STUDY UNIT NINETEEN
PRODUCT COSTING AND RELATED TOPICS

This study unit is the second of three relating to cost measurement. It addresses the principal methods of accumulating costs and assigning them to products.

19.1 SPOILAGE AND SCRAP

1. **Spoilage** consists of completed products that do not meet quality standards. Because they are defective, they will not fetch the normal selling price.
   a. **Normal spoilage** is an expected part of the production process. It is treated as a product cost and is thus included in CGM.
   b. **Abnormal spoilage** is in excess of what is expected. It is treated as a period cost and is thus charged to a loss account when detection occurs.
2. **Scrap** consists of leftover raw materials after the production process is finished, and is therefore in no sense a completed product like spoilage.
   a. The sale of the normal amount of scrap arising from a manufacturing process is usually recorded as follows:

Cash	$XXX	
Manufacturing overhead control		$XXX

   b. An alternative is

Cash	$XXX	
Miscellaneous revenue		$XXX

   c. In both cases, the effect is to allocate the net cost of the scrap (historical cost – disposal proceeds) to the good units produced. Thus, the total cost of scrap remains in work-in-process control, but overhead that otherwise would have been applied to the good units is reduced by the amount received for the scrap.
      1) If scrap is applicable to a specific job, the realized amounts directly reduce the cost of specific units.
   d. Regardless of the accounting, good units continue to bear at least the costs of scrap that cannot be recovered by its sale.

19.2 JOB-ORDER COSTING

1. Job-order costing is concerned with **accumulating costs by specific job**.
   a. This method is appropriate when producing products with individual characteristics or when identifiable groupings are possible, e.g., batches of certain styles or types of furniture.
   b. Units (jobs) should be dissimilar enough to warrant the special record keeping required by job-order costing.
2. The accumulation of costs in a job-order system follows the document flow, whether printed or electronic.
   a. A **sales order** is received from a customer requesting a product or special group of products.
   b. The sales order is approved and a **production order** is issued.
   c. The physical inputs required for the production process are obtained from suppliers.

Raw materials	$XXX	
Accounts payable		$XXX

   d. Production commences and three documents feed cost amounts into the costing system:
      1) **Materials requisition forms** request **direct materials** to be pulled from the warehouse and sent to the production line.

Work-in-process -- Job 1015	$XXX	
Raw materials		$XXX

      2) **Time tickets** track the **direct labor** that workers expend on various jobs.

Work-in-process -- Job 1015	$XXX	
Wages payable		$XXX

      3) These two major components of product cost are charged to work-in-process using the **actual amounts** incurred.
   e. Under job-order costing, the third component, **manufacturing overhead**, is charged using an **estimated rate**.
      1) The application of an estimated overhead rate is necessary under job-order costing because the outputs are customized and the processes vary from period to period.
         a) Contrast this with the treatment of overhead under process costing (item 2.c. in Subunit 19.3) in which actual overhead costs incurred are charged to work-in-process at the end of the period.
      2) As indirect costs are paid throughout the year, they are collected in the **manufacturing overhead control account**.
         a) Note that work-in-process is not affected when actual overhead costs are incurred.

Manufacturing overhead control	$XXX	
Property taxes payable		$XXX
Manufacturing overhead control	$XXX	
Prepaid insurance		$XXX
Manufacturing overhead control	$XXX	
Accumulated depreciation -- factory equipment		$XXX

3) Overhead costs are applied to ("absorbed" by) each job based on a **predetermined overhead application rate** for the year.

a) At the beginning of the year, an estimate is made of the total amount that will be spent for manufacturing overhead during that year.

b) This total is divided by the allocation base, such as direct labor hours or machine hours, to arrive at the application rate.

c) The amount applied equals the number of units of the allocation base used during the period times the application rate.

i) The credit is to manufacturing overhead applied, a contra-account for manufacturing overhead control.

Work-in-process -- Job 1015	$XXX	
Manufacturing overhead applied		$XXX

d) By tracking the amounts applied to the various jobs in a separate account, the actual amounts spent on overhead are preserved in the balance of the overhead control account.

i) In addition, the firm can determine at any time how precise its estimate of overhead costs for the period was by comparing the balances in the two accounts. The closer they are (in absolute-value terms), the better the estimate was.

4) At the **end of the period**, the overhead control and applied accounts are **netted**.

a) If the result is a **credit**, overhead was **overapplied** for the period. If the result is a **debit**, overhead was **underapplied**.

i) If the variance is **immaterial**, it can be closed directly to cost of goods sold.

ii) If the variance is **material**, it should be allocated based on the relative values of work-in-process, finished goods, and cost of goods sold.

f. The amounts from the input documents are accumulated on **job-cost sheets**. These serve as a subsidiary ledger page for each job.

1) The total of all job-cost sheets will equal the balance in the general ledger work-in-process account.

3. Output that does not meet the quality standards for salability is considered spoilage.

a. If the spoilage is the amount expected in the ordinary course of production, it is considered **normal spoilage**.

1) The accounting treatment is to include normal spoilage as a product cost.

2) This is accomplished by allowing the net cost of the spoilage to remain in the work-in-process account of the job that generated it.

a) If the normal spoilage is worthless and must be discarded, no entry is made.

b) If the normal spoilage can be sold, the entry is:

Spoiled inventory (at fair market value)	$XX	
Work-in-process -- Job 1015		$XX

b. If the spoilage is over and above the amount expected in the ordinary course of production, it is considered **abnormal spoilage**.

1) The accounting treatment is to highlight abnormal spoilage as a period cost so that management can address the deficiency that caused it.

2) This is accomplished by charging a loss account for the net cost of the spoilage.

a) If the abnormal spoilage is worthless and must be discarded, the entry is:

Loss from abnormal spoilage (costs up to point of inspection)	$XX	
Work-in-process -- Job 1015		$XX

b) If the abnormal spoilage can be sold, the entry is:

Spoiled inventory	$XX	
Loss from abnormal spoilage (difference)	XX	
Work-in-process -- Job 1015 (costs up to point of inspection)		$XX

