CH 7
COST ALLOCATION: DEPARTMENT, JOINT PRODUCTS

Part 1

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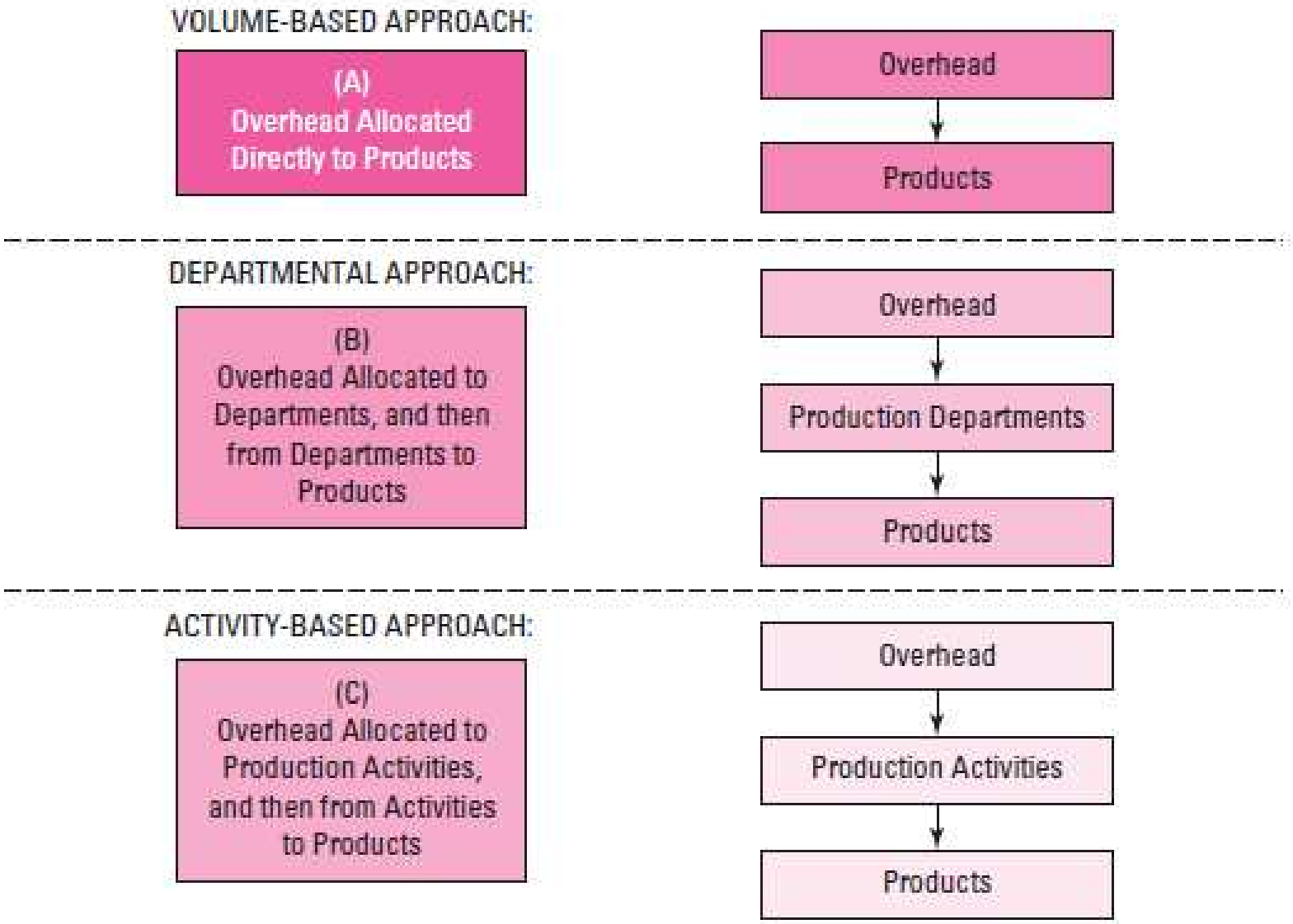
Introduction

- This chapter explains methods for allocating common costs to products for two broad types of common costs:
  - (1) the costs of production and service departments shared by two or more individual products and
  - (2) the joint manufacturing costs for products that are not separately identifiable until later in the manufacturing process.
- An example of the latter is the cost of refining crude oil (the joint cost) into the individual products: gasoline, heating oil, and other products.

