LEARNING OBJECTIVES

- Use the five-step decision-making process to make decisions
- Distinguish relevant from irrelevant information in decision situations
- Explain the importance of strategic and qualitative factors in decision making
- Explain the opportunity cost concept and why it is used in decision making
- Choose which products to produce when there are capacity constraints
- Describe factors managers must consider when adding or dropping customers or segments
- Explain why carrying amount of equipment is irrelevant in equipment-replacement decisions
- Explain how conflicts can arise between the decision model used by a manager and the performance-evaluation model used to evaluate the manager
The management accountant’s role in decision making

- To provide relevant information to managers and teams who make the decisions
- **Tactical decisions**
  - Do not require significant or permanent resource commitments
  - Can be changed or reversed quickly
- **Long-term (strategic) decisions**
  - Tend to be more strategic in nature
  - May involve increases or decreases in capacity-related resources
  - More difficult to reverse and effects may extend over longer time periods

Information and the decision process

- A decision model is a formal method of making a choice, often involving both quantitative and qualitative analyses.
- Managers often use some variation of the five-step decision-making process.
Model for Making Tactical Decisions

- Recognise and **define the problem**.
- Identify alternatives as possible solutions to the problem, and eliminate alternatives that are clearly not feasible.
- Identify the costs and benefits associated with each feasible alternative.
- Classify costs and benefits as relevant or irrelevant and eliminate irrelevant ones from consideration.

Decision-Making (Continued)

- Gather necessary data on all relevant costs and benefits, expressing them on the same periodically recurring basis.
- Total the relevant costs and benefits for each alternative.
- Select the alternative with the greatest overall benefit.
- Implement the decision and evaluate performance and learn.

THE DEVIL IS IN THE DETAILS
The concept of relevance

**Relevant costs and relevant revenues:**
- relevant information has two characteristics
  - it occurs in the future
  - it differs among the alternative courses of action
- relevant costs = expected future costs
- relevant revenues = expected future revenues.

**SUNK COSTS ARE NEVER RELEVANT**
- Costs that have already been incurred and are irrelevant to any future decisions
- However PREDICTION OF FUTURE COSTS may be based on past data

---

**Sunk Costs**

Cost already incurred which cannot be recovered regardless of future events.

Chasing sunk costs is like insisting on using a gate that leads nowhere, just because it is there.

---

**SUNK COSTS**

what are they?

WHAT THEY ARE IS...
GONE...GONE. GONE

Not sure what that means...??
Then how about.... THEY ARE JUST GONE

---
Characteristics of relevant information

- **Timeliness versus accuracy**
  - Information available in time to be used in the decision-making process
  - As accuracy increases, timeliness may decrease
- **Qualitative and quantitative relevant information**
  - **Quantitative** factors are outcomes that are measured in numerical terms
  - **Qualitative** factors are outcomes that are difficult to measure accurately in numerical terms
  - are just as important as quantitative factors even though they are difficult to measure.

Characteristics of relevant information (summarised)

- Past (historical) costs may be helpful as a basis for making predictions. However, **past costs** themselves are always **irrelevant** when making decisions.
- Different alternatives can be compared by examining differences in expected total future revenues and expected total future costs.
- Not all expected future revenues and expected future costs are relevant.
  - Expected future revenues and expected future costs that do not differ between alternatives are irrelevant and hence can be eliminated from the analysis. The key question is always, **What difference will an action make?**
- Appropriate weight must be given to **qualitative factors** and **quantitative non-financial factors**.

The importance of providing only relevant information

Generating information is a costly process

- Supplying irrelevant data can result in a waste of managerial resources
- Information overload decreases the effectiveness of decision making
Information for unique versus repetitive decisions

- **Unique decisions**
  - Arise infrequently or only once
  - Relevant information will often be found both inside and outside the organisation
  - Relevant information is harder to generate

- **Repetitive decisions**
  - Made at regular or irregular intervals
  - May draw on a large amount of historical data
  - Relevant information is readily available

Information for decisions: terminology

- **Incremental revenue**
  - The additional revenue that will be gained as a result of choosing one course of action over another

- **Incremental costs**
  - The additional costs that arise from choosing one course of action over another

- **Differential cost**
  - The difference in total cost between two alternatives

- **Differential revenue**
  - The difference in total revenue between two alternatives.

