

Introduction

Operation Research is a relatively new discipline. The contents and the boundaries of the OR are not yet fixed. Therefore, to give a formal definition of the term Operations Research is a difficult task. The OR starts when mathematical and quantitative techniques are used to substantiate the decision being taken. The main activity of a manager is the decision making. In our daily life we make the decisions even without noticing them. The decisions are taken simply by common sense, judgment and expertise without using any mathematical or any other model in simple situations. Operations Research tools are not from any one discipline. takes tools from different discipline such as Mathematics, Statistics, Economics, Psychology, Engineering etc, and Combines these tools to make a new set of knowledge for Decision Making.

DEFINITION of OR :

According to the Operational Research Society of Great Britain “Operational Research is the attack of modern science on complex problems arising in the direction and management of large systems of Men, Machines, Materials and Money in Industry, Business, Government and Defense. Its distinctive approach is to develop a Scientific model of the system, Incorporating measurements of factors such as Change and Risk, with which to predict and compare the outcomes of alternative Decisions, Strategies or Controls. The purpose is to help management determine its policy and actions scientifically”.

According Morse and Kimball, “OR is A scientific method of providing executive departments with a quantitative basis for decisions regarding the operations under their control”

According Miller and Starr, “O.R. is applied decision theory, which uses any scientific, mathematical or logical means to attempt to cope with the problems that confront the executive, when he tries to achieve a thorough-going rationality in dealing with his decision problem”.

Stages of Development of Operations Research: The stages of development of O.R. are also known as phases and process of O.R

Step I: Observe the problem environment

Step II: Analyze and define the problem

Step III: Develop a model

Step IV: Select appropriate data input

Step V: Provide a solution and test its reasonableness

Step VI: Implement the solution

Step I : Observe the problem Environment

Process Activities	Process Output
Site visits, Conferences, Observations, Research	Sufficient information and support to proceed

Step II : Analyze and define the problem

Process Activities	Process Output
Define: Use, Objectives, Limitations	Clear grasp of need for and nature of solution requested

Step III: Develop a mode

Process Activities	Process Output
Define inter relationships, Formulate equations, Use known O.R. Model, Search alternate Model	Models that works under stated environmental constraints

Step IV: Select appropriate data input

Process Activities	Process Output
Analyze: internal-external data, Facts Collect options Use computer data banks	Sufficient inputs to operate and test model

Step V: Provide a solution and test its reasonableness

Process Activities	Process Output
Test the model, find limitations, Update the model	Solution(s) that support current organizational goals

Step VI: Implement the solution

Process Activities	Process Output
Resolve behavioral issues, Sell the idea, Give explanations, Management involvement	improved working and Management support for longer run operation of model

Relationship between Manager/Decision Maker and O.R. Specialists

Steps in problem recognition, formulation and solution	Involvement O.R. specialist or manager
Recognize from organizational symptoms that a problem exists.	Manager
Decide what variables are involved; state the problem in quantitative relationships among the variables.	Manager and O.R. Specialist
Investigate methods for solving the problems as stated above; determine appropriate quantitative tools to be used	O.R. Specialist
Attempt solutions to the problems; find various solutions; state assumptions underlying these solutions; test alternative solutions.	O.R. Specialist
Determine which solution is most effective because of practical constraints within the organization; decide what the solution means for the organization.	Manager and O.R. Specialist
Choose the solution to be used.	Manager
Sell the decision to operating managers; get their understanding and cooperation.	Manager and O.R. Specialist

Tools and Techniques :

The common frequently used tools/techniques are mathematical procedures, cost analysis, electronic computation. However, operations researchers given special importance to the development and the use of techniques like

- Linear Programming
- Game Theory
- Decision Theory
- Queuing Theory
- Inventory Models and Simulation

In addition to the above techniques, some other common tools are

- Non-Linear Programming
- Integer Programming
- Dynamic Programming
- Sequencing Theory
- Markov Process,
- Network Scheduling (PERT/CPM),
- Symbolic Model,
- Information theory, and
- Value theory.