Cost Allocation to Service and Production Departments

- The preceding chapters on job costing (Chapter 4), and process costing (Chapter 6) provide a useful context for introducing cost allocation.
- The volume-based approach in which overhead was allocated to products in two steps:
  - First to departments and then to products, in what we called the departmental approach.
- The departmental approach is an improvement over the single step volume-based approach because it takes into account differences in costs incurred in the different departments and differences in consumption of the departments' resources by the products, thus leading to more accurate product costs.

Three Types of Overhead Allocation



Cost Allocation

- The departmental approach recognizes that the typical manufacturing operation involves two types of manufacturing departments: production departments and service departments.
  - Service departments provide human resources, maintenance, engineering, and other support to the production departments.
  - Production departments directly assemble and complete the product.
- The departmental approach has three phases:
  - (1) trace all direct manufacturing costs and allocate manufacturing overhead costs to both the service departments and the production departments
  - (2) allocate the service department costs to the production departments, and
  - finally (3) allocate the production department costs to the products.

Cost Allocation

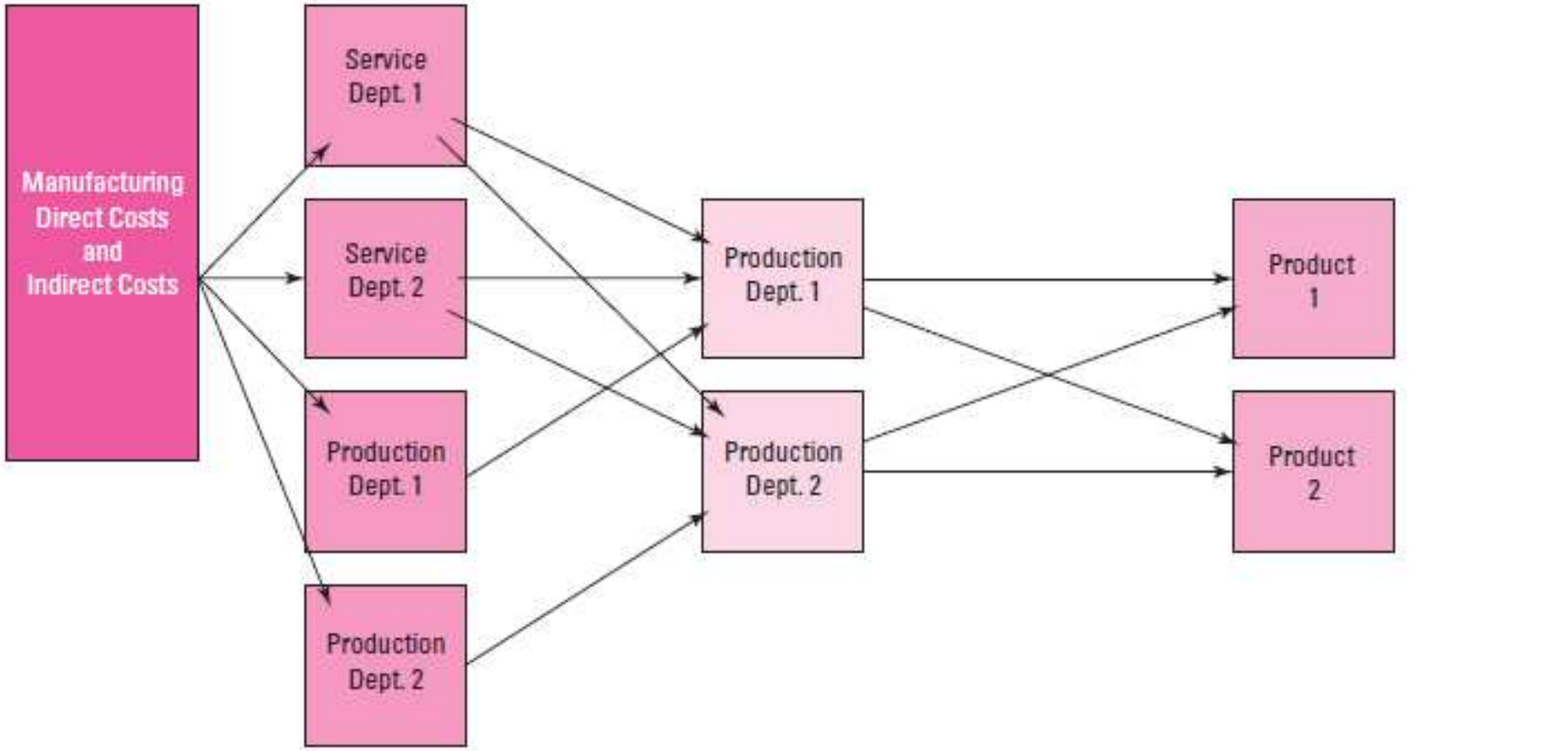
- Direct manufacturing costs are wages and materials that can be directly traced to a department;
  - for example, direct materials and direct labor costs would be traced to the production departments where they are used.
  - Direct labor and materials used in a service department would be traced to that service department.
- Indirect costs (manufacturing overhead) are the indirect materials and indirect labor costs that are allocated by means of a predetermined cost driver to the departments that use those resources.
  - For example, the indirect labor cost of the plant supervisor who oversees all production and support departments would be allocated to all departments.
  - While the indirect labor for inspection of the output of the two production departments would be allocated only to those two production departments.