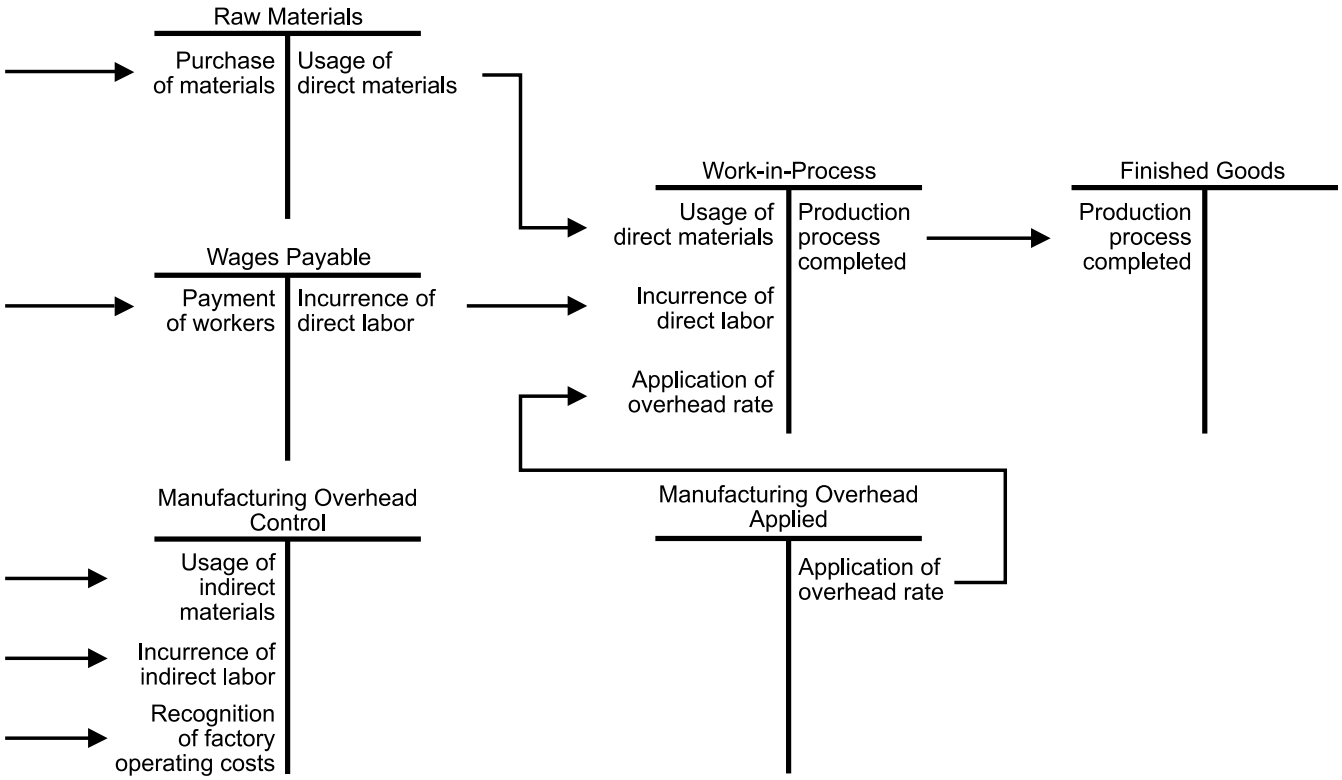
4. When a job order is completed, all the costs are transferred to finished goods.

Finished goods	$X,XXX	
Work-in-process -- Job 1015		$X,XXX

5. When the output is sold, the appropriate portion of the cost is transferred to cost of goods sold.

Cost of goods sold	$X,XXX	
Finished goods		$X,XXX

6. The following diagram depicts the flow of cost accumulation in a job-order costing system:



19.3 PROCESS COSTING

1. Process cost accounting is used to assign costs to inventoriable goods or services. It is applicable to **relatively homogeneous products** that are mass produced on a continuous basis (e.g., petroleum products, thread, computer monitors).
   a. Where job-order costing uses subsidiary ledgers to keep track of specific jobs, process costing typically has a **work-in-process account for each department** through which the production of output passes.
   b. Process costing is an averaging process that calculates the average cost of all units:
      1) Costs are accumulated for a cost object that consists of a large number of similar units of goods or services;
      2) Work-in-process is stated in terms of equivalent units; and
      3) Unit costs are established.
2. The accumulation of costs under a process costing system is **by department rather than by project**. This reflects the continuous, homogeneous nature of the manufacturing process.
   a. As in job-order costing, the physical inputs required for the production process are obtained from suppliers.

Raw materials	$XXX	
Accounts payable		$XXX

   b. **Direct materials** are used by the first department in the process.

Work-in-process -- Department A	$XXX	
Raw materials		$XXX

   c. **Conversion costs** are the sum of direct labor and manufacturing overhead. The nature of process costing makes this accounting treatment more efficient (the implications of this for the calculation of unit quantities are covered in item 4. on page 7).

Work-in-process -- Department A	$XXX	
Wages payable (direct and indirect labor)		$XXX
Manufacturing supplies (indirect materials)		XXX
Property taxes payable		XXX
Prepaid insurance		XXX
Accumulated depreciation -- factory equipment		XXX

   d. The products move from one department to the next.

Work-in-process -- Department B	$XXX	
Work-in-process -- Department A		$XXX

   e. The second department adds more direct materials and more conversion costs.

Work-in-process -- Department B	$XXX	
Raw materials		$XXX
Work-in-process -- Department B	$XXX	
Wages payable (direct and indirect labor)		$XXX
Manufacturing supplies (indirect materials)		XXX
Property taxes payable		XXX
Prepaid insurance		XXX
Accumulated depreciation -- factory equipment		XXX

   f. Because manufacturing overhead is assigned to work-in-process as part of conversion costs, there is rarely an overhead control or overhead applied account under process costing, and the issue of over- or underapplied overhead does not arise.
      1) The exception is when a standard costing system is used. Under standard costing, a predetermined overhead rate (as in job-order costing) is used to assign overhead costs.

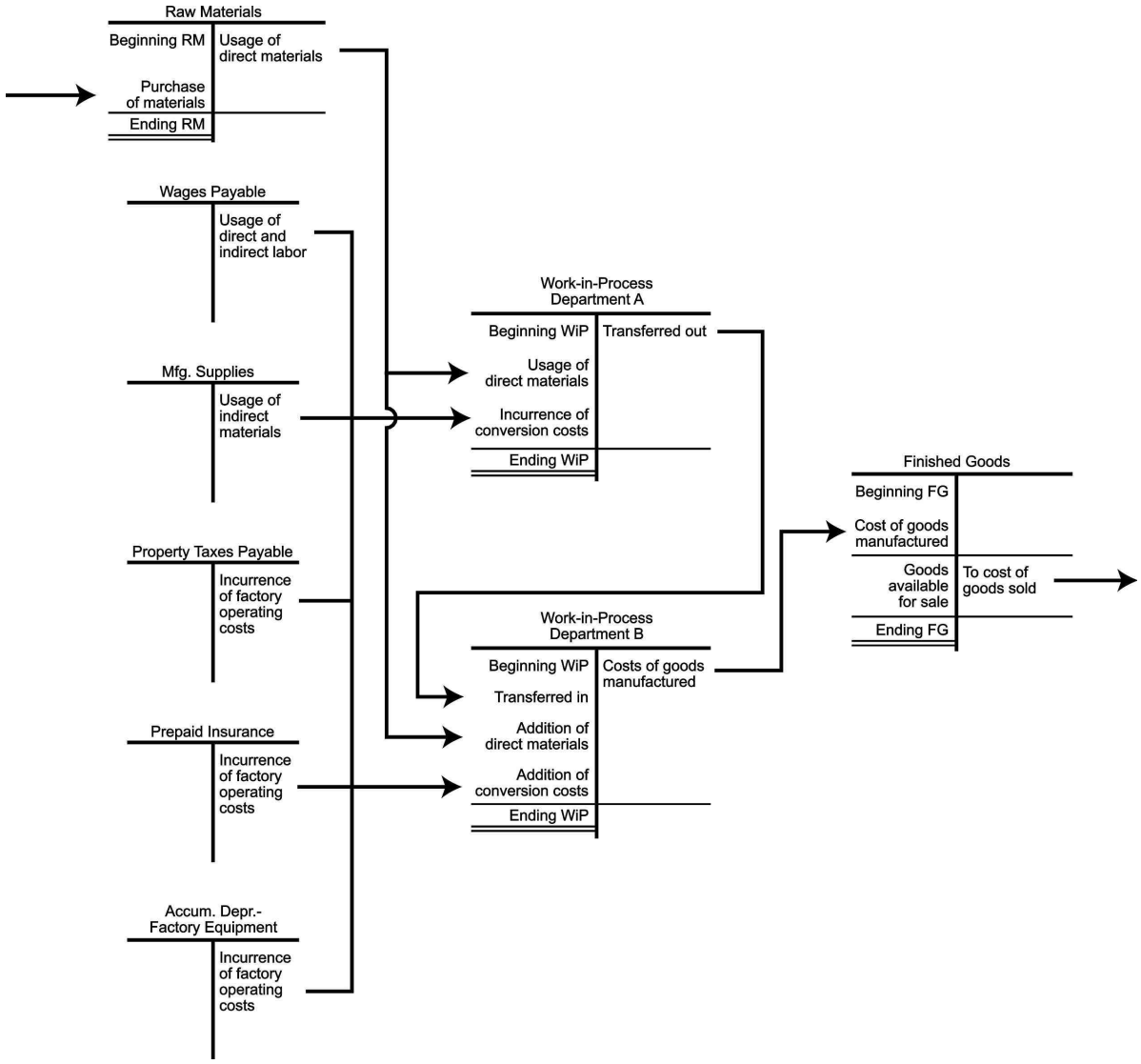
g. When processing is finished in the last department, all the costs are transferred to finished goods.

