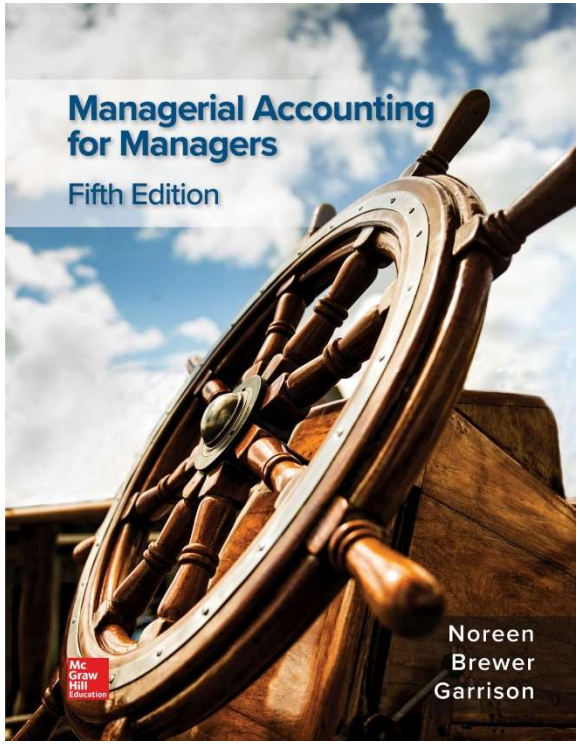
Differential Analysis: The Key to Decision Making

CHAPTER 6



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Learning Objective 1

Identify relevant and irrelevant costs and benefits in a decision.

Decision Making – Six Key Concepts – Concepts 1 and 2

Key Concept #1

Every decision involves choosing from among at least two alternatives. Therefore, the **first step** in decision-making is to **define the alternatives** being considered.

Key Concept #2

Once you have defined the alternatives, you need to **identify the criteria** for choosing among them.

- **Relevant costs** and **relevant benefits** should be considered when making decisions.
- **Irrelevant costs** and **irrelevant benefits** should be ignored when making decisions.

Decision Making – Six Key Concepts – Concept 3

Key Concept #3

The key to effective decision making is **differential analysis—focusing on the future costs and benefits that differ between the alternatives**. *Everything else is irrelevant and should be ignored.*

- A future cost that differs between any two alternatives is known as a **differential cost**.
- Future revenue that differs between any two alternatives is known as **differential revenue**.
- An **incremental cost** is an increase in cost between two alternatives.
- An **avoidable cost** is a cost that can be eliminated by choosing one alternative over another.

Decision Making – Six Key Concepts – Concepts 4 and 5

Key Concept #4

Sunk costs are always irrelevant when choosing among alternatives.

- A **sunk cost** is a cost that has already been incurred and cannot be changed regardless of what a manager decides to do.

Key Concept #5

Future costs and benefits that do not differ between alternatives are irrelevant to the decision-making process.

Decision Making – Six Key Concepts – Concept 6

Key Concept #6

Opportunity costs also need to be considered when making decisions.

- An **opportunity cost** is the potential benefit that is given up when one alternative is selected over another.

Identifying Relevant Costs – An Example

Cynthia, a Boston student, is considering visiting her friend in New York. She can drive or take the train. By car, it is 230 miles to her friend's apartment. She is trying to decide which alternative is less expensive and has gathered the following information.

Automobile Costs (based on 10,000 miles driven per year)

		Annual Cost of Fixed Items	Cost per Mile
1	Annual straight-line depreciation on car	$ 2,800	$ 0.280
2	Cost of gasoline		0.100
3	Annual cost of auto insurance and license	1,380	0.138
4	Maintenance and repairs		0.065
5	Parking fees at school	360	0.036
6	Total average cost		$ 0.619

$45 per month × 8 months

$2.70 per gallon ÷ 27 MPG

$24,000 cost – $10,000 salvage value ÷ 5 years

Identifying Relevant Costs – Additional Information

Automobile Costs (based on 10,000 miles driven per year)			
		Annual Cost of Fixed Items	Cost per Mile
1	Annual straight-line depreciation on car	$ 2,800	$ 0.280
2	Cost of gasoline		0.100
3	Annual cost of auto insurance and license	1,380	0.138
4	Maintenance and repairs		0.065
5	Parking fees at school	360	0.036
6	Total average cost		$ 0.619

	Additional Information	
7	Reduction in resale value of car per mile of wear	$ 0.026
8	Round-tip train fare	$ 104
9	Benefits of relaxing on train trip	????
10	Cost of putting dog in kennel while gone	$ 40
11	Benefit of having car in New York	????
12	Hassle of parking car in New York	????
13	Per day cost of parking car in New York	$ 25

Identifying Relevant Costs – Part 1

Which costs and benefits are relevant in Cynthia's decision?

The cost of the car is a sunk cost and is not relevant to the current decision.

The annual cost of insurance is not relevant. It will remain the same if she drives or takes the train.

However, the cost of gasoline is clearly relevant if she decides to drive. If she takes the train, she would avoid the cost of the gasoline, so the cost differs between the alternatives.

Identifying Relevant Costs – Part 2

Which costs and benefits are relevant in Cynthia's decision?

The cost of maintenance and repairs is relevant. In the long-run, these costs depend upon miles driven.

The monthly school parking fee is not relevant because it must be paid if Cynthia drives or takes the train.

At this point, we can see that some of the average cost of $0.619 per mile are relevant and others are not.