Cost Allocation

- The cost drivers commonly used include labor-hours, machine-hours, headcount (number of personnel in the department), and square feet of space in the department, among others.
- For example, the cost of the plant supervisor might be allocated to all departments based on the proportion of total labor-hours in the departments.
- The cost of the inspection in the production departments might be allocated based on the number of units of output in those two departments.
- In practice, a variety of cost drivers are used; the goal is to use a cost driver such that the cost allocation reflects the usage of the resource in the departments.

Three Phases in Departmental Cost Allocation

EXHIBIT 7.2 The Three Phases in Departmental Cost Allocation



First Phase: Trace Direct Costs and Allocate Indirect Costs to Departments

	Service Department 1	Service Department 2	Production Department 1	Production Department 2	Total Hours	Total Amount
Labor-hours	1,800	1,200	3,600	5,400	12,000	
Machine-hours	320	160	1,120	1,600	3,200	
Direct costs	$1,600	$5,500	$15,500	$13,400		$36,000
Indirect labor			Not traceable			25,000
Indirect materials			Not traceable			5,000
						$66,000

EXHIBIT 7.4 Departmental Allocation, First Phase: Beary Company

	All Departments				
Departmental Allocation Bases	**Service Department 1**	**Service Department 2**	**Production Department 1**	**Production Department 2**	**Total**
Direct labor-hours	1,800	1,200	3,600	5,400	12,000
Percent	15%	10%	30%	45%	100%
Machine-hours	320	160	1,120	1,600	3,200
Percent	10%	5%	35%	50%	100%
First Phase: Trace Direct Costs and Allocate Indirect Costs to all Departments					
Direct costs	$1,600	$5,500	$15,500	$13,400	$36,000
Allocate indirect costs to departments:					
Indirect labor	3,750 = 15% × $25,000	2,500 = 10% × $25,000	7,500 = 30% × $25,000	11,250 = 45% × $25,000	25,000
Indirect materials	500 = 10% × $5,000	250 = 5% × $5,000	1,750 = 35% × $5,000	2,500 = 50% × $5,000	5,000
Totals for all departments	**$5,850**	**$8,250**	**$24,750**	**$27,150**	**$66,000**

Service department 1	$ 5,850
Service department 2	8,250
Production department 1	24,750
Production department 2	27,150
Total	$66,000

Allocation Phases Two and Three

- The second phase allocates service department costs to the producing departments.
- This is the most complex of the allocation phases because services can flow back and forth between the service departments.
- These are often called **reciprocal flows.** Accountants use three common methods to allocate costs for the second phase:
  - (1) the direct method
  - (2) the step method and
  - (3) the reciprocal method.

	To			
From:	Service Department 1	Service Department 2	Production Department 1	Production Department 2
Service Department 1	—	40%	30%	30%
Service Department 2	10%	—	30	60

The Direct Method

- The **direct method** of departmental cost allocation is the simplest of the three methods because it ignores the reciprocal flows.
- The cost allocation is accomplished by using the service flows *only to production departments* and determining each production department's share of that service.
- For example, for service department 1, the share of time for each production department is 50 percent of the total production department service, determined as follows.

