Differential Analysis: The Key to Decision Making

Chapter 11 - Part II

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 – Example

- 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 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.

Incremental revenue (3,000 × $10)	**$ 30,000**
Incremental cost (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.

Concept 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.

Concept 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

Concept 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

Answer: C

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?

Concept Check 2

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

A. Product 1: 1 unit = Product 2: 0.5 unit
B. Product 1: 1 unit = Product 2: 2.0 units
C. Product 1: 2 units = Product 2: 1.0 unit
D. Product 1: 2 units = Product 2: 0.5 unit

Concept Check 2a

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

A. Product 1: 1 unit = Product 2: 0.5 unit

B. Product 1: 1 unit = Product 2: 2.0 units

C. Product 1: 2 units = Product 2: 1.0 unit

D. Product 1: 2 units = Product 2: 0.5 unit

Answer: B

Concept 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.

Concept 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

C. They both would generate the same profit.

D. Cannot be determined.

Answer: B

- 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

- 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.**
- **Allotting 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.**
- **Allotting 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.**
- **Allotting 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 Machine A1 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.**

Concept Check 3

Colonial Heritage makes reproduction of 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

Concept 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

Answer: B

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

Concept Check 4

	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

Concept Check 4a (1 of 2)

	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

Answer: B

Concept Check 4a (2 of 2)

	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

Concept Check 5

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

Concept Check 5a

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

Answer: C

The additional wood would be used to make tables. In this case, 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.