Identifying Relevant Costs – Part 3

Which costs and benefits are relevant in Cynthia's decision?

The decline in resale value due to additional miles is a relevant cost.

The round-trip train fare is clearly relevant. If she drives the cost can be avoided.

Relaxing on the train is relevant even though it is difficult to assign a dollar value to the benefit.

The kennel cost is not relevant because Cynthia will incur the cost if she drives or takes the train.

Identifying Relevant Costs – Part 4

Which costs and benefits are relevant in Cynthia's decision?

The cost of parking in New York is relevant because it can be avoided if she takes the train.

The benefits of having a car in New York and the problems of finding a parking space are both relevant but are difficult to assign a dollar amount.

Identifying Relevant Costs – Part 5

From a financial standpoint, Cynthia would be better off taking the train to visit her friend. Some of the non-financial factors may influence her final decision.

Relevant Financial Cost of Driving	
Gasoline (460 @ $0.100 per mile)	$ 46.00
Maintenance (460 @ $0.065 per mile)	29.90
Reduction in resale (460 @ $0.026 per mile)	11.96
Parking in New York (2 days @ $25 per day)	50.00
Total	$ 137.86

Relevant Financial Cost of Taking the Train	
Round-trip ticket	$ 104.00

Total and Differential Cost Approaches – Total Cost Approach

The management of a company is considering a new labor saving machine that rents for $3,000 per year. Data about the company's annual sales and costs with and without the new machine are:

	Current Situation	Situation With New Machine	Differential Costs and Benefits
Sales (5,000 units @ $40 per unit)	$ 200,000	$ 200,000	-
Less variable expenses:			
Direct materials (5,000 units @ $14 per unit)	70,000	70,000	-
Direct labor (5,000 units @ $8 and $5 per unit)	40,000	25,000	15,000
Variable overhead (5,000 units @ $2 per unit)	10,000	10,000	-
Total variable expenses	120,000	105,000	-
Contribution margin	80,000	95,000	15,000
Less fixed expense:			
Other	62,000	62,000	-
Rent on new machine	-	3,000	(3,000)
Total fixed expenses	62,000	65,000	(3,000)
Net operating income	$ 18,000	$ 30,000	12,000

Total and Differential Cost Approaches – Differential Cost Approach

As you can see, the only costs that differ between the alternatives are the direct labor costs savings and the increase in fixed rental costs.

	Current Situation	Situation With New Machine	Differential Costs and Benefits
Sales (5,000 units @ $40 per unit)	$ 200,000	$ 200,000	-
Less variable expenses:			
Direct ma			-
Direct lab			15,000
Variable			-
Total varial			-
Contributio			15,000
Less fixed			
Other			-
Rent on n			(3,000)
Total fixed			(3,000)
Net operati			12,000

We can efficiently analyze the decision by looking at the different costs and revenues and arrive at the same solution.

Net Advantage to Renting the New Machine	
Decrease in direct labor costs (5,000 units @ $3 per unit)	$ 15,000
Increase in fixed rental expenses	(3,000)
Net annual cost saving from renting the new machine	$ 12,000

Total and Differential Cost Approaches

Using the differential approach is desirable for two reasons:

1. Only rarely will enough information be available to prepare detailed income statements for both alternatives.
2. Mingling irrelevant costs with relevant costs may cause confusion and distract attention away from the information that is really critical.

Learning Objective 2

Prepare an analysis showing whether a product line or other business segment should be added or dropped.

Adding/Dropping Segments – Part 1

One of the most important decisions managers make is whether to add or drop a business segment. Ultimately, a decision to drop an old segment or add a new one is going to hinge primarily on its financial impact.

To assess this impact, it is necessary to carefully analyze the costs.

Adding/Dropping Segments – Part

Due to the declining popularity of digital watches, Lovell Company's digital watch line has not reported a profit for several years. Lovell is considering whether to keep this product line or drop it.

A Contribution Margin Approach

DECISION RULE

Lovell should drop the digital watch segment only if its profit would increase.

Lovell will compare the contribution margin that would be lost if the digital watch line was discontinued to fix expenses that would be avoided if the line was discontinued.

Adding/Dropping Segments – Example – Part 1

Segment Income Statement Digital Watches		
Sales		$ 500,000
Less: variable expenses		
Variable manufacturing costs	$ 120,000	
Variable shipping costs	5,000	
Commissions	75,000	200,000
Contribution margin		$ 300,000
Less: fixed expenses		
General factory overhead	$ 60,000	
Salary of line manager	90,000	
Depreciation of equipment	50,000	
Advertising - direct	100,000	
Rent - factory space	70,000	
General admin. expenses	30,000	400,000
Net operating loss		$ (100,000)

Adding/Dropping Segments – Example – Part 2

Segment Income Statement
Digital Watches

Sales		$ 500,000
Rent - factory space	70,000	
General admin. expenses	30,000	400,000
Net operating loss		$ (100,000)

An investigation has revealed that the fixed general factory overhead and fixed general administrative expenses will not be affected by dropping the digital watch line. The fixed general factory overhead and general administrative expenses assigned to this product would be reallocated to other product lines.

Adding/Dropping Segments – Example – Part 3

Segment Income Statement
Digital Watches

Sales		$ 500,000
Less: variable expenses		
C		200,000
		$ 300,000
Less: fixed expenses		
General factory overhead	$ 60,000	
Salary of line manager	90,000	
Depreciation of equipment	50,000	
Advertising - direct	100,000	
Rent - factory space	100,000	
General admin. expenses	50,000	400,000
Net operating loss		$ (100,000)

The equipment used to manufacture digital watches has no resale value or alternative use.