(continues)

Information for decisions: terminology (cont.)

- **Avoidable costs**
  - Costs that will not be incurred in the future if a particular decision is made

- **Unavoidable costs**
  - Costs that will continue to be incurred no matter which decision alternative is chosen
  - **Irrelevant** to the decision
Why differential analysis of relevant costs?

- **Focus** on costs that differ under alternative actions.
- Shows the **impact** of the decision at hand.

Relevance: choosing output levels

**Potential problems in relevant-cost analysis:**
- **avoid** incorrect general assumptions about information, especially including:
  - that all variable costs are relevant and all fixed costs are irrelevant
  - **unit cost data** can potentially **mislead** decision makers in two ways:
    - when irrelevant costs are included (often because they have been allocated and then unitised)
    - when the same unit costs are used at different output levels.

Relevance: choosing output levels

**Avoiding potential problems with relevant-cost analysis:**
- focus on total revenues and total costs, not their per-unit equivalents
- continually evaluate data to ensure that it meets the requirements of relevant information.
Special considerations

- Importance of time span
  - All costs are variable and relevant in long run
  - Market price levels change over time
  - Full costs should be considered
- Opportunity costs of other alternatives
- Non-quantitative (qualitative) considerations

Illustrative Examples of Tactical Decision Making

- Make or Buy
- Keep or Drop
- Special Order
- Sell or Process Further
- Product Mix

Activity resource usage model and assessing relevancy

- Resources acquired as used and needed
- Resources acquired in advance (short-term)
- Resources acquired in advance (multiperiod service capacity)
Activity Resource Usage Model and Assessing Relevancy

(Continued)

**Resources Acquired as Needed**

- Demand changes across alternative
  - Relevant
  - Not Relevant

- Demand does not change across alternatives
  - Relevant
  - Not Relevant

**Acquired in Advance (Short Term)**

**Committed Resources**

- Demand Increase < Unused Capacity
  - Not Relevant

- Demand Increase > Unused Capacity
  - Relevant

- Demand Decrease (Permanent)
  - 1. Activity Capacity Reduced
    - Relevant
  - 2. Activity Capacity Unchanged
    - Not Relevant

**Resources Acquired in Advance Multiperiod Capacity**

**These are “Sunk” Costs**

- Demand Increase < Unused Capacity
  - Not Relevant

- Demand Decrease (Permanent)
  - Not Relevant

- Demand Increase > Unused Capacity
  - Not Relevant

*The decision to acquire multiperiod capacity is not a tactical decision but a strategic decision - typically supported by capital budgeting decision processes.*
Illustrative Examples of Tactical Decision Making

Assumptions of C-V-P Analysis
- The analysis assumes a linear revenue function and a linear cost function.
- The analysis assumes that price, total fixed costs, and unit variable costs can be accurately identified and remain constant over the relevant range.
- The analysis assumes that what is produced is sold.
- For multiple-product analysis, the sales mix is assumed to be known.
- The selling price and costs are assumed to be known with certainty.

Insourcing-versus-outsourcing and make-versus-buy decisions

Outsourcing and idle facilities:
- **Outsourcing** – purchasing goods or services from outside vendors
- **Insourcing** – producing the same goods or services within the organisation
  - also called the ‘make or buy’ decision
- Quality, dependability of suppliers, and costs are generally the most important factors in the make-or-buy decision.

