Differential Analysis: The Key to Decision Making

Chapter 14

Cost Concepts for Decision Making

A **relevant cost** is a cost that differs between alternatives.

Identifying Relevant Costs

An **avoidable cost** is a cost that can be eliminated, in whole or in part, by choosing one alternative over another. Avoidable costs are relevant costs. Unavoidable costs are irrelevant costs.

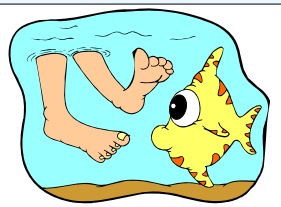
Two broad categories of costs are never relevant in any decision. They include:

1. **Sunk costs.**
2. **Future costs that do not differ between the alternatives.**

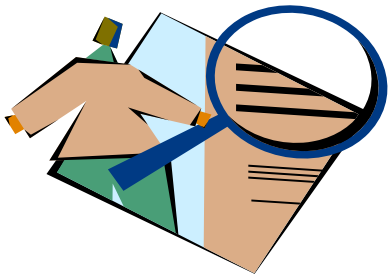
Relevant Cost Analysis: A Two-Step Process

Step 1 **Eliminate costs and benefits that do not differ between alternatives.**

Step 2 **Use the remaining costs and benefits that differ between alternatives in making the decision. The costs that remain are the differential, or avoidable, costs.**



Different Costs for Different Purposes



Costs that are relevant in one decision situation may not be relevant in another context. Thus, in each decision situation, the manager must examine the data at hand and isolate the relevant costs.

Identifying Relevant Costs

Cynthia, a Malaysian student studying in Penang, is considering visiting her friend in Kuala Lumpur. She can drive or take the budget airline. 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

Automobile Costs (based on 10,000 miles driven per year)				
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6	Total average cost		$	0.619

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

Notes:

Identifying Relevant Costs

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 plane.

However, the cost of gasoline is clearly **relevant** if she decides to drive. If she takes the plane, the cost would not be incurred, so it varies depending on the decision.

Identifying Relevant Costs

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 plane.

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

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 airfare is clearly **relevant**. If she drives the cost can be avoided.

Relaxing on the plane 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 plane.

Identifying Relevant Costs

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

The cost of parking in Kuala Lumpur is **relevant** because it can be avoided if she takes the plane.

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

Identifying Relevant Costs

From a financial standpoint, Cynthia would be better off taking the plane to visit her friend. Some of the non-financial factor 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 Kuala Lumpur (2 days @ $25 per day)	50.00
Total	$ 137.86

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

Total and Differential Cost Approaches

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

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.**

Notes:

Adding/Dropping Segments

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 the impact the decision will have on net operating income.

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

Adding/Dropping Segments

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 discontinuing this product line.

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 to the costs that would be avoided if the line was to be dropped.

Let's look at this solution.

Adding/Dropping Segments

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)

A Contribution Margin Approach

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
Net disadvantage		$ (40,000)

Comparative Income Approach

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 Solution

	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	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)

Notes:

Beware of Allocated Fixed Costs

Why should we keep the digital watch segment when it's showing a $100,000 loss?

The answer lies in the way we allocate common fixed costs to our products.

Beware of Allocated Fixed Costs

Including unavoidable common fixed costs makes the product line appear to be unprofitable.

Our allocations can make a segment look less profitable than it really is.

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.

Notes:

Vertical Integration- Advantages

- **Smoother flow of parts and materials**
- **Better quality control**
- **Realize profits**

Vertical Integration- Disadvantage

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

- 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 we accept the supplier's offer?

The Make or Buy Decision

	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.

Should we make or buy part 4A?
Answer:_____

Notes:

Special Orders - Key Terms and Concepts

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 Corporation. 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 Corporation is currently producing and selling only 5,000 units.

Should Jet accept the offer?

Special Orders

Jet Corporation
Contribution Income Statement

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

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
Increase in net income	$ 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 ✓

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 ✓

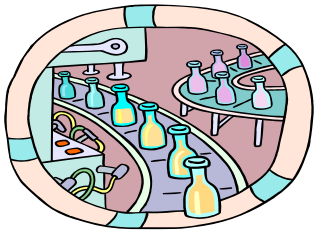
What is the rock bottom minimum price below which Northern Optical should not go in its negotiations with the customer? In other words, below what price would Northern Optical actually be losing money on the sale? There is ample idle capacity to fulfill the order and the imprinting machine has no further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

a. $50
b. $10
c. $15
d. $29

Utilization of a Constrained Resource - 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

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

- **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?

