Decision making and Relevant Information
Introduction

- This chapter explores the decision-making process.
- It focuses on specific decisions such as accepting or rejecting a one-time-only special order, insourcing or outsourcing products or services, and replacing or keeping equipment.
- A decision model is a formal method for making a choice, often involving quantitative and qualitative analysis.
Five-Step Decision Process

1. Gathering information
2. Making predictions
3. Choosing an alternative
4. Implementing the decision
5. Evaluating performance
The Meaning of Relevance

- Relevant costs and relevant revenues are expected future costs and revenues that differ among alternative courses of action.
- Historical costs are irrelevant to a decision but are used as a basis for predicting future costs.
- Sunk costs are past costs which are unavoidable.
- Differential income (net relevant income) is the difference in total operating income when choosing between two alternatives.
- Differential costs (net relevant costs) are the difference in total costs between two alternatives.
Quantitative and Qualitative Relevant Information

- Quantitative factors are outcomes that are measured in numerical terms:
  - Financial
  - Nonfinancial

- Qualitative factors are outcomes that cannot be measured in numerical terms.
One-Time-Only Special Order

- Gabriela & Co. manufactures fancy bath towels in Boone, North Carolina.
- The plant has a production capacity of 44,000 towels each month.
- Current monthly production is 30,000 towels.
- The assumption is made that costs can be classified as either variable with respect to units of output or fixed.

<table>
<thead>
<tr>
<th></th>
<th>Variable Costs</th>
<th>Fixed Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Per Unit</td>
<td>Per Unit</td>
</tr>
<tr>
<td>Materials</td>
<td>$6.50</td>
<td>$0</td>
</tr>
<tr>
<td>Labor</td>
<td>.50</td>
<td>1.50</td>
</tr>
<tr>
<td>Other manufact. costs</td>
<td>1.50</td>
<td>3.50</td>
</tr>
<tr>
<td>Total</td>
<td>$8.50</td>
<td>$5.00</td>
</tr>
</tbody>
</table>
One-Time-Only Special Order

- Total fixed non-manufacturing overhead is $105,000.
- Marketing costs per unit are $7 ($5 of which is variable).

What is the full cost per towel?
- Variable ($8.50 + $5.00): $13.50
- Fixed: 7.00
- Total $20.50

- A hotel in Puerto Rico has offered to buy 5,000 towels from Gabriela & Co. at $11.50 per towel for a total of $57,500.
One-Time-Only Special Order

- No marketing costs will be incurred for this one-time-only special order.
- Should Gabriela & Co. accept this order?  
  - Yes!
  - Why?
    - The relevant costs of making the towels are $42,500.
    - $8.50 × 5,000 = $42,500 incremental costs
    - $57,500 – $42,500 = $15,000 incremental profits
    - $11.50 – $8.50 = $3.00 contribution margin per towel
One-Time-Only Special Order

Decision criterion:

- Accept the order if the revenue differential is greater than the cost differential.
- Accept the order if the contribution margin is positive.
- But: *Beware of aftereffects.* Is it really an isolated one-time-only special order or does it change the situation for future business?
Potential Problems in Relevant-Cost Analysis

- General assumptions:
  - Do not assume that all variable costs are relevant.
  - Do not assume that all fixed costs are irrelevant.
- Unit-cost data can potentially mislead decision makers:
  - Irrelevant costs are included.
  - The same unit costs are used at different output levels.
Short term production decisions

Income
= revenue − cost

**Contribution** of a Product
= (variable) revenue − variable costs

**Contribution Margin**
= contribution ÷ number of product units

**Rule 1:** Do not produce products with a negative contribution margin.
Constraints

- Mostly, a company is not free in its decision but faces constraints
  - procurement constraints
  - production constraints
  - sales constraints
- Constraints might affect
  - only single products (e.g. sales constraints)
  - multiple products
    several products compete for scarce resources (e.g. procurement constraints)
The formal decision problem