Should Lovell retain or drop the digital watch segment?

A Contribution Margin Approach Solution

Contribution Margin Solution		
Contribution margin lost if digital watches are dropped		$ (300,000)
Less fixed costs that can be avoided		
Salary of the line manager	$ 90,000	
Advertising - direct	100,000	
Rent - factory space	70,000	260,000
Financial disadvantage of dropping the digital watches product line		$ (40,000)

Comparative Income Approach – Part 1

The Lovell solution can also be obtained by preparing comparative income statements showing results with and without the digital watch segment.

Let's look at this second approach.

Comparative Income Approach – Part 2

	Keep Digital Watches	Drop Digital Watches	Difference
Sales	$ 500,000	$ -	$ (500,000)
Less variable expenses:		-	
Manufacturing expenses	120,000	-	120,000
Shipping	5,000	-	5,000
Commissions	75,000	-	75,000
Total variable expenses	200,000	-	200,000
Contribution margin	300,000	-	(300,000)
Less fixed expenses:			
General factory overhead	60,000		
Salary of line manager	90,0		
Depreciation	50,0		
Advertising - direct	100,0		
Rent - factory space	70,0		
General admin. expenses	30,0		
Total fixed expenses	400,0		
Net operating loss	$ (100,0		

If the digital watch line is dropped, the company loses $300,000 in contribution margin.

Comparative Income Approach – Part 3

	Keep Digital Watches	Drop Digital Watches	Difference
Sales	$ 500,000	$ -	$ (500,000)
Less variable expenses:		-	
Manufacturing expenses	120,000	-	120,000
Shipping	5,000	-	5,000
Commissions	75,000	-	75,000
Total variable expenses	200,000	-	200,000
Contribution margin	300,000	-	(300,000)
Less fixed expenses:			
General factory overhead	60,000	60,000	-
Salary of line manager	90,000		
Depreciation	50,000		
Advertising - direct	100,000		
Rent - factory space			
General admin. expenses			
Total fixed expenses			
Net operating loss			

On the other hand, the general factory overhead would be the same under both alternatives, so it is irrelevant.

Comparative Income Approach – Part 4

	Keep Digital Watches	Drop Digital Watches	Difference
Sales	$ 500,000	$ -	$ (500,000)
Less variable expenses:		-	
Manufacturing expenses	120,000	-	120,000
Shipping	5,000	-	5,000
Commissions	75,000	-	75,000
Total variable expenses	200,000	-	200,000
Contribution margin	300,000	-	(300,000)
Less fixed expenses:			
General factory overhead	60,000	60,000	-
Salary of line manager	90,000	-	90,000
Depreciation	50,000		
Advertising - direct	100,000		
Rent - factory			
General admin			
Total fixed expe			
Net operating I			

The salary of the product line manager would disappear, so it is relevant to the decision.

Comparative Income Approach – Part 5

	Keep Digital Watches	Drop Digital Watches	Difference
Sales	$ 500,000	$ -	$ (500,000)
Less fixed expenses:			
General factory overhead	60,000	60,000	-
Salary of line manager	90,000	-	90,000
Depreciation	50,000	50,000	-
Advertising - direct	100,000		
Rent - factory space	70,000		
General admin. expenses	30,000		
Total fixed expenses	400,000		
Net operating loss	$ (100,000)		

The depreciation is a sunk cost. Also, remember that the equipment has no resale value or alternative use, so the equipment and the depreciation expense associated with it are irrelevant to the decision.

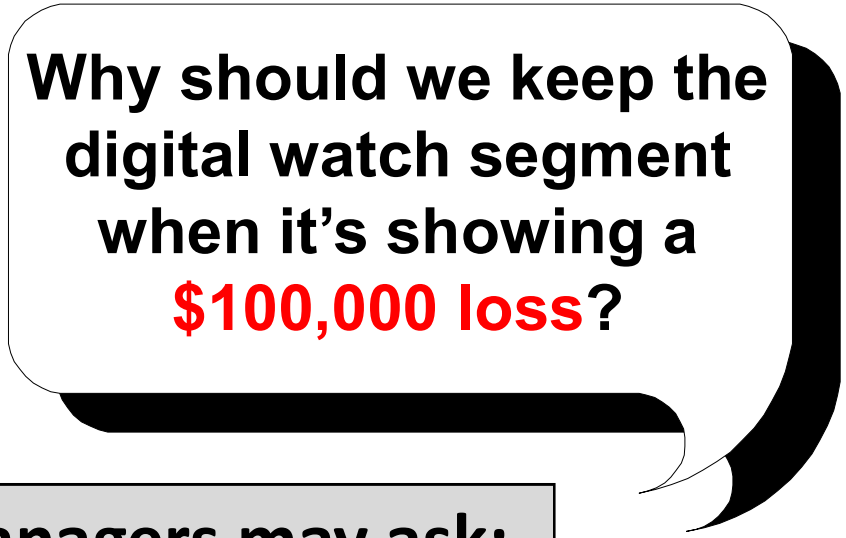
Comparative Income Approach – Part 6

	Keep Digital Watches	Drop Digital Watches	Difference
Sales	$ 500,000	$ -	$ (500,000)
Less variable expenses:		-	
Manufacturing expenses	120,000	-	120,000
Shipping			5,000
Commissions			75,000
Total variable			200,000
Contribution m			(300,000)
Less fixed exp			
General fact			-
Salary of line manager	90,000	-	90,000
Depreciation	50,000	50,000	-
Advertising - direct	100,000	-	100,000
Rent - factory space	70,000	-	70,000
General admin. expenses	30,000	30,000	-
Total fixed expenses	400,000	140,000	260,000
Net operating loss	$ (100,000)	$ (140,000)	$ (40,000)

The complete comparative income statements reveal that Lovell would earn $40,000 of additional profit by retaining the digital watch line.

