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Learning Material for VM New Challenges for Management Accounting.

Chapter 6: Process Costing.

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Chapter 6: Process Costing

Learning objectives

1. Identify the situations in which process-costing systems are appropriate
2. Understand the basic concepts of process costing and compute average unit costs
3. Describe the five steps in process costing and calculate equivalent units
4. Use the weighted-average method and first-in, first-out (FIFO) method of process costing
5. Understand the need for hybrid-costing systems such as operation costing
6. Understand why and how managers allocate joint and common costs

Key words

conversion costs, equivalent units, first-in, first-out (FIFO), hybrid-costing system, operation, operation costing, process-costing method, process-costing system, transferred-in costs, weighted-average process-costing method

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6.1 Situations in which Process-costing Systems are Appropriate

A job-costing system is best suited to operations that have distinct, identifiable units of a product, such as designer clothes.

A process-costing system is used for costing of masses of identical or similar units of a product or service, for example, food or chemical processing, postal delivery.

In a process-costing system, the unit cost of a product or service is obtained by assigning total costs to many identical or similar units of output.

$$Unit\ costs = \frac{Total\ costs\ incurred}{The\ number\ of\ units\ of\ output}$$

The main difference between process costing and job costing is the **extent of averaging**.

- *In a job-costing system*, individual jobs use different quantities of production resources, so it would be incorrect to cost each job at the same average production cost.
- *Process costing* uses broad averages to determine an average production cost for all units produced.

However, there are certain process, such as **clothes manufacturing**, that have aspects of both process costing (cost per unit of each operation, such as cutting or sewing, is identical) and job costing (different materials are used in different batches of clothing, say, wool versus cotton).

Process-costing systems separate costs into cost categories according to when costs are introduced into the process. Often managers need only two cost classifications – **direct materials** or **direct labor** and **conversion costs** – to assign costs to products. The conversion cost is a term used interchangeably with the indirect-cost category.

The diagram in Figure 6.1 explains, with the help of a practical illustration, that direct materials, such as circuit board, antenna, and microphone are added at the beginning of the assembly process. However, conversion costs are added evenly during assembly.

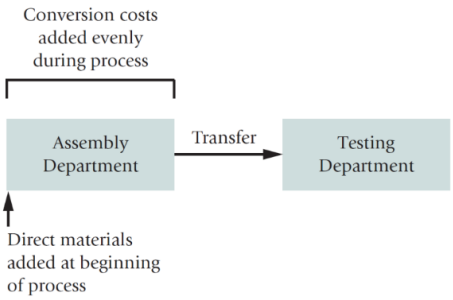


Figure 6.1 Illustrating process costing
Source: DATAR, S. M., RAJAN, M. V. Managerial Accounting, Making Decisions and Motivating Performance

6.2 Basic Concepts of Process Costing

The simplest case of **process costing** occurs when there is no beginning and no ending inventories of work-in-process. This rare situation is the simplest as the average unit cost can simply be determined by dividing total manufacturing costs incurred in the period by the number of units completed.

$$Average\ unit\ costs = \frac{Total\ costs\ in\ a\ given\ accounting\ period}{Total\ units\ produced\ in\ that\ period}$$

Such a case applies whenever a company produces a homogeneous product or service but has no incomplete units when each accounting period ends. Such a situation is rare in a manufacturing set-up but is common in service-sector organizations.

Example 1:

On January 1, 2013, there was no beginning inventory of SG-40 units in the assembly department. During the month of January, Pacific Electronics started, completely assembled, and transferred 400 units to the testing department. Data for the assembly department for January 2013 are as follows:

Physical Units for January 2013

Work in process, beginning inventory (January 1)	0 units
Started during January	400 units
Completed and transferred out during January	400 units
Work in process, ending inventory (January 31)	0 units

Physical units refer to the number of output units, whether complete or incomplete. In January 2013, all 400 physical units started were completed.