Strategic and qualitative factors
- Strategic and qualitative (non-quantitative) factors may be extremely important in an evaluation process, yet do not show up directly in calculations:
  - quality requirements
  - reputation of outsourcer
  - employee morale
  - sustainability
  - logistical considerations – distance from plant, etc.
Make-or-Buy Decisions

Assume the following cost data relate to the decision to produce 12,000 units of a product or buy from an external source:

<table>
<thead>
<tr>
<th>Total Costs</th>
<th>Unit Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rental of equipment</td>
<td>$15,000</td>
</tr>
<tr>
<td>Equip. depreciation</td>
<td>$3,000</td>
</tr>
<tr>
<td>Direct materials</td>
<td>$12,000</td>
</tr>
<tr>
<td>Direct labour</td>
<td>$24,000</td>
</tr>
<tr>
<td>Variable overhead</td>
<td>$9,000</td>
</tr>
<tr>
<td>Fixed overhead</td>
<td>$36,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$99,000</td>
</tr>
</tbody>
</table>

Purchase price from an outside vendor is $5.50 per unit

---

Make-or-Buy Decision (Continued)

<table>
<thead>
<tr>
<th>Alternatives</th>
<th>Make</th>
<th>Buy</th>
<th>Differential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rental of equipment</td>
<td>$15,000</td>
<td>$15,000</td>
<td></td>
</tr>
<tr>
<td>Equip. depreciation</td>
<td>$3,000</td>
<td>$3,000</td>
<td></td>
</tr>
<tr>
<td>Direct materials</td>
<td>$12,000</td>
<td>$12,000</td>
<td></td>
</tr>
<tr>
<td>Direct labour</td>
<td>$24,000</td>
<td>$24,000</td>
<td></td>
</tr>
<tr>
<td>Variable overhead</td>
<td>$9,000</td>
<td>$9,000</td>
<td></td>
</tr>
<tr>
<td>Fixed overhead</td>
<td></td>
<td></td>
<td>Not Relevant</td>
</tr>
<tr>
<td>Purchase Cost</td>
<td>$66,000.00</td>
<td>($66,000)</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$63,000</td>
<td>$66,000</td>
<td>($3,000)</td>
</tr>
</tbody>
</table>

Decision: Manufacture parts in-house

---

Keep-or-Drop Decision

Assume the following:

<table>
<thead>
<tr>
<th>Regular</th>
<th>Deluxe</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales Units</td>
<td>400</td>
<td>200</td>
</tr>
<tr>
<td>Sales revenue</td>
<td>$200,000</td>
<td>$150,000</td>
</tr>
<tr>
<td>Less variable expenses:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Variable cost of sales</td>
<td>($96,000)</td>
<td>($60,000)</td>
</tr>
<tr>
<td>Variable selling &amp; admin.</td>
<td>($10,000)</td>
<td>($7,500)</td>
</tr>
<tr>
<td>Contribution Margin</td>
<td>$94,000</td>
<td>$82,500</td>
</tr>
<tr>
<td>Less direct fixed expenses:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct fixed costs</td>
<td>($40,000)</td>
<td>($35,000)</td>
</tr>
<tr>
<td>Product Margin</td>
<td>$54,000</td>
<td>$47,500</td>
</tr>
<tr>
<td>Less common fixed costs</td>
<td>($30,000)</td>
<td></td>
</tr>
<tr>
<td>Net income</td>
<td>$24,000</td>
<td></td>
</tr>
</tbody>
</table>

Should the Deluxe product line be eliminated?
Keep-or-Drop (Continued)

<table>
<thead>
<tr>
<th>Deluxe</th>
<th>Keep</th>
<th>Drop</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales revenue</td>
<td>$150,000</td>
<td>($150,000)</td>
<td></td>
</tr>
<tr>
<td>Less variable expenses:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Variable cost of sales</td>
<td>($60,000)</td>
<td>$60,000</td>
<td></td>
</tr>
<tr>
<td>Variable selling &amp; admin.</td>
<td>($7,500)</td>
<td>$7,500</td>
<td></td>
</tr>
<tr>
<td>Contribution Margin</td>
<td>$82,500</td>
<td>($82,500)</td>
<td></td>
</tr>
<tr>
<td>Less direct fixed expenses:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct fixed costs</td>
<td>($85,000)</td>
<td>$85,000</td>
<td></td>
</tr>
<tr>
<td>Less common fixed costs</td>
<td>Not Relevant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net income</td>
<td>($2,500)</td>
<td>$2,500</td>
<td></td>
</tr>
</tbody>
</table>

Decision: Drop the Deluxe product line but investigate alternative use of facilities. This analysis provides a benchmark for future decisions.

