


Operations Research

Introduction




OPERATIONS RESEARCH: HISTORY

- **The roots of OR can be traced back many decades, when early attempts were made to use a scientific approach in the management of organizations.**
- **However, the beginning of the activity called *operations research* has generally been attributed to the military services early in World War II.**
- **Because of the war effort, there was an urgent need to allocate scarce resources to the various military operations and to the activities within each operation in an effective manner.**

- **Therefore, the British and then the U.S. military management called upon a large number of scientists to apply a scientific approach to dealing with this and other strategic and tactical problems.**
 - **In effect, they were asked to do *research on (military) operations*. These teams of scientists were the first OR teams.**
 - **By developing effective methods of using the new tool of radar, these teams were instrumental in winning the Air Battle of Britain.**
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- **O.R. as a formal subject is about fifty five years old, origins may be traced to the latter half of World War II. The impetus for its origin was the development of radar defense systems for the Royal Air Force, and the first recorded use of the term Operations Research is attributed to a British Air Ministry official named **A. P. Rowe** who constituted teams to do “operational researches” on the communication system and the control room at a British radar station.**

OPERATIONS RESEARCH :DEFINITIONS

- **Operations Research (OR) – The science that applies mathematical and computer science tools to support decision making.**
 - **Operations Research is concerned with scientifically deciding how to best design and operate man-machine systems usually requiring the allocating of scarce resources.**
-Operations Research Society, America
 - **OR is the art of winning wars without actually fighting.**
-Arthur Clarke
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➤ **OR is a scientific method of providing executive departments with a quantitative basis for decision regarding the operations under their control.**

-Morse and Kimbal

➤ **OR is the art of giving bad answers to problems where otherwise worse answers are given.**

-T.L Satty



CHARACTERISTICS OPERATIONS RESEARCH

- **Operation Research is the applications 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 problems. The significant features of operation research are as below :**

1. OR is a system approach: The essence of systems approach is to find all significant and indirect effects on all parts of a system and to evaluate each action in terms of the effects for the system as a whole. e.g., a new strategy of marketing department can effect all the other departments of the organisation and so in evaluating the strategy, not only its effects on the marketing department should be considered but also the effects of the proposal on other departments as well.

2. OR is an Inter-disciplinary team approach: OR is interdisciplinary in nature and needs a team approach solving economic, physical, psychological, biological, sociological and engineering aspects of any problem by the assistance of mathematicians, statisticians, engineers, and computer experts, this team for a given problem tries to analyse the cause and effect relationship between various parameters and evaluates the outcome of various alternative strategies.

3. **OR increases creative ability of the decision maker:** OR is a powerful tool in increasing the effectiveness of managerial decision. techniques help the decision maker to improve his creative and capabilities, analyse and understand the problem situation leading to better control, co-ordination, system finally better decisions.

4. OR is Scientific approach : OR gives scientific methods for the purpose of solving problems, and there is no place of whims or guesswork in it. It is a formalized process of reasoning and consists of the following steps:

(i) **Defining:** The problem to be analyzed clearly and defining the conditions for observations.

(ii) **Observing:** Observations are made under different conditions to determine the behaviour of the system.


(iii) **Formulating:** A hypothesis describing how the various factors involved are believed to interact and the best solution to the problem is formulated on the basis of above observations.

(iv) **Testing:** Finally the result of experiment is design and executed, observations are made and measurements are recorded.

(v) **Analysing:** Finally the result of experiment are analysis and check whether hypothesis is accepted or not. If the hypothesis is accepted it means the solution obtained is optimum.

5. OR is Objectivistic approach : OR attempts to find out the strategic or optimal solution to the problem under consideration. For this purpose, it is required that a measure of effectiveness be defined which is based on the objectives of the organisation. This measure is then used as the basis to compare the alternative courses of action.

6. Digital computer : Use of digital computer has become an integral part of the operations research approach to decision-making. The computer may be required due to the complexity of the model, volume of data required or the computations to be made. Many quantitative techniques are available in the form of 'canned' programmes.

- 7. Quantitative solution.** Operation research assists the management with a quantitative basis for decision making. OR attempts to provide a systematic and scientific rational approach for quantitative solutions to the various managerial problems.
- 8. OR is a continuing process :** OR is a continuing process. It continues with the emergence of new problems, finding and implementing solutions and interpreting the results of such implementation. Problems continue to arise in the modern dynamic environment. As such OR becomes a continuing process.
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9. Optimizing Nature : OR tries to optimize total return by maximizing the profit and minimizing the cost or loss.

10. Human judgment : In deriving quantitative solution, sometimes human factors, play significant role, in the problems, are ignored. So, study of the OR is incomplete without a study of human factors.


WHY OPERATIONS RESEARCH

- You may ask, “Why must we learn the Operations Research techniques?” Here are a few motivating reasons:
- Organizations are becoming more complex, Huge numbers of choices and relentless time pressures and margin pressures make the decisions you face more daunting and more difficult.
- Environments are changing so rapidly that past practices are no longer adequate. Meanwhile, new enterprise applications and software are generating massive amounts of data – and it can see like an overwhelming task to turn that data into insight and answers.
- The costs of making bad decisions have increased.

SCOPE OF OPERATION RESEARCH

(The Multidisciplinary and Interdisciplinary Nature of Operations Research)

I. IN DEFENCE OPERATIONS

- Administration
 - Intelligence
 - Operations, and
 - Training and supply.
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II.IN INDUSTRY


Applications of operations research in the area of management

1. Production Management : The production manager can apply OR methods for

- The remunerative policy with regard to time and piece rate.
- Determination of optimum product mix.
- Production, scheduling and sequencing the production run by allocation of machines.
- Work study operation including time study.
- Selecting plant location and design of the sites.
- Distribution policy
- Loading and unloading facility for road transportation.
- Maintenance crew sizes.