Total Costs for January 2013

Direct material costs added during January	$32,000
Conversion costs added during January	$24,000
Total assembly department costs added during January	$56,000

Pacific Electronics records direct material costs and conversion costs in the assembly department as these costs are incurred. By averaging, the assembly cost of SG-40 is itemized as follows:

Direct material cost per unit ($32,000 , 400 units)	$80
Conversion cost per unit ($24,000 , 400 units)	$60
Assembly department cost per unit	$140

Average unit costs are calculated by dividing total costs in a given accounting period by total units produced in that period. Because each unit is identical, managers assume all units receive the same amount of direct material costs and conversion costs. This example of case applies whenever a company produces a homogeneous product or service but has

no incomplete units when each accounting period ends, which is a common situation in service-sector organizations. For example, a bank can adopt this process-costing approach to compute the unit cost of processing 100,000 customer deposits made in a month because each deposit is processed in the same way regardless of the amount of the deposit.

6.3 Steps in Process Costing

When there are zero beginning and some ending work-in-process inventory, estimates must be made about the percentage of completion of the unfinished units.

These partially completed units must then be characterized into equivalent units of production. Cost incurred for partially assembled units are not the same as fully assembled units. In order to make comparisons between periods and accurately determine unit cost, the costs for the period must be divided by the equivalent units of production for the period.

There will be separate equivalent unit calculations for materials and for conversion cost due to the fact that material is typically introduced at the beginning of the process, whereas conversion costs are added uniformly throughout the process.

- Because materials are added at the beginning of the process, the partially processed units in the ending inventory will be fully processed with respect to materials.
- Conversion costs, however, would be added evenly during assembly. The accuracy of completion estimate of conversion costs depends on care, skill, and experience of the estimator and the nature of the conversion process.

Faced with some fully assembled units and some partially assembled units, managers use **equivalent units** to compare the work done in each category and obtain a total measure of work done.

The cost of fully assembled units as well as **partially assembled units** can be calculated with the help of these **five steps**:

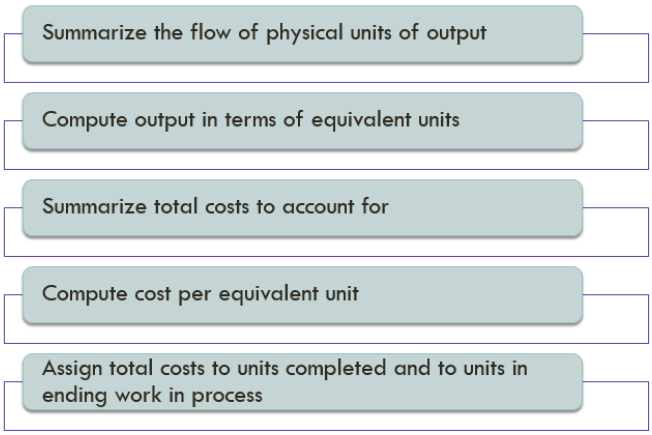


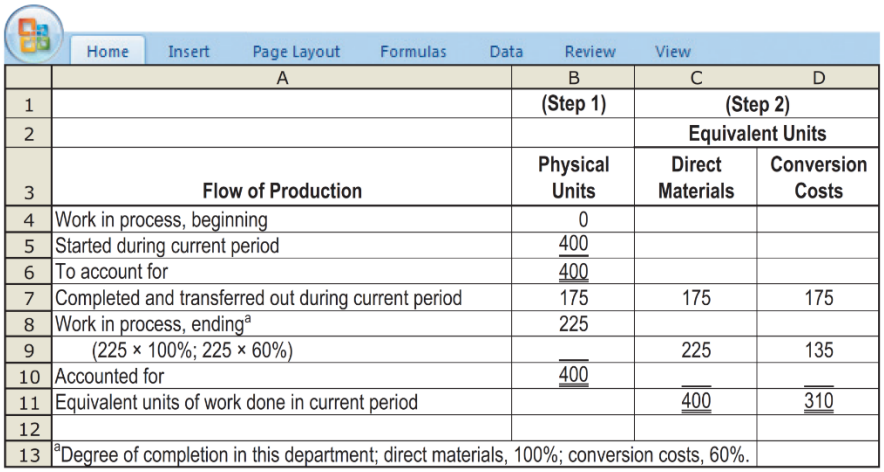
Figure 6.2 Process-costing allocation
Source: DATAR, S. M., RAJAN, M. V. Managerial Accounting, Making Decisions and Motivating Performance

Step 1: **Summarize the flow of physical units of output**. Physical units are the number of output units, whether complete or incomplete. This includes tracking the units of inventory that were started, completed, and transferred out of production. When there is no beginning inventory, units started must equal the sum of units transferred out and ending inventory

Step 2: **Compute output in terms of equivalent units**. As there is some ending inventory left during the month of production, managers compute output in equivalent units and not in physical units.

