Decision making and Relevant Information

Session 11
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>$0.00</td>
</tr>
<tr>
<td>Labor</td>
<td>$0.50</td>
<td>$1.50</td>
</tr>
<tr>
<td>Manufacturing 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 manufacturing labor amounts to $45,000.
- Total fixed 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 \times 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:

- **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 \( (p_2 - k_2) \cdot a_1/a_2 \)

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 overhead $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.
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
Equipment-Replacement Decisions

- 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 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.
Decisions and Performance Evaluation

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