Linear Programming : This is constrained optimization technique, which optimize some criterion within some constraints. In Linear programming the objective function (profit, loss or return on investment) and constraints are linear. There are different methods available to solve linear programming

Game Theory : This is used for making decisions under conflicting situations where there are one or more players/opponents. In this the motive of the players are dichotomized. The success of one player tends to be at the cost of other players and hence they are in conflict.

Decision Theory : It is concerned with making decisions under conditions of complete certainty about the future outcomes and under conditions such that we can make some probability about what will happen in future.

Queuing Theory : This is used in situations where the queue is formed (for example customers waiting for service, aircrafts waiting for landing, jobs waiting for processing in the computer system, etc). The objective here is minimizing the cost of waiting without increasing the cost of servicing.

Inventory Model : It make a decisions that minimize total inventory cost. This model successfully reduces the total cost of purchasing, carrying, and out of stock inventory.

Simulation : It is a procedure that studies a problem by creating a model of the process involved in the problem and then through a series of organized trials and error solutions attempt to determine the best solution. Some times this is a difficult/time consuming procedure. Simulation is used when actual experimentation is not feasible or solution of model is not possible.

Non-linear Programming : This is used when the objective function and the constraints are not linear in nature. Linear relationships may be applied to approximate non-linear constraints but

limited to some range, because approximation becomes poorer as the range is extended. Thus, the non-linear programming is used to determine the approximation in which a solution lies and then the solution is obtained using linear methods

Dynamic Programming : It is a method of analyzing multistage decision processes. In this each elementary decision depends on those preceding decisions and as well as external factors.

Information Theory : This analytical process is transferred from the electrical communication field to O.R. field. The objective of this theory is to evaluate the effectiveness of flow of information with a given system. This is used mainly in communication networks but also has indirect influence in simulating the examination of business organizational structure with a view of enhancing flow of information.

Applications of Operations Research

Accounting:

- Assigning audit teams effectively
- Credit policy analysis
- Cash flow planning
- Developing standard costs
- Establishing costs for byproducts
- Planning of delinquent account strategy

Construction:

- Project scheduling, monitoring and control
- Determination of proper work force
- Deployment of work force
- Allocation of resources to projects

Facilities Planning :

- Factory location and size decision
- Estimation of number of facilities required
- Hospital planning
- International logistic system design
- Transportation loading and unloading
- Warehouse location decision

Finance:

- Building cash management models
- Allocating capital among various alternatives
- Building financial planning models
- Investment analysis
- Portfolio analysis
- Dividend policy making

Manufacturing:

- Inventory control
- Marketing balance projection
- Production scheduling
- Production smoothing

Marketing:

- Advertising budget allocation
- Product introduction timing
- Selection of Product mix
- Deciding most effective packaging alternative

Organizational Behavior / Human Resources:

- Personnel planning
- Recruitment of employees
- Skill balancing
- Training program scheduling
- Designing organizational structure more effectively

Purchasing:

- Optimal buying
- Optimal reordering
- Materials transfer

Research and Development:

- R & D Projects control
- R & D Budget allocation
- Planning of Product introduction

Limitations of Operations Research

Distance between O.R. specialist and Manager : Operations Researchers job needs a mathematician or statistician, who might not be aware of the business problems. Similarly, a manager is unable to understand the complex nature of OR. Thus there is a big gap between the two personnel

Magnitude of Calculations : The aim of the O.R. is to find out optimal solution taking into consideration all the factors. In this modern world these factors are enormous and expressing them in quantitative model and establishing relationships among these require voluminous calculations, which can be handled only by machines

Money and Time Costs : The basic data are subjected to frequent changes, incorporating these changes into the operations research models is very expensive. However, a fairly good solution at present may be more desirable than a perfect operations research solution available in future or after some time

Non-quantifiable Factors : When all the factors related to a problem can be quantifiable only then OR provides solution otherwise not. The non-quantifiable factors are not incorporated in OR models. Importantly O.R. models do not take into account emotional factors or qualitative factors.

Implementation : Once the decision has been taken it should be implemented. The implementation of decisions is a delicate task. This task must take into account the complexities of human relations and behavior and in some times only the psychological factors.