Equivalent units is a derived amount of output units that:

1. combines the quantity of each input in units completed and in incomplete units of work in process and
2. converts the quantity of input into the amount of completed output units that could be produced with that quantity of input.



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	A	B	C	D
1		(Step 1)	(Step 2)	
2			Equivalent Units	
3	Flow of Production	Physical Units	Direct Materials	Conversion Costs
4	Work in process, beginning	0		
5	Started during current period	400		
6	To account for	400		
7	Completed and transferred out during current period	175	175	175
8	Work in process, ending[a]	225		
9	(225 × 100%; 225 × 60%)		225	135
10	Accounted for	400		
11	Equivalent units of work done in current period		400	310
12				
13	[a]Degree of completion in this department; direct materials, 100%; conversion costs, 60%.			

Figure 6.3 Process-costing allocation: steps 1 and 2 illustrated
Source: DATAR, S. M., RAJAN, M. V. Managerial Accounting, Making Decisions and Motivating Performance

Step 3: Summarize total costs to account for. The total cost to account are the total charges or debit to the Work in Process—Assembly account. As the beginning balance of work-in-process inventory is zero, the total costs to account for will consist of costs added during the month.

Step 4: Compute cost per equivalent unit. Calculate the cost per equivalent unit separately for direct materials and for conversion costs by dividing direct material costs and conversion costs added during a period by the related quantity of equivalent units of work done in this period.

Step 5: Assign total costs to units completed and to units in ending work in process. Equivalent output units (from step 2) for each input are multiplied by cost per equivalent unit derived in the earlier step.

	A	B	C	D	E
1			Total Production Costs	Direct Materials	Conversion Costs
2	(Step 3)	Costs added during February	$50,600	$32,000	$18,600
3		Total costs to account for	$50,600	$32,000	$18,600
4					
5	(Step 4)	Costs added in current period	$50,600	$32,000	$18,600
6		Divide by equivalent units of work done in current period (Exhibit 5-1)		÷ 400	÷ 310
7		Cost per equivalent unit		$ 80	$ 60
8					
9	(Step 5)	Assignment of costs:			
10		Completed and transferred out (175 units)	$24,500	(175[a] × $80)	+ (175[a] × $60)
11		Work in process, ending (225 units):	26,100	(225[b] × $80)	+ (135[b] × $60)
12		Total costs accounted for	$50,600	$32,000	+ $18,600
13					
14	[a] Equivalent units completed and transferred out from Exhibit 5-1, step 2.				
15	[b] Equivalent units in ending work in process from Exhibit 5-1, step 2.				

Figure 6.4 Process-costing allocation: steps 3,4 and 5 illustrated
Source: DATAR, S. M., RAJAN, M. V. Managerial Accounting, Making Decisions and Motivating Performance

The idea is to attach dollar/euro amounts to the equivalent output units for direct materials and conversion costs of (a) units completed and (b) ending work in process.

The journal entries associated with process **costing are similar to those for a job-costing system**. However, there will be separate work-in-process accounts for each production department, along with separate overhead accounts.

Figure 6.5 shows the entries recorded in a particular month in various T-accounts by taking an example of a company transferring finished goods from its assembly department to its testing department.

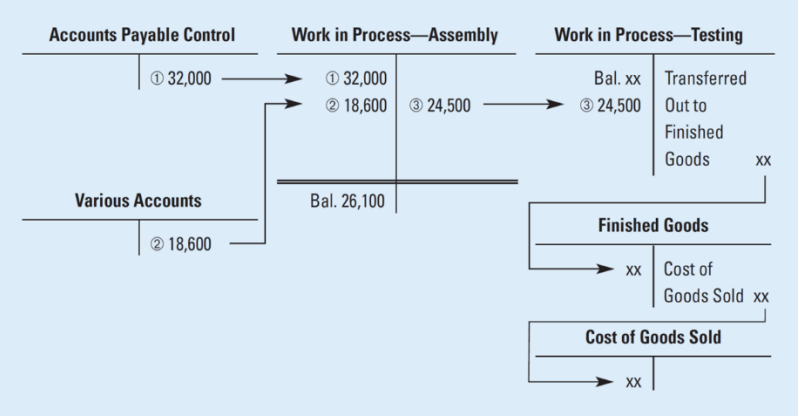

Figure 6.5 Process-costing allocation: T-account entries
Source: DATAR, S. M., RAJAN, M. V. Managerial Accounting, Making Decisions and Motivating Performance

When materials are purchased for use in production, the Work-in-Process account of the first process is debited.

