CHAPTER 6

JOINT AND BY-PRODUCT COSTING

Scope

Introduction

General Characteristics of Joint Production
- Cost separability and the need for allocation
- Distinction between joint and by-products

Four Common Methods of Allocating Joint Costs
- Physical measures method
- Sales value at split-off point method
- Net realizable value method
- Constant gross profit percentage method

Comparison of methods

Accounting for by-products

JOINT AND BY-PRODUCT COSTING

Introduction

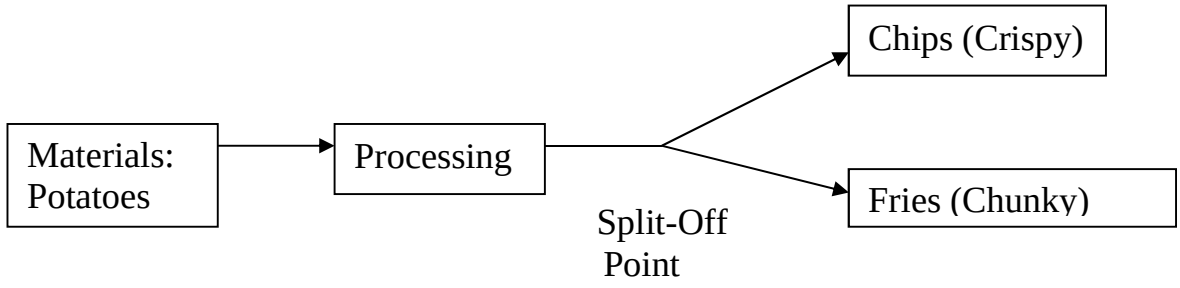
Joint products:

- Two or more products produced simultaneously by the same process up to the 'split-off' point
- Each product has a significant relative sales value
- Joint-products are so related to each other such that an increase in the output of one increases the output of the others, although not necessarily in the same ratio.

Key point to note:

- Direct material, direct labour, and overhead costs incurred up to the initial split-off point are joint costs that can be allocated to the final product only in some arbitrary manner.

Joint Production Process



General Characteristics of Joint Production

a. Cost separability and the need for allocation

- Costs are either separable or not
- Separable costs are directly traced to individual products and pose no problem
- If costs are not separable, they must be allocated to various products for various reasons – but cost allocation are arbitrary
- In practice, the aim of performing joint cost allocation is to determine the most appropriate way to allocate a cost that is not really separable
- Why do we allocate joint costs? To meet requirements of financial reporting and tax
- Basic output of the joint cost allocation process is the determination of the product costs for use in income measurement and inventory valuation.

Note:

It is important to note that the allocation of joint costs has limited usefulness for internal decision-making purposes as these costs are not incremental costs in relation to a decision.

b. Distinction between joint and by-products

- Distinction is based upon the relative importance of their sales value
- A by-product is the secondary product recovered in the course of manufacturing a primary product
- The by-product is a product whose total sales value is relatively minor in comparison with the sales value of the main product(s)

Four Common Methods of Allocating Joint Costs

Two basic approaches are used to allocate joint costs:

i. Allocate costs using physical-measure-based data such as weights or volume (Physical measures method in this lecture);

ii. Allocate costs using market-based data such as revenues (Three methods in this lecture)

Computational example of joint-cost apportionments

Joint costs for the period £60 000
Output and sales
X = 4 000 units at £7.50
Y = 2 000 units at £25
Z = 6 000 units at £3.33
There are no further processing costs after split-off point.

a. Physical Measures Method

- Joint costs are allocated to the joint products on the basis of the relative weight, volume, or other physical measure at the split-off point of the total production of these products during the accounting period
- Each product is assumed to receive similar benefits from the joint cost
- The cost per unit is the same for each of the product
- Main advantage is the simplicity of computation

Computational example of joint-cost apportionments

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Output and sales
X = 4 000 units at £7.50
Y = 2 000 units at £25
Z = 6 000 units at £3.33
There are no further processing costs after split-off point.

