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Operational Research in Order to Predict the Demand for Products

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Abstract: In correlation with the new achievements in the field of management, and in the context of increasingly complex market developments, operational research as a set of methods and techniques with macro-enrichment, aspire to a serious role in the decision-making process of managers.

Unsatisfactory state of use of methods and techniques of Operational Research by current users in the economy is a special challenge for educated managers. In this sense, the offer of selection of methods and techniques presented in this paper should serve a positive movement in the approach to decision making.

The structure of the methods and techniques is a consequence of the author's assessment of the possibilities of application. In this context, the question of adapting to the needs of managers and, consequently, appropriate changes and content, which could occur on the basis of feedback, remains open.

The selected method and technique of linear programming, which is presented in this paper, is presented in such a way that it can be applied in marketing research. Truth be told, managers in various areas of their activity, including market research, have always been engaged in new, better solutions to perceived problems.

The nature of the relevant material was and remains a limitation in terms of achieving sufficient credibility of the solutions found.

The development of mathematical methods, procedures and appropriate algorithms has changed the interest of managers when the development of industrial production has increased and the general and specific conditions in the functioning of business entities. Then the interest in operational research increased sharply and now it is simply inconceivable that innovative managers who want to manage their poles well do not use these methods and operations.

Keywords: field of management, market development, operational research, innovative managers

Introduction

In today's fast-moving and high-technology environment, the focus on quality has given way to a focus on innovation. Quality methodology has been shared and integrated into organizations around the world. High quality is now a given for products and services produced in Japan, the United States, Germany, Italy, China, India—yes, everywhere. Competition is more fierce and intense than ever before.

The key to being competitive is staying ahead of the competition. That means coming out faster and with more competitive products and services than the competition. The problem that every organization whether it is public or private, profit or nonprofit, product oriented or service oriented, has the need to have innovative ideas that are implemented in the company for better management and for more and better work.(Harrington, Voehl 2016)

The OM/OR research team focuses on problems that concern how to conduct and coordinate the operations within an organization. More specifically, the operations refer to the production, services and information provided by a company. Whereas previously the principles of operations management were only applied to a single unit in a static environment, the decisions within a company should nowadays be taken in the perspective of a bigger entity in a competitive and dynamic environment. As a result of this increasing complexity, operations research is applied as the primary research methodology to structure, model, analyze and support decisions that concern operations management. Using operations research our research team aims to develop new models, processes and algorithms that are able to optimize the often conflicting goals of the stakeholders in a company. By developing new analytical solution methods and associated decision support systems, the research team OM/OR aims to obtain innovative insights in the organizational policies and external factors of problems.

In addition to operations research, the research team approaches problems in a multidisciplinary way by making use of other methods such as empirical and theoretical research methods, qualitative and quantitative data analysis techniques, artificial intelligence, business intelligence, combinatorial optimization and simulation in function of the purpose of the research. (Vanhoucke, M.2020).

Taking into account the operations of companies in dynamic conditions, strong competition in the market, it is necessary to apply more complex approaches in marketing researchthat will improve the collection, processing and analysis of data needed to solve a specific problem that is related with the market and its impact on the choice of products or services.

The accelerated technical-technological development, the increase of the organic composition of the assets, the expressed uncertainty, risk and instability in the conditions of the current and future operation increase the need for planning of the enterprises. The importance of planning and its implementation will enable the company to be able to catalyze the opportunities provided by the external environment, to improve its performance through which it will achieve comparative advantages over other companies and will be more successful and more competitive. in certain markets. Planning as the first function of management is responsible for making planning decisions about goals, policies, and plans. But these activities of the management would not be performed without prior forecasting of the internal and external environment of the company. Foresight is an important prerequisite and initial stage for quality and rational planning. (Bennett, P.D. 1988).

If the market research sees the impact of various factors on the formation of needs, demand and consumption, then such research is a methodological basis for a logical continuation of the forecasting process. That is, the forecast itself is an upgrade or continuity of the research that will enable obtaining certain amounts of anticipatory information and data that will assess the future market development and the future position of the company depending on the desired dimension of the time horizon.

The operational researches can vary from the type of research that is to be conducted to the results that need to be obtained. Therefore the mathematical operation methods and the proper algorithms are oriented in solving the problems that appear while market research is conducted.

Having in mind that the management structure deals with a lots of problems, strategic, tactical and meaningful the operations as linear program, transport model, theory of the game, the tree and other operations are having their importance in market researches.