Similarly, when conversion costs are incurred in a process, they are accumulated by debiting the Work-in-Process account.

When goods are transferred to the next process, the Work-in-Process account of the transferring process is credited and the Work-in-Process account of the next process is debited.

6.4 Weighted-Average Method of Process Costing

The most complex situation arises in process costing when the company has **beginning and ending work-in-process inventories**.

There are two methods for process costing: **the weighted-average process-costing method** and the **first-in, first-out (FIFO) process-costing method**. The difference in the two methods deals with how equivalent units of production are calculated.

The weighted-average process-costing method calculates cost per equivalent unit of all work done to date (regardless of the accounting period in which it was done) and assigns this cost to equivalent units completed and transferred out of the process and to equivalent units in ending work-in-process inventory.

$$Weighted\ average\ cost = \frac{Total\ of\ all\ costs}{Total\ equivalent\ units}$$

The weighted-average method using the **five-step procedure** is as follows:

Step 1: Summarize the flow of physical units of output.

Step 2: Compute output in terms of equivalent units. The relationship below is used to compute output in terms of equivalent units. Note that the stage of completion of the current-period beginning work in process is not used in this computation.

Equivalent units in beginning work in process	+	Equivalent units of work done in current period	=	Equivalent units completed and transferred out in current period	+	Equivalent units in ending work in process

Figure 6.6 shows equivalent units of work done to date for an example company (Assembly Department of Pacific Electronics).

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	A	B	C	D
1		(Step 1)	(Step 2)	
2			Equivalent Units	
3	Flow of Production	Physical Units	Direct Materials	Conversion Costs
4	Work in process, beginning (given, p. 179)	225		
5	Started during current period (given, p. 179)	275		
6	To account for	500		
7	Completed and transferred out during current period	400	400	400
8	Work in process, ending[a] (given, p. 179)	100		
9	(100 × 100%; 100 × 50%)		100	50
10	Accounted for	500		
11	Equivalent units of work done to date		500	450
12				
13	[a]Degree of completion in this department; direct materials, 100%; conversion costs, 50%.			

Figure 6.6 Weighted-average method of process costing: steps 1 and 2
Source: DATAR, S. M., RAJAN, M. V. Managerial Accounting, Making Decisions and Motivating Performance

Step 3: Summarize total costs to account for. Total costs to account for is the addition of the beginning work in process and costs added during the month.

Step 4: Compute cost per equivalent unit. It is the process of computation of weighted-average cost per equivalent unit for direct materials and conversion costs. Weighted-average cost per equivalent unit is obtained by dividing the sum of costs for beginning work in process plus costs for work done in the current period by total equivalent units of work done to date.

Step 5: Assign total costs to units completed and to units in ending work in process. This step takes the equivalent units completed and transferred out and equivalent units in ending work in process calculated in step 2, and assigns dollar amounts to the units using the weighted-average cost per equivalent unit for direct materials and conversion costs calculated in step 4.

Figure 6.7 summarizes total costs to account for, computes cost per equivalent unit, and assigns total costs to units completed and to units in ending work in process using weighted-average method of process costing for assembly department of Pacific Electronics.