Beware of Allocated Fixed Costs – Part 1

Be aware that allocated fixed costs can distort the keep/drop decision.



Lovell's managers may ask:

Beware of Allocated Fixed Costs – Part 2

Beware of Allocated Fixed Costs – Part 3

Including unavoidable common fixed costs makes the product line appear to be unprofitable, when in fact *dropping* the product line would decrease the company's overall net operating income.

Learning Objective 3

Prepare a make or buy analysis.

The Make or Buy Decision

When a company is involved in more than one activity in the entire value chain, it is vertically integrated. A decision to carry out one of the activities in the value chain internally, rather than to buy externally from a supplier is called a "make or buy" decision.

Vertical Integration- Advantages

Vertical Integration- Disadvantages

Companies may fail to take advantage of suppliers who can create economies of scale advantage by pooling demand from numerous companies.

While the economics of scale factor can be appealing, a company must be careful to retain control over activities that are essential to maintaining its competitive position.

The Make or Buy Decision – An Example

Essex Company manufactures part 4A that is used in one of its products. The unit product cost of this part is:

Direct materials	$ 9
Direct labor	5
Variable overhead	1
Depreciation of special equip.	3
Supervisor's salary	2
General factory overhead	10
Unit product cost	$ 30

The Make or Buy Decision – Part 1

The special equipment used to manufacture part 4A has no resale value.

The total amount of general factory overhead, which is allocated on the basis of direct labor hours, would be unaffected by this decision.

The $30 unit product cost is based on 20,000 parts produced each year.

An outside supplier has offered to provide the 20,000 parts at a cost of $25 per part.

Should the company stop making part 4A and buy it from an outside supplier?

The Make or Buy Decision – Part 2

	Cost Per Unit	Cost of 20,000 Units	
		Make	Buy
Outside purchase price	$ 25		$ 500,000
Direct materials (20,000 units)	$ 9	180,000	
Direct labor	5	100,000	
Variable overhead	1	20,000	
Depreciation of equip.	3	-	
Supervisor's salary	2	40,000	
General factory overhead	10	-	
Total cost	$ 30	$ 340,000	$ 500,000

The avoidable costs associated with making part 4A include direct materials, direct labor, variable overhead, and the supervisor's salary.

The Make or Buy Decision – Part 3

	Cost Per Unit	Cost of 20,000 Units	
		Make	Buy
Outside purchase price	$ 25		$ 500,000
Direct materials (20,000 units)	$ 9	180,000	
Direct labor	5	100,000	
Variable overhead	1	20,000	
Depreciation of equip.	3	-	
Supervisor's salary	2	40,000	
General factory overhead	10	-	
Total cost	$ 30	$ 340,000	$ 500,000

The cost incurred to buy the equipment is a sunk cost; the depreciation simply spreads this sunk cost over the equipment's useful life.

The Make or Buy Decision – Part 4

	Cost Per Unit	Cost of 20,000 Units	
		Make	Buy
Outside purchase price	$ 25		$ 500,000
Direct materials (20,000 units)	$ 9	180,000	
Direct labor	5	100,000	
Variable overhead	1	20,000	
Depreciation of equip.	3	-	
Supervisor's salary	2	40,000	
General factory overhead	10	-	
Total cost	$ 30	$ 340,000	$ 500,000

The allocated general factory overhead represents allocated costs common to all items produced in the factory and would continue unchanged. Thus, it is irrelevant to the decision.

The Make or Buy Decision – Part 5

	Cost Per Unit	Cost of 20,000 Units	
		Make	Buy
Outside purchase price	$ 25		$ 500,000
Direct materials (20,000 units)	$ 9	180,000	
Direct labor	5	100,000	
Variable overhead	1	20,000	
Depreciation of equip.	3	-	
Supervisor's salary	2	40,000	
Allocated gen. fact. overhead	10	-	
Total cost	$ 30	$ 340,000	$ 500,000
Financial advantage of making part 4A		$160,000	

Should we make or buy part 4A? Given that the total avoidable costs are less than the cost of buying the part, Essex should continue to make the part.

Opportunity Cost

Opportunity costs are not actual cash outlays and are not recorded in the formal accounts of an organization.

An **opportunity cost** is the benefit that is foregone as a result of pursuing some course of action.

If the space to make Part 4A had an alternative use, the opportunity cost would have been equal to the segment margin that could have been derived from the best alternative use of the space.

Learning Objective 4

Prepare an analysis showing whether a special order should be accepted.

Special Orders

A special order is a one-time order that is not considered part of the company's normal ongoing business.

When analyzing a special order, only the incremental costs and benefits are relevant.

Since the existing fixed manufacturing overhead costs would not be affected by the order, they are not relevant.

Special Orders

- Jet Inc. makes a single product whose normal selling price is $20 per unit.
- A foreign distributor offers to purchase 3,000 units for $10 per unit.
- This is a one-time order that would not affect the company's regular business.
- Annual capacity is 10,000 units, but Jet Inc. is currently producing and selling only 5,000 units.

