

OPERATIONAL RESEARCH, AN ASSISTANCE IN DIFFERENT AREAS

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Abstract

There are many definitions about operation research. The aims of operation research include: solving operational questions, solving questions related to resources' operations, and solving decision-making questions. Operational research has a relation with different areas of study and it has several applications. Operation research is considered as a tool of productivity. In comparison to traditional approaches, operation research provides more extensive, quantitative, and detailed information about different issues and managers can implement their decisions based on quantitative analyses. Operation research will be a good assistance for managers in different areas.

Key Words: Operation research, areas of operational research, decision-making

Introduction

Everybody has a perception and imagination about operation research, all of them are not considered as operation research, of course. We can examine this subject from two dimensions. One of them is that formation of every system or scientific area won't be done completely from the beginning, but it will develop and take form in parallel with different studies over time. This is a normal process in every scientific area. But, this process reaches to a point that represents a common and clear image in front of researchers of that area. It seems that operation research has passed this process. The other dimension is that the lack of familiarity with basics, concepts, and principals of operation research and also one-dimensional view has resulted into different perceptions. Some scientists consider operation research as optimizing methods, and others take its methods as the science of statistics. In this article we try to remove above mentioned ambiguities as much as possible and present a clear image of operation research.

Although there are numerous scientific resources in the area of operation research, but a small percentage of them has addressed to concepts, principals, and methods of research in this area. Some of the reasons for this failure should be searched among the reasons of loss of development in research method in basic sciences and engineering ones. These conditions have made application aspect of operation research to remain obsolete. With respect to the fact that almost every scientific area and filed has the same conditions in Iran, the above mentioned situation for operation research has been intensified more than any other places.

Definitions

Operation research, in its general sense, means: to apply scientific methods, techniques, and tools in different issues such as systems' operations in a way to control operations of such systems in

form of optimum responses to issues (Arnoff Churchman, C. W., R. L. Ackoff and E.L., 1957). Operation research is an applied and experimental science that addresses to observation, perception, and prediction of targeted systems' behavior which are composed of human and machine (Caywood, 1971). Operation research means: to adopt a planned approach (a scientific and up-to-date method) and a multidisciplinary group in order to represent complicated functional communications in form of mathematical models with the aim of presenting a quantitative basis for decision-making and exploring new issues for quantitative analysis (Theirauf, R. J. and R. C. Keklamp, 1975). Operation research is defined as "the art of presenting bad responses to questions that worse responses have been given to them before". Operation research means: to help managers in decision-making through presenting them with required numeral information based on scientific method of analysis (Saaty, 1988). Operation research focuses its effort on understanding behavior of operational systems which are composed of nature, human, and machines. Machines include something more than man-made stuffs, like laws, common customs, human behaviors, and social customs and structures. Such systems are common in business, management, and government. The type of research regarding operation research includes both developments of theories (which is called model, in operation research) and application of this science for improvement of systems' operations (Warner, 1996).

Objectives of Operation Research

We can present objectives of operation research as the following:

1. Solving operational questions
2. Solving questions related to resources' operations such as: human, machine, materials, energy, information, and funds.
3. Solving decision-making questions

Operation is defined as a series of a few or several independent actions or duties related to raw materials, human, and machines that form an integrated structure when they are put together, and as a result an action in direction of greater objectives will be provided (Saaty, 1988). Murdick and Munson (1986) have defined operation as the following: "operation is a series of job elements that result into voluntary changes in physical or chemical features of an object, assembly or disassembly of components, arrangement and preparation of other operations, transportation, control, filing an object, or recording data". Also, operation will occur when intellectual effort is employed in relation to components of a complicated question or for a simple one. Operational questions and systems' operations are issues that emerge in implementing, controlling, guiding, coordinating, arranging, planning, scheduling, optimizing, and improving operations. Many authors make no distinction between answers of questions and decision, and also between solving question and decision-making. Murdick and Munson (1986) do not believe that question and decision are the same thing; questions emerge when we are dissatisfied, when something annoys us to the extent that we feel we should take some actions. Solving a question or problem means: "looking for solutions or policies which decrease our dissatisfaction". Generally, there are several solutions for a question that some of them are better than others. Choosing among these solutions or policies and the manner of selection is called decision-making.

