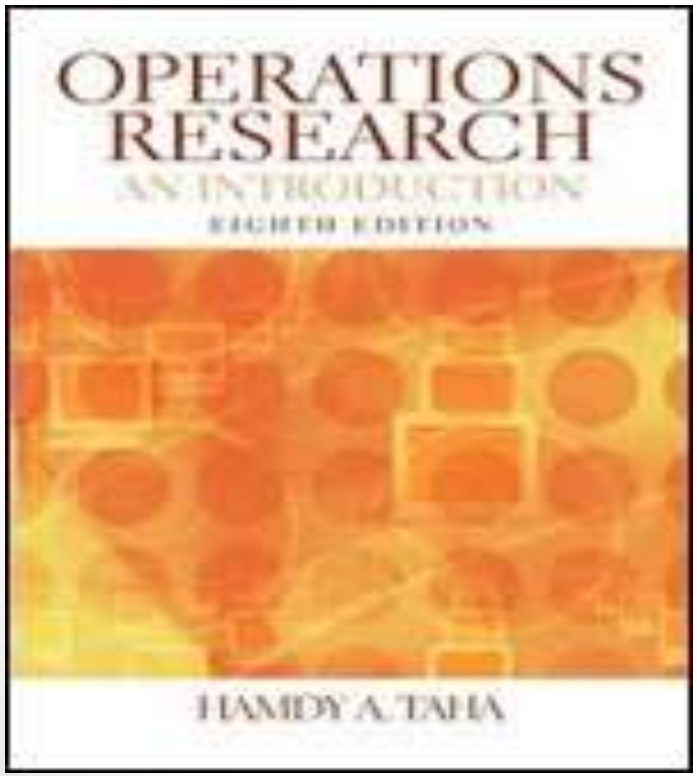
Introduction to Operation Research



Hamdy A. Taha, Operations Research: An introduction

What is management sciences/ Operation Research (OR)?

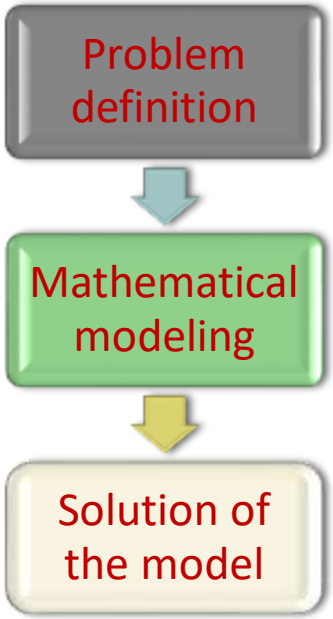
- In general, the organization goal is to optimize the use of available resources.
- Management science/OR is a discipline that adapts the scientific approach to problem solving to decision making.

Mathematical Modeling and the Management Science/Operation Research Process

- **Mathematical Modeling**
  - **A process that translates observed phenomena into mathematical expressions.**

Operation Research Process

- The Management Science/OR Process
  - By and large, the Management Science/OR process can be described by the following steps procedure.



Operation Research Process

- Basic Steps of the Management Science/OR Process

  1- Defining the Problem.

  2- Building a Mathematical Model.

  3- Solving a Mathematical Model.

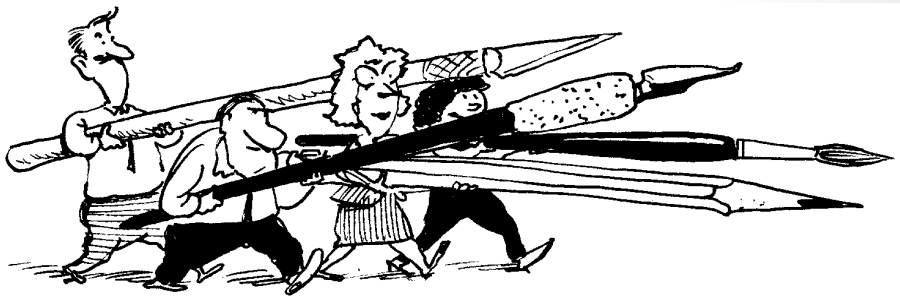
1- Defining the Problem

- **Management Science/ OR is Applied**

When -

- Designing and implementing new operations.
- Evaluating ongoing Operations and Procedures.
- Determining and recommending corrective actions.

Process



How to Start and How to Proceed

- Identify the problem.
- Observe the problem from various points of view.
- Keep things simple.
- Identify constraints.
- Work with management, get feedback .

2- Building a Mathematical Model

- Identify Decision Variables
  - Which factors are controllable?
- Quantify the Objective and Constraints
  - Formulate the function to be optimized (profit, cost).
  - Formulate the requirements and/or restrictions.
- Construct a Model Shell
  - Help focus on the exact data required.
- Gather Data --
  - Consider time / cost issues.

Mathematical Formulation

Mathematical modeling formulation: The general OR model can be organized in the following general format:-

Maximize or minimize {Objective Function}

subject to

{Constraints}

3- Solving a Mathematical Model

- Choose an Appropriate Solution Technique
  - An optimization algorithm.
  - A heuristic algorithm.
- Generate Model Solutions
- Test / Validate Model Results
  - Is the solution reasonable?
  - Are radical changes needed?
  - Does it fit present and future plans?
  - Unacceptable results? Return to modeling.
- Perform "What--If" Analyses

EXAMPLES

- Example 1:

  Wilson company produces three products: desk, chairs, and molded steel.

It is trying to decide on the number of desks (D), chair (C), and pound of model steels (M)

Step 1

Assumption :

1- If the nets $ 50 profit on each desk produced, $30 on each chair produced, and $ 6 per pound of modeled steel produced. What the total profit?

The answer :

Total profit for production run can be modeled by the expression

$$50\,D + 30\,C + 6\,M$$

Step 2

2- if 7 pounds of raw steel are needed to manufacture a desk, 3 pounds to manufacture a chair, and 1.15 pounds to produce a pound of model steel. What the amount of raw steel used during the production?

The answer:

The amount of raw steel used during the production run is modeled by the expression:

$$7D + 3C + 1.5\ M$$

Step 3

3- Wilson has only 2000 pounds of raw steel available.

And at least 100 desk must be produced to satisfy contract commitment.

The answer:

The function constraint can be modeled as :

$$7D + 3C + 1.5M <= 2000 \text{ (raw steel)}$$

$$D >= 100 \text{ (contract)}$$

Problem Formulation

The Mathematical model for this problem is formulated as :

MAXIMIZE 50 D + 30 C + 6 M

SUBJECT TO

7D + 3C + 1.5M <= 2000 (Raw steel)

D >= 100 (contract)