Operations research

The British/Europeans refer to "operational research", the Americans to "operations research" - but bothare often shortened to just "OR" - which is the term we will use.
Another term which is used for this field is "management science" ("MS"). The Americans sometimes combine the terms OR and MS together and say "OR/MS" or "ORMS". Yet other termssometimes used are "industrial engineering" ("IE") and "decision science" ("DS"). In recent years therehas been a move towards a standardization upon a single term for the field, namely the term "OR". (Taha, 1999)

The Operational Research (in the further text (O.R.) has stages of development with main six important steps. The first one is observing the problem environment, the second is analyzing and defining the problem, the third is developing a model, the fourth one is selection of the most appropriate data input the fifth one is providing a solution and test its reasonableness and the sixth one is implementation of the solution.

All of this steps are important for OR of market and bringing the best operative decision for the business. The key responsibility of the manager is to make right decision, therefore the O.R. specialist is there to help the manager in order to make the better decision.

The manager recognizes from organizational symptoms that a problem exist. Then he decides together with the O.R. Specialist what variables are involved, state the problem in quantitive relationships among the variables.

The O.R. Specialist investigates the methods for solving the problems as stated above and determines the quantitative tools that he/she will use. Also the O.R. Specialist attempts solutions to the problems, finds various solutions, states assumptions underlying these solutions and tests the alternative solutions.

After all this is done the manager and the O.R. specialist together determine which solution is the most effective because of practical constraintswithin the organization; decide what the solution means for the organization.

The manager chooses the solution to be used and together with the O.R. Specialist ‘Sell’ the decision to operating managers;get their understanding and cooperation. (Beer, Stafford 1966)

Operations Research uses any suitable tools or techniques available. The common frequently usedtools/techniques are mathematical procedures, cost analysis, electronic computation. However,operations researchers given special importance to the development and the use of techniques like linearprogramming, game theory, decision theory, queuing theory, inventory models and simulation. Inaddition to the above techniques, some other common tools are non-linear programming, integerprogramming, dynamic programming, sequencing theory, Markov process, network scheduling(PERT/CPM), symbolic Model, information theory, and value theory. There is many other OperationsResearch tools/techniques also exists. The brief explanations of some of the above techniques/tools areas follows:

Linear Programming:

This is a 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 tobe at the cost of other players and hence they are in conflict.

Decision Theory:

Decision theory is concerned with making decisions under conditions of complete certainty about thefuture outcomes and under conditions such that we can make some probability about what will happenin future.

Queuing Theory:

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

Inventory Models:

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

Simulation:

Simulation 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:

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

Integer Programming:

If one or more variables of the problem take integral values only then dynamic programming method is used. For example number or motor in an organization, number of passenger in an aircraft, number of generators in a power generating plant, etc.

Markov Process:

Markov process permits to predict changes over time information about the behavior of a system is known. This is used in decision making in situations where the various states are defined. The probability from one state to another state is known and depends on the current state and is independent of how we have arrived at that particular state.

Network Scheduling:

This technique is used extensively to plan, schedule, and monitor large projects (for example computer system installation, R & D design, construction, maintenance, etc.). The aim of this technique is minimize trouble spots (such as delays, interruption, production bottlenecks, etc.) by identifying the critical factors. The different activities and their relationships of the entire project are represented diagrammatically with the help of networks and arrows, which is used for identifying critical activities and path. There are two main types of technique in network scheduling, they are: Program Evaluation and Review Technique (PERT) – is used when activities time is not known accurately/ only probabilistic estimate of time is available. Critical Path Method (CPM) – is used when activities time is know accurately.

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.(Sharma, 1989)

Linear programing

Linear programming is perhaps the most famous and one of the most widely used techniques in management science.

It is a mathematical method of allocating scarce resources all in terms of achieving a given goal, such as profit maximization. Liar programming has found wide application in business, with most management problems requiring resource allocation. For example, management problems in decision-making in the areas of production management, budget planning, staff allocation, advertising and promotion planning are related to achieving a set goal (profit maximization or price maximization), all depending on limited resources (money, materials, human resources) , time, etc.) Linear programming involves describing real-world decision-making situations through a mathematical model consisting of a linear goal function and linear resource constraints. (Levin, Rubin, Stinson Gardner. 1992)

Some characteristic applications of this method are described in the following cases:

The manufacturer wants to improve the production schedule and inventory approach that would meet the requirements of sales in future periods. This schedule would, ideally, allow the company to meet demand and at the same time minimize the total production cost.