Utilization of a Constrained Resource

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.

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

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			min.
Total time available			min.
Time used to make Product 2			min.
Time available for Product 1			min.
Time required per unit	÷		min.
Production of Product 1			units

Utilization of a Constrained Resource

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.

Notes:

Managing Constraints

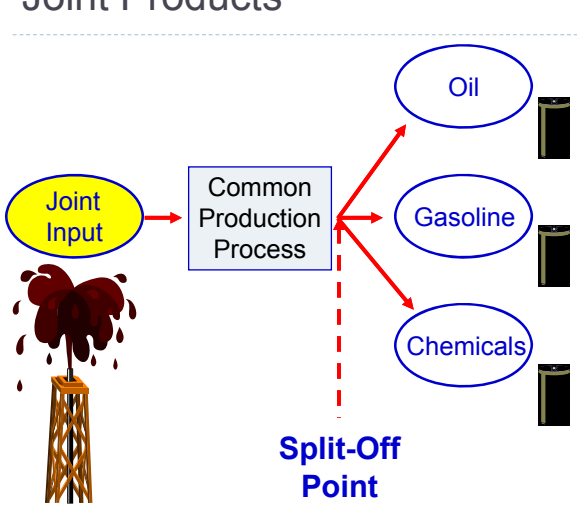
It is often possible for a manager to increase the capacity of a bottleneck, which is called relaxing (or elevating) the constraint, in numerous ways such as:

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.**

Joint Costs

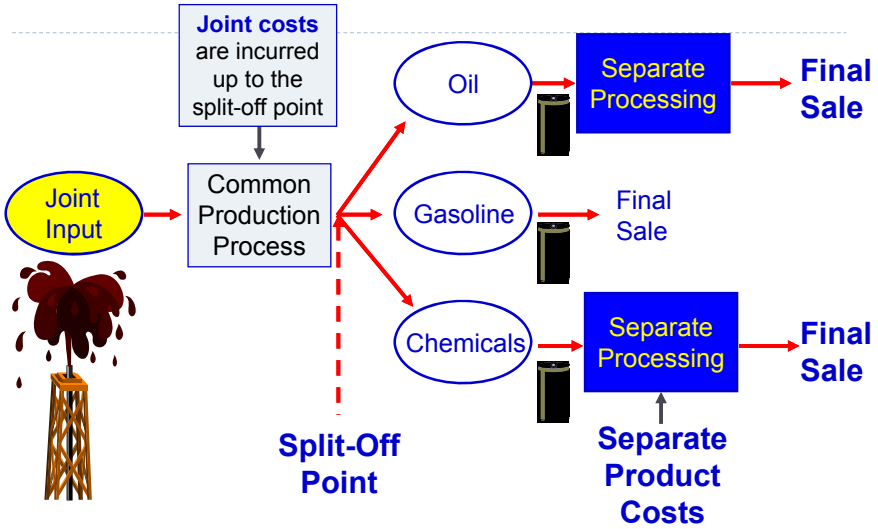
- In some industries, a number of end products are produced from a single raw material input.
- Two or more products produced from a common input are called joint products.
- The point in the manufacturing process where each joint product can be recognized as a separate product is called the split-off point.

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



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

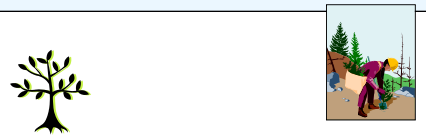
Joint costs are irrelevant in decisions regarding what to do with a product from the split-off point forward. Therefore, these costs should not be allocated to end products for decision-making purposes.

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.

Notes:

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

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

Analysis of Sell or Process Further

	Per Log	
	Lumber	Sawdust
Sales value after further processing	$ 270	$ 50
Sales value at the split-off point	140	40
Incremental revenue	130	10
Cost of further processing		
Profit (loss) from further processing		

End of Chapter 14