Finished goods	$X,XXX	
Work-in-process -- Department B		$X,XXX

h. As products are sold, the costs are transferred to cost of goods sold.

Cost of goods sold	$X,XXX	
Finished goods		$X,XXX

3. The following diagram depicts the flow of cost accumulation in a process costing system:



4. Some units remain unfinished at the end of the period. For each department to account adequately for the costs attached to its unfinished units, the units must be restated in terms of equivalent units of production.

   a. **Equivalent units of production (EUP)** is the number of complete goods that could have been produced using the inputs consumed during the period.

      1) The EUP conversion is a two-phase process: First, the **equivalent units** are determined; second, the **per-unit cost** is calculated.

      2) The two calculations are made separately for direct materials and conversion costs (transferred-in costs are by definition 100% complete). Conversion costs are assumed to be uniformly incurred.

   b. Two methods of calculating EUP are in common use: weighted-average and FIFO.

      1) Under the **weighted-average method**, units in beginning work-in-process inventory are treated as if they were started and completed during the current period. Beginning work-in-process is therefore not included in the EUP calculation.

      2) Under the **first-in, first-out (FIFO) method**, units in beginning work-in-process inventory are part of the EUP calculation. The calculation is thus more complex than weighted-average but tends to be more accurate.

   c. EXAMPLE: A department of a manufacturing concern is preparing its cost reports for the month.

      1) The first step is to prepare a quantity schedule:

	Units	Completed for Direct Materials	Completed for Conversion Costs
Beginning work-in-process	2,000	80%	40%
Units started during period	8,000		
Units to account for	10,000		
Units transferred to next department	9,000		
Ending work-in-process	1,000	90%	70%
Units accounted for	10,000		

      2) The costs to be allocated are presented in this table:

	Direct Materials	Conversion Costs
Beginning work-in-process	$25,000	$10,000
Added during the month	55,000	50,000

      3) The next step is to calculate the equivalent units of production. This table illustrates the different outcomes of applying the two methods. Note that beginning work-in-process plays no role in the weighted-average computation but is backed out under FIFO.

	Weighted-Average		FIFO	
	Direct Materials	Conversion Costs	Direct Materials	Conversion Costs
Units transferred to next department	9,000	9,000	9,000	9,000
Add: ending work-in-process FUP				
Direct materials: 1,000 units × 90%	900		900	
Conversion costs: 1,000 units × 70%		700		700
Total completed units			9,900	9,700
Less: beginning work-in-process EUP				
Direct materials: 2,000 units × 80%			(1,600)	
Conversion costs: 2,000 units × 40%				(800)
Equivalent units of production	9,900	9,700	8,300	8,900

4) Once the equivalent units have been calculated, the per-unit costs under each of the two methods can be derived.

a) Under the **weighted-average** method, **all direct materials and conversion costs** are averaged in, both those incurred in the current period and those in beginning work-in-process.

Direct materials:	$\frac{\$25{,}000 + \$55{,}000}{9{,}900 \text{ EUP}}$	= $ 8.08
Conversion costs:	$\frac{\$10{,}000 + \$50{,}000}{9{,}700 \text{ EUP}}$	= $ 6.19
Total unit cost under weighted-average		$14.27

b) Under the **FIFO** method, **only the costs incurred in the current period** are included in the calculation.

Direct materials:	$\frac{\$55{,}000}{8{,}300 \text{ EUP}}$	= $ 6.63
Conversion costs:	$\frac{\$50{,}000}{8{,}900 \text{ EUP}}$	= $ 5.62
Total unit cost under first-in, first-out		$12.24

19.4 OVERHEAD COSTS AND NORMAL COSTING

1. Whenever overhead is to be allocated, as in job-order costing and activity-based costing, an appropriate **allocation base** must be chosen.

a. In traditional cost accounting, allocation bases include direct labor hours, direct labor cost, machine hours, materials cost, and units of production.

b. The crucial quality of an allocation base is that it be a **cost driver** of the costs in the pool to be allocated.

1) Recall that a cost driver must capture a **cause-and-effect relationship** between the cost being allocated and the cost object to which the costs are being attached.

2) Overhead is usually allocated to products based upon the **level of activity**.

a) For example, if overhead is largely made up of machine maintenance, the activity base may be machine hours.

b) In capital-intensive industries, the amount of overhead will probably be related more to machine hours than to either direct labor hours or direct labor cost.

c) In labor-intensive industries, overhead is usually allocated on a labor activity base.

i) If more overhead is incurred by the more highly skilled and paid employees, the overhead rate should be based upon direct labor cost rather than direct labor hours.

3) Overhead is usually not allocated on the basis of units produced because of the lack of a cause-and-effect relationship.

a) When only one product is manufactured, this method may be acceptable because all costs are to be charged to the single product.

2. The **predetermined overhead application rate** equals budgeted overhead divided by the budgeted activity level (measure of capacity).
   a. The **numerator** of the calculation is the total amount of manufacturing overhead that must be allocated for the period, i.e., the sum of indirect materials, indirect labor, depreciation, factory insurance, etc.
      1) The **denominator** is the allocation base.
   b. Inevitably, the overhead amounts applied throughout the year will vary from the amount actually incurred, which is only determinable once the job is complete.
      1) This variance is called **over- or underapplied overhead**.
      2) Overapplied overhead (a credit balance in overhead) results when product costs are overstated because the
         a) Activity level was higher than expected, or
         b) Actual overhead costs were lower than expected.
      3) Underapplied overhead (a debit balance in overhead) results when product costs are understated because the
         a) Activity level was lower than expected, or
         b) Actual overhead costs were higher than expected.
      4) Over- and underapplied overhead is subject to one of two treatments:
         a) If the variance is **immaterial**, it can be closed directly to cost of goods sold.

If overapplied:		
Manufacturing overhead applied	$XXX	
Cost of goods sold		$XXX

If underapplied:		
Cost of goods sold	$XXX	
Manufacturing overhead applied		$XXX

         b) If the variance is **material**, it should be allocated based on the relative values of work-in-process, finished goods, and cost of goods sold.