Should Jet accept the offer?

Special Orders – Part 1

Jet Inc.

Contribution Inc. Stmt., before considering a special order

Revenue (5,000 × $20)		$ 100,000
Variable costs:		
Direct materials	$ 20,000	
Direct labor	5,000	
Manufacturing overhead	10,000	
Marketing costs	5,000	
Total variable costs		40,000
Contribution margin		60,000
Fixed costs:		
Manufacturing overhead	$ 28,000	
Marketing costs	20,000	
Total fixed costs		48,000
Net operating income		$ 12,000

$8 variable cost

Special Orders – Part 2

If Jet accepts the special order, the incremental revenue will exceed the incremental costs. In other words, net operating income will increase by $6,000. This suggests that Jet should accept the order.

Increase in revenue (3,000 × $10)	$30,000
Increase in costs (3,000 × $8 variable cost)	24,000
Financial advantage of accepting the order	$ 6,000

Note: This answer assumes that the fixed costs are unavoidable and that variable marketing costs must be incurred on the special order.

Quick Check 1

Northern Optical ordinarily sells the X-lens for $50. The variable production cost is $10, the fixed production cost is $18 per unit, and the variable selling cost is $1. A customer has requested a special order for 10,000 units of the X-lens to be imprinted with the customer's logo. This special order would not involve any selling costs, but Northern Optical would have to purchase an imprinting machine for $50,000.

(see the next page)

Quick Check 1a

What is the rock bottom minimum price below which Northern Optical should not go in its negotiations with the customer? In other words, below what price would Northern Optical actually be losing money on the sale? There is ample idle capacity to fulfill the order and the imprinting machine has no further use after this order.

a. $50

b. $10

c. $15

d. $29

Quick Check 1b

What is the rock bottom minimum price below which Northern Optical should not go in its negotiations with the customer? In other words, below what price would Northern Optical actually be losing money on the sale? There is ample idle capacity to fulfill the order and the imprinting machine has no further use after this order.

a. $50

b. $10

c. $15

d. $29

Variable production cost	$100,000
Additional fixed cost	+ 50,000
Total relevant cost	$150,000
Number of units	10,000
Average cost per unit=	$15

Learning Objective 5

Determine the most profitable use of a constrained resource.

Volume Trade-Off Decisions

Companies are forced to make volume trade-off decisions when they do not have enough capacity to produce all of the products and sales volumes demanded by their customers.

- In these situations, companies must trade off, or sacrifice production of some products in favor of others in an effort to maximize profits.

Key Terms and Concepts

When a limited resource of some type restricts the company's ability to satisfy demand, the company is said to have a constraint.

The machine or process that is limiting overall output is called the bottleneck – it is the constraint.

Utilization of a Constrained Resource

Fixed costs are usually unaffected in these situations, so the product mix that maximizes the company's total contribution margin should ordinarily be selected.

A company should not necessarily promote those products that have the highest unit contribution margins.

Rather, total contribution margin will be maximized by promoting those products or accepting those orders that provide the highest contribution margin in relation to the constraining resource.

Utilization of a Constrained Resource – An Example – Part 1

Ensign Company produces two products and selected data are shown below:

	Product 1	Product 2
Selling price per unit	$ 60	$ 50
Less variable expenses per unit	36	35
Contribution margin per unit	$ 24	$ 15
Current demand per week (units)	2,000	2,200
Contribution margin ratio	40%	30%
Processing time required on machine A1 per unit	1.00 min.	0.50 min.

Utilization of a Constrained Resource – An Example – Part 2

Machine A1 is the constrained resource and is being used at 100% of its capacity.

There is excess capacity on all other machines.

Machine A1 has a capacity of 2,400 minutes per week.

Should Ensign focus its efforts on Product 1 or Product 2?

Quick Check 2

How many units of each product can be processed through Machine A1 in one minute?

	Product 1	Product 2
a.	1 unit	0.5 unit
b.	1 unit	2.0 units
c.	2 units	1.0 unit
d.	2 units	0.5 unit

Quick Check 2a

How many units of each product can be processed through Machine A1 in one minute?

	Product 1	Product 2
a.	1 unit	0.5 unit
b.	**1 unit**	**2.0 units**
c.	2 units	1.0 unit
d.	2 units	0.5 unit

Quick Check 2b

What generates more profit for the company, using one minute of machine A1 to process Product 1 or using one minute of machine A1 to process Product 2?

a. Product 1

b. Product 2

c. They both would generate the same profit.

d. Cannot be determined.

Quick Check 2c

What generates more profit for the company, using one minute of machine A1 to process Product 1 or using one minute of machine A1 to process Product 2?

a. Product 1

b. Product 2

With one minute of machine A1, Ensign could make 1 unit of Product 1, with a contribution margin of $24, or 2 units of Product 2, each with a contribution margin of $15 per unit.

$2 \times \$15 = \$30 > \$24$

Utilization of a Constrained Resource – Part 1

The key is the contribution margin per unit of the constrained resource.

		Product 1		Product 2	
Contribution margin per unit		$ 24		$ 15	
Time required to produce one unit	÷	1.00	min.	0.50	min.
Contribution margin per minute		$ 24		$ 30	

Ensign should emphasize Product 2 because it generates a contribution margin of $30 per minute of the constrained resource relative to $24 per minute for Product 1.

Utilization of a Constrained Resource – Part 2

The key is the contribution margin per unit of the constrained resource.

