University of Anbar

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Operations Research

third stage

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the first lecturer

Introduction to Operations Research

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Introduction to Operations Research

A brief history of operations research:

The use of operations research methods dates back to World War II when Americans and English used quantitative methods to solve the problems they faced at the time. This was done by forming a team of scientists specialized in mathematics, engineering, behaviors, etc., so that the team would study the problem and propose appropriate solutions using the scientific method. Among the decisions discussed and taken in this way are determining military objectives, timing of air strikes, determining the best and safest means for military landings, and transportation of supplies and personnel**.** The success of using these methods during the war stimulated military decisions and the expansion of the base of uses through the use of basic principles in various aspects of non-military administration. The first book on operations research appeared in the year 1946 CE under the name "Methods of Operations Research: by Maurice and Kemball. The most important discoveries in this regard by Georg Danzig in 1947 CE were the Simplex method for solving linear programming problems, followed by developments that led to the emergence of the Operations Research book in 1957."

What is Operations Research?

Operations Research is one of the analytical tools that are used in solving problems and making decisions. Operations research is of great benefit to the management of organizations. Through it, the problem is divided into sub-problems, and then it is solved by following specific steps through mathematical analysis.

It is also defined as: “A set of standard tools that enable management to reach more accurate and objective decisions, by providing a quantitative basis for data and information analysis.

And there are those who define operations research as: “a quantitative or mathematical approach to making decisions, based on some mathematical treatments in solving multiple problems facing management.”

There are many disciplines that are similar to or overlap with Operations Research, including; Statistical analysis, optimization theory, management science, artificial intelligence, and network analysis, all of which have in common, aim to solve complex problems and improve decisions.

Decision making and operations research

The decision-making process includes the following steps:

1- Defining the problem

2- Determine the alternatives

3- Choosing a scale to compare the alternatives

4- Evaluate the alternatives

5- Choose one of the alternatives

From the observation of the fourth step, we find that the evaluation process takes two main directions:

- Qualitative analysis: This trend is based on the manager's experience and this includes his intuitive ability or what we know as the sixth sense, if the problem has already occurred or was relatively easy. The manager often uses his acumen and experience in dealing with it, but if he does not have the necessary experience and the problem is difficult and complex, then a quantitative approach is required in analyzing the problem and then choosing the best alternative.
- Quantitative analysis: using quantitative analysis, the focus of the analyst is to understand the quantitative facts and data related to the problem, and then be a mathematical model from the reality of his understanding and knowledge of the problem. The model must represent the goal, constraints,

and interrelationships in the problem best represented, and using quantitative methods, the analyst can analyze the model and suggest the optimal solution to the problem.

Reasons for the need for operations research methods:

There is a need for operations research methods when we notice any of the following signs on the organization, which makes it useful to use an operations research specialist, perhaps the most important of them:

1- The existence of a very complex problem where several factors overlap and the available systems are unable to find a suitable solution.

2- When the decision requires quantitative justification.

3- The need to assess or reduce risk, as is the case when starting a new project, where there is no prior experience of how to make a logical decision.

4- Repetition of the problem and the facility's inability to benefit from the data to solve the problem.

5- To improve the level of performance, reduce risk and achieve the competitive advantage of the organization.

The use of models in operations research:

The most important models used in operations research are:

1- Mathematical models

2- Automated simulation

Mathematical models are built in operations research through the administrative problem in the form of equations that include in their composition a group of variables that can be controlled and another group of variables that the organization cannot control. Mathematical models help in the following:

- In dealing with the problem as a whole (ie in a comprehensive way)
- Helps the analyst see the problem clearly and determine what data is relevant
- It helps to clarify the relationship between cause and effect, which may not be clear without a mathematical anthropomorphism.

Quantitative Analysis Steps:

First: Defining the problem:

The step of defining the problem is one of the most important steps and depends on the success or failure of the quantitative approach in decision-making, as it requires a lot of imagination, creativity and teamwork in order to formulate the problem and put it in a framework that can be addressed quantitatively. Often the problem is:

1- A new situation that has not been taken before.

2- An area that did not succeed as expected.

3- In case of re-evaluating the policy to see the possibility of improving it

Second: the formation of the mathematical model

The formulation of the problem in a mathematical model is the most important characteristic that distinguishes the science of operations research from other sciences based on the use of quantitative methods. The mathematical model is formed by translating linguistic expressions into a mathematical relationship, which is:

A- Inputs: are those that the organization cannot control, such as the price of the commodity or the cost of production, as well as the inputs that the organization can control, such as the number of units produced or the quantity of goods, which we define as unknowns, which must be determined to solve the model.

B - Determinants: They represent technical, economic and other constraints that limit the value of possible solutions.

C - Objective function: It determines the measure of adequacy of management and we represent it as a mathematical function of the controlled variables. And we get the optimal solution when the value of the controlled variables achieves the best value of the function within the limits of the imposed restrictions.

Third: Data collection:

It is the stage of collecting data on uncontrolled variables.

Fourth: solving the model:

This means trying to find out the values of the controlled variables that give the best possible solution without exceeding the restrictions imposed on the problem.

Fifth: Writing the report:

It should be written in simple language, explaining the solution and how to implement it.

Operations research methods

Linear programming, multi-programming, network analysis, simulation, and Markov chains model are the most widely used methods in practice.

References:

1- Al-Hayali, Ali Darub Kassar. Mathematical economics. University House for printing, publishing and translation. Baghdad. 2014.
2- 2- Al-Muhtadi, Akram Muhammad Irfan. Quantitative methods in managerial decision-making (operations research). Dar Safaa for Publishing and Distribution - Amman. 2004.