2.1 THE NATURE AND MEANING OF 'OR'

'OR' has been defined so far in various ways and it is perhaps still too young to be defined in some authoritative way. So it is important and interesting to give below a few opinions about the definition of OR which have been changed according to the development o(the subject.

1. OR, is a scientific method of providing executive departments with a quantitative basis for decision regarding the operations under their control. —Morse and Kimbal (1946)

2. OR is a scientific method of providing executive with an analytical and objective basis for decisions. —P.MS. Blacken (1948)

3. The term 'OR' has hitherto-fore been used to connate various attempts to study operations of war by scientific methods. From a more general point of view, OR can be considered to be an attempt to study those operations of modern society which involved organizations of men or of men and machines. —P.M. Morse (1948)

4. OR is the application of scientific methods, techniques and tools to problems involving the operations of systems so as to provide these in control of the operations with optimum solutions to the problem. —Churchman, Acoff, Arnoff(1987)

5. OR is the art of giving bad answers to problems to which otherwise worse answers arc given. —F. L. Saaty (1958)

6. OR is a management activity pursued in two complementary ways—one half by the free and bold exercise of commensense untrammelled by any routine, and other half by the application of a repertoire of well established precreated methods and techniques. —Jagjit Singh (1968)

7. OR is the attack of modern methods on complex problems arising in the direction and management to large systems of men, machines, materials, and money in industry, business and defence. The distinctive approach-is to developed a scientific model of the system, incorporating measurements of factors such as chance and risk with which to predict and compare the outcomes of alternative decisions, strategies or controls. The purpose is to help management to determine its policy and actions scientifically. —Operations Research Quarterly (1971)

8. Operations Research is the art of winning war without actually fighting it.

9. OR is an applied decision theory. It uses any scientific mathematical or logical means to attempt to cope with the problems that confront the executive when he tries to achieve a through going rationality in dealing with his decision problems. —Miller and Starr.

10. OR is a scientific approach to problem solving for executive management.—HM. Wagner

11. OR is an aid for the executive in making his decisions by providing him with the needed quantitative information based on the scientific method of analysis. —C. Kittel

12. OR is the systematic method oriented study of the basic structure, characteristics, functions and relationships of an organization to provide the executive with a sound, scientific and quantitative basis for decision making. —E.L. Arnoff& MJ. Netzorg

13. OR is the application of scientific methods to problems arising from operations involving integrated systems of men, machines and materials. It normally utilizes the knowledge and skill of an inter-disciplinary research team to provide the managers of such systems with optimum operating solutions. —Fabrycky and Torgersen

14. OR is an experimental and applied science devoted to observing, understanding and predicting the behaviour of purposeful man-machine systems and OR workers are actively engaged in applying this knowledge to practical problems in business, government, and society. —OR Society of America

15. OR is the application of scientific method by inter-disciplinary teams to problems involving the controls of organized (man-machine) systems so as to provide solutions which best serve the purpose of the organization as a whole. —Ackoff & Sasieni, (1968)

16. OR utilizes the planned approach (updated scientific method) and an inter-disciplinary team in order to represent complex functional relationships as mathematical models for purpose of providing a quantitative basis for decision making and uncovering new problems for quantitative analysis. —Thieanfand Klekamp (1975)

2.2 MAIN CHARACTERISTICS (FEATURES) OF OPERATIONS RESEARCH

The main characteristics of OR are as follows:

1. Inter-disciplinary team approach. In OR, the optimum solution is found by a team of scientists selected from various disciplines such as mathematics, statistics, economics, engineering, physics, etc.

For example, while investigating the inventory management in a factory, perhaps we may require an engineer who knows the functions of various items of stores. We also require a cost accountant and a mathematician-cum-statistician. Each member of such OR team is benefitted by the view points of others, so that the workable solution obtained through such collaborative study has a greater chance of acceptance by management.

Further more, an OR team required for a big organization may include a statistician, an economist, a mathematician, one or more engineers, a psychologist, and some supporting staff like computer programmers, etc. A mathematician or a probabilist can apply his tools in a plant problem only if he gets to understand some of the physical implications of the plant from an engineer. Otherwise, he may give such a solution which may not be possible to apply.

2. Wholistic approach to the system. The most of the problems tackled by OR have the characteristic that OR tries to find the *best (optimum)* decisions relative to largest possible portion of the total organization. The nature of organization is essentially immaterial.

For example, in attempting to solve a maintenance problem in a factory, OR tries to consider how this affects the production department as a whole. If possible, it also tries to consider how this effect on the production department in turn affects other department and the business as a whole. It may even try to go further and investigate how the effect on this particular business organization in turn affects the industry as a whole, etc. Thus OR attempts to consider inter-actions or chain of effects as far out as these effects are significant.

3. Imperfectness of solutions. By OR techniques, we cannot obtain perfect answers to our problems but, only the quality of the solution is improved from worse to bad answers.

4. Use of scientific research. OR uses techniques of scientific research to reach the optimum solution.

5. To optimize the total output. OR tries to optimize total return by maximizing the profit and minimizing the cost or loss.