		Product 1		Product 2	
Contribution margin per unit		$ 24		$ 15	
Time required to produce one unit	÷	1.00	min.	0.50	min.
Contribution margin per minute		$ 24		$ 30	

Ensign can maximize its contribution margin by first producing Product 2 to meet customer demand and then using any remaining capacity to produce Product 1. The calculations would be performed as follows.

Utilization of a Constrained Resource – Part 3

Let's see how this plan would work.

Alloting Our Constrained Resource (Machine A1)

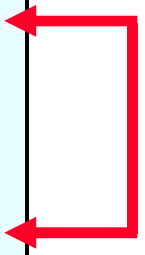
Weekly demand for Product 2		2,200	units
Time required per unit	×	0.50	min.
Total time required to make Product 2		1,100	min.

Utilization of a Constrained Resource – Part 4

Let's see how this plan would work.

Alloting Our Constrained Resource (Machine A1)

Weekly demand for Product 2		2,200	units
Time required per unit	×	0.50	min.
Total time required to make Product 2		1,100	min.
Total time available		2,400	min.
Time used to make Product 2		1,100	min.
Time available for Product 1		1,300	min.



Utilization of a Constrained Resource – Part 5

Let's see how this plan would work.

Alloting Our Constrained Resource (Machine A1)

Weekly demand for Product 2		2,200	units
Time required per unit	×	0.50	min.
Total time required to make Product 2		1,100	min.
Total time available		2,400	min.
Time used to make Product 2		1,100	min.
Time available for Product 1		1,300	min.
Time required per unit	÷	1.00	min.
Production of Product 1		1,300	units

Utilization of a Constrained Resource – Part 6

According to the plan, we will produce 2,200 units of Product 2 and 1,300 of Product 1. Our contribution margin looks like this.

	Product 1	Product 2
Production and sales (units)	1,300	2,200
Contribution margin per unit	$ 24	$ 15
Total contribution margin	$ 31,200	$ 33,000

The total contribution margin for Ensign is $64,200.

Learning Objective 6

Determine the value of obtaining more of the constrained resource.

Value of a Constrained Resource – Example

Increasing the capacity of a constrained resource should lead to increased production and sales.

How much should Ensign be willing to pay for an additional minute of A1 machine time?

Value of a Constrained Resource - Solution

The additional machine time would be used to make more units of Product 1, which had a contribution margin per minute of $24.

Ensign should be willing to pay up to $24 per minute. This amount equals the contribution margin per minute of machine time that would be earned producing more units of Product 1.

Quick Check 3

Colonial Heritage makes reproduction colonial furniture from select hardwoods.

	Chairs	*Tables*
Selling price per unit	$80	$400
Variable cost per unit	$30	$200
Board feet per unit	2	10
Monthly demand	600	100

The company's supplier of hardwood will only be able to supply 2,000 board feet this month. Is this enough hardwood to satisfy demand?

a. Yes

b. No

Quick Check 3a

Colonial Heritage makes reproduction colonial furniture from select hardwoods.

	Chairs	*Tables*
Selling price per unit	$80	$400
Variable cost per unit	$30	$200
Board feet per unit	2	10
Monthly demand	600	100

The company's supplier of hardwood will only be able to supply 2,000 board feet this month. Is this enough hardwood to satisfy demand?

a. Yes

b. No

$$(2 \times 600) + (10 \times 100) = 2{,}200 > 2{,}000$$

Quick Check 3b

	Chairs	*Tables*
Selling price per unit	$80	$400
Variable cost per unit	$30	$200
Board feet per unit	2	10
Monthly demand	600	100

The company's supplier of hardwood will only be able to supply 2,000 board feet this month. What plan would maximize profits?

a. 500 chairs and 100 tables

b. 600 chairs and 80 tables

c. 500 chairs and 80 tables

d. 600 chairs and 100 tables

Quick Check 3c

	Chairs	Tables
Selling price per u		
Variable cost per u		
Board feet per unit		
Monthly demand		

The company's supplier of ha
2,000 board feet this month.

a. 500 chairs and 100 tables

b. 600 chairs and 80 tables

c. 500 chairs and 80 tables

d. 600 chairs and 100 tables

	Chairs	Tables
Selling price	$ 80	$ 400
Variable cost	30	200
Contribution margin	$ 50	$ 200
Board feet	2	10
CM per board foot	$ 25	$ 20
Production of chairs	600	
Board feet required	1,200	
Board feet remaining	800	
Board feet per table	10	
Production of tables	80	

Quick Check 4

As before, Colonial Heritage's supplier of hardwood will only be able to supply 2,000 board feet this month. Assume the company follows the plan we have proposed. Up to how much should Colonial Heritage be willing to pay above the usual price to obtain more hardwood?

a. $40 per board foot

b. $25 per board foot

c. $20 per board foot

d. Zero

Quick Check 4a

As before, Colonial Heritage's supplier of hardwood will only be able to supply 2,000 board feet this month. Assume the company follows the plan we have proposed. Up to how much should Colonial Heritage be willing to pay above the usual price to obtain more hardwood?

a. $40 per board foot

b. $25 per board foot

c. $20 per board foot

The additional wood would be used to make tables. In this use, each board foot of additional wood will allow the company to earn an additional $20 of contribution margin and profit.