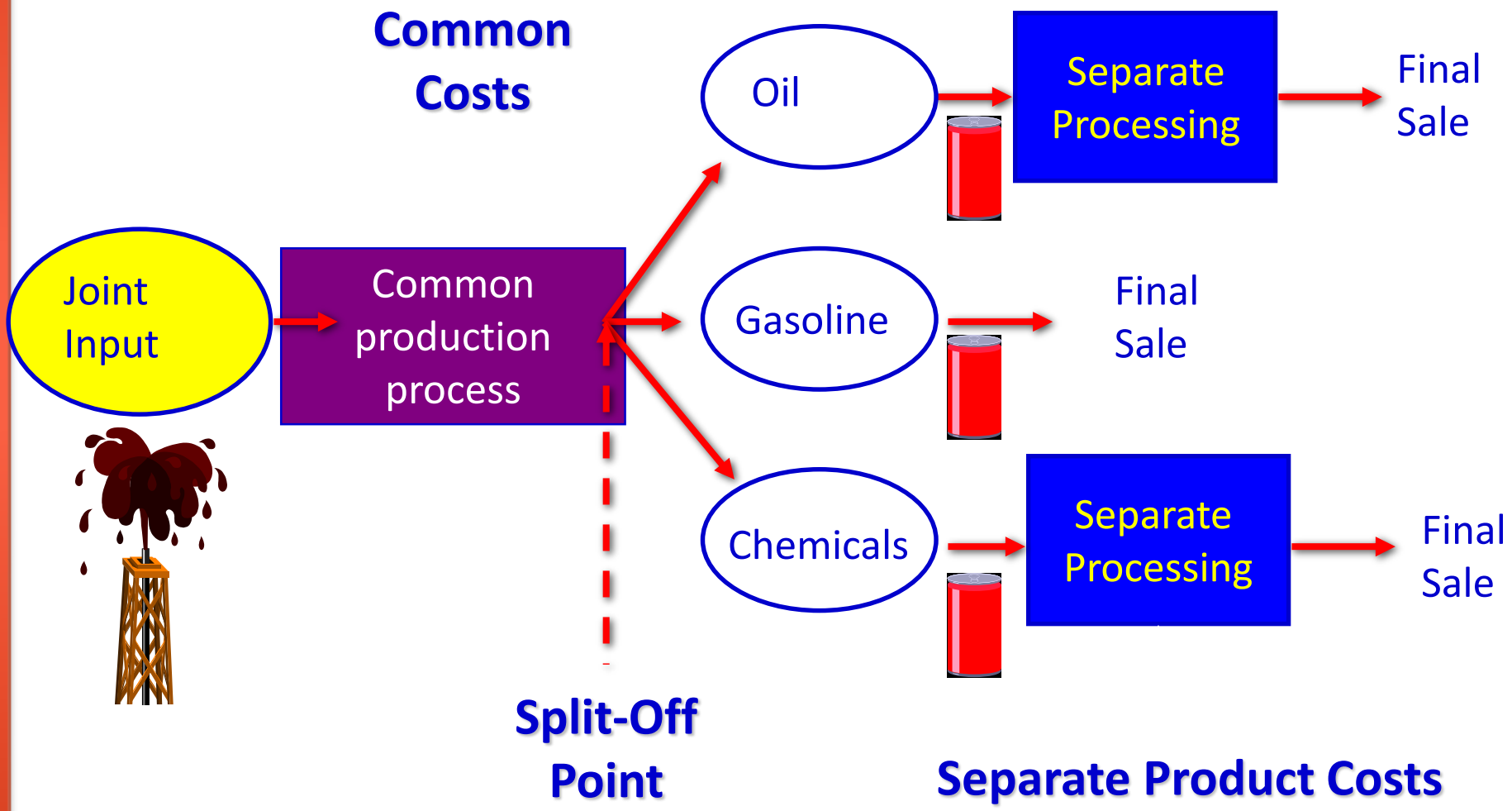
Learning Objective 7

"Sell or process further": whether joint products should be sold at the split-off point or processed further.

Joint Product 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 Product



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	Per Log: 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	Per Log: 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	Per Log: 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.

Exercises

"Make or buy"

Troy Engines, Ltd., manufactures a variety of engines for use in heavy equipment. The company has always produced all of the necessary parts for its engines, including all of the carburetors. An outside supplier has offered to sell one type of carburetor to Troy Engines, Ltd., for a cost of 35$ per unit. To evaluate this offer, Troy Engines Ltd., has gathered the following information relating to its own cost of producing the carburetor internally

	Per Unit	15,000 Units per Year
Direct materials	$14	$210,000
Direct labor	10	150,000
Variable manufacturing overhead	3	45,000
Fixed manufacturing overhead, traceable	6*	90,000
Fixed manufacturing overhead, allocated	9	135,000
Total cost	$42	$630,000

*One-third supervisory salaries; two-thirds depreciation of special equipment (no resale value).

Required:

1. Assuming the company has no alternative use for the facilities that are now being used to produce the carburetors, what would be the financial advantage (disadvantage) of buying 15,000 carburetors from the outside supplier?
2. Should the company 'make or buy'?

[Ex.01]

	Per Unit Differential Costs		15,000 units	
	Make	Buy	Make	Buy
Cost of purchasing		$35		$525,000
Direct materials	$14		$210,000	
Direct labor	10		150,000	
Variable manufacturing overhead	3		45,000	
Fixed manufacturing overhead, traceable[1]	2		30,000	
Fixed manufacturing overhead, common	___	___	_____	_____
Total costs	$29	$35	$435,000	$525,000
Financial (disadvantage) of buying the carburetors		$(6)		$(90,000)

1

Only the supervisory salaries of $2 per unit (= $6 per unit × 1/3) can be avoided if the carburetors are purchased. The remaining book value of the special equipment is a sunk cost; hence, the $4 per unit depreciation expense (= $6 × 2/3) per unit is not relevant to this decision.

2. Based on these data, the company should **reject** the offer and should continue to **produce the carburetors internally.**

"Sell or process further"

ABC Products Company manufactures three products in a joint processing operation. Joint processing costs up to the split-off point total $40,000 per year. The company allocates these costs to the joint products on the basis of their total sales value at the split-off point. Each product may be sold at the split-off point or processed further. Additional processing requires no special facilities. The additional processing costs and the sales value after further processing for each product (on an annual basis) are shown below:

Product	Additional Processing Costs	Sales Value after Further Processing	Sales Value at Split-off Point
A	$20,000	$44,000	$20,000
B	$30,000	$60,000	$35,000
C	$12,000	$50,000	$30,000

Required:
Which product or products should be sold at the split-off point, and which product or products
should be processed further?

[Ex.02]

***Required**:* Which product or products should be sold at the split-off point, and which product or products should be processed further?

	A	B	C
Sales value after further processing	$44,000	$60,000	$50,000
Sales value at split-off point	20,000	35,000	30,000
Incremental revenue	24,000	25,000	20,000
Cost of further processing	20,000	30,000	12,000
Financial advantage (disadvantage) of further processing	$4,000	$(5,000)	$8,000