The Direct Method

For service department 1:

Net service to both production departments from service department 1:
=100% − Time of service to second service department
=100% − 40% = 60%

Production department 1's share: 30 percent/60 percent =	50 percent
Production department 2's share: 30 percent/60 percent =	50 percent

For service department 2:

Net service to both production departments from service department 2:
100 percent − 10 percent = 90 percent

Production department 1's share: 30 percent/90 percent =	33.33%
Production department 2's share: 60 percent/90 percent =	66.67%

EXHIBIT 7.6 Departmental Allocation Second and Third Phases, Using the Direct Method: Beary Company

Second Phase: Allocate Service Department Costs to Production Departments

Direct Method		Production 1 Department	Production 2 Department	Total
Service Department 1	Service % to producing dept.	30%	30%	
	Allocation % per direct method	50% = 30/(30 + 30)	50% = 30/(30 + 30)	
	Allocation amount	$2,925 = 50% × $5,850	$2,925 = 50% × $5,850	$5,850
Service Department 2	Service % to producing dept.	30%	60%	
	Allocation % per direct method	33.33% = 30/(30 + 60)	66.67% = 60/(30 + 60)	
	Allocation amount	2,750 = 33.33% × $8,250	5,500 = 66.67% × $8,250	8,250
Plus: First-phase allocation		24,750	27,150	51,900
Totals for Production Departments		$30,425	$35,575	$66,000

Third Phase: Allocate Production Department Costs to Products

1. Allocation Base	Product 1	Product 2	
Base: labor-hours			
Hours	1,800	1,800	3,600
Percent	50%	50%	
Machine-hours			
Hours	400	1,200	1,600
Percent	25%	75%	

2. Cost Allocation to Products

Production Department 1 (labor-hour basis)	$15,212.50 = 50% × $30,425	$15,212.50 = 50% × $30,425	
Production Department 2 (machine-hour basis)	$8,893.75 = 25% × $35,575	$26,681.25 = 75% × $35,575	
Totals for each product	$24,106.25	$41,893.75	$66,000

The Step Method

- The second method to allocate service department costs is the step method, so-called because it uses a sequence of steps in allocating service department costs to production departments.
- In the first step, one service department is selected to be allocated fully, that is, to the other service department as well as to each production department.
- The department to be allocated fully usually is chosen because it provides the most service to other service departments.

EXHIBIT 7.7 Departmental Allocation, Second and Third Phases, Using the Step Method

Second Phase: Allocate Service Department Costs to Production Departments: Using the Step Method	Service Department 2	Production Department 1	Production Department 2	Total
First Step				
Service Department 1				
Service percent	40%	30%	30%	
Amount	**$2,340** = 40% × $5,850	**$1,755** = 30% × $5,850	**$1,755** = 30% × $5,850	**$5,850**
Second Step				
Service Department 2				
Service percent		30%	60%	
Allocation percent per direct method		33.33	66.67	
Amount	**10,590** = $8,250 + $2,340	**3,530** = 33.33% × $10,590	**7,060** = 66.67% × $10,590	**8250** (= 3,530 + 7,060 − 2,340)
Plus: First-phase allocation		**24,750**	**27,150**	**51,900**
Totals for production departments		**$30,035**	**$35,965**	**$66,000**
Third Phase: Allocate Production Department Costs to Products				
1. Allocation Base		**Product 1**	**Product 2**	
Labor-hours				
Hours		1,800	1,800	3,600
Percentage		50%	50%	
Machine-hours				
Hours		400	1,200	1,600
Percentage		25%	75%	
2. Cost Allocation to Products				
Production Department 1 (labor-hour basis)		**$15,017.50** = 50% × $30,035	**$15,017.50** = 50% × $30,035	
Production Department 2 (machine-hour basis)		**$8,991.25** = 25% × $35,965	**$26,973.75** = 75% × $35,965	
Totals for each product		**$ 24,008.75**	**$41,991.25**	**$66,000**

The Reciprocal Method

- The **reciprocal method** is the preferred of the three methods because, unlike the others, it considers *all* reciprocal flows between the service departments.
- This is accomplished by using simultaneous equations; the reciprocal flows are simultaneously determined in a system of equations.
- An equation for each service department represents the cost to be allocated, consisting of the first-phase allocation costs plus the cost allocated from the other department.