	Output (units)	Apportioned costs £	Sales £	Profit (Loss)
Product X	4000 ($\frac{1}{3}$)	20000	30000	10000
Product Y	2000 ($\frac{1}{6}$)	10000	50000	40000
Product Z	6000 ($\frac{1}{2}$)	30000	20000	(10000)
	12000	60000	100000	40000

b. Sales Value Method

- Joint costs are allocated to the joint products on the basis of the relative sales value at the split-off point of the total production of these products during the accounting period
- Can be viewed as a means of apportioning profits or losses according to sales value, rather than a method for allocating costs. (See text for more discussion: p.133/134)

Computational example of joint-cost apportionments

Joint costs for the period £60 000
Output and sales
X = 4 000 units at £7.50
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Z = 6 000 units at £3.33
There are no further processing costs after split-off point.

	Sales £	Apportioned costs £	Profit (Loss)
Product X	30000 (30%)	18000	12000
Product Y	50000 (50%)	30000	20000
Product Z	20000 (20%)	12000	8000
	100000	60000	40000

c. Net realizable value method

- Where further processing costs are incurred and sales values at split-off point may not be available
- Further processing costs are deducted from sales value to estimate NRV at split-off point

Example

	Sales £	Further process costs £	NRV £	% Joint cost allocated
Product A	36 000	8 000	28 000	28%
Product B	60 000	10 000	50 000	50%
Product C	24 000	2 000	22 000	22%
	120 000	20 000	100 000	

d. Constant gross profit percentage method

- Based on the assumption that the gross profit should be identical for each product

- Joint costs are therefore allocated so that the **gross profits percentages** at split-off point are identical for each product

- Using the previous example and assuming that joint costs are £60 000, the gross profit is £40 000 (£120 000 sales less £80 000 total costs). Therefore, the total gross profit is 33.33%.

	Product A	**Product B**	**Product C**	**Total**
	£	£	£	£
Sales value	36 000	60 000	24 000	120 000
Gross profit (33.33%)	12 000	20 000	8 000	40 000
Cost of goods sold	24 000	40 000	16 000	80 000
Less further processing costs	8 000	10 000	2 000	20 000
Allocated joint costs (balance)	16 000	30 000	14 000	60 000

Comparison of methods

- Cause-and-effect criterion cannot be applied so allocation should be based on benefits received

- If benefits received cannot be measured allocation should be based on the principle of equity or fairness

- Literature tends to advocate the net realizable method

Accounting for by-products

- The major objective is to produce the joint products. Therefore the joint costs should be charged only to the joint products

- Further processing costs should be charged to the by-product

Tutorial questions

Discussion:

a. What is the joint costing problem?

b. How do joint costs differ from other common costs?

c. Should joint costs be considered in a sell-or-produce further decisions?

Computation:

Question 1:

Pancake Company produces two main products and a by-product out of a joint process. The ratio of output quantities to input quantities of direct materials used in the joint process remains consistent from month to month. Pancake has employed the physical measures method to allocate joint production costs to the two main products. The net realizable value of the by-products is used to reduce the joint production costs before the joint costs are allocated to the main products. Data regarding Pancake's operations for the current month are presented in the table below. During the month, Pancake incurred joint production costs of £2,520,000. The main products are not marketable at the split-off point and, therefore, have to be processed further.

	First Main Product	Second Main Product	By-product
Monthly outputs (kgs)	**90,000**	**150,000**	**60,000**
Selling price per kg	**£30**	**£14**	**£2**
Separable process costs	**£540,000**	**£660,000**	

Required:

1. Calculate the net realizable value of the by-product. What is the total joint cost to be allocated?
2. Calculate the amount of joint production cost that Pancake would allocate to (a) the first main product and (b) the second main product by using the physical measures method to allocate the joint production costs. (CMA adapted)

Question 2:

Edin-Chem Ltd. is a small company that acquires high-grade crude oil from low volume producing wells owned by individuals. The crude oil is processed in a single refinery into Two Oil, Six Oil, and impure distillates. Edin-Chem does not have the technology or capacity to process these products further and sells most of its output each month to major refineries. There were no beginning finished goods or work-in-process inventories on January 1. The production costs and output of Edin-Chem for January are as follows:

Crude oil acquired and placed into production	**£5,000,000**
Direct labour and related costs	**2,000,000**
Manufacturing overhead	**3,000,000**

Production and sales:

Two Oil: 300,000 barrels produced;
80,000 barrels sold at £20 each

Six Oil: 240,000 barrels produced;
120,000 barrels sold at £30 each

Distillates: 120,000 barrels produced and
sold at £15 per barrel

Required:

1. **Calculate the amount of joint production cost that Edin-Chem would allocate to each of the three joint products by using the physical measures method. (Perform the ratio calculation to four decimal places.)**

2. **Calculate the amount of joint production cost that Edin-Chem would allocate to each of the three joint products by using the relative sales value method. (CMA adapted)**

Question 3:

2005 Examination Question

3.. Barry Company manufactures two products, Glossy and Shiny, from a joint production process. One production run costs £6000 and results in 1000 units of Glossy and 4000 units of Shiny. Neither product is saleable at split-off, but both must be further processed such that the separable cost for Glossy is £3 per unit and for Shiny is £2 per unit. The eventual market price for Glossy is £12 and for Shiny is £14.

Required:

3(i). Allocate joint production costs to each product using the physical measures method. (2 marks)

3(ii). Allocate joint production costs to each product using the net realizable value method. (Compute up to three decimal points.) (2 marks)

3(iii). In relation to the company, discuss the differences between these two methods. Which method do you prefer? Why? (3 marks)

Problem-1: Market value method for joint cost allocation and reversal cost method for by products

The Abraham Company produces three products – product A, Product B and Product C. Product A and B are the joint products. Product C has a relatively small market value and is therefore treated as a by-product.

During March, 8,000 units of product A, 10,000 units of product B and 2,000 units of product C were processed in refining department. The joint processing cost incurred in the refining department was 204,000.

Some additional data is given below:

	Product A	Product B	Product C
Sales price per unit	$20	$25	$5
Production cost after separation	5	7	1
Marketing and admin. expenses per unit			1
Operating profit per unit			1

The Abraham Company uses market value method to assign cost to product A and product B and reversal cost method to allocate cost to product C.

Required: Allocate joint cost to by-product C and joint product A and B.

Solution

1. Allocation of cost to by-product (i.e., product C):

Final market value per unit of by-product		$5
Gross profit consisting of:		
Operating profit	$ 1	
Marketing and administrative expenses	1	2
		$3
Further processing cost		1
Value per unit of by-product at split-off		$2

Value of by-product (i.e., product C) to be credited to joint cost:

Number of units produced × Value per unit of by-product at split-off
= 2,000 units × $2
$4,000

2. Apportionment of cost to joint product A and B:

Product	Ultimate market value per unit	Units Produced	Ultimate market value	Separable processing cost	Hypo-thetical market value	*Joint cost allocation
Product A	$20	8,000	$160,000	$ 40,000	$120,000	$ 80,000
Product B	25	10,000	250,000	70,000	180,000	120,000
			$410,000	$110,000	$300,000	**$200,000

*Ratio to allocate cost prior to separation
**Total joint cost less value credited to by-product ($204,000 – $4,000 = $200,000)

Problem-2: Market value at the split-off point for joint cost allocation

The Roberts Company purchases a material known as TX-5 @ $0.80 per liter. The company has three production departments. In department 1, the material TX-5 splits off into three different products – product X, product Y and product Z. Product X is sold to customers immediately after split-off where as products Y and Z are further processed before they can be sold to customers. Product Y is processed in department 2 and product Z is processed in department 3. The related data for the last year is given below:

	DEPARTMENT		
	1	2	3
Cost of material TX-5	$96,000	--	--
Direct labor	14,000	$ 45,000	$65,000
Factory overhead	10,000	21,000	49,000

	PRODUCT		
	X	Y	Z
Sales in dollars	$30,000	$96,000	$141,750
Liters sold	20,000	30,000	45,000
Liters on hand at the end of the year	10,000	--	15,000

There were no material TX-5 and finished goods inventories at the start of the last year. The whole quantity of material TX-5 purchased during the year had been used till the end of the year. No factory overhead variances occurred in the last year. There were no work in process inventories at the start and end of the year.

The Roberts always uses market value at split-off point to allocate joint cost to all of its joint products.