Special-Order Decisions

One-time-only special orders:
- one type of decision that affects output levels is one-time-only special orders, and whether to accept or reject them when there is idle production capacity, and whether the special orders have long-run implications
- decision rule: does the special order generate additional operating profit?
  ✔ YES – ACCEPT
  ❌ NO – REJECT
- compares relevant revenues and relevant costs to determine profitability.

Important: XYZ Company has idle capacity and can produce the special order without affecting its current production.

Assume the following price quotation sheet for the XYX Company who has received an offer buy at $38 per unit.

| Direct materials | $12 |
| Direct labour | $14 |
| Variable overhead | $4 |
| Variable selling & admin | $2 |
| Fixed manufacturing | $20 |
| Total | $52 |
| Markup—50% | $26 |
| Target selling price | $78 |
Special-Order Decisions
Decision Rule: The “floor” for establishing a price for a special order is incremental cost (variable cost in this case).

<table>
<thead>
<tr>
<th>Incremental Costs</th>
<th>$12</th>
<th>$14</th>
<th>$4</th>
<th>$2</th>
<th>Not Relevant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct materials</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct labour</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Variable overhead</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Variable selling &amp; admin</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>$32</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Incremental Income $38
Incremental Costs $32
Incremental Income $6

Question: What impact is this decision likely to have on existing customers?

A Decision to Sell or Process Further

Joint Input → Joint Costs

<table>
<thead>
<tr>
<th>Joint products</th>
</tr>
</thead>
</table>

Should the company process further?

Product A

Separate Processing

Product B

Separate Processing

A Decision to Sell or Process Further

<table>
<thead>
<tr>
<th>Products</th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales value at split-off</td>
<td>$240,000</td>
<td>$300,000</td>
</tr>
<tr>
<td>Sales value after additional processing</td>
<td>$320,000</td>
<td>$450,000</td>
</tr>
<tr>
<td>Allocated joint product costs</td>
<td>$160,000</td>
<td>$200,000</td>
</tr>
<tr>
<td>Cost of further processing</td>
<td>$100,000</td>
<td>$120,000</td>
</tr>
<tr>
<td>Incremental revenue from processing</td>
<td>$80,000</td>
<td>$180,000</td>
</tr>
<tr>
<td>Cost of additional processing</td>
<td>$100,000</td>
<td>$120,000</td>
</tr>
<tr>
<td>Profit (loss) from further processing</td>
<td>$80,000</td>
<td>$60,000</td>
</tr>
<tr>
<td>Decision</td>
<td>Sell at split-off</td>
<td>Process further</td>
</tr>
</tbody>
</table>

Joint costs are irrelevant

Joint Cost Allocation Methods not covered in this unit. If you are curious about how to go to:
http://accountingexplained.com/managerial/cost-allocation/joint-cost-allocation-methods
Opportunity costs and outsourcing

The opportunity cost approach

- **Opportunity cost** is the contribution to operating profit that is foregone by not using a limited resource in its next-best alternative use.
  - The **relevant cost** of any **alternative** is:
    - the **incremental cost** of the alternative, plus
    - the **opportunity cost** of the profit forgone from choosing that alternative.
  - How much profit did the firm ‘lose out on’ by not selecting this alternative?

Carrying costs of inventory

- Special type of opportunity cost:
- Holding cost for inventory.
- Funds tied up in inventory are not available for investment elsewhere.

Product mix decisions with capacity constraints

- The decisions that are made by a company about which products to sell and in what quantities.
- Decision rule (**with a constraint**) – choose the product that produces the highest contribution margin per unit of the constraining resource.
Theory of Constraints

- The **Theory of Constraints (TOC)** describes methods to maximise operating profit when faced with some constraint(s), bottleneck and some non-bottleneck operations.
- TOC focuses on a short-run time period and assumes that operating costs are fixed costs.
- Throughput contribution equals revenues minus the direct material cost of the goods sold.