The Reciprocal Method

- For Beary Company, the equation for service department 1 is as follows, using the symbol S1 to represent service department 1 costs and the symbol S2 to represent costs in service department 2.

$$\textbf{Allocated S1 Costs} = \textbf{Initial allocation} + \textbf{Cost allocated from S2}$$

$$S1 = \$5{,}850 + (10\% \times S2)$$

Similarly, the equation for the second service department is as follows:

$$\textbf{Allocated S2 Costs} = \textbf{Initial allocation} + \textbf{Cost allocated from S1}$$

$$S2 = \$8{,}250 + (40\% \times S1)$$

These two equations can be solved for S1 and S2 by substituting the second equation into the first as follows:

$$S1 = \$5{,}850 + [10\% \times (\$8{,}250 + 40\% \times S1)]$$

$$S1 = \$6{,}953.13$$

And substituting S1 back into the second equation:

$$S2 = \$11{,}031.25$$

EXHIBIT 7.8 Departmental Allocation Second and Third Phases, Using the Reciprocal Method

Second Phase: Allocate Service Department Costs to Production Departments Using the Reciprocal Method

First: Solve the simultaneous equations for Service 1 and Service 2 (see text):

Amount allocated from service 1	$ 6,953.13
Amount allocated from service 2	$11,031.25

	Production Department 1	Production Department 2	Total
Second: Allocate to producing departments			
Service Department 1			
Service %	30%	30%	
Allocated amount	**$2,086** = 30% × $6,953	**$2,086** = 30% × $6,953	**$4,172**
Service Department 2			
Service %	30%	60%	
Allocated amount	**3,309** = 30% × $11,031	**6,619** = 60% × $11,031	**9,928**
Plus: Costs allocated in first phase	**24,750**	**27,150**	**51,900**
Totals for Production Departments	**$30,145**	**$35,855**	**$66,000**
Third Phase: Allocate Production Department Costs to Products			
1. Allocation Base	**Product 1**	**Product 2**	
Base: Direct labor-hours			
Hours	1,800	1,800	3,600
Percent	50%	50%	
Machine-hours			
Hours	400	1,200	1,600
Percent	25%	75%	
2. Cost Allocation to Products			
Production Department 1 (direct labor-hour basis)	**$15,072.50** = 50% × $30,145	**$15,072.50** = 50% × $30,145	
Production Department 2 (machine-hour basis)	**$8,963.75** = 25% × $35,855	**$26,891.25** = 75% × $35,855	
Totals for each product	**$24,036.25**	**$41,963.75**	**$66,000**

Joint Product Costing

- Many manufacturing plants yield more than one product from a joint manufacturing process.
- For example, the petroleum industry processes crude oil into multiple products: gasoline, naphtha, kerosene, fuel oils, and residual heavy oils.
- The semiconductor industry processes silicon wafers into a variety of computer memory chips.
- Other industries that yield joint products include lumber production, food processing, soap making, grain milling, dairy farming, and fishing.

Joint Product Costing

- **Joint products** are products from the same production process that have relatively substantial sales values.
- Products whose total sales values are minor in comparison to the sales value of the joint products are classified as **by-products.**
- The point in a joint production process at which individual products can be identified for the first time is called the **split-off point.**
- Joint costs include all manufacturing costs incurred prior to the split-off point (including direct materials, direct labor, and factory overhead).
- Additional costs incurred after the split-off point that can be identified directly with individual products are called **additional processing costs** or **separable costs.**