If overapplied:		
Manufacturing overhead applied (balance)	$XXX	
Work-in-process (overapplied amount × allocation %)		$XXX
Finished goods (overapplied amount × allocation %)		XXX
Cost of goods sold (overapplied amount × allocation %)		XXX
Manufacturing overhead control (balance)		XXX

If underapplied:		
Manufacturing overhead applied (balance)	$XXX	
Work-in-process (underapplied amount × allocation %)	XXX	
Finished goods (underapplied amount × allocation %)	XXX	
Cost of goods sold (underapplied amount × allocation %)	XXX	
Manufacturing overhead control (balance)		$XXX

3. During times of low production, per-unit overhead charges will skyrocket. This leads to higher product costs during years of lower production and to **distortions in the financial statements**.

   a. EXAMPLE: A manufacturing firm is expecting the following units of production and sales over a three-year period. Note that production is expected to fluctuate but sales are expected to be even:

	Year 1	Year 2	Year 3	Totals
Production	10,000	6,000	8,000	24,000
Sales	7,000	7,000	7,000	21,000

Variable overhead costs are calculated at $1 per unit, and fixed overhead is projected to remain constant over the period:

	Year 1	Year 2	Year 3	Totals
Variable overhead cost	$10,000	$ 6,000	$ 8,000	$24,000
Fixed overhead cost	20,000	20,000	20,000	60,000
Total overhead cost	$30,000	$26,000	$28,000	$84,000

Next, the overhead application rate for each year is calculated.

	Year 1	Year 2	Year 3
Estimated total overhead / Estimated production	$\frac{\$30,000}{10,000} = \$3.00$	$\frac{\$26,000}{6,000} = \$4.33$	$\frac{\$28,000}{8,000} = \$3.50$

These fluctuations in the applied overhead rate will lead to fluctuations in unit cost:

	Year 1	Year 2	Year 3
Direct materials	$ 3.00	$ 3.00	$ 3.00
Direct labor	4.00	4.00	4.00
Manufacturing overhead	3.00	4.33	3.50
Total overhead cost	$10.00	$11.33	$10.50

The comparative income statements make clear the distorting effect:

	Year 1	Year 2	Year 3	Totals
Production:				
From Year 1	7,000	3,000		
From Year 2		4,000	2,000	
From Year 3			5,000	
Expected unit sales	7,000	7,000	7,000	
Expected selling price	× $12	× $12	× $12	
Total expected sales	$84,000	$84,000	$84,000	$252,000
Cost of goods sold:				
From Year 1	$70,000	$30,000		
From Year 2		45,333	$22,667	
From Year 3			52,500	
Total expected CGS	$70,000	$75,333	$75,167	$220,500
Gross margin	$14,000	$ 8,667	$ 8,833	$ 31,500

Large fluctuations in gross margin are reported during a period when there was no fluctuation at all in the company's underlying cost structure.

b. To prevent these distortions in the financial statements, **normal costing** derives the overhead application rate by looking at several years at a time, not just one.

1) EXAMPLE: Instead of using a different overhead application rate for each year, the company uses a single average figure for the period.

a) The company expects to produce 24,000 units over three years.

b) Dividing the fixed overhead of $20,000 for each year by an average of 8,000 units per year yields a fixed overhead application rate of $2.50.

c) The new total overhead application rate per unit is $3.50 ($1.00 variable cost + $2.50 fixed cost).

d) The new per-unit cost for all three years is thus $10.50 ($3.00 direct materials + $4.00 direct labor + $3.50 overhead application rate).

e) The revised income statements prepared using a normalized overhead rate reveal the smoothing effect on gross margin:

	Year 1	Year 2	Year 3	Totals
Production:				
From Year 1	7,000	3,000		
From Year 2		4,000	2,000	
From Year 3			5,000	
Expected unit sales	7,000	7,000	7,000	
Expected selling price	× $12	× $12	× $12	
Total expected sales	$84,000	$84,000	$84,000	$252,500
Cost of goods sold:				
From Year 1	$73,500	$31,500		
From Year 2		42,000	$21,000	
From Year 3			52,500	
Total expected CGS	$73,500	$73,500	$73,500	$220,500
Gross margin	$10,500	$10,500	$10,500	$ 31,500

c. **Extended normal costing** applies the use of a normalized rate to direct costs as well as to manufacturing overhead.

d. The following table summarizes the use of rates in the three costing methods described:

	Actual Costing	**Normal Costing**	**Extended Normal Costing**
Direct Materials	Actual	Actual	Budgeted
Direct Labor	Actual	Actual	Budgeted
Manufacturing Overhead	Actual	Budgeted	Budgeted

19.5 ACTIVITY-BASED COSTING (ABC)

1. **Activity-based costing (ABC)** is a response to the significant increase in the incurrence of indirect costs resulting from the rapid advance of technology.
   a. ABC is a **refinement of an existing costing system** (job-order or process)
      1) Under a traditional (volume-based) costing system, overhead is simply dumped into a single cost pool and spread evenly across all end products.
      2) Under ABC, indirect costs are attached to activities which are then rationally allocated to end products.
   b. ABC may be used by manufacturing, service, or retailing entities.
2. The inaccurate averaging or spreading of indirect costs over products or service units that use different amounts of resources is called **peanut-butter costing**.
   a. Peanut-butter costing results in **product-cost cross-subsidization**, the condition in which the miscosting of one product causes the miscosting of other products.
   b. The peanut-butter effect of using a **traditional (i.e., volume-based) costing system** can be summarized as follows:
      1) Direct labor and direct materials are traced to products or service units.
      2) A single pool of indirect costs (overhead) is accumulated for a given organizational unit.
      3) Indirect costs from the pool are assigned using an allocative (rather than a tracing) procedure, such as using a single overhead rate for an entire department, e.g., $3 of overhead for every direct labor hour.
         a) The effect is an averaging of costs that may result in significant inaccuracy when products or service units do not use similar amounts of resources.
3. EXAMPLE: The effect of product-cost cross-subsidization can be illustrated as follows:
   a. A company produces two similar products.
      1) Both products require one unit of raw material and one hour of direct labor. Raw materials costs are $20 per unit, and direct labor is $70 per hour.
   b. During the month just ended, the company produced 1,000 units of Product A and 100 units of Product B. Manufacturing overhead for the month totaled $20,000.
   c. Using direct labor hours as the overhead allocation base, per-unit costs and profits are calculated as follows:

	Product A	Product B	Total
Raw materials	$ 14,000	$ 1,400	
Direct labor	70,000	7,000	
Overhead {$20,000 × [$70,000 ÷ ($70,000 + $7,000)]}	18,182		
Overhead {$20,000 × [$7,000 ÷ ($70,000 + $7,000)]}		1,818	
Total costs	$102,182	$ 10,218	$112,400
Selling price	$ 119.99	$ 139.99	
Cost per unit	(102.18)	(102.18)	
Profit per unit	$ 17.81	$ 37.81	

d. The company's management accountants have determined that overhead consists almost entirely of production line setup costs and that the two products require equal setup times. Allocating overhead on this basis yields vastly different results.