Managing throughput

- The **Theory of Constraints**
  - Focuses on identifying and removing bottlenecks to improve the rate of throughput
  - Recognises the rate of production is limited to the capacity of the constraints (or bottlenecks) that exist
- Throughput accounting
  - Measures effects of bottlenecks and other operational decisions using measures of throughput, inventory and operating expenses
Theory of Constraints

Significance of bottlenecks

- Maximum speed of the process is the speed of the slowest operation.
- Any improvements will be wasted unless the bottleneck is relieved.
  - Bottlenecks must be identified and improved if the process is to be improved.

Purpose is to identify bottlenecks or other constraints and exploit them to the extent possible.
- Identification of constraints allows management to take action to alleviate the constraint in the future.
  - Reduce cycle time – Time from receipt of customer order to shipment.
  - Improve manufacturing cycle efficiency (MCE) – Processing time / total cycle time.

Assumes current constraints cannot be changed in the short-run.
- What should be produced now, with current resources, to maximize profits?
  - Question cannot be answered by traditional accounting methods.
Theory of Constraints

- Management tool, not an accounting tool
  - Not used to determine inventory values
  - Not used to allocate overhead to inventory
  - Does not comply with GAAP
- Does indicate how to use available resources most effectively

The Need for TOC

Standard costing
- Can promote undesirable behavior
  - Work to keep people busy
    - Local optimization
    - Inventory is produced regardless of need
- **Does indicate** what it should cost to produce a product
- **Does not indicate** which products will maximize profits given the constraints
  - Doesn’t take constraints into account
  - Does not consider the demands each item places on limited resources

Absorption costing
- Can promote undesirable behavior
  - Production costs are assets until sold
    - Accumulation of inventory keeps costs off the income statement
    - Illusion of profitability
- **Does indicate** what it costs to produce a product
- **Does not indicate** which products will maximize profits given the constraints
  - Doesn’t take constraints into account
  - Absorption cost does not consider the demands each item places on limited resources
The Need for TOC

**Variable (direct) costing**
- Identifies the incremental costs of producing a product
  - Identifies product that provides the greatest contribution margin, or contribution margin per unit of constrained resource
  - Cannot deal with more than one constraining resource at a time

Traditional definition of variable cost doesn’t always hold up in the short-run
- Labor, variable overhead aren’t necessarily variable on a day-to-day basis
- Some costs are truly variable in the short-run
  - Material, commissions, delivery costs, out-of-pocket selling costs, etc.
  - Each additional unit produced or sold causes more of the cost to be incurred

Theory of constraints – web link
The Need for TOC

Theory of Constraints

- Uses linear programming to determine best use of limited resources
- Indicates what should be produced and in what quantities

Basic Concepts of Constrained Optimization
Linear Programming Approach

For illustration purposes let's say the unit contribution margins are $300 and $600 for X and Y, respectively.

\[ Z = 300X + 600Y \]

Total contribution margin

This equation is called the objective function, the function to be optimized.

Basic Concepts of Constrained Optimization
Linear Programming Approach

One Binding Internal Constraint

<table>
<thead>
<tr>
<th>Products</th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Machine Hours available</td>
<td>120</td>
<td>120</td>
</tr>
<tr>
<td>Contribution margin</td>
<td>$300</td>
<td>$600</td>
</tr>
<tr>
<td>Production time (machine hrs)</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Contribution/hour</td>
<td>$300</td>
<td>$200</td>
</tr>
<tr>
<td>Available hours</td>
<td>120</td>
<td>120</td>
</tr>
<tr>
<td>Total Contribution</td>
<td>$36,000</td>
<td>$24,000</td>
</tr>
</tbody>
</table>

Optimal mix is 120

Products

120
More than one binding constraint.

**Objective Function**: Max \( Z = 300X + 600Y \)

**Data**

<table>
<thead>
<tr>
<th>Resource</th>
<th>Available Usage/Unit</th>
<th>Part X Usage/Unit</th>
<th>Part Y Usage/Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grinding</td>
<td>80 hours</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Drilling</td>
<td>120 hours</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Polishing</td>
<td>90 hours</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Market Demand X</td>
<td>60 units</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Market Demand Y</td>
<td>100 units</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