2. MARKETING MANAGEMENT

The marketing manager can apply OR method for

- Product selection, timing and formulation of competitive strategies.
 - Marketing research.
 - Distribution strategies.
 - Sales forecasting.
 - Sales promotion.
 - Selection of advertising media and terms of cost and time factor
 - To find optimum number of Salesmen.
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3. FINANCIAL MANAGEMENT

The financial manager can apply OR method for

- Apply cash flow analysis for capital budgeting
 - Formulate credit policies, evaluate credit risks
 - Determine optimum replacement strategies.
 - Frame claim and complaint procedures.
 - Frame policies regarding capital structure.
 - Long range capital requirement.
 - Investments portfolio.
 - Dividend policies.
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4. PERSONAL MANAGEMENT

The personal manager can apply OR method for

- Forecasting the manpower requirement, framing of recruitment policies, assignment of jobs to machines or workers etc.
- Selection of suitable personnel with due consideration for age, education skills training etc.
- Determination of optimum number of persons for each service centre.
- The promotional policies.
- Mixes of age and skills.


5. PURCHASE DEPARTMENT

The purchased department can apply OR method for


- Determining the quantity and timing of purchase of raw materials, machinery etc.
 - Bidding policies.
 - Rules for buying and supplies under varying prices.
 - Equipment replacement policies.
 - Determination of quantities and timing of purchases.
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6. RESEARCH AND DEVELOPMENT DEPARTMENT

**The research and development department can
apply OR method for**

- Determining the areas for research and development.
 - Scheduling and control of R and D projects.
 - Resource allocation and crashing in projects.
 - Project selection.
 - Reliability and alternative design.
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7. MANUFACTURING DEPARTMENT

- **The manufacturing department can apply OR method for :**
 - **Inventory control**
 - **Projection marketing balance.**
 - **Production scheduling**
 - **Production smoothing.**
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8. HR DEPARTMENT

The OB department can apply OR method for

- Personnel selection and planning.
- Scheduling of training programs.
- Skills balancing.
- Recruitment of Employees.

9. ACCOUNTING

DEPARTMENT

**The accounting department can apply OR
method for**

- Cash flow and fund flow planning.
- Credit policy analysis.
- Planning of delinquent account strategy.

10. GENERAL MANAGEMENT

The Techniques & General Management can apply OR method for

- Decision support systems and MIS;
- forecasting.
- Organizational design and control
- Project management,
- Strategic planning.

III. IN GOVERNMENT PLANNING

IV. AGRICULTURE: With the explosion of population and consequent shortage of food, every country is facing the problem of :

- Optimum allocation of land and various crops in accordance with the climatic conditions;
- Optimum distribution of water from various resources like canal for irrigation purposes.
- Thus there is a need of determining best policies under the prescribed restrictions. Hence a good amount of work can be done in this direction.

V. IN HOSPITALS

VI. IN LIFE INSURANCE CORPORATION

VII. IN CONSTRUCTION PROJECTS

VIII. OPERATIONS RESEARCH MANAGEMENT INFORMATION SYSTEMS

IX. OPERATIONS RESEARCH AS SYSTEM SCIENCE:

LIMITATIONS OF OPERATIONS RESEARCH

Operation Research has certain limitations. However, these limitations are mostly related to the problems of model building and the time and money factors involved in its application rather than its practical utility.

Some of them are as follows:

❖ MAGNITUDE OF COMPUTATIONS

O.R tries to find out optimal solution taking into account all the factors. In the modern society these factors are enormous and expressing them in quantity and establishing relationships among these are required complicated calculations which can only be handled by machines.

❖ **NON-QUANTIFIABLE FACTORS**

O.R provides solution only when all elements related to a problem can be qualified. All relevant variables do not lend themselves to quantification. Factors which cannot be quantified, find no place in O.R.

❖ **GAP BETWEEN MANAGER AND OPERATIONS RESEARCHER**

O.R being specialist's job requires a mathematician or a statistician, who might not be aware of the business problems. Similarly, a manager fails to understand the complex working of O.R. Management itself may offer a lot of resistance due to conventional thinking.

❖ MONEY AND TIME COSTS

When the basic data are subjected to frequent changes, incorporation them into the O.R models is a costly affair. Moreover, a fairly good solution at present may be more desirable than a perfect O.R solution available after sometime.

❖ IMPLEMENTATION

Implementation of decisions is a delicate task. It must take into account the complexities of human relations and behaviour. Sometimes resistance is offered only due to psychological factors.

❖ SELECTION OF TECHNIQUE

Operations Research techniques are very useful but they cannot be used indiscriminately. Choice of technique depends upon the nature of problem, operating conditions, assumptions, objectives, etc. Thus, identification and use of an appropriate technique is essential.

❖ NOT A SUBSTITUTE OF MANAGEMENT

Operations Research only provides the tools and cannot be a substitute of management. It only examines the results of alternative courses of action and final decision is made by management within its authority and judgment.

❖ SUB- OPTIMISATION

Sub- optimisation is deciding in respect of a relatively narrow aspect of the whole business situation or optimisation of a sub- section of the whole. Functional heads some times, without taking care of wider implications, sub- optimise their functions. This may cause loss in that part of the organisation which is left out of the exercise and as such should be avoided.



OR Models to be learnt

Linear Programming Problem (LPP)

Transportation Problem (TP)

Assignment Problem (AP)

Network Analysis

Queuing Theory

Game Theory

Simulation