Managing Constraints

It is often possible for a manager to increase the capacity of a bottleneck, which is called relaxing (or elevating) the constraint, in numerous ways such as:

1. **Working overtime on the bottleneck.**
2. **Subcontracting some of the processing that would be done at the bottleneck.**
3. **Investing in additional machines at the bottleneck.**
4. **Shifting workers from non-bottleneck processes to the bottleneck.**
5. **Focusing business process improvement efforts on the bottleneck.**
6. **Reducing defective units processed through the bottleneck.**

Learning Objective 7

Prepare an analysis showing whether joint products should be sold at the split-off point or processed further.

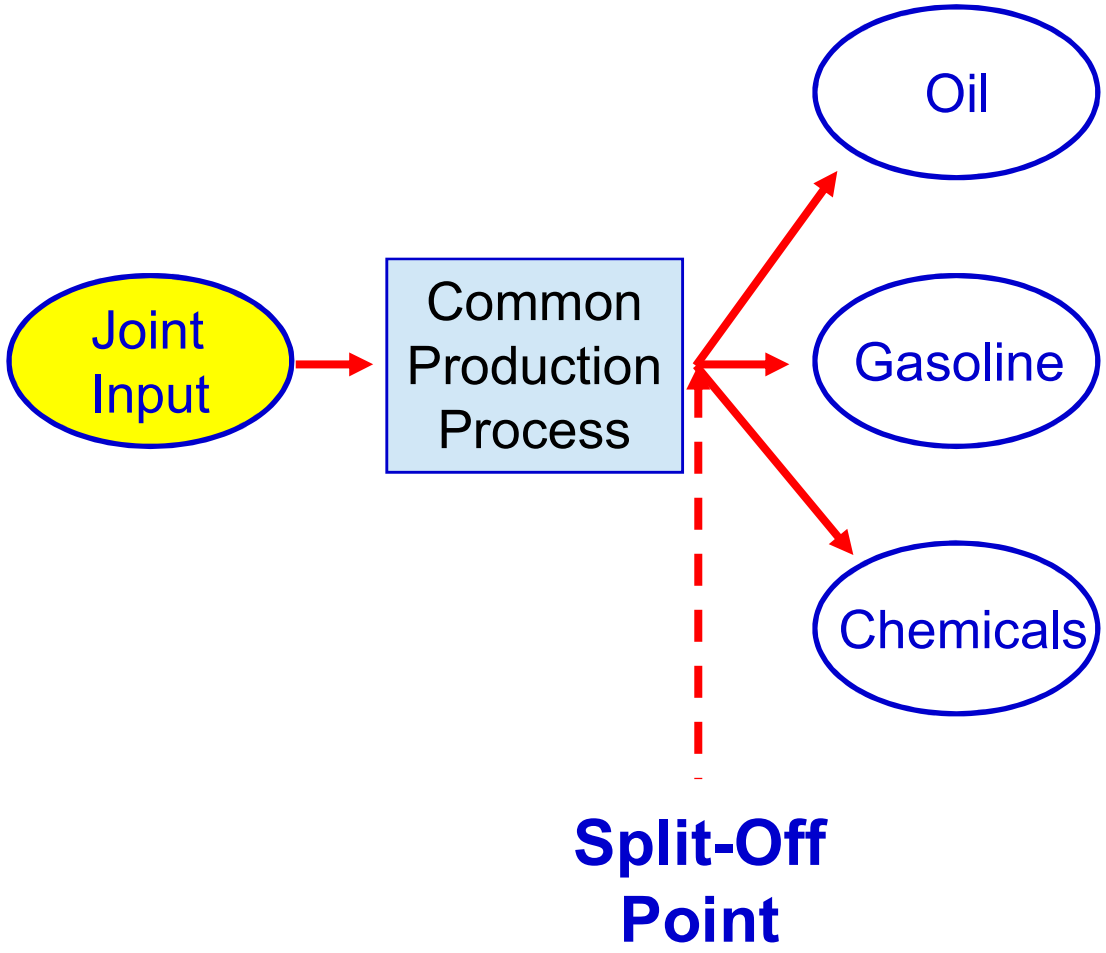
Joint Costs

In some industries, two or more products, known as joint products are produced from a single raw material input.

The point in the manufacturing process where joint products can be recognized as a separate product is called the split-off point.

