

## **CMS-A-DSE-B--1-TH: Operation Research (O.R.)**

### **Lesson I: Introduction**

#### **1.1 INTRODUCTION**

The term Operations Research was first coined in 1940 by McClosky and Trefthen in a small town, Bowdsey, of the United Kingdom. This new science came into existence in military context. During World War II, military management called on scientists from various disciplines and organized them into teams to assist in solving strategic and tactical problems (ie) to discuss, evolve and suggest ways and means to improve the execution of various military projects. By their joint efforts, experience and deliberations, they suggested certain approaches that showed remarkable progress. This new approach to systematic and scientific study of the operations of the system was called the Operations Research or Operational Research (abbreviated as O.R).

During the year 1950, O.R achieved recognition as a subject worthy of academic study in the Universities. Since then, the subject has been gaining more and more importance for students of Economics, Management, Public Administration, Behavioral Sciences, Social Work, Mathematics, Commerce and Engineering.

Operations Research Society of America was formed in 1950 and in 1957 the International Federation of O.R Societies was established. In several Countries, International Scientific Journals in O.R began to appear in different languages. The primary journals are Operations Research, Transportation Science, Management Sciences, Operational Research Quarterly, Journal of the Canadian Operational Research Society, Mathematics of Operational Research, International journal of Game Theory etc.

#### **1.2 Operational Research in India**

In India, Operational Research came into existence in 1949 with the opening of an Operational Research Unit at the Regional Research Laboratory at Hyderabad. In 1953, an Operational Research Unit was established in the Indian Statistical Institute, Calcutta for the application of Operational Research methods in national planning & survey. Operational Research Society of India was formed in 1957. It became a member of the International Federation of Operational Research Societies in 1959. The first Conference of Operational Research Society of India was held in Delhi in 1959. Operational Research Society of India started a journal "Opsearch" in 1963. Other journals which deal with Operational Research are: Journal of the National Productivity Council, Materials Management journal of India and the Defence Science journal.

### **1.3 Definition**

Because of the wide scope of applications of Operational Research, giving a precise definition is difficult. However, a few definitions of Operational Research are as under:

1. “Operational Research is the application of scientific methods, techniques and tools to problems involving the Operations of a system so as to provide those in control of the system with optimum solutions to the problem”.

- C.W.Churchman, R.L.Ackoff & E.L.Arnoff

2. “Operational Research is the art of giving bad answers to problems which otherwise have worse answers”.

- T.L.Saaty

### **1.4 Models in Operational Research**

A model in Operational Research is a simplified representation of an operation or a process in which only the basic aspects or the most important features of a typical problem under investigation are considered.

#### **Types of Models**

There are many ways to classify models and therefore, the decision-maker must identify which type of model best suits the decision problem.

#### **Physical Models**

These models provide a physical appearance of the real object under study either reduced in size or scaled up physical models are useful only in design problems because they are easy to observe, build and describe.

1. **Iconic models:** Iconic model retain some of the physical properties and characteristics of the system they represent.
2. **Analogue models:** The models represent a system by the set of properties different from that of the original system and does not resemble physically.

## **Symbolic Models**

These models use letters, numbers and other symbols to represent the properties of the system.

1. **Verbal Models:** These models describes a situation in written or spoken language.  
e.g.:- Written Sentences, books etc.,
2. **Mathematical Models:** These models involve the use of mathematical Symbols, letters, numbers and mathematical operators (+, -,  $\div$ ,  $\times$ ) to represent relationship among various variables of the systems to describe its properties or behavior.

## **Descriptive Models**

These models simply describe some aspects of a situation, based on observation, survey, questionnaire results or other available data of a situation and do not predict or recommend.

E.g.:- Plant layout diagram

## **Predictive Models**

These models are used to predict the outcomes due to a given set of alternatives for problem. These models do not have an objective function as a part of the model to evaluate decision alternatives.

## **Optimization Models**

These models provide the 'best' or 'optimal' solution to problems subject to certain limitations of the use of resources.

## **Static Models**

Static models present a system at some specified time and do not account for changes over time.

### **Dynamic Models**

In a dynamic model, time is considered as one of the variables and to admit the impact of changes generated by time in the selection of the optimal courses of action.

### **Deterministic Models**

If all the parameters, constants and functional relationships are assumed to be known with certainty when the decision is made, then the model is said to be deterministic. For a specific set of input values, there is a uniquely determined output which represents the solution of the model under conditions of certainty.

E.g.:- Linear Programming Model.

### **Probabilistic (Stochastic Models)**

Models in which at least one parameter or decision variable is a random variable are called probabilistic (or Stochastic) models. Since at least one decision variable is random, therefore, an independent variable which is the function of dependent variable(s) will also be random. This means consequences or payoff due to certain changes in the independent variable cannot be predicted with certainty. However, it is possible to predict a pattern of values of both the variable by their probability distribution.

E.g.:- Insurance against risk of fire, accidents, sickness etc.

### **Analytical Models**

These models have a specific mathematical structure and thus can be solved by known analytical or mathematical techniques. Any optimization model (which requires maximization or minimization of an objective function) is an analytical model.

### **Simulation Models**

These models also have a mathematical structure but are not solved by applying mathematical structure but are not solved by applying mathematical techniques to get a solution. Instead, a simulation model is essentially a computer assisted experimentation on a mathematical structure of a real-life problem in order to describe and evaluate its behavior under certain assumptions over a period of time.