Required:

1. For product X, find the market value at split-off of total units produced during the year.
2. What is the total joint cost for the last year to be allocated among three products.
3. Find the total cost of products X, Y and Z produced during the last year.
4. Compute the cost assigned to products X, Y and Z ending inventory.

Solution

1. Product x – market value at split off point:

Market value per unit × Units produced during the year
= *$1.50 × 30,000 units**
= $45,000

*$30,000/20,000 units
**20,000 units sold + 10,000 units on hand

2. Total joint cost to be allocated:

Cost of material TX-5	$ 96,000
Direct labor	14,000
Factory overhead	10,000
Total joint cost	$120,000

3. Total cost of products X, Y and Z produced during the year:

Joint products	No. of units pro-duced	Ultimate market value per unit	Ultimate market value	Separ-able costs	Hypo-thetical market value at split-off	*Allo-cation of joint cost	Total cost
X	30,000	$1.50	$ 45,000	$ 0	$ 45,000	$ 36,000	$ 36,000
Y	30,000	2.00	96,000	66,000	30,000	24,000	90,000
Z	60,000	3.00	189,000	114,000	75,000	60,000	174,000
Total....			$330,000	$180,000	$150,000	$120,000	$300,000

*Joint cost is 80% of hypothetical market value.

Hypothetical market value is equal to ultimate market value less separable production costs.

4. Cost assigned to product X and Z ending inventory:

Product X:

Cost per unit × Units in ending inventory
= *$1.20 × 10,000 units
= $12,000

*Total cost of product X as per solution to requirement 3/Number of units produced
= $36,000/30,000 units
= $1.20

Product Z:

Cost per unit × Units in ending inventory
= *$2.90 × 15,000 units
= $43,500

*Total cost of product Z as per solution to requirement 3/Number of units produced
= $174,000/60,000 units
= $2.90

Problem-3: joint cost allocation; sell immediately or process further

Problem-3 (a):

The T&T Company produces three chemicals – chemical P, chemical Q and chemical R. Chemical P is sold for $7 per liter, chemical Q for $5 per liter and chemical R for $8 per liter. During the month of July, 20,000 liters of chemical P, 50,000 liters of chemical Q and 30,000 liters of chemical R were produced and sold.

The cost data for July is given below:

Joint cost:			
Direct materials	$180,000		
Direct labor	100,000		
Factory overhead	70,000		
Total joint cost	$350,000		
	Chemical P	**Chemical Q**	**Chemical R**
Processing cost after split off:			
Direct labor	$25,000	$35,000	$18,000
Factory overhead	15,000	25,000	12,000

There were no inventories at the start and end of the month. The company uses market value method for allocating joint cost to joint products.

Required:

1. Allocate joint cost and compute gross profit for each chemical.
2. Decide whether chemical P should be sold at split-off point for $4.50 per liter or processed further and sold for $7 per liter.

Solution

Allocation of joint cost and computation of gross profit:

Joint products	No. of units pro-duced	Ultimate market value per unit	Ultimate market value	Separ-able costs	Hypo-thetical market value at split-off	*Allocation of joint cost	Total cost	Gross profit
P	20,000	$7.00	$140,000	$40,000	$100,000	$ 70,000	$110,000	$ 30,000
Q	50,000	$5.00	$250,000	$60,000	$190,000	$133,000	$193,000	$ 57,000
R	30,000	$8.00	$240,000	$30,000	$210,000	$147,000	$177,000	$ 63,000
Total....			$630,000	$130,000	$500,000	$350,000	$480,000	$150,000

The joint cost is 70% of the hypothetical market value.

Hypothetical market value is equal to the ultimate market value less processing cost after split-off point.

2. Sell immediately after split-off or process further:

Differential revenue [20,000 liters × ($7.00 - $4.50)]	$50,000
Differential cost	40,000
Net advantage to further processing before sale	$10,000

Problem-3 (b):

Products A, B and C are produced by incurring a joint cost of $100,000 in a joint production process. All of the three products can be sold at split-off point or processed further and sold at relatively higher prices. You are provided with the following data:

Product	No. of units	Sales price at split-off	Costs after split-off	Sales price after further processing
A	3,000	$10.00	$60,000	$25
B	4,000	15.00	50,000	30
C	8,000	20.00	90,000	35

Required: Which product(s) should be sold at split-off point and which product(s) should be further processed after split-off point. All processing costs are variable.