Techniques, Tools, and Scientific Method of Operation Research

Scientific techniques refer to an approach for achieving scientific goals, or implementing a scientific strategy. Therefore, techniques are the ways of using scientific tools. For example, different methods of sampling are scientific techniques which have used random digits tables as a scientific tool. Calculation and graphic analysis are different techniques for finding minimum and maximum value of an action. By scientific tool we mean a physical or conceptual tool that is used in scientific researches. Examples of such tools include: mathematical signs, electronic computers, microscopes, logarithmic tables and random digits, thermometers, and catalysts. Scientific method is referred to the way of selecting techniques in science; i.e. evaluation of different scientific strategies. Therefore, as the techniques which a scientist uses are the results of his/her decisions, the manner of adopting these decisions is considered as a result of his decision-making criteria. Methods are criteria of selection. Techniques are selections themselves. For example, the manner of selecting the best possible collection among sample designs is a scientific method; and selecting the most suitable collection among different alternatives for measuring a feature such as length, hardness, intelligence, or cooperation requires using a method (Ackoff, 1998). Methodology of operation research relies on model. The main work of operation research is designing models and using them. A model is a simplified presentation of the fact. In other word, a model is an abstraction of a physical system or some characteristics of that system or a concept. It is necessary to notice that a model is always and necessarily a presentation which is not complete. Scientific method of operation research is mainly a modeling process and the tool of this scientific method is the model. Of course, with this assumption that a real object exists that we call it **real system** and an understandable reason exists for tendency towards analyzing it.

Actions of operation research

1. Planning

Here, by planning we mean planning in cases where decisions are taken through working with quantitative methods. We should not get it wrong with qualitative planning such as strategic planning and so on.

2. Scheduling

Every operation has a series of elements which work together. The success of operation requires coordination among the activities of all elements. One of the aspects of coordination is time coordination.

3. Allocation of resources

Every operation needs resources. These resources may include raw materials, manpower, machinery and side equipments, information, budget, place and time. All operations which exist in a system can use resources to what extent to be able to fulfill system's objectives? Allocating and distributing limited resources between operations and their elements is one of the other actions of operation research.

4. Optimization

Optimization means achieving the best control in form of optimum responses and the best manner of utilization of limited resources in return for improvement of systems' operations and presentation of better responses. The aim of operation research is to improve conditions but in an optimum manner and if this aim be achievable, it will be desirable.

5. Determination of policies and decisions

As we mentioned before, solving decision-making questions is one of the objectives of operation research. Selecting projects, determining the manner of investment, selecting strategy, selecting proper solution and ... are actions which are involved in operation research.

6. Description

Description includes a series of actions in which characteristic(s) of operations and systems will be described in form of model. Line models are an example of these models in which characteristics of a line system is described in form of model and other necessary characteristics which are not accessible directly from collected information will be evaluated based on the model.

7. Prediction

In many cases we need to consider hypothetical conditions for an operation or system and evaluate its behavior in those particular conditions. Such conditions do not exist in reality and creating it for emergence of new behavior requires spending time and money. A more simple way for achieving those conditions and resulted behavior is prediction. As a result, by using modeling, we not only can describe operation or system, but also we can create desired conditions through changing characteristics of model and then we can predict new behaviors by solving the model. For example, in line models we can predict the length of line and waiting time by changing the characteristic of service providers' number in the model without being necessary to change the number of service providers in existing system.

Operation Research and Related Areas

Beside operation research, there are other areas that may be similar to each other with respect to their objectives, scientific methods, techniques or tools, and their application. They may also have a relation in a way that one of them is employed for developing concepts and solving questions of the other area. These areas include: management science, systems analysis, decision-making, industrial engineering, and statistics. Here, we will describe these areas briefly.