**Internal Constraints**

- \( X + Y \leq 80 \) grinding hours
- \( 2X + Y \leq 90 \) labour hours
- \( X + 3Y \leq 120 \) drilling hours

**External Constraints**

- \( X \leq 60 \)
- \( Y \leq 100 \)

**Non-negativity constraints**

- \( X \geq 0 \)
- \( Y \geq 0 \)

---

**Graphical Solution**

- If \( y = 0 \) then \( x = 45 \)
- If \( x = 0 \) then \( y = 90 \)
- If \( y = 0 \) then \( x = 80 \)
- If \( x = 0 \) then \( y = 80 \)
- If \( y = 0 \) then \( x = 120 \)
- If \( x = 0 \) then \( y = 40 \)

---

**Solve using simultaneous equations**

1. \( 2X + Y = 90 \)
2. \( X + 3Y = 120 \)
3. \( X = 120 - 3Y \)
4. Substituting \( X \): \( 2(120 - 3Y) + Y = 90 \)
5. \( 240 - 6Y + Y = 90 \)
6. \( 5Y = 150 \)
7. \( Y = 30 \)
8. Substituting \( Y \): \( X + 3Y = 120 \) and \( X + 90 = 120 \)
9. \( X = 30 \)
Basic Concepts of Constrained Optimization

* Solve using simultaneous equations

\[
\begin{align*}
2X + Y &= 90 \\
X + 3Y &= 120
\end{align*}
\]

\[
\begin{align*}
Y &= 90 - 2X \\
Y &= 30
\end{align*}
\]

\[
X + 3Y = 120
\]

\[
X + 3(90 - 2X) = 120
\]

\[
5X = 150
\]

\[
X = 30
\]

\[
X + 2Y = 90
\]

\[
60 + Y = 120
\]

\[
Y = 30
\]

Basic Concepts of Constrained Optimization

**Linear Programming**

<table>
<thead>
<tr>
<th>Corner Point</th>
<th>X-Value</th>
<th>Y-Value</th>
<th>(Z = 300X + 600Y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>B</td>
<td>0</td>
<td>40</td>
<td>24,000</td>
</tr>
<tr>
<td>C</td>
<td>30</td>
<td>30</td>
<td>27,000</td>
</tr>
<tr>
<td>D</td>
<td>45</td>
<td>0</td>
<td>13,500</td>
</tr>
</tbody>
</table>

C is the optimal solution!

Theory of Constraints

Based on the concepts of drum, buffer and ropes

- **Drum**
  - Output of the constraint is the **drumbeat**
    - Sets the **tempo** for other operations
    - Tells upstream operations what to produce
    - Tells downstream operations what to expect
Theory of Constraints

- **Buffer**
  - Stockpile of work in process in front of constraint
    - Precaution to keep constraint running if upstream operations are interrupted
- **Rope**
  - Sequence of processes prior to and including the constraint
    - Want to "pull" the rope at the maximum speed
    - Speed of the constraint
Theory of Constraints

Five-Step Method for Improving Performance
1. Identify an organization’s constraints.
2. Exploit the binding constraints.
3. Subordinate everything else to the decisions made in Step 2.
4. Elevate the organization’s binding constraints.
5. Repeat the process as a new constraint emerges to limit output.