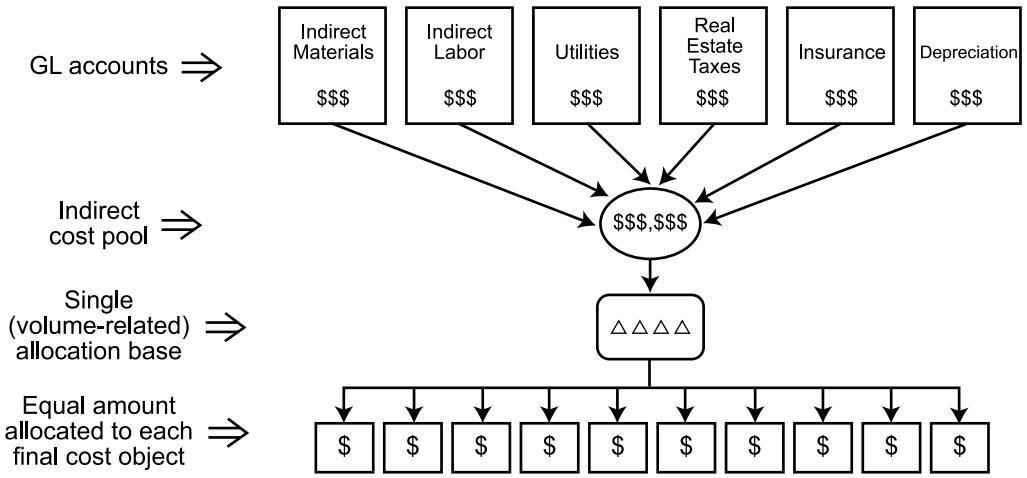
	Product A	Product B	Total
Raw materials	$14,000	$ 1,400	
Direct labor	70,000	7,000	
Overhead ($20,000 × 50%)	10,000		
Overhead ($20,000 × 50%)		10,000	
Total costs	$94,000	$18,400	$112,400
Selling price	$119.99	$139.99	
Cost per unit	(94.00)	(184.00)	
Profit (loss) per unit	$ 25.99	$ (44.01)	

e. Rather than the comfortable profit the company believed it was making on both products using peanut-butter costing, it becomes clear that the company is losing money on every unit of Product B that it sells. The high-volume Product A has been heavily subsidizing the setup costs for the low-volume Product B.

4. The example beginning on the previous page assumed a single component of overhead for clarity. In reality, overhead is made up of many components.

a. The **peanut-butter effect** of traditional overhead allocation is illustrated in the following diagram:

Overhead Allocation in a Traditional (Volume-Based) Cost Accumulation System



5. Volume-based systems were appropriate throughout the decades when direct costs were the bulk of manufacturing costs. With **increasing automation**, however, overhead became an ever greater percentage of the total. ABC was developed to deal with this increasing complexity of overhead costs.

a. **Volume-based systems**, as illustrated above, involve:

1) Accumulating costs in **general ledger accounts** (utilities, taxes, etc.)
2) Using a **single cost pool** to combine the costs in all the related accounts
3) Selecting a **single driver** to use for the entire indirect cost pool
4) Allocating the indirect cost pool to **final cost objects**

b. **Activity-based systems**, by contrast, involve:

1) Identifying organization **activities** that constitute overhead
2) Assigning the costs of **resources** consumed by the activities
3) Assigning the costs of the activities to **final cost objects**

6. **Step 1 – Activity Analysis**
   a. An **activity** is a set of work actions undertaken within the entity, and a **cost pool** is established for each activity.
   b. Activities are classified in a **hierarchy** according to the level of the production process at which they take place.
      1) **Unit-level activities** are performed for each unit of output produced. Examples are using direct materials and using direct labor.
      2) **Batch-level activities** occur for each group of outputs produced. Examples are materials ordering, materials handling, and production line setup.
      3) **Product-sustaining** (or service-sustaining) **activities** support the production of a particular product (or service), irrespective of the level of production. Examples are product design, engineering changes, and testing.
      4) **Facility-sustaining activities** concern overall operations and therefore cannot be traced to products at any point in the production process. Examples are accounting, human resources, maintenance of physical plant, and safety/security arrangements.
   c. EXAMPLE: Fabulous Foundry uses a job-order system to accumulate costs for the custom pipe fittings of all sizes that it produces.
      1) Since the 1950s, Fabulous has accumulated overhead costs in six general ledger accounts (indirect materials, indirect labor, utilities, real estate taxes, insurance, and depreciation), combined them into a single indirect cost pool, and allocated the total to its products based on machine hours.
         a) At the time this system was established, overhead was a relatively small percentage of the foundry's total manufacturing costs.
         b) With increasing reliance on robots in the production process and computers for monitoring and control, overhead is now a greater percentage of the total while direct labor costs have shrunk.
      2) To obtain better data about product costs, Fabulous has decided to refine its job-order costing system by switching to activity-based costing for the allocation of overhead.
         a) The foundry's management accountants conducted extensive interviews with production and sales personnel to determine how the incurrence of indirect costs can be viewed as activities that consume resources.
         b) The accountants identified five activities and created a cost pool for each to capture the incurrence of indirect costs:

Activity	**Hierarchy**
Product design	Product-sustaining
Production setup	Batch-level
Machining	Unit-level
Inspection & testing	Unit-level
Customer maintenance	Facility-sustaining

7. **Step 2 – Assign Resource Costs to Activities**
   a. Once the activities are designated, the next step in enacting an ABC system is to **assign the costs of resources** to the activities. This is termed **first-stage allocation**.
   b. **Identifying resource costs** is not the simple matter it is in volume-based overhead allocation (where certain GL accounts are designated for combination into a single cost pool).
      1) A **separate accounting system** may be necessary to track resource costs separately from the general ledger.
   c. Once the resources have been identified, resource drivers are designated to allocate resource costs to the activity cost pools.
      1) **Resource drivers** are measures of the resources consumed by an activity.
   d. EXAMPLE: Fabulous Foundry's management accountants identified the following resources used by its indirect cost processes:

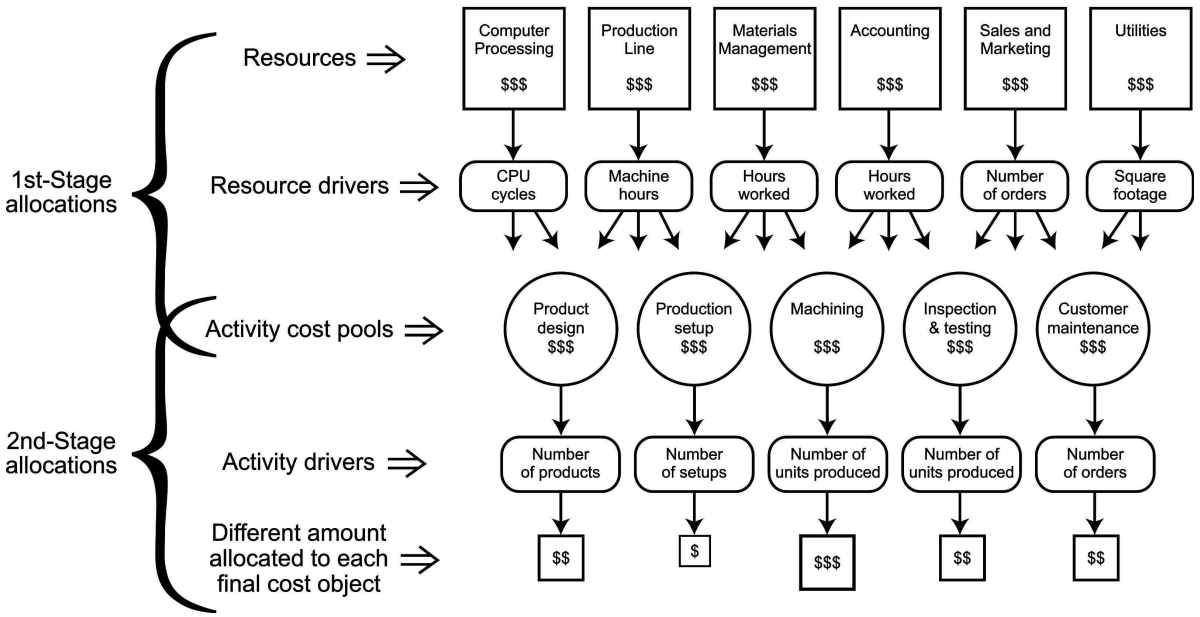
Resource	**Driver**
Computer processing	CPU cycles
Production line	Machine hours
Materials management	Hours worked
Accounting	Hours worked
Sales & marketing	Number of orders