Solution

Product	Incremental revenue if processed further	Separable further processing cost	Additional contribution margin
A	($25 – $10) × 3,000 = $ 45,000	$60,000	$(15,000)
B	($30 – $15) × 4,000 = 60,000	50,000	10,000
C	($35 – $20) × 8,000 = 120,000	90,000	30,000

According to above analysis, product A should be sold immediately after split-off point but products B and C should be processed further. If product A is processed further, it gives a negative additional contribution margin which means the further processing of this product would negatively impact the net profit of the firm. In case the products B and C are further processed, their differential revenue becomes more than their differential cost which means an additional contribution margin for these two products. The higher contribution margin would eventually translate into additional profit for the firm.

Problem-4: Three methods of allocating joint costs

The Sun Inc. produces four joint products – product A, product B, product C and product D. The joint production cost at split-off point is $70,000. The data for the month of April is given below:

Product	Unites produced	Ultimate market value per unit	Processing cost after split-off	Weight factors
A	5,000	$5.50	$1,500	3.0 points
B	20,000	1.60	3,000	2.0 points
C	15,000	1.50	2,500	4.0 points
D	10,000	3.00	5,000	2.5 points

Required: Allocate joint production cost using:

1. The market value method
2. The average unit cost method
3. The weighted average method

Solution

1. The market value method:

Joint products	No. of units produced	Ultimate market value per unit	Ultimate market value	Processing costs after split-off	Hypothetical market value at split-off	*Allocation of joint cost
A	5,000	$5.50	$ 27,500	$ 1,500	$ 26,000	$18,200
B	20,000	1.60	32,000	3,000	29,000	20,300
C	15,000	1.50	22,500	2,500	20,000	14,000
D	10,000	3.00	30,000	5,000	25,000	17,500
Total....			$112,000	$12,000	$100,000	$70,000

*The joint cost is 70% of the hypothetical market value.

2. Average unit cost method:

Product	Units produced	*Average unit cost	Joint cost allocation
Product A	5,000	$1.40	$ 7,000
Product B	20,000	1.40	28,000
Product C	15,000	1.40	21,000
Product D	10,000	1.40	14,000
Total....	50,000		$70,000

*Joint cost/Total number of units produced
= $70,000/50,000
= $1.40 per unit

3. Weighted average method:

Product	Units produced	Points	Weighted units	*Joint cost per weighted unit	Joint cost allocation
A	5,000	3.00	45,000	$0.50	$ 7,500
B	20,000	2.00	40,000	0.50	20,000
C	15,000	4.00	60,000	0.50	30,000
D	10,000	2.50	25,000	0.50	12,500
Total....			140,000		$70,000

*Joint cost/Total number of weighted units
= $70,000/140,000
= $.50 per weighted unit

Problem-5: Joint product costing – Constant gross margin percentage method

Problem-5 (a):

The Northern Company manufactures three products at a joint production cost of $1,250,000. The Data for the month of January is provided to you:

Product	Quantity	Processing cost after split-off	Selling price per unit
X	25,000	$ 750,000	$ 40
Y	40,000	750,000	50
Z	35,000	210,000	20

Required: Allocate the joint production cost to products X, Y and Z using constant gross margin percentage method.

Solution

	X	Y	Z	Total
Sales revenue	$1,000,000	$2,000,000	$700,000	$3,700,000
Cost of goods sold:				
Joint cost				$1,250,000
Separable cost	750,000	750,000	$210,000	1,710,000
				$2,960,000
Gross margin				$ 740,000

Gross margin percentage = Gross margin/Sales revenue
= $740,000/$3,700,000
= 0.2 or 20%

	X	Y	Z	Total
Ultimate sales value	$1000,000	$2,000,000	$700,000	$3,700,000
Less 20% gross margin	200,000	400,000	140,000	740,000
Total cost	$ 800,000	$1,600,000	$560,000	$2,960,000
Separable cost	750,000	750,000	210,000	1,710,000
Joint cost allocation	$ 50,000	$ 850,000	$350,000	$1,250,000

Problem-5 (b):