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	A	B	C	D	E
1			Total Production Costs	Direct Materials	Conversion Costs
2	(Step 3)	Work in process, beginning (given, p. 179)	$26,100	$18,000	$ 8,100
3		Costs added in current period (given, p. 179)	36,180	19,800	16,380
4		Total costs to account for	$62,280	$37,800	$24,480
5					
6	(Step 4)	Costs incurred to date		$37,800	$24,480
7		Divide by equivalent units of work done to date (Exhibit 5-4)		÷ 500	÷ 450
8		Cost per equivalent unit of work done to date		$ 75.60	$ 54.40
9					
10	(Step 5)	Assignment of costs:			
11		Completed and transferred out (400 units)	$52,000	(400^a × $75.60)	+ (400^a × $54.40)
12		Work in process, ending (100 units):	10,280	(100^b × $75.60)	+ (50^b × $54.40)
13		Total costs accounted for	$62,280	$37,800	+ $24,480
14					
15	[a]Equivalent units completed and transferred out from Exhibit 5-4, Step 2.				
16	[b]Equivalent units in ending work in process from Exhibit 5-4, Step 2.				

Figure 6.7 Weighted-average method of process costing: steps 3,4 and 5
Source: DATAR, S. M., RAJAN, M. V. Managerial Accounting, Making Decisions and Motivating Performance

6.5 First-in, First-out (FIFO) Method of Process Costing

The first-in, first-out (FIFO) process-costing method:

- assigns the cost of the previous accounting period's equivalent units in beginning work-in-process inventory to the first units completed and transferred out of the process,
- assigns the cost of equivalent units worked on during the current period first to complete beginning inventory, next to start and complete new units, and finally to units in ending work-in-process inventory.

It assumes that the earliest equivalent units in work in process are completed first. Unlike the weighted-average method, **it keeps separate work done on beginning inventory before the current period from work done in the current period**. Costs incurred and units produced in the current period are used to calculate cost per equivalent unit of work done in the current period.

The FIFO method is illustrated using the same example of Pacific Electronics. Figure 6.8 summarizes output in physical units and compute output in equivalent units.

	A	B	C	D
1		(Step 1)	(Step 2)	
2			Equivalent Units	
3	Flow of Production	Physical Units	Direct Materials	Conversion Costs
4	Work in process, beginning (given, p. 179)	225	(work done before current period)	
5	Started during current period (given, p. 179)	275		
6	To account for	500		
7	Completed and transferred out during current period:			
8	From beginning work in process[a]	225		
9	[225 × (100% – 100%); 225 × (100% – 60%)]		0	90
10	Started and completed	175[b]		
11	(175 × 100%; 175 × 100%)		175	175
12	Work in process, ending[c] (given, p. 179)	100		
13	(100 × 100%; 100 × 50%)		100	50
14	Accounted for	500		
15	Equivalent units of work done in current period		275	315
16				
17	[a]Degree of completion in this department; direct materials, 100%; conversion costs, 60%.			
18	[b]400 physical units completed and transferred out minus 225 physical units completed and			
19	transferred out from beginning work-in-process inventory.			
20	[c]Degree of completion in this department: direct materials, 100%; conversion costs, 50%.			

Figure 6.8 First-in, first-out method of process costing: steps 1 and 2
Source: DATAR, S. M., RAJAN, M. V. Managerial Accounting, Making Decisions and Motivating Performance

Figure 6.9 shows the assignment of costs under the FIFO method. Costs of work done in the current period are assigned (1) first to the additional work done to complete the beginning work in process, then (2) to work done on units started and completed during the current period, and finally (3) to ending work in process.

	A	B	C	D	E
1			Total Production Costs	Direct Material	Conversion Costs
2	(Step 3)	Work in process, beginning (given, p. 184)	$26,100	$18,000	$ 8,100
3		Costs added in current period (given, p. 184)	36,180	19,800	16,380
4		Total costs to account for	$62,280	$37,800	$24,480
5					
6	(Step 4)	Costs added in current period		$19,800	$16,380
7		Divide by equivalent units of work done in current period (Exhibit 5-6)		÷ 275	÷ 315
8		Cost per equivalent unit of work done in current period		$ 72	$ 52
9					
10	(Step 5)	Assignment of costs:			
11		Completed and transferred out (400 units):			
12		Work in process, beginning (225 units)	$26,100	$18,000 + $8,100	
13		Costs added to beginning work in process in current period	4,680	(0^a × $72) + ($90^a$ × $52)	
14		Total from beginning inventory	30,780		
15		Started and completed (175 units)	21,700	(175^b × $72) + ($175^b$ × $52)	
16		Total costs of units completed and transferred out	52,480		
17		Work in process, ending (100 units):	9,800	(100^c × $72) + ($50^c$ × $52)	
18		Total costs accounted for	$62,280	$37,800 + $24,480	
19					
20	[a]Equivalent units used to complete beginning work in process from Exhibit 5-6, Step 2.				
21	[b]Equivalent units started and completed from Exhibit 5-6, Step 2.				
22	[c]Equivalent units in ending work in process from Exhibit 5-6, Step 2.				