8. **Step 3 – Allocate Activity Cost Pools to Final Cost Objects**
   a. The final step in enacting an ABC system is **allocating the activity cost pools** to final cost objects. This is termed **second-stage allocation**.
   b. Costs are reassigned to final-stage (or, if intermediate cost objects are used, next-stage) cost objects on the basis of activity drivers.
      1) **Activity drivers** are measures of the demands made on an activity by next-stage cost objects, such as the number of parts in a product used to measure an assembly activity.
      2) EXAMPLE: Fabulous Foundry's management accountants have designated these drivers to associate with their corresponding activities:

Activity	**Driver**
Product design	Number of products
Production setup	Number of setups
Machining	Number of units produced
Inspection & testing	Number of units produced
Customer maintenance	Number of orders

9. The differences between traditional overhead allocation and activity-based costing are illustrated in the following diagram:

Indirect Cost Assignment in an Activity-Based Costing System



10. **Drivers** (both resource and activity) must be chosen on the basis of a **cause-and-effect relationship** with the resource or activity cost being allocated, not simply on the basis of a high positive correlation.
    a. A **cost object** may be a job, product, process, activity, service, or anything else for which a cost measure is desired.
    b. **Intermediate cost objects** receive temporary accumulations of costs as the cost pools move from their originating points to the final cost objects.
        1) For example, work-in-process is an intermediate cost object, and finished salable goods are final cost objects.

19.6 BACKFLUSH COSTING AND JIT INVENTORY

1. **Backflush costing** is often used by firms that have adopted a **just-in-time (JIT)** production philosophy.
    a. A JIT system **treats carrying inventory as a nonvalue-adding activity**.
        1) Hence, components are made available just in time to be used in the production process.
        2) Backflush costing **complements JIT** because it simplifies costing.
    b. A traditional system tracks costs as they are incurred (sequential tracking), but backflush costing delays recording of some cost information.
        1) Backflush costing treats the detailed recording of inventory data as a nonvalue-adding activity.

2) **Work-in-process is usually eliminated**, journal entries to inventory accounts may be delayed until the time of product completion or even the time of sale, and standard costs are used to assign costs to units when journal entries are made, that is, to "flush" costs out of the system to the points at which inventories remain.

c. Backflush costing works well with JIT systems because of the simplification of production, which is reflected in the use of **manufacturing cells**.

1) These cells are groups of machines and workers producing a given type of product.
2) Each worker can operate and maintain the machines, perform set-up activities, make quality inspections, and move work-in-process within the cell.
3) The result is **less need for central support departments**, placement of materials and tools close to the point of use, savings of space, and greater production flexibility.
4) A further benefit is that a JIT system allows for identification of more direct costs and therefore minimizes overhead allocations.

a) For the same reason, backflush costing also complements activity-based costing (ABC).

d. **One variation of backflush costing** records raw materials inventory at standard cost when it is purchased.

1) Because materials arrive just in time for processing, an entry to a separate materials inventory account is unnecessary.

Raw and in-process inventory	$XXX	
Materials price variance (dr. or cr.)	XXX	
Accounts payable		$XXX

2) Conversion costs (direct labor and overhead) are recorded when incurred at their actual amounts.

Conversion costs	$XXX	
Salaries and wages payable, etc.		$XXX

3) The entry for the transfer to finished goods is where backflush costing gets its name. Because costs have not been accumulated sequentially during production, these costs must be "flushed out" once production is complete.

Finished goods (standard cost)	$XXX	
Raw and in-process inventory (standard cost)		$XXX
Conversion costs (standard cost)		XXX

a) This one entry summarizes the effect of all the sequential entries of a traditional costing system that do not get made in backflush costing.

4) After a count, raw and in-process inventory is adjusted for the materials efficiency variance (debit or credit).

a) This variance is recorded for the difference between actual usage and standard usage for the amount of goods finished.

5) The under- or overapplied conversion costs (debit conversion costs applied and credit conversion costs control) are usually closed to cost of goods sold instead of being prorated because the amounts tend to be small.
6) The final entry is the same as under a traditional costing system.

Cost of goods sold	$XXX	
Finished goods		$XXX

e. **A greater departure from traditional methods** is to recognize the sale but not the completion of units.

1) In this variation of backflush costing, only one inventory account is used (inventory control) instead of two (raw and in-process inventory and finished goods).

2) The entry at the time of the acquisition of direct materials is:

Inventory control	$XXX	
Materials price variance (dr. or cr.)	XXX	
Accounts payable		$XXX

3) As described in d.2) on the previous page, actual conversion costs are debited to a control account.

4) Under this method, no finished goods inventory is carried at all.

Cost of goods sold	$XXX	
Inventory control		$XXX
Conversion costs		XXX

5) As described in d.5) on the previous page, under- or overapplied conversion costs are recognized by debiting conversion costs applied and crediting conversion costs control with, typically, a debit or credit to cost of goods sold.

6) All conversion costs are period costs in this version of backflush costing.

7) If recognition of a direct materials efficiency variance is desired, a physical count is made, and the difference between what is on hand and what should be on hand is the variance for which inventory is adjusted.

f. **Another possibility** is to eliminate entries to a materials inventory account altogether.

1) Accordingly, finished goods are debited when completed (with credits to accounts payable, etc., and to overhead applied) and credited when sold, but no other inventory entries are made.

g. **Yet another variation** of backflush costing records costs (direct materials, direct labor, and overhead) directly in cost of goods sold.

1) At the end of the period, the standard costs of the ending work-in-process and finished goods inventories are flushed back from cost of goods sold (debit WIP and FG, credit CGS).

h. Backflush costing may undervalue inventory and is therefore **inconsistent with GAAP** except when the difference is not material or an adjustment is made. Another criticism is that the lack of sequential tracking leaves an inadequate audit trail.

19.7 JOINT PRODUCT AND BY-PRODUCT COSTING

1. When two or more separate products are produced by a common manufacturing process from a common input, the outputs from the process are **joint products**.

a. **Joint (common) costs** are those costs incurred up to the point where the products become separately identifiable, called the split-off point.

1) Joint costs include direct materials, direct labor, and manufacturing overhead. Because they are not separately identifiable, they must be allocated to the individual joint products.

2) EXAMPLE: Crude oil can be refined into multiple salable products. All costs incurred in getting the crude oil to the distilling tower are joint costs.

b. At the **split-off point**, the joint products acquire separate identities. Costs incurred after split-off are separable costs.

1) **Separable costs** can be identified with a particular joint product and allocated to a specific unit of output.

2) EXAMPLE: Once crude oil had been distilled into asphalt, fuel oil, diesel fuel, kerosene, and gasoline, costs incurred in further refining and distributing these individual products are separable costs.