Maximize the firm’s profit

\[
\max_{x_i} (p_1 - k_1)x_1 + \ldots + (p_I - k_I)x_I - K_f
\]

such that

- sales constraints
- production constraints
- procurement constraints

\[
0 \leq x_i \leq X_i
\]
\[
a_{j1}x_1 + \ldots + a_{jI}x_I \leq Cap_j
\]

are kept satisfied
Special case 1: Only sales constraints

Rule 2

- Identify all products with a positive contribution margin
- For each selected product set the production level equal to the maximum quantity
## Example

<table>
<thead>
<tr>
<th>Product</th>
<th>( i = 1 )</th>
<th>( i = 2 )</th>
<th>( i = 3 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales price</td>
<td>200</td>
<td>480</td>
<td>1,100</td>
</tr>
<tr>
<td>Variable costs</td>
<td>160</td>
<td>400</td>
<td>1,170</td>
</tr>
<tr>
<td>Contribution margin</td>
<td>400</td>
<td>80</td>
<td>-70</td>
</tr>
<tr>
<td>Sales constraint ( X_i )</td>
<td>300</td>
<td>200</td>
<td>600</td>
</tr>
<tr>
<td>Input coefficient ( a_1 )</td>
<td>2</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>Input coefficient ( a_2 )</td>
<td>9</td>
<td>4</td>
<td>1</td>
</tr>
</tbody>
</table>

\[ K^F = 4.000 \]

<table>
<thead>
<tr>
<th>Machine</th>
<th>( j = 1 )</th>
<th>( j = 2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity</td>
<td>2.500</td>
<td>3.700</td>
</tr>
</tbody>
</table>
Special case 2: a single resource constraint

Example:

- **Resource A**: raw material
- **Resource B**: raw material
- **Resource 3**: Machine (limited capacity)
- **Product 1**: $a_1$
- **Product 2**: $a_2$

**Problem**: production of an additional unit of product 1 makes production of $a_1/a_2$ units of product 2 impossible
When should you expand production 1?

Expansion should increase total contribution

+ additional contribution $(p_1 - k_1) \cdot 1$

− loss of contribution $(p_2 - k_2) \cdot \frac{a_1}{a_2}$

Rule:

$$(p_1 - k_1) > (p_2 - k_2) \cdot \frac{a_1}{a_2}$$

or

$$\frac{p_1 - k_1}{a_1} > \frac{p_2 - k_2}{a_2}$$

„Relative contribution margins“ (CM per machine hour)
Product-Mix Decisions Under Capacity Constraints

Which product(s) should be produced first?

- The product(s) with the highest contribution margin per unit of the constraining resource.
The detailed rule (rule 3)

- **Step 1**: go for the product with the highest contribution margin per hour of capacity usage
  - until sales constraint is binding
  - or until capacity constraint is binding
  - if there is capacity left after step 1...

- **Step 2**: go for the product with the second highest contribution margin per hour of capacity usage
  - until sales constraint is binding
  - or until capacity is binding
  - if there is capacity left after step 2...

- go on analogously until there is no capacity left
Example

<table>
<thead>
<tr>
<th>Machine</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity</td>
<td>1.000</td>
<td>3.700</td>
</tr>
</tbody>
</table>

\[
p_1 - k_1 = 40, \quad p_2 - k_2 = 80
\]

\[
a_1 = 2, \quad a_2 = 8
\]

\[
\frac{p_1 - k_1}{a_1} = \frac{40}{2} = 20
\]

\[
\frac{p_2 - k_2}{a_2} = \frac{80}{8} = 10
\]

\[x_1^* = 300; \quad x_2^* = 50; \quad x_3^* = 0\]

Contribution: 16,000
Profit: 12,000
Insourcing versus Outsourcing

- **Outsourcing** is the process of purchasing goods and services from outside vendors rather than producing goods or providing services within the organization, which is called **insourcing**.
Opportunity Costs, Outsourcing, and Constraints

- Opportunity cost is the contribution to income that is forgone or rejected by not using a *limited* resource in its *next best* alternative use.
- The opportunity cost of holding inventory is the income forgone from tying up money in inventory and not investing it elsewhere.
- Carrying costs of inventory can be a significant opportunity cost and should be incorporated into decisions regarding lot purchase sizes for materials.
Opportunity Costs, Outsourcing, and Constraints

- Opportunity costs are not recorded in formal accounting records since they do not generate cash outlays.
- These costs also are not ordinarily incorporated into formal reports: ad hoc analyses required to estimate them.
Make-or-Buy Decisions

- Decisions about whether to outsource or produce within the organization are often called make-or-buy decisions.