Managing bottlenecks

Five-Step Method for Improving Performance
1. Identify an organization’s constraints
2. Recognise that the bottleneck operation (constraint) that determines throughput contribution of the entire system (called the drummer)
3. Identify the bottleneck operation by identifying operations with large quantities of inventory waiting to be worked on
4. Focus is on maximizing throughput
   - Sales – totally variable costs
   - All other costs treated as fixed operational expenses
   - Cannot vary much in the short-run

Managing bottlenecks

1. Identify an organization’s constraints
   - Internal
     - Process constraints
     - Machine time, etc.
     - Policy constraints
     - No overtime, etc.
   - External
     - Material constraints
     - Insufficient materials
     - Market constraints
     - Insufficient demand
2. How is a bottleneck constraint identified?
   - The graphical solution readily identifies the bottleneck constraint
Managing bottlenecks

Five-step method for improving performance

1. Keep the bottleneck operation busy
   - Constraint must be kept operating at its full capacity
   - If not, the entire process slows further
   - Take actions to increase the efficiency and capacity of the bottleneck operation. The objective is to increase the difference between throughput contribution and the incremental costs of increasing efficiency and capacity
   - Eliminate idle time at the bottleneck operation
   - Reduce setup time and processing time at bottleneck operations
   - Improve the quality of parts or products manufactured at the bottleneck operation.

2. Subordinate all non-bottleneck operations to the bottleneck operation
   - All other operations must be geared toward the goal of keeping the bottleneck operation working at 100%.
   - May require sub-optimization in other areas
   - Upstream operations must provide only what the constraint can handle
   - Downstream operations will only receive what the constraint can put out
   - Process only those parts or products that increase throughput contribution, not parts or products that will remain in finished goods or spare-parts inventories
   - Shift products that do not have to be made on the bottleneck operation to non-bottleneck processes, or to outside processing facilities
   - May need to change performance measures to conform upstream activities to the “rope” speed

Theory of Constraints

3. Elevate the organization’s binding constraints.
   - Determine how to increase its capacity

4. Repeat the process as a new constraint emerges to limit output.
   - Always a new constraint
**Basic Concepts of Constrained Optimization**

- Solve using simultaneous equations

\[
\begin{align*}
2X + Y &= 90 \\
X + Y &= 80
\end{align*}
\]

\[
X = 80 - Y
\]

Substitute \( X \) into \( 2X + Y = 90 \)

\[
2(80 - Y) + Y = 90
\]

\[
160 - 2Y + Y = 90
\]

\[
Y = 70
\]

Substitute \( Y \) into \( X + Y = 80 \)

\[
X + 70 = 80
\]

\[
X = 10
\]

---

**Evaluation of TOC**

**Advantages**

- Improves capacity decisions in the short-run
- Avoids build up of inventory
- Aids in process understanding
- Avoids local optimization
- Improves communication between departments

**Disadvantages**

- Negative impact on non-constrained areas
  - Diverts attention from other areas that may be the next constraint
  - Temptation to reduce capacity
Evaluation of TOC

- Ignores long-run considerations
  - Introduction of new products
  - Continuous improvement in non-constrained areas
- May lead organization away from strategy
- Not a substitute for other accounting methods

Managing bottlenecks – web links

- ‘Busting bottlenecks in the Bakken’ article and video showing how bottlenecks in the flow of energy to the market are being dealt with can be found at: http://www.minneapolisfed.org/publications_papers/pub_display.cfm?id=5083
- ‘Unblocking bottlenecks: fixing unbalanced processes’ can be found at: http://www.mindtools.com/pages/article/newTMC_76.htm

Customer profitability, activity-based costing and relevant costs

Relevant-revenue and relevant-cost analysis of dropping or adding a customer:
- If the cost object is a customer, companies must make decisions about adding or dropping customers (analogous to a product line)
- decision rule: does adding or dropping a customer add operating profit to the firm?
  - ✔ YES – ADD or DON’T DROP
  - ✘ NO – DROP or DON’T ADD
- decision is based on profitability, not how much revenue is generated.
Segment profitability, activity-based costing and relevant costs

**Relevant-revenue and relevant-cost analysis of closing or adding branch offices or segments**
- Companies must make decisions about adding or dropping:
  - a branch office
  - a business segment.
- **decision rule**: Does the action add operating profit to the firm?
- There is a need to consider strategic factors, such as consequences to their employees from the shutdown. Can these employees be relocated to the new location?

