4 (Concluded)

Incremental division profit	\$ 4,000,000
Add corporate headquarters allocation.....	135,000
Adjusted incremental division profit	\$ 4,135,000
Add adjusted divisional profit without fleet replacement	2,235,000
Adjusted divisional profit with fleet replacement.....	\$ 6,370,000
Division current assets.....	\$ 2,748,000
Division fixed assets (fleet replacement cost).....	25,000,000
Adjusted divisional capital employed with fleet replacement	\$27,748,000
Adjusted rate of return on capital employed.....	23%
Adjusted divisional profit.....	\$ 6,370,000
Less 20% of incremental capital employed	5,549,600
Adjusted incremental residual income.....	\$ 820,400

Even when adjusted, the rate of return on capital employed is above the corporate target level and the incremental residual income is positive. Furthermore, assuming that profits do not fall in the future, the return on assets employed should rise in the future because the amount of assets employed will decline due to depreciation. As a result, it appears that from a quantitative perspective the airline should not be sold. Nevertheless, the investment required to replace the fleet should be evaluated using one of the capital expenditure evaluation techniques that considers the time value of money (e.g., the net present value method or the discounted cash flow rate of return method).

From a qualitative perspective, factors such as spill-over business, offering a full line to customers, ultimate profitability when the economy improves, possible advantage to a competitor from the sale of the division, etc., may override quantitative analysis.

- (4) The bonus scheme should be based on residual income rather than rate of return on capital employed in order to avoid the problem of managers making suboptimal decisions from the corporation's overall perspective.
- (5) The divisional performance measures should be computed without allocations of corporate headquarters costs or assets, because such allocations are arbitrary and divisional managers cannot control such costs or the use of such assets. Also, capital investments (such as the ones faced by the Marine Division and the Airline Division) should be evaluated by using the capital budgeting evaluation methods (such as the net present value method or the internal rate of return method).

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C25-5

- (1) General criteria that should be used in selecting performance measures to evaluate operating managers include the following:
 - (a) The measures should be controllable by the manager and reflect the actions and decisions made by the manager in the current period.
 - (b) The measures should be mutually agreed upon, clearly understood, and accepted by all the parties involved.
 - (c) The measures should (1) reward long-term performance; (2) tie incentive compensation to achieving strategic (nonfinancial) goals, such as target market share, productivity levels, improvement in product quality, product development, and personnel development; and (3) evaluate operating profits before gains from financial transactions; before deductions for approved expenditures on research and development, quality improvements, and preventive maintenance; and before deductions for the incremental amount of accelerated depreciation.
- (2) A major expansion of Star Paper's plant was completed in April, 20A. This expansion included additions to the production-line machinery and the replacement of obsolete and fully depreciated equipment. As a result, the value of the division's asset base increased considerably. While productivity undoubtedly increased during the first year in the expanded plant, the increase was not immediate nor sufficient to offset the increase in the value of the capital employed.
- (3) Apparent weaknesses in the performance evaluation process at Royal Industries include the following:
 - (a) There was no mutual agreement on the use of return on capital employed as the only measurement of performance.
 - (b) The feedback from Fortner was insufficient. Fortner indicated that Harris would receive feedback about the questions raised concerning the appropriateness of using the return on capital employed to evaluate performance, but feedback was not provided.
 - (c) There is only one single measure of performance that may give a distorted picture of actual performance at Star Paper. A single measure could encourage division management to make decisions that could improve short-run return at the expense of long-run profits. Examples include deferring maintenance, avoiding plant modernization, eliminating employee training, discontinuing research and development, etc.
- (4) Multiple performance evaluation criteria would be appropriate for the evaluation of the Star Paper Division. The criteria suggested by Harris take into account more of the results of the key decision being made by the manager, are not in conflict with each other, and emphasize the balance of profits with the control of current assets. These three measures are controllable by division managers and, in conjunction with return on capital employed, provide a more complete picture of business success.

-6

- (1) The 20B bonus pool available for the management teams of each division follow:

Meyers Service Company

$$\begin{aligned}\text{Bonus Pool} &= 10\% \times \text{income before income tax and bonuses} \\ &= .10 \times \$417,000 \\ &= \$41,700\end{aligned}$$

Wellington Products Inc.

$$\begin{aligned}\text{Bonus Pool} &= 1\% \times (\text{Revenue} - \text{Cost of Product}) \\ &= .01 \times (\$10,000,000 - \$4,950,000) \\ &= .01 \times \$5,050,000 \\ &= \$50,500\end{aligned}$$

- (2) Two of the advantages and two of the disadvantages to Renslen Inc. of the bonus pool incentive plan at Meyers Service Company follow:

Advantages

- (a) The management team will be motivated by the bonus plan because they have the opportunity to earn additional compensation if they work hard as a team and take some risks for the company.
- (b) Because management shares in the benefits of efficient operations, there is an incentive to control all costs (product costs as well as overhead costs) and to promote sales.

Disadvantages

- (a) The plan may motivate management to increase the "bottom line" only and concentrate on the short run. The plan may encourage managers to sacrifice quality or avoid new product development for the sake of current profits.
- (b) Management may postpone necessary expenditures such as maintenance or research and development in order to increase current net income.

Two of the advantages and two of the disadvantages to Renslen Inc. of the bonus pool incentive plan at Wellington Products Inc. follow:

Advantages

- (a) The management team will be motivated by the bonus plan because each manager has the opportunity to earn additional compensation by working hard and taking some risks for the company.
- (b) The managers will be encouraged to sell the most profitable mix of products.