- The most important factors in the make-or-buy decision are quality, dependability of supplies, and costs.
Example 1:

- A company produces three products (A, B, C). All products go through a single machine with limited capacity of 8,000 h per period.

<table>
<thead>
<tr>
<th>Products</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selling price</td>
<td>4,500</td>
<td>6,000</td>
<td>1,800</td>
</tr>
<tr>
<td>Variable prod. costs</td>
<td>2,000</td>
<td>4,000</td>
<td>600</td>
</tr>
<tr>
<td>Purchase costs</td>
<td>-</td>
<td>4,800</td>
<td>500</td>
</tr>
<tr>
<td>Input coefficient</td>
<td>5</td>
<td>2.5</td>
<td>1</td>
</tr>
<tr>
<td>Sales constraint</td>
<td>1,000</td>
<td>2,000</td>
<td>4,000</td>
</tr>
</tbody>
</table>
Example 1:

<table>
<thead>
<tr>
<th>Products</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contr. margin</td>
<td>2,500</td>
<td>2,000</td>
<td>1,200</td>
</tr>
<tr>
<td>Contr. Margin outsourcing</td>
<td>-</td>
<td>1,200</td>
<td>1,300</td>
</tr>
<tr>
<td>rel. CM</td>
<td>500</td>
<td></td>
<td>buy</td>
</tr>
<tr>
<td>rel. CM of production</td>
<td>-</td>
<td>320</td>
<td></td>
</tr>
<tr>
<td>Production sequence</td>
<td>1</td>
<td>2</td>
<td>-</td>
</tr>
</tbody>
</table>

Optimal program:

A: 1,000, B: produce 1,200 and buy 800, C: buy 4,000

Contribution margin:

1,000 x 2,500 + 1,200 x 2,000 + 800 x 1,200 + 1,300 x 4,000
Example 2:

- Gabriela & Co. also manufactures bath accessories.
- Management is considering producing a part it needs (#2) or using a part produced by Alec Enterprises.
Example 2:

- Gabriela & Co. has the following costs for 150,000 units of Part #2:
  - Direct materials $ 28,000
  - Direct labor 18,500
  - Mixed overhead 29,000
  - Variable overhead 15,000
  - Fixed overhead 30,000
  - Total $120,500

- Mixed overhead consists of material handling and setup costs.
- Gabriela & Co. produces the 150,000 units in 100 batches of 1,500 units each.
- Total material handling and setup costs equal fixed costs of $9,000 plus variable costs of $200 per batch.
Make-or-Buy Decisions

- What is the cost per unit for Part #2?
  - $120,500 ÷ 150,000 units = $0.8033/unit
- Alec Enterprises offers to sell the same part for $0.55.
- Should Gabriela & Co. manufacture the part or buy it from Alec Enterprises?
- The answer depends on the difference in expected future costs between the alternatives.
- Gabriela & Co. anticipates that next year the 150,000 units of Part #2 expected to be sold will be manufactured in 150 batches of 1,000 units each.
Make-or-Buy Decisions

- Variable costs per batch are expected to decrease to $100.
- Gabriela & Co. plans to continue to produce 150,000 next year at the same variable manufacturing costs per unit as this year.
- Fixed costs are expected to remain the same as this year.
- What is the variable manufacturing cost per unit?
  - Direct material $28,000
  - Direct labor 18,500
  - Variable overhead 15,000
  - Total $61,500
  - $61,500 ÷ 150,000 = $0.41 per unit
Make-or-Buy Decisions

- Expected relevant cost to make Part #2:
  - Manufacturing: $61,500
  - Material handling and setups: $15,000*
  - Total relevant cost to make: $76,500
    *150 × $100 = $15,000

- Cost to buy: (150,000 × $0.55) = $82,500

- Gabriela & Co. will save $6,000 by making the part.
Make-or-Buy Decisions

- Now assume that the $9,000 in fixed clerical salaries to support material handling and setup will not be incurred if Part #2 is purchased from Alec Enterprises.
- Should Gabriela & Co. buy the part or make the part?