1. Management science

Management science is an area which is developed in the 1960s and in a close relation with operation research. Techniques which are used in this field are the same ones which we observe in operation research, but its difference with operation research is in respect of its application domain. The techniques of management science are often employed in management, business, and official affairs. Nowadays, scientists make no distinction between these two areas and usually introduce them together and in form of OR/MS(Hicks, 1977).

3. Systems analysis

Systems analysis has a comprehensive approach in its analyses and takes all the system's dimensions into account. But operation research focuses on specific dimensions of the system which are necessary for solving existing questions and problems (Soper, Osborn and Zweizing, 1990&Pollock, Rothkopf and Barnett, 1994).

Operation research suggests changing system's approaches, while systems analysis or systems engineering suggests changing the whole or a part of a system and substituting the system or new equipments. Therefore, we can consider operation research as an effort for specifying the manner of optimizing systems' performance. But systems analysis or systems engineering deals with designing a system base on predetermined objectives (Hicks, 1977, 48).

3. Decision-making

One of the objectives of operation research is solving questions related to decision- making. But this relation does not mean that operation research is equal with decision-making. In fact, operation research enhances scientific basis of a part of decision-making process by presenting tools and techniques of mathematical analysis. But decision-making requires concepts and theories regarding behavior of decision-maker, decision basics, patterns and selection strategies which their goals, process, and logic is different from operation research scientifically, and need a different approach and scientific method.

4. Industrial engineering

The history of industrial engineering and operation research is separate from each other, but existential philosophy of both of them is the same. That is, presenting effective and efficient solutions for issues related to design, analysis, and evaluation. The main difference between industrial engineering and operation research is analysis domain, type of models, and methodology that each of them employs. Primary developments of industrial engineering have been in relation to manufacturing workshops. It is strongly dependent on using mental systematic methods instead of employing mathematical ones. Some of these methods include process planning, improving methods, standardizing work time and utilizing them, and work evaluation. These methods are considered as traditional methods of industrial engineering. In the last thirty years, the main part of industrial engineering has been done via analysis techniques which are based on applied mathematics' concepts (Miller and Schmidt, 1984).

5. Statistics

The most phenomena which are under investigation in operation research have a random aspect instead of certain one. For example, equipments failures do not occur based on a determined regulation, but they have a random and accidental aspect. Determining parameters in production processes are generally uncontrollable in a specified amount and a range will be defined for them. Changing parameter in this respect will be probable. Time of manufacturing, production, or offering services has probable distribution in the most cases. Above mentioned conditions and many other probable conditions make analysis, development and required evaluations in operation research to be along with probable and uncertain conditions. Therefore, employing concepts, techniques, and tools of statistics will be inevitable. But, it doesn't mean that applying statistics in concepts, techniques, and tools of operation research makes them to belong to statistics. For example, statistical simulation is one of the techniques that are used in solving

complicated models and systems which modeling them is very difficult. But, applying statistical concepts in simulation does not make it a reason to consider statistical simulation as one of the statistical methods. For example, planning accidental mathematics in which statistical concepts in modeling and solving model are used does not change this type of planning into a statistical technique or method.

Conclusion

Operation research is considered as a tool of productivity and it is one of the most efficient tools of decision-making. In this article we found out that operation research is used in deferent actions such as planning, scheduling, optimizing, determining policies and decisions, allocating resources, description and prediction, and it really helpful. At present, current focus of many industries is on employing operation analysts for decreasing expenses, increasing production, and improving the speed of customer access to products. In comparison to traditional approaches, operation research provides more extensive, quantitative, and detailed information about different issues and managers can implement their decisions based on quantitative analyses. Operation research will be a good assistance for managers in different areas. With respect to what mentioned above, the need for operation research in the most areas is obvious.

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