2.3 MANAGEMENT APPLICATIONS OF OPERATIONS RESEARCH

Some of the areas of management decision making, where the 'tools' and 'techniques' ofO Rare applied, can be outlined as follows:

1. **Finance-Budgeting and Investments**
   - (i) Cash-flow analysis, long range capital requirements, dividend policies, investment portfolios,
   - (ii) Credit policies, credit risks and delinquent account procedures,
   - (iii) Claim and complaint procedures.
2. **Purchasing, Procurement and Exploration**
   - (i) Rules for buying, supplies and stable or varying prices-.
   - (ii) Determination of quantities and timing of purchases.
   - (iii) Bidding policies.
   - (iv) Strategies for exploration and exploitation of raw material sources,

(v) Replacement policies.

3. Production Management

(i) Physical Distribution

(a) Location and size of warehouses, distribution centres and retail outlets.

(b) Distribution policy,

(ii) Facilities Planning

(a) Numbers and location of factories, warehouses, hospitals etc.

(b) Loading and unloading facilities for railroads and trucks determining the transport schedule.

(iii)Manufacturing

(a) Production scheduling and sequencing.

(b) Stabilization of production and employment training, layoffs and optimum product mix.

(iv) Maintenance and Project Scheduling

(a) Maintenance policies and preventive maintenance.

(b) Maintenance crew sizes.

(c) Project scheduling and allocation of resources.

4. Marketing

(i) Product selection, timing, competitive actions.

(ii) Number of salesman, frequency of calling on accounts per cent of time spent on prospects.

(iii)Advertising media with respect to cost and time.

5. Personnel Management

(i) Selection of suitable personnel on minimum salary.

(ii) Mixes of age and skills.

(iii)Recruitment policies and assignment of jobs.

6. Research and Development

(i) Determination of the areas of concentration of research and development.

(ii) Project selection.

(iii)Determination of time cost trade-off and control of development projects.

(iv)Reliability and alternative design.

From all above areas of applications, we may conclude that OR can be widely used in taking timely management decisions and also used as a corrective measure. The application of this tool involves certain data and not merely a personality of decision maker, and hence we can say : OR has replaced management by personality.

2.4 SCOPE OF OPERATIONS RESEARCH

In its recent years of organized development, OR has entered successfully many different areas of research for military, government and industry. The basic problem in most of the developing countries in Asia and Africa is to remove *poverty* and *hunger* as quickly as possible. So there is a great scope for economists, statisticians, administrators, politicians and the technicians working in a team to solve this problem by an OR approach. Besides this, OR is useful in the following various important fields.

1. In Agriculture. With the explosion of population and consequent shortage of food, every country is facing the problem of—

(i) optimum allocation of land to various crops in accordance with the climatic conditions; and

(ii) 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.

2. In Finance. In these modern times of economic crisis, it has become very necessary for every government to have a careful planning for the economic development of her country. OR-techniqucs can be fruitfully applied:

(i) to maximize the per capita income with minimum resources;

(ii) to find out the profit plan for the company;

(iii) to determine the best replacement policies, etc.

3. In Industry. If the industry manager decides his policies (not necessarily optimum) only on the basis of his past experience (without using OR techniques) and a day comes when he gets retirement, then a heavy loss is encountered before the Industry. This heavy loss can immediately be compensated by newly appointing a young specialist of OR techniques in *business management.* Thus OR is useful to the *Industry Director* in deciding optimum allocation of various limited resources such as men, machines, material, money, time, etc., to arrive at the optimum decision.

4. In Marketing. With the help of OR techniques a *Marketing Administrator* (Manager) can decide :

(i) where to distribute the products for sale so that the total cost of transportation etc. is minimum,

(ii) the minimum per unit sale price,

(iii) the size of the stock to meet the future demand,

(iv) how to select the best advertizing media with respect to time, cost, etc.

(v) how, when, and what to purchase at the minimum possible cost ?

5. In Personnel Management. A personnel manager can use OR techniques :

(i) to appoint the most suitable persons on minimum salary,

(ii) to determine the best age of retirement for the employees,

(iii) to find out the number of persons to be appointed on full time basis when the workload is seasonal (not continuous).

6. In Production Management. A production manager can use OR techniques :

(i) to find out the number and size of the items to be produced;

(ii) in scheduling and sequencing the production run by proper allocation of machines;

(iii) in calculating the optimum product mix; and

(iv) to select, locate, and design the sites for the production plants,

7. In L.I.C. OR approach is also applicable to enable the L.I.C. offices to decide :

(i) what should be the premium rates for various modes of policies,

(ii) how best the profits could be distributed in the cases of with profit policies ?etc.

Finally, we can say : wherever there is a problem, there is OR. The applications of OR cover the whole extent of any thing. A recent publication of the OR society contains a summary of the applications of OR. The reader wishing more details on applications may consult the publication : ***'Progress in OR'*** **Vol. 2 by** ***Hertz-, D.B.*** **and** ***R. T. Eddison***.