Figure 6.9 First-in, first-out method of process costing:: steps 3,4 and 5
Source: DATAR, S. M., RAJAN, M. V. Managerial Accounting, Making Decisions and Motivating Performance

6.6 Comparison of Weighted-Average and FIFO Methods

Cost of units completed will differ materially between the weighted-average and FIFO methods when:

1. *direct material or conversion cost per equivalent unit varies significantly from period to period and*
2. *physical inventory levels of work in process are large in relation to the total number of units transferred out of the process.*

As differences in unit costs and inventory levels from period to period decrease, the difference in cost of units completed under the weighted-average and FIFO methods will also decrease.

In a period of falling prices, the higher cost of goods sold under the FIFO method will lead to lower operating income and lower tax payments, saving the company cash and increasing the company's value. FIFO is the preferred choice, but managers may not make this choice.

FIFO has the advantage of providing information about changes in costs from one period to the next. This will allow managers to adjust selling prices based on current conditions. It is, in theory, the method yielding the most precise unit prices.

Weighted-average has the advantage of simplicity and is more representative of average unit costs when prices fluctuate markedly from month-to-month.

6.7 Standard-Costing Method

Companies using process-costing systems find it fairly easy to set standards for quantities of inputs needed to produce output. Standard cost per unit can then be multiplied by input quantity standards to develop standard cost per output unit.

Under the standard-costing method, teams of design and process engineers, operations personnel, and management accountants work together to determine separate standard costs per equivalent unit on the basis of different technical processing specifications for each product.

The application of **the standard-costing method is identical to the FIFO method** discussed earlier. The only difference is that a standard cost of direct materials and conversion costs for each output unit is predetermined at the start of the year.

6.8 Hybrid-Costing Systems

Product-costing systems do not always fall neatly into either job-costing or process-costing categories.

A hybrid-costing system blends characteristics from both job-costing and process-costing systems. Manufacturers of a relatively wide variety of closely related standardized

products (for example, televisions, dishwashers, washing machines, and shoes) tend to use hybrid-costing systems.

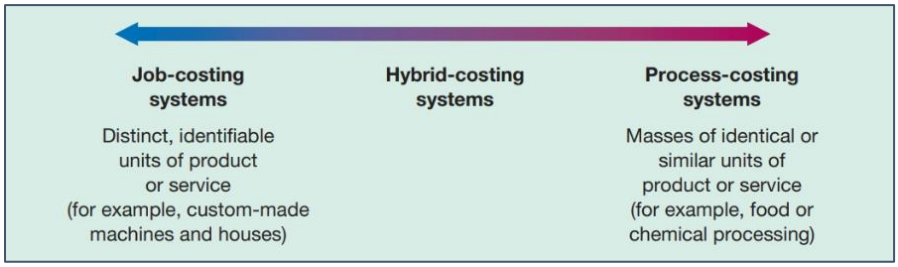

Figure 6.10 The hybrid-costing systems continuum
Source: BHIMANI, A. et al. Management and Cost Accounting

An **operation-costing system** is a common type of **hybrid-costing system** that is applied to batches of similar, but not identical, products.

An operation is a standardized method or technique that is performed repetitively, often on different materials, resulting in different finished goods. Multiple operations are usually conducted within a department. *For instance, a suit maker may have a cutting operation and a hemming operation within a single department.* The term operation, however, is often used loosely. It may be a synonym for a department or process. *For example, some companies may call their finishing department a finishing process or a finishing operation.*

Each batch of products is often a variation of a single design, and it proceeds through a sequence of operations. Within each operation, all product units are treated exactly alike, using identical amounts of the operation's resources. A key point in the operation system is that each batch does not necessarily move through the same operations as other batches. Batches are also called **production runs**.

For example, in a company that makes suits, management may select a single basic design for every suit to be made, but depending on specifications, each batch of suits varies somewhat from other batches. Batches may vary depending on the material used or the type of stitching.