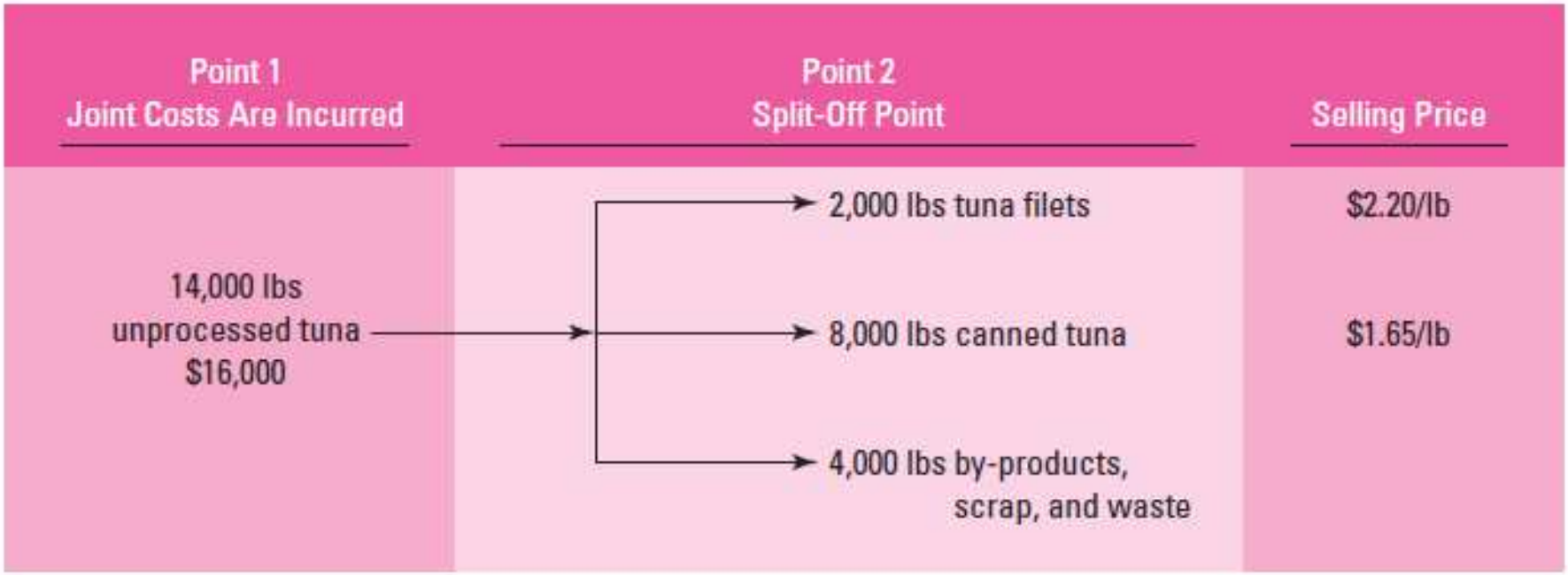
Methods for Allocating Joint Costs to Joint Products

- (1) the physical measure,
- (2) the sales value at split-off, and
- (3) the net realizable value methods.

The Physical Measure Method

- The **physical measure method,** naturally enough, uses a physical measure such as pounds, gallons, yards, or units of volume produced at the split-off point to allocate the joint costs to joint products.
- **Assume that Johnson Seafood** produces tuna filets and canned tuna for distribution to restaurants and supermarkets in the southeastern United States. The cost of 14,000 pounds of raw, unprocessed tuna plus the direct labor and overhead for cutting and processing the tuna into filets and canned tuna is the joint cost of the process.

The Physical Measure Method



Product	Physical Measure	Proportion	Allocation of Joint Cost	Cost per Pound
Tuna filets	2,000 lbs	0.20	$16,000 × 20% = $ 3,200	$1.60
Canned tuna	8,000 lbs	0.80	16,000 × 80% = 12,800	1.60
Total	10,000 lbs	1.00	$16,000	

The physical measure used to determine the relative weights for allocating the joint cost should be the measure of the products at the *split-off point,* not the measure when the production of the products is completed. Thus, the relevant measure in the example is the 2,000 pounds of filets and 8,000 pounds of canned tuna.

The production costs per pound for both products follow:

Filets	$1.60 per pound = $3,200/2,000 pounds
Canned tuna	$1.60 per pound = $12,800/8,000 pounds

The Physical Measure Method

- ***Advantages and Limitations***
  - (1) it is easy to use and
  - (2) the criterion for the allocation of the joint costs is objective.
- This method, however, ignores the revenue-producing capability of individual products that can vary widely among the joint products and have no relationship at all to any physical measure.
- Each product can also have a unique physical measure (gallons for one, pounds for another) and, hence, the physical measure method might not be applicable.

The Sales Value at Split-Off Method

- The **sales value at split-off method** (or more simply, *sales value method*) allocates joint costs to joint products on the basis of their relative sales values at the split-off point.
- This method can be used only when joint products can be sold at the split-off point.
- If we assume that Johnson can sell a pound of filets for $2.20 and a pound of canned tuna for $1.65 and that Johnson has produced 2,000 pounds of filets and 8,000 pounds of canned tuna, the $16,000 joint cost should be allocated.