2. Several methods are available to **allocate joint costs**. These can be grouped into two approaches.

a. A **physical measure-based approach** employs a physical measure such as volume, weight, or a linear measure.

1) The **physical-unit method** allocates joint production costs to each product based on its relative proportion of the measure selected.

2) EXAMPLE: A refinery processes 1,000 barrels of crude oil and incurs $100,000 of processing costs. The process results in the following outputs. Under the physical unit method, the joint costs up to split-off are allocated as follows:

Asphalt	$100,000 × (300 barrels ÷ 1,000 barrels) =	$ 30,000
Fuel oil	$100,000 × (300 barrels ÷ 1,000 barrels) =	30,000
Diesel fuel	$100,000 × (200 barrels ÷ 1,000 barrels) =	20,000
Kerosene	$100,000 × (100 barrels ÷ 1,000 barrels) =	10,000
Gasoline	$100,000 × (100 barrels ÷ 1,000 barrels) =	10,000
		$100,000

3) The physical-unit method's simplicity makes it appealing, but it does not match costs with the individual products' revenue-generating potential.

b. A **market-based approach** assigns a proportionate amount of the total cost to each product on a quantitative basis.

1) These allocations are performed using the entire production run for an accounting period, not units sold. This is because the joint costs were incurred on all the units produced, not just those sold.

2) Three major methods of allocation are available under this approach.

3) The **sales-value split-off method** is based on the relative sales values of the separate products at split-off.

a) EXAMPLE: The refinery estimates that the five outputs can sell for the following prices at split-off:

Asphalt	300 barrels @ $ 60/barrel =	$ 18,000
Fuel oil	300 barrels @ $180/barrel =	54,000
Diesel fuel	200 barrels @ $160/barrel =	32,000
Kerosene	100 barrels @ $ 80/barrel =	8,000
Gasoline	100 barrels @ $180/barrel =	18,000
		$130,000

The total expected sales value for the entire production run at split-off is thus $130,000. Multiply the total joint costs to be allocated by the proportion of the total expected sales of each product:

Asphalt	$100,000 × ($18,000 ÷ $130,000) =	$ 13,846
Fuel oil	$100,000 × ($54,000 ÷ $130,000) =	41,538
Diesel fuel	$100,000 × ($32,000 ÷ $130,000) =	24,616
Kerosene	$100,000 × ($ 8,000 ÷ $130,000) =	6,154
Gasoline	$100,000 × ($18,000 ÷ $130,000) =	13,846
		$100,000

4) The **estimated net realizable value (NRV) method** also allocates joint costs based on the relative market values of the products.

   a) The significant difference is that, under the estimated NRV method, all separable costs necessary to make the product salable are added in before the allocation is made.

   b) EXAMPLE: The refinery estimates final sales prices as follows:

Asphalt	300 barrels @ $ 70/barrel =	$ 21,000
Fuel oil	300 barrels @ $200/barrel =	60,000
Diesel fuel	200 barrels @ $180/barrel =	36,000
Kerosene	100 barrels @ $ 90/barrel =	9,000
Gasoline	100 barrels @ $190/barrel =	19,000
		$145,000

   From these amounts, separable costs are deducted:

Asphalt	$21,000 – $1,000 =	$ 20,000
Fuel oil	$60,000 – $1,000 =	59,000
Diesel fuel	$36,000 – $1,000 =	35,000
Kerosene	$ 9,000 – $1,000 =	7,000
Gasoline	$19,000 – $1,000 =	17,000
		$138,000

   The total final sales value for the entire production run is thus $138,000. Multiply the total joint costs to be allocated by the proportion of the final expected sales of each product:

Asphalt	$100,000 × ($20,000 ÷ $138,000) =	$ 14,493
Fuel oil	$100,000 × ($59,000 ÷ $138,000) =	42,754
Diesel fuel	$100,000 × ($35,000 ÷ $138,000) =	25,362
Kerosene	$100,000 × ($ 7,000 ÷ $138,000) =	5,072
Gasoline	$100,000 × ($17,000 ÷ $138,000) =	12,319
		$100,000

5) The **constant gross-margin percentage NRV method** is based on allocating joint costs so that the gross-margin percentage is the same for every product.

   a) There are three steps under this method:

      i) Determine the overall gross-margin percentage.

      ii) Subtract the appropriate gross margin from the final sales value of each product to calculate total costs for that product.

      iii) Subtract the separable costs to arrive at the joint cost amount.

   b) EXAMPLE: The refinery uses the same calculation of expected final sales price as under the estimated NRV method:

Asphalt	300 barrels @ $ 70/barrel =	$ 21,000
Fuel oil	300 barrels @ $200/barrel =	60,000
Diesel fuel	200 barrels @ $180/barrel =	36,000
Kerosene	100 barrels @ $ 90/barrel =	9,000
Gasoline	100 barrels @ $190/barrel =	19,000
		$145,000

   The final sales value for the entire production run is thus $145,000. From this total the joint costs and total separable costs are deducted to arrive at a total gross margin for all products:

$$\$145,000 - \$100,000 - \$7,000 = \$38,000$$

   The gross margin percentage can then be derived:

$$\$38,000 \div \$145,000 = 26.21\%$$

Deduct gross margin from each product to arrive at a cost of goods sold:

Asphalt	$21,000 – ($21,000 × 26.21%)	=	$ 15,497
Fuel oil	$60,000 – ($60,000 × 26.21%)	=	44,276
Diesel fuel	$36,000 – ($36,000 × 26.21%)	=	26,565
Kerosene	$ 9,000 – ($ 9,000 × 26.21%)	=	6,641
Gasoline	$19,000 – ($19,000 × 26.21%)	=	14,021
			$107,000

Deduct the separable costs from each product to arrive at the allocated joint costs:

Asphalt	$15,497 – $1,000 =	$ 14,497
Fuel oil	$44,276 – $1,000 =	43,276
Diesel fuel	$26,566 – $1,000 =	25,565
Kerosene	$ 6,641 – $2,000 =	4,641
Gasoline	$14,021 – $2,000 =	12,021
		$100,000

3. **By-products** are one or more products of relatively small total value that are produced simultaneously from a common manufacturing process with products of greater value and quantity.

   a. The first question that must be answered in regard to by-products is: Do the **benefits** of further processing and bringing them to market **exceed the costs**?

Selling price	$x,xxx
Less: additional processing costs	(xxx)
Less: selling costs	(xxx)
Net realizable value	**$x,xxx**

      1) If the **net realizable value** is zero or negative, the by-products should be discarded as scrap.

   b. Once the decision is made to proceed with further processing, two more questions must be answered to determine the **proper accounting treatment** for by products:

      1) Will the net realizable value of the by-products be **material** enough to warrant recognizing them as inventory on the **balance sheet**?

      2) Will the expected proceeds from the sale of the by-products be reported as **revenue** or as a reduction to **cost of goods**?

   c. If the by-products are **material**, they are recognized at the **time of production** and recorded in a separate inventory account, as in this example:

Finished goods inventory – Asphalt (net manufacturing costs)	$xx,xxx	
Finished goods inventory – Fuel oil (net manufacturing costs)	xx,xxx	
Finished goods inventory – Diesel fuel (net manufacturing costs)	xx,xxx	
Finished goods inventory – Kerosene (net manufacturing costs)	xx,xxx	
Finished goods inventory – Gasoline (net manufacturing costs)	xx,xxx	
By-product inventory – Sludge (estimated net realizable value)	x,xxx	
Work-in-process (total manufacturing costs for period)		$xxx,xxx

      1) The amount of miscellaneous revenue (or reduction to cost of goods sold) reported is the **entire estimated net realizable value** of the by-products generated during the period.

         a) This treatment is justifiable when a ready market for the by-products is available.