Relevant cost to make:

- Variable: $76,500
- Fixed: 9,000
- Total: $85,500

- Cost to buy: $82,500
- Gabriela would save $3,000 by buying the part.
Again: Beware of the long-run consequences of your decision

- dependence on suppliers
- technological know-how may be lost
- information asymmetry may increase to the detriment of the buyer
- strategic orientation of outsourcing decisions: intended core competencies will not be outsourced even if this would be profitable from a pure accounting standpoint
Assume that Gabriela & Co. is considering replacing a cutting machine with a newer model.
The new machine is more efficient than the old machine.
Revenues will be unaffected.
## Equipment-Replacement Decisions

<table>
<thead>
<tr>
<th></th>
<th>Existing Machine</th>
<th>Replacement Machine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original cost</td>
<td>$80,000</td>
<td>$105,000</td>
</tr>
<tr>
<td>Useful life</td>
<td>4 years</td>
<td>4 years</td>
</tr>
<tr>
<td>Accumulated</td>
<td></td>
<td></td>
</tr>
<tr>
<td>depreciation</td>
<td>$50,000</td>
<td></td>
</tr>
<tr>
<td>Book value</td>
<td>$30,000</td>
<td></td>
</tr>
<tr>
<td>Disposal price</td>
<td>$14,000</td>
<td></td>
</tr>
<tr>
<td>Annual costs</td>
<td>$46,000</td>
<td>$10,000</td>
</tr>
</tbody>
</table>
Equipment-Replacement Decisions

- Ignoring the time value of money and income taxes, should Gabriela replace the existing machine?
- Yes!
- The cost savings per year are $36,000.
- The cost savings over a 4-year period will be $36,000 \times 4 = $144,000.
Equipment-Replacement Decisions

- Investment = $105,000 – $14,000 = $91,000
- $144,000 – $91,000 = $53,000 advantage of the replacement machine.

Irrelevance of Past Costs:
- The book value of existing equipment is irrelevant since it is neither a future cost nor does it differ among any alternatives (sunk costs never differ).
- The disposal price of old equipment and the purchase cost of new equipment are relevant costs and revenues because...
  - they are future costs or revenues that differ between alternatives to be decided upon.
Decisions and Performance Evaluation

What is the journal entry to sell the existing machine?

- Cash 14,000
- Accumulated Depreciation 50,000
- Loss on disposal 16,000
- Machine 80,000
Decisions and Performance Evaluation

- In the real world would the manager replace the machine?
- An important factor in replacement decisions is the manager’s perceptions of whether the decision model is consistent with how the manager’s performance is judged.
Managers often behave consistent with their short-run interests and favor the alternative that yields best performance measures in the short run.

When conflicting decisions are generated, managers tend to favor the performance evaluation model.

Top management faces a challenge – that is, making sure that the performance-evaluation model of subordinate managers is consistent with the decision model.
True or False ???

- The cost of a machine purchased last year will be relevant in a decision for next year.
- A sunk cost can never be relevant.
- Qualitative factors, because they are not measured numerically, are unimportant in the decision-making process.
- All variable costs are relevant and all fixed costs are irrelevant.
- When the performance evaluation model and the decision model conflict, managers usually will give preference to the performance evaluation model.
Pick your Choice I:

- POP produces three products that all use material A in their production. Information regarding the products and their costs are as follows (all information is per unit):

<table>
<thead>
<tr>
<th></th>
<th>Product 1</th>
<th>Product 2</th>
<th>Product 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selling price</td>
<td>$200</td>
<td>$400</td>
<td>$500</td>
</tr>
<tr>
<td>Variable cost</td>
<td>120</td>
<td>280</td>
<td>340</td>
</tr>
<tr>
<td>As used per unit</td>
<td>5</td>
<td>7</td>
<td>9</td>
</tr>
</tbody>
</table>

- During the next period, POP will only be able to obtain 5,000 units of material A. In what order should POP produce the products next period to maximize profit?
  - 1, 2, 3
  - 2, 3, 1
  - 3, 2, 1