Product	Units	Price per unit	Sales Value	Proportion	Joint Cost Allocated	Cost per Pound
Filets	2,000 lbs	$2.20	$ 4,400	0.25	$16,000 × 25% = $ 4,000	$2.00
Canned tuna	8,000 lbs	1.65	13,200	0.75	16,000 × 75% = 12,000	1.50
Total			$17,600	1.00	$16,000	

The production costs per pound for both products are calculated as follows:

Filets	$2.00 per pound = $4,000/2,000
Canned tuna	$1.50 per pound = $12,000/8,000

	Tuna Filets	Canned Tuna
Sales	$2.20 × 2,000 = $4,400	$1.65 × 8,000 = $13,200
Cost of goods sold	$2.00 × 2,000 = 4,000	$1.50 × 8,000 = 12,000
Gross margin	$ 400	$ 1,200
Gross margin percent	9.09%	9.09%

The Sales Value at Split-Off Method

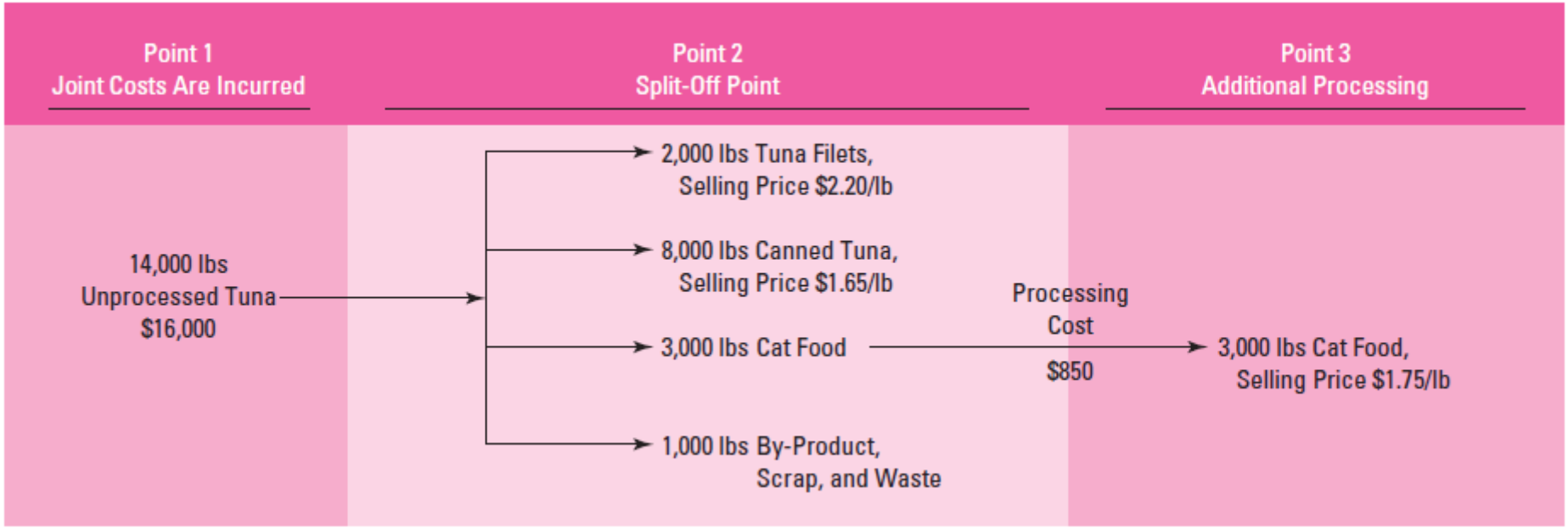
- ***Advantages and Limitations***
- (1) is easy to calculate and
- (2) is allocated according to the individual product's revenues.
- This method is superior to the physical measure method because it allocates the joint costs in proportion to the products' ability to absorb these costs.
- The sales price at split-off might not be available because additional processing is necessary before the product can be sold.