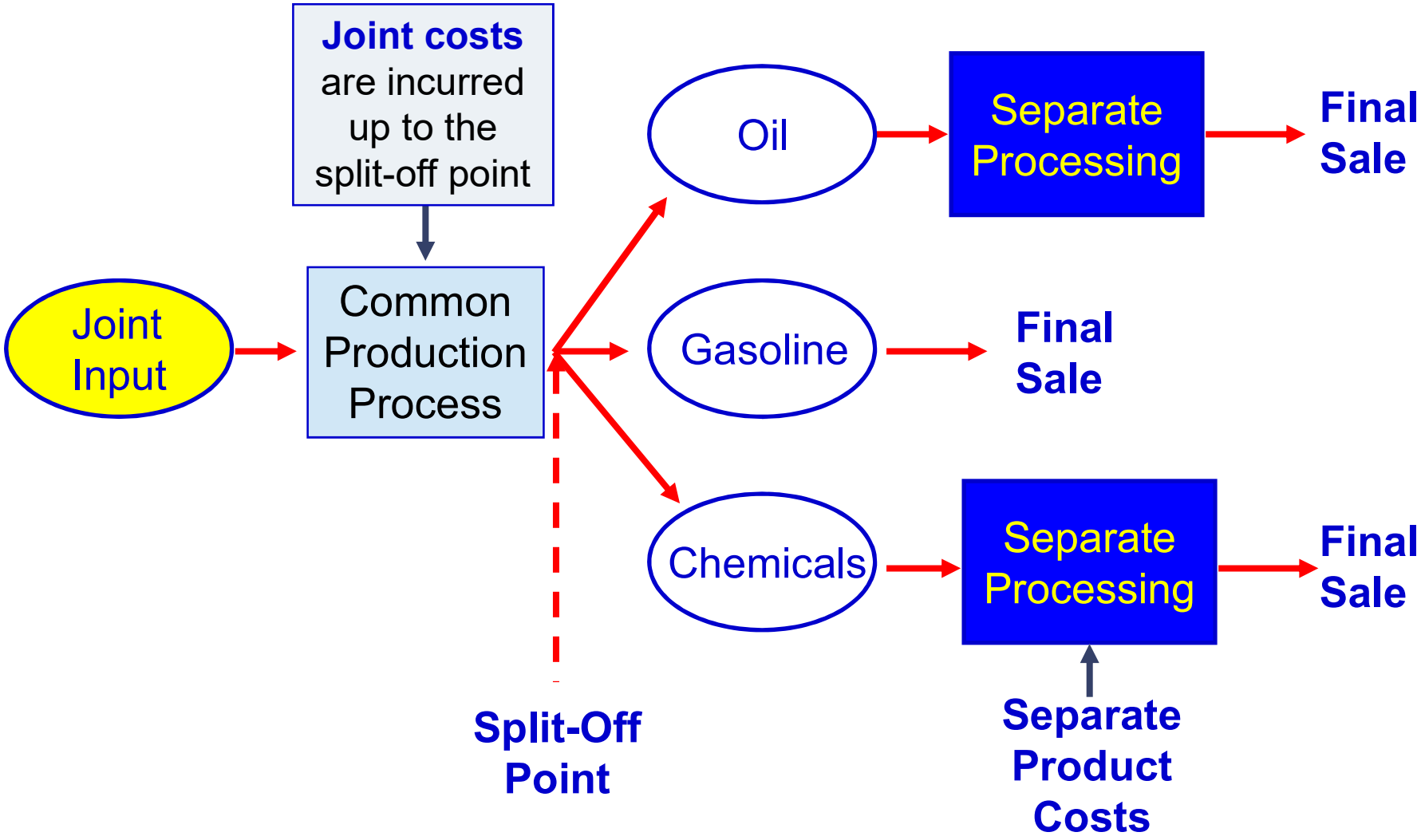
A decision as to whether a joint product should be sold at the split-off point or processed further is known as a sell or process further decision.

Joint Products



For example, in the petroleum refining industry, a large number of products are extracted from crude oil, including gasoline, jet fuel, home heating oil, lubricants, asphalt, and various organic chemicals.

Joint Products – Additional Processing



The Pitfalls of Allocation

Joint costs are traditionally allocated among different products at the split-off point. A typical approach is to allocate joint costs according to the relative sales value of the end products.

Although allocation is needed for some purposes such as balance sheet inventory valuation, allocations of this kind are very dangerous for decision making.

Sell or Process Further

Joint costs are irrelevant in decisions regarding what to do with a product from the split-off point forward. Therefore, these costs should not be allocated to end products for decision-making purposes.

With respect to sell or process further decisions, it is profitable to continue processing a joint product after the split-off point so long as the incremental revenue from such processing exceeds the incremental processing costs incurred after the split-off point.

Sell or Process Further: An Example

Sawmill, Inc. cuts logs from which unfinished lumber and sawdust are the immediate joint products.

Unfinished lumber is sold “as is” or processed further into finished lumber.

Sawdust can also be sold “as is” to gardening wholesalers or processed further into “presto-logs.”

Sell or Process Further – Additional Data

Data about Sawmill's joint products includes:

	Per Log	
	Lumber	Sawdust
Sales value at the split-off point	$ 140	$ 40
Sales value after further processing	270	50
Allocated joint product costs	176	24
Cost of further processing	50	20

Sell or Process Further – Part 1

Analysis of Sell or Process Further		
	Per Log	
	Lumber	Sawdust
Final sales value after further processing	$ 270	$ 50
Sales value at the split-off point	140	40
Incremental revenue from further processing	130	10
Cost of further processing		
Financial advantage (disadvantage) of further processing		

Sell or Process Further – Part 2

Analysis of Sell or Process Further		
	Per Log	
	Lumber	Sawdust
Final sales value after further processing	$ 270	$ 50
Sales value at the split-off point	140	40
Incremental revenue from further processing	130	10
Cost of further processing	50	20
Financial advantage (disadvantage) of further processing	$ 80	$ (10)

Sell or Process Further – Part 3

Analysis of Sell or Process Further

	Per Log	
	Lumber	Sawdust
Final sales value after further processing	$ 270	$ 50
Sales value at the split-off point	140	40
Incremental revenue from further processing	130	10
Cost of further processing	50	20
Financial advantage (disadvantage) of further processing	$ 80	$ (10)

The lumber should be processed further and the sawdust should be sold at the split-off point.

Activity-Based Costing and Relevant Costs

ABC can be used to help identify potentially relevant costs for decision-making purposes.

However, managers should exercise caution against reading more into this "traceability" than really exists.

People have a tendency to assume that if a cost is traceable to a segment, then the cost is automatically avoidable, which is untrue. Before making a decision, managers must decide which of the potentially relevant costs are actually avoidable.

End of Chapter 6