Customer profitability, activity-based costing and relevant costs – web link

- A YouTube lecture on ABC and customer profitability analysis can be found at: [http://www.youtube.com/watch?v=vxD1UR59f1M](http://www.youtube.com/watch?v=vxD1UR59f1M)

Irrelevance of past costs and equipment replacement decisions

- These decisions are sometimes difficult due to amount of information at hand that is irrelevant, for example:
  - cost, accumulated depreciation, and carrying amount of existing equipment
  - any potential gain or loss on the transaction – a financial accounting phenomenon only.
- **Decision rule** – select the alternative that will generate the highest operating profit.
Irrelevance of past costs and equipment replacement decisions
Which of the following items are relevant, and which are irrelevant, to the replacement decision?
1. carrying amount of old machine
2. current disposal value of old machine
3. loss on disposal
4. cost of new machine.

Answer:
✘ 1 and 3 are irrelevant
✔ 2 and 4 are relevant.

Decisions and performance evaluation
• Despite the quantitative nature of some aspects of decision making not all managers will choose the best alternative for the firm.
• In order to be considered for a bonus, managers could engage in self-serving behavior, such as delaying needed equipment maintenance, in order to meet their personal profitability.
• Cost systems may be designed explicitly to encourage certain biases in decision making
• To encourage managers and employees to make certain decisions, systems must be designed with this in mind

Implications of activity-based cost analysis for decisions
Identification of relevant costs, incremental costs, opportunity costs, sunk costs and avoidable costs
• Costs may be more accurately assigned to products or departments
• Leads to the identification of precise cost implications of various decision alternatives
Pitfalls to avoid in using accounting data for decisions

- Ignore sunk costs
- Beware of unitised fixed costs in decision making
- Beware of allocated fixed costs; identify the avoidable costs
- Pay special attention to identifying and including opportunity costs in a decision analysis

Relevant and Irrelevant Costs

<table>
<thead>
<tr>
<th>SUMMARY CLASSIFICATIONS</th>
<th>RELEVANT COSTS</th>
<th>IRRELEVANT COSTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Future costs that differ among competing alternatives</td>
<td>Costs that do not differ among competing alternatives</td>
<td></td>
</tr>
<tr>
<td>Opportunity Costs</td>
<td>Outlay Costs</td>
<td>Sunk Costs</td>
</tr>
<tr>
<td>Net cash flow from the best alternatives</td>
<td>Future costs requiring future expenditures that differ</td>
<td>Future costs requiring future expenditures that do not differ</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A historical cost resulting from a past decision</td>
</tr>
</tbody>
</table>

Summary

- Tactical decisions do not require significant changes in capacity and can be changed if better opportunities arise
- Relevant information will include quantitative and qualitative information, as well as strategic issues
- In decision analysis, incremental revenues and costs are usually the focus, and in some cases so are avoidable costs
- Identifying whether there is spare capacity is important in special orders and make or buy decisions, as opportunity costs become relevant where there is no spare capacity

(cont.)
Summary (cont.)

- Adding or deleting a product/department involves consideration of avoidable and unavoidable costs
- Processing joint products further requires consideration of incremental revenue and costs
- ABC system may provide more accurate information than costs generated from conventional costing systems
- Management incentives can sometimes distort the collection and analysis of information in decisions
- Accounting data should be used carefully in decision analysis as it can be problematic

Simple method of calculating and ISO line

- An isocline (from ἱκλίνειν or klinein, meaning 'to lean or slope') is a line joining points with equal slope. Frequently referred to as an ISO line
- Used in TOC to identify the optimised intersection point.
- In this case the ISO line is the ISO-Contribution
- For the Objective Function Max Z=300X+600Y
- Multiply the two coefficients (in this case 300 and 600) = 180,000
- Solve the objective function for x and y using the answer above (ie 300x + 600y = 180,000 and substituting 0 (zero) for x and y respectively; x will equal the coefficient of y and y will equal the coefficient of x)
- X=600 & y=300; you can now adjust the values of x & y proportionately to fit onto the graphical solution. In this case by dividing all sides by 10, x=60 & y=30; or if you like divide all sides by 20 and x=30 & y=15; or try dividing all sides by 5... etc etc...that's all there is to it.