The Net Realizable Value Method

- Not all joint products can be sold at the split-off point.
- The concept of net realizable value is used.
- The **net realizable value (NRV)** of a product is the product's *estimated sales value* at the split-off point.
- It is determined by subtracting the additional processing and selling costs beyond the split-off point from the estimated ultimate sales value of the product.

$$\text{NRV} = \text{Ultimate sales value} - \text{Additional processing and selling cost}$$

The Net Realizable Value Method



Product	Pounds	Price	Sales Value	Additional Processing	Net Realizable Value	Percent of NRV	Allocated Cost	Total Cost	Cost per Pound
Filets	2,000	$2.20	$ 4,400	—	$ 4,400	20%	$ 3,200	$ 3,200	$1.60
Canned tuna	8,000	1.65	13,200	—	13,200	60	9,600	9,600	1.20
Cat food	3,000	1.75	5,250	$850	4,400	20	3,200	4,050	1.35
Total	13,000		$22,850	$850	$22,000	100%	$16,000	$16,850	

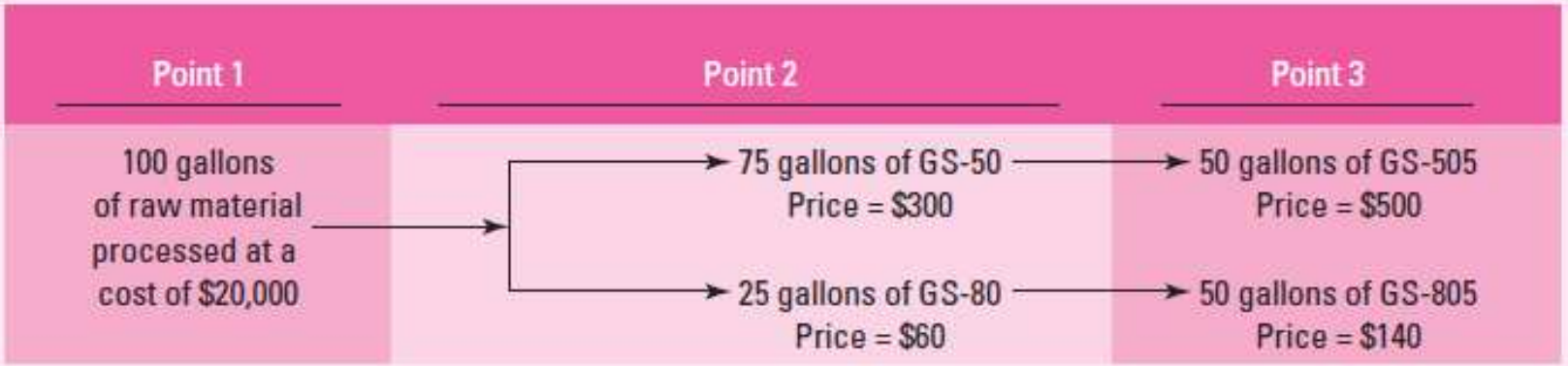
	Tuna Filets	Canned Tuna	Cat Food
Sales	$2.20 × 2,000 = $4,400	$1.65 × 8,000 = $13,200	$1.75 × 3,000 = $5,250
Cost of goods sold	$1.60 × 2,000 = 3,200	$1.20 × 8,000 = 9,600	$1.35 × 3,000 = 4,050
Gross margin	$1,200	$ 3,600	$1,200
Gross margin percent	27.27%	27.27%	22.86%

The Net Realizable Value Method

- The NRV method is superior to the physical measure method.
- Because, like the sales value at split-off method, it produces an allocation that yields a predictable, comparable level of profitability among the products.
- The physical measure method might provide misleading guidance to top management regarding product profitability.

Joint Product Costing

Northern Company processes 100 gallons of raw materials into 75 gallons of product GS-50 and 25 gallons of GS-80. GS-50 is further processed into 50 gallons of product GS-505 at a cost of $5,000, and GS-80 is processed into 50 gallons of product GS-805 at a cost of $2,000. Exhibit 1 depicts this manufacturing flow.



The production process starts at point 1. A total of $20,000 in joint manufacturing costs are incurred in reaching point 2. Point 2 is the split-off point of the process that manufactures GS-50 and GS-80. At this point, GS-50 can be sold for $300 a gallon, and GS-80 can be sold for $60 a gallon. The process is completed at point 3—products GS-505 and GS-805 have a sales price of $500 a gallon and $140 a gallon, respectively.

Required Allocate the joint product costs using each of the three methods: (1) physical measure, (2) sales value at split-off, and (3) net realizable value.