      2) Because revenue (or cost of goods sold) was affected at the time of production, these accounts are unaffected when the by-products are sold.

Cash	$x,xxx	
By-product inventory – Sludge		$x,xxx

d. If the by-products are **immaterial**, they are not recognized until the **time of sale** and are thus not recorded on the balance sheet.

1) The amount of miscellaneous revenue (or reduction to cost of goods sold) reported is the **actual proceeds** from the sale of the by-products.

e. Regardless of the timing of their recognition in the accounts, by-products usually do not receive an allocation of joint costs because the cost of this accounting treatment ordinarily exceeds the benefit.

4. The decision to **sell or process further** is made based on whether the incremental revenue to be gained by further processing exceeds the incremental cost thereof.

a. The joint cost of the product is irrelevant because it is a sunk cost.

19.8 SERVICE COST ALLOCATION

1. **Service (support) department costs** are considered part of overhead (indirect costs). Thus, they cannot feasibly be traced to cost objects and therefore must be allocated to the operating departments that use the services.

a. When service departments also render services to each other, their costs may be allocated to each other before allocation to operating departments.

2. Four criteria are used to allocate costs.

a. **Cause and effect** should be used if possible because of its objectivity and acceptance by operating management.

b. **Benefits received** is the most frequently used alternative when a cause-and-effect relationship cannot be determined.

1) However, it requires an assumption about the benefits of costs, for example, that advertising which promotes the company but not specific products was responsible for increased sales by the various divisions.

c. **Fairness** is sometimes mentioned in government contracts but appears to be more of a goal than an objective allocation base.

d. **Ability to bear** (based on profits) is usually unacceptable because of its dysfunctional effect on managerial motivation.

3. **Three methods** of service department allocation are in general use.

a. The **direct method** is the simplest.

1) The direct method allocates service department costs directly to the producing departments without regard for services rendered by service departments to each other.

2) Service department costs are allocated to production departments based on an allocation base appropriate to each service department's function.

3) EXAMPLE:

a) A company has the following service department costs and allocation bases:

Service Department	Costs to Be Allocated	Allocation Base
Information Technology	$120,000	CPU cycles
Custodial Services	40,000	Floor space
Total	$160,000	

b) The production departments have the following preallocation costs and allocation base amounts:

Production Department	Preallocation Costs	CPU Cycles Used	%	Floor Space in Sq. Ft.	%
Department A	$300,000	60,000,000	62.5%	56,000	70.0%
Department B	200,000	36,000,000	37.5%	24,000	30.0%
Totals	$500,000	96,000,000	100.0%	80,000	100.0%

c) The direct method allocates the service department costs to the production departments as follows:

	Service Departments		Production Departments		
	Information Technology	Custodial Services	Department A	Department B	Total
Totals before allocation	$120,000	$40,000	$300,000	$200,000	$660,000
Allocate IT (62.5%, 37.5%)	(120,000)		75,000	45,000	0
Allocate Custodial (70.0%, 30.0%)		(40,000)	28,000	12,000	0
Totals after allocation	$ 0	$ 0	$403,000	$257,000	$660,000

b. The **step** or **step-down method** allocates some of the costs of services rendered by service departments to each other.

1) The step method derives its name from the procedure involved: The service departments are allocated in order, from the one that provides the most service to other service departments down to the one that provides the least.

2) EXAMPLE:

a) The services that each service department provides the other must be ascertained:

Service Department	CPU Cycles Used	%	Floor Space in Sq. Ft.	%
Information Technology	196,000,000	98.0%	20,000	80.0%
Custodial Services	4,000,000	2.0%	5,000	20.0%
Totals	200,000,000	100.0%	25,000	100.0%

b) Looking just at reciprocal service department activity, custodial services provides 20% of its services to information technology, but IT only provides 2% of its services to custodial. Thus, custodial will be allocated first.

c) The next step is to determine the relative proportions of the three departments that will receive the first allocation (the second allocation will only be distributed to the two production departments, whose allocation bases were determined under the direct method beginning on the previous page).

Allocate Custodial Services:	Floor Space in Sq. Ft.	%
To Department A	56,000	56.0%
To Department B	24,000	24.0%
To Information Technology	20,000	20.0%
Totals	100,000	100.0%

d) The step-down allocation is performed as follows:

	Service Departments		Production Departments		
	Custodial Services	Information Technology	Department A	Department B	Total
Totals before allocation	$40,000	$120,000	$300,000	$200,000	$660,000
Allocate Custodial (20.0%, 56.0%, 24.0%)	(40,000)	8,000	22,400	9,600	0
Totals after first allocation	$ 0	$128,000	$322,400	$209,600	$660,000
Allocate IT (62.5%, 37.5%)		(128,000)	80,000	48,000	0
Totals after allocation		$ 0	$402,400	$257,600	$660,000

c. The **reciprocal method** is the most complex and the most theoretically sound of the three methods. It is also known as the simultaneous solution method, cross allocation method, matrix allocation method, or double distribution method.

1) The reciprocal method recognizes services rendered by all service departments to each other.

2) EXAMPLE:

a) The reciprocal method requires calculating the allocation base amounts for information technology, i.e., the service department that was not allocated to the other service department under the step method.

Allocate Information Technology:	CPU Cycles Used	%
To Department A	60,000,000	60.0%
To Department B	36,000,000	36.0%
To Custodial Services	4,000,000	4.0%
Totals	100,000,000	100.0%

b) Use linear algebra to calculate fully reciprocated information technology costs (FRITC) and fully reciprocated custodial services costs (FRCSC):

FRITC = Preallocation IT costs (FRCSC × Portion of custodial effort used by IT)
= $120,000 (FRCSC × 20%)

FRCSC = Preallocation custodial costs (FRITC × Portion of IT effort used by custodial)
= $40,000 (FRITC × 4%)

c) These algebraic equations can be solved simultaneously.

FRITC = $120,000 + (FRCSC × 20%)
= $120,000 + {[$40,000 + (FRITC × 4%)] × 20%}
= $120,000 + [($40,000 + .04FRITC) × .2]
= $120,000 + $8,000 + .008FRITC
.992FRITC = $128,000
FRITC = $129,032

FRCSC = $40,000 + (FRITC × 4%)
= $40,000 + ($129,032 × .04)
= $40,000 + $5,161
= $45,161

d) The reciprocal allocation is performed as follows:

	Service Departments		Production Departments		
	Custodial Services	Information Technology	Department A	Department B	Total
Totals before allocation	$40,000	$120,000	$300,000	$200,000	$ 660,000
Allocate Custodial Services	(45,161)				(45,161)
(20.0%, 56.0%, 24.0%)		9,032	25,290	10,839	45,161
Allocate Information Technology		(129,032)			(129,032)
(4.0%, 60.0%, 36.0%)	5,161		77,419	46,452	129,032
Totals after allocation	$ 0	$ 0	$402,710	$257,290	$ 660,000

4. Some service department cost allocation methods involve a **dual-rate method**, i.e., variable costs from a service department allocated using one rate and fixed costs allocated using another. The examples in this section employed a single rate.