Disadvantages

- (a) The plan omits accountability for all costs except for production costs. Therefore, managers may feel no obligation to control the costs that are shown below the gross profit line.
- (b) The plan may cause managers to focus all energies to maximizing current sales and production regardless of the impact this could have on the manufacturing plant. There is a strong motivation to defer maintenance, employee training, quality improvement, etc., because the incentive is to produce and sell high volume.

C25-6. (Concluded)

- (3) (a) Having two different incentive plans for the two operating divisions could result in behavioral problems and may reduce teamwork/synergy between the two divisions if the managers of either division believe they are being treated unfairly.

The management team at Meyers Service may believe that they have to work harder to achieve their bonuses because they are responsible for all costs and must achieve overall efficient operations to earn substantial bonuses.

The management team at Wellington Products may believe that they have less of an opportunity to affect the size of the bonuses they receive because only changes in sales and/or product costs will increase the gross profit.

These perceptions of inequity could lead to decreased motivation that could result in decreased divisional performance.

- (b) In order to justify having different incentive plans for the two divisions, Renslen management could argue the following:

(1) The goals and products of the two businesses are different (one is a service organization while the other is a manufacturing organization) and, therefore, should be measured on different criteria. For example, the control of manufacturing costs and improved productivity may be the most important factor in maintaining Wellington Products' competitiveness, while it may be critical for Meyers Service to control all costs to maintain profitability.

(2) The plans were in place when the businesses were acquired and had proved satisfactory, previously.

5-7

- (1) In terms of what is best for the total company in the long run, Omar probably should not supply Defco with Electrical Fitting #1726 for the \$5 per unit price. In this case, it appears that Omar and Defco serve different markets and do not represent closely related operating units. Omar operates at capacity; Defco does not. No mention is made of any other inter-divisional business. In the long run, Gunnco Corporation is probably better served if Omar is permitted to continue dealing with its regular customers at the market price. If Defco is having difficulties, the solution probably does not lie with temporary help at the expense of another division, whose sales to regular customers could be lost. The purposed course of action should not be followed unless it will yield a greater long-run profit for the total company (Gunnco) than will any other alternative.
- (2) Gunnco would be \$5.50 better off, in the short run, if Omar supplied Defco Electrical Fitting #1726 for \$5 and sold the brake unit for \$49.50. Assuming that the \$8 per unit for fixed factory overhead and administrative expenses represents an allocation of the costs Defco incurs, regardless of the brake unit order, Gunnco would lose \$2.50 in cash flow for each fitting sold to Defco, but would gain \$8 from each brake unit sold by Defco.
- (3) In the short run, there is an advantage to Gunnco of transferring Electrical Fitting #1726 at the \$5 price and, thus, selling the brake unit for \$49.50. To make this happen, Gunnco will have to overrule the decision of Omar's management. This action would be counter to the purposes of decentralized decision making. If such action were necessary on a regular basis, the decentralized decision making inherent in the divisionalized organization would be a sham. Then the organizational structure is inappropriate for the situation.

On the other hand, if this is an occurrence of relative infrequency, the intervention of corporate management will not indicate inadequate organizational structure. It may, however, create problems with division managements. In the case at hand, if Gunnco management requires that Electrical Fitting #1726 be transferred at \$5, the result will be to enhance Defco's operating results at the expense of Omar. This certainly is not in keeping with the concept that a manager's performance should be measured on the results achieved by the decision he or she controls. Omar is operating at capacity and would lose \$2.50 ($\$7.50 - \5) for each fitting sold to Defco. The management performance of Omar is measured by return on investment and dollar profits. Selling to Defco at \$5 per unit would adversely affect those performance measures.

C25-8

- (1) The Lorax Electric Company will earn higher profits if the necessary integrated circuits (ICs) are sold to the Systems Division rather than to regular customers. The improved profit will be \$1.00 per clock system as shown below.

Contribution margin from clock system:

Proposed sales price		\$7.50
Less variable production costs:		
Integrated circuits IC378 (5 @ \$.15)	\$.75	
Outside components	2.75	
Circuit board etching .....	.40	
Assembly, testing, packaging	1.35	5.25
Contribution margin per unit on clock system		\$2.25
Contribution margin forgone in Devices Division:		
Sales price of IC 378	\$.40	
Variable production costs .....	.15	
Contribution margin per circuit	\$.25	
Units for clock system	x 5	
Contribution margin lost		1.25
Net advantage to Lorax Company if clock system is produced by Systems Division		<u>\$1.00/unit</u>

- (2) Intervention by executive management generally is not advisable, except in unusual circumstances, because it takes away the delegated decision power given to division management and influences the measures used to judge the performance of division management. It conflicts with important objectives of decentralization—division autonomy over operating decisions and decisions made by those closest to the operating scene. Such interference can result in lower morale and poorer performance by division management, because they will be evaluated using measures that are not substantially within their control. However, a division should not be allowed to make a decision that is not in the best interest of the total company over the long run.
- (3) The described policy would avoid the need for intervention by executive management or an arbitration committee. However, the policy is undesirable because other unfavorable consequences outweigh this benefit. With the described policy, there would be no analysis to determine the most profitable use of an item required to be transferred at variable cost. In addition, a division manager would have less control over the division's operations, and there would be an "uncontrollable" influence on the manager's performance measure; this could result in lower moral for managers.