The financial analyst must choose an investment portfolio between different storage alternatives and binding investments. The analyst would like to establish a portfolio that maximizes return on investment.

The marketing manager wants to determine how best to allocate a permanent advertising budget between different alternatives such as social media, TV, billboards or newspapers. The manager would like to determine a “media mix” that maximizes the effects of advertising.

The company has warehouses in various locations throughout the country. For a given set of consumer requirements for its products, the company would like to determine which warehouse should be, how many products and to which consumers to deliver in order to minimize the total cost of transport.

These are examples of situations where linear LP programming is used successfully, but also illustrate the breadth of application of LP applications. Further consideration of these requirements leads to the following conclusion: all these examples concern the maximization or minimization of a certain size. In all LP tasks, the subject of research is maximization or minimization of a quantity.

In mathematical terms, these requirements are described by the function of the goal. The goal function is also called the management criterion or the optimality criterion. Another feature of LP problems is the

limitations that limit the degree of possible increment of goal function. In the first example, the producer is limited by the required demand for the product to be met, as well as the limitations of production capacity. The problem of the financial analyst is determined by the total amount of available investment funds, as well as the maximum amount that can be invested in any procurement or payment of mandatory investments. The decision on the choice of media made by the marketing manager is limited by a fixed budget for advertising and the availability of certain media. In the transport problem, the minimum price of the transport schedule is determined by the purchase of available products from each warehouse. These limitations are another common feature of any LP problem.(Tadic, Sunkovic, Radojevic, Jovanovic 2005).

General model of Linear Programing

The application of Linear Programming has a clear pattern for the general formulation of linear programming problems. In each problem are defined: decision-making variables, goal function and limiting factors that together formed a mathematical model of the real situation in decision-making.

Variable decision making

In each problem, decision variables are defined, which indicate the level of activity or the amount produced. In the general model, these variables are defined as:

$x_1, x_2, \ldots x_3 \ldots . x_n \ldots$

Function of the goal
The goal function is a basic condition for the existence of any management task. Without a defined goal function, it is impossible to achieve concrete management. The goal function represents the total sum of all contributions to the goal function of each of the variable decisions. In the mathematical sense, the objective function is a function of several variables for which it is necessary to do an extreme value, ie. determine its minimum or maximum. This is shown as:

Max(Min)F(X)=c1x1+c2x2+…+cjxj+…cnxn=$\sum_{jn}^{n} c, x,$
Where:

- F(X) – total value of the foal function
- cj - contribution per unit of activity; unit profit

(or unit cost) j-1,2…..,n

Defining limiting factors

The limiting factors of the LP model show the limited availability of resources in the problem. The value of each of the *m* available resources is defined as b_i, (for $i = 1,2, \ldots, m$). If a_{ij} is the value of the resource *i*is consumed per unit of activity *j* ($j + 1,2, \ldots, n$). So, the equations by which we define constraints are as follows:

$a_{11}x_1+a_{12}x_2+\ldots+a_{ij}x_j+\ldots+a_{1n}x_n \leq b_1$

$a_{21}x_1+a_{22}x_2+\ldots+a_{i2}x_2+\ldots+a_{2n}x_n \leq b_2$

These basic relations show some of the limitations with ≤ inequalities.

Finally, the parameters of the problem that is to be solved with linear programming are values as b_1 *or* b_2 and that shows that these parameters are constants. (Wagner, Harvey 1975).

Conclusion

Operations Research is relatively a new discipline, which originated in World War II, and became verypopular throughout the world. India is one of the few first countries in the world who started usingoperations research. Operations Research is used successfully not only in military/army operations butalso in business, government and industry. Now a day's operations research is almost used in all the fields.

Proposing a definition to the operations research is a difficult one, because its boundary and content are not fixed. The tools for operations search is provided from the subject's economics,engineering, mathematics, statistics, psychology, etc., which helps to choose possible alternative coursesof action. The operations research tool/techniques include linear programming, non-linear programming,dynamic programming, integer programming, Markov process, queuing theory, etc.

Operations Research has a number of applications. Similarly it has a number of limitations,

which is basically related to the time, money, and the problem involves in the model building. Day-bydayoperations research gaining acceptance because it improves decision making effectiveness of themanagers inalmost all the areas of business use for decision making.

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