The Smart Company produces three products – Alpha, Beta and Gama. Alpha and Beta are main products where as Gama is a by-product. Alpha is sold immediately after split-off but Beta and Gama require additional processing before sale. The data for the last year is given below:

	Alpha	Beta	Gamma	Total
Joint costs:				
Variable				$ 88,000
Fixed				148,000
Separable costs				
Variable		$120,000	$ 3,000	123,000
Fixed		90,000	2,000	92,000
Production in pounds	50,000	40,000	10,000	100,000
Sale price per pound	$ 5.00	$ 7.50	$ 1.10	

The company deducts net revenue of by-product from manufacturing cost of the main products. The joint production cost is allocated to joint products to achieve the same percentage of gross profit for each product.

In Star Company, no spoilage of direct materials occurs during the normal course of production. The variable costs change in direct proportion to the quantity of finished goods produced. There were no finished goods and direct materials inventories at the start and end of the last year.

Required

1. What is the total gross profit of joint products Alpha and Beta?
2. Allocate the joint cost to joint products Alpha and Beta.

3. Compute the gross profit of joint products Alpha and Beta.

Solution

1. Total gross profit of Joint products

	Alpha	Beta	Total
Sales revenue	$25,000	$300,000	$550,000
Cost of goods sold:			
Joint cost [$236,000 – Gamma net revenue ($11,000 – $5,000 separable cost)]			$230,000
Separable cost ($215,000 – $5,000 for Gamma)		$210,000	210,000
			$440,000
Gross margin			$110,000

Gross margin percentage = Gross margin/Sales revenue
= $110,000/$550,000
= 0.2 or 20%

2. Allocation of joint cost to Alpha and Beta

	Alpha	Beta	Total
Ultimate sales value	$250,000	$300,000	$550,000
Less 20% gross margin	50,000	60,000	110,000
Total cost	$200,000	$240,000	$440,000
Separable cost		210,000	210,000
Joint cost allocation	$200,000	$ 30,000	$230,000

3. Gross profit of Alpha and Beta:

The gross profit of Alpha is $50,000 and Beta is $60,000 (See line 2 of requirement 2).

Problem-6: Sales-to-production-ratio method of joint cost allocation

The Adolph Inc. produces five products — S-25,T-30,U-35, V-15 and W-50. The joint production cost is $1,000,000 and there is no further processing cost. The demand for Adolph's products has been fluctuating significantly and production has remained constant.

The information for the past year is provided below:

Product	No. of units sold	No. of units produced	Market price per unit
S-25	25,000	$ 4.00	$ 30,000
T-30	40,000	5.00	30,000
U-35	35,000	2.00	50,000
V-15	50,000	1.50	60,000
W-50	75,000	3.50	80,000

Required:

1. Briefly explain the sales-to-production-ratio method of joint cost allocation.
2. Allocate the joint production cost of Adolph Inc. to five products using sales-to-production-ratio method.

Solution

1. About sales-to-production-ratio method:

Under **sales-to-production-ratio method**, the joint production cost is allocated to different joint products in accordance with a weighting factor which compares the sales percentage with the production percentage. This method allocates a larger share of joint cost to those products that sell the most.

The steps involved in this method are given below:

1. Compute the percentage of total sales based on the units of joint product sold.
2. Compute the percentage of total production based on the units of joint product produced.

3. Compute sales-to-production-ratio using this formula:
   Sales-to-production-ratio = Percentage of total sales/percentage of total production
4. Allocate joint cost by using the sales-to-production-ratio percentage computed in step 3.

2. Allocation of joint cost:

Product	Units Sold	Percentage of Total Sales	Units Produced	Percentage of Total Production	Sales-to-Production Ratio	Joint Cost Allocation Ratio	Joint Cost Allocation
S-25	25,000	11.11%	30,000	12.00%	0.9259	17.97%	$ 179,695
T-30	40,000	17.78%	30,000	12.00%	1.4815	28.75%	287,511
U-35	35,000	15.56%	50,000	20.00%	0.7778	15.09%	150,943
V-15	50,000	22.22%	60,000	24.00%	0.9259	17.97%	179,695
W-50	75,000	33.33%	80,000	32.00%	1.0417	20.22%	202,156
Total	225,000		250,000		5.1528		$1,000,000