Product costs are compiled for each work order. Direct materials that are unique to different work orders are specifically identified with the appropriate work order, as in job costing. However, each unit is assumed to use an identical amount of conversion costs for a given operation, as in process costing.

A single average conversion cost per unit is calculated for each operation by:

$$Single\ average\ conversion\ cost\ per\ unit = \frac{Total\ conversion\ costs\ for\ that\ operation}{Number\ of\ units\ that\ pass\ through\ the\ operation}$$

This average cost is assigned to each unit passing through the operation.

6.9 Cost Allocation for Joint Costs and Common Costs

Process-costing computations determine the costs assigned to completed goods and to ending work-in-process inventory. In other words, process costing focuses on the assignment of costs between the current period (costs of completed goods) and the next period (cost of ending work-in-process inventory). Some processes, however, yield **more than one product**. Other processes involve sharing of costs across two or more users. These situations result in joint cost allocations and common cost allocations.

Joint costs are costs of a production process that yields multiple products simultaneously. *For example, in processing of beef, the yield includes steaks, roasts, and hamburger in addition to cowhide and other products.*

The splitoff point is the juncture in a joint production process when two or more products become separately identifiable, for example, the point at which coal becomes coke, natural gas, and other products.

Separable costs are costs incurred beyond the split off point and include manufacturing, marketing, distribution, and other costs.

The question is how to allocate joint costs to two or more products when all products appear together – no individual product can be produced without the accompanying products appearing.

- Managers are interested in joint-cost allocation mainly for calculating cost of goods sold and inventory values for the individual products. The most common method is to allocate costs **on the basis of the sales value of the products at the splitoff point**.
- If the sales value at the splitoff point is not available, managers frequently approximate the sales value at splitoff by determining **the value of the product sold after further processing minus the separable costs.**

Managers sometimes must evaluate common costs. **A common cost** is a cost of operating a facility, department, activity, or similar cost object that two or more users share.

There are **two methods of allocating this common cost** between the two companies:

1. **The stand-alone cost-allocation method** determines the weights for cost allocation by considering each user of the cost as a separate entity. Advocates of this method often emphasize its fairness or equity. The method is viewed as reasonable because each company bears a proportionate share of total costs in relation to the individual stand-alone costs.

2. **The incremental cost-allocation method** ranks the individual users of a cost object in the order of users most responsible for the common cost and then uses this ranking to allocate cost among those users. The first-ranked user of the cost object is the primary user (also called the primary party) and is allocated costs up to the costs of the primary user as a stand-alone user. The second-ranked user is

the first-incremental user (first-incremental party) and is allocated the additional cost that arises from two users instead of only the primary user, and so on.

Summary

A process-costing system is used to determine the cost of a product or service when masses of identical or similar units are produced. Unit costs are computed by first assigning costs to these similar units and then dividing by the number of these units. Industries using process-costing systems include food, textiles and oil refining.

The five key **steps in a process-costing system** using equivalent units are: (a) summarise the flow of physical units of output, (b) compute output in terms of equivalent units, (c) compute equivalent-unit costs, (d) summarise total costs to account for, and (e) assign total costs to units completed and to units in closing work in progress.

Equivalent units is a derived amount of output units that takes the quantity of each input in units completed or in work in progress, and converts it into the amount of completed output units that could be made with that quantity of input. Equivalent unit calculations are necessary when all physical units of output are not uniformly completed during an accounting period. Journal entries in a process-costing system are similar to entries in a job-costing system. The main difference is that in a process-costing system, there is a separate Work-in-Progress account for each department.

The weighted-average method of process costing computes unit costs by focusing on the total costs and the total equivalent units completed to date and assigns this average cost to units completed and to units in closing work-in-progress stock.

The first-in, first-out (FIFO) method of process costing assigns the costs of the opening work-in-progress stock to the first units completed, and assigns the costs of the equivalent units worked on during the current period first to complete beginning stock, then to start and complete new units, and finally to units in closing work-in-progress stock.

The standard-costing method simplifies process costing because standard costs serve as the costs per equivalent unit when assigning costs to units completed and to units in closing work-in-progress stock.

A hybrid-costing system blends characteristics from both job-costing systems and process-costing systems. An **operation costing** is a common type of hybrid-costing system.

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