

A Study on Mathematical Model of Transportation and Applications

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Abstract - Transportation problems can be approached from at least two different viewpoints: the supply and demand. Operation Research (OR) is one of the popular managerial decision science tools used by profit and non-profit organizations. Operation research has gained significance in applications like world-class Manufacturing systems lean production quality management and so on..The growth of global markets and the resulting increase in managerial skills is ability to allocate and utilize resources appropriately environment, decision based on intuition with minimal quantitative basis may be reasonably acceptable and practical in achieving the goal of the organization. Present paper is an attempt to study the importance of Operation Research and various techniques used to improve the operational efficiency of the organization.

Keywords – O.R model, basic feasible solution, Transportation Problem, linear programming.

I. INTRODUCTION

Operation Research techniques including transportation models, linear programming, and organization leaders can make high quality decisions. Operation managers are not expected to be experts in any decision science tools. However they must have fundamental knowledge of such tools to acquire right resources and to make the most economically sounding decisions for the company as a whole. Such wide usage of operational research models by the government, industry and academicians would not only contribute to the discipline but also would contribute to the enhanced quality of life in India. The present paper is an attempt to highlight the significance of operation research, different techniques used and its application in business and industry.

HISTORY OF OR:

Operation research as a new field started in the year 1930's and has grown and expanded tremendously in the last 35 years. The British army was conducting exercises on the radar system for detecting the aircrafts. In July 1938, the Superintendent of Bawdsey Research Station, announced that although the exercise had demonstrated the technical feasibility of the radar system for detecting aircraft, its operational achievements were not up to what was required. He therefore proposed that a crash program of research into the operational-as opposed to the technical-aspects of the system should begin. The term "Operation Research" was coined as a suitable description of the new branch of applied science. In 1953, Prof.P.C.Mahalanobis established an Operation Research team in the Indian Statistical Institute, Calcutta to solve problems related to national planning and survey. In 1958, project scheduling techniques and Transportations are developed as efficient tools for scheduling and monitoring lengthy, complex and expensive projects of that time. The real development of Operation Research in the national panning. Operation Research is also being used in Railway, waiting or queueing problems of passengers for tickets at booking windows or trains queueing up in the marshalling yard, waiting to be sorted out are tackled by various operation Research techniques.

II. ACADEMIC SIDE OF OPERATION RESEARCH

Operational Research was accepted as a legitimate management tool in defence research establishments and subsequently for efficient resource planning and allocation by Government departments. Business supported the accelerated growth of this discipline by funding real and potential applications. Over a period of time, a symbiotic relationship between government, business and academic ensured the growth and expansion of the discipline for

their mutual benefit. During the last 50 years, operational research has evolved as a multidisciplinary function involving economics, mathematics, statistics, industrial engineering and management.

III. USES OF OPERATION RESEARCH

Operation research is multidisciplinary character and application in varied fields; it has a bright future, provided people devoted to operation Research study can help meet the needs of society. Some of the problems in the area of hospital management, energy conservation, environmental pollution, etc. have been solved by operation research specialities and this is an indication that operation research can also contribute towards the improvement in the social life and areas of global need. Operation research has come to be used in a very large number of areas such as problems of traffic, question of deciding a suitable fare structure for public transport, or industrial process like ore-handling. Its use has now extended to academic spheres, such as the problems of communication, socio-economic fields and national planning.

IV. APPROACH

Operation Research represents an integrated framework to help make decisions, it is important to have a clear understanding of this framework so that it can be applied to a generic problem. To achieve this, the so-called OR approach is now detailed. This approach comprises the following seven sequential steps.

- (1) Orientation
- (2) Problem definition
- (3) Data Collection
- (4) Model Formulation
- (5) Solution
- (6) Model Validation and output Analysis, and
- (7) Implementation and Monitoring.

V. TRANSPORTATION TECHNIQUE

The Origin of transportation was first presented by F.L.Hitchcock in 1941 also presented a study entitled “The Distribution of a Product from several sources to numerous Localities”. These presentations considered to be the first important contribution to the solution of transportation problems. In 1947 T.C.Koopmans presented an independent study, not related to Hitchcock’s and called “Optimum Utilization of the transportation System”. These two contributions helped in the development of transportation methods which involve a number of shipping applications involve determining how to optimally transport goods. Type of transportation problems where the objectives is to minimize the cost of distributing a product from a number of sources (example: factories) to a number of destinations (example: warehouse) while satisfying both the supply limits and the demand requirement. Generally, the transportation model can be extended to areas other than the direct transportation of a commodity, including among others, inventory control, employment scheduling and personnel assignment. The objective of the transportation problem is to satisfy the required quantity of goods or services at each demand destination, within the limited quantity of goods or services available at each supply origin, at the minimum transportation cost or time. Transportation problem for m sources and n destinations are generally given as:

$$\text{Minimize } Z = \sum_{i=1}^m \sum_{j=1}^n c_{ij}x_{ij}$$

$$\text{Subject to: } \sum_{i=1}^m x_{ij} \geq d_j, j=1,2,\dots,m \text{ (Row sum)}$$

$$\sum_{j=1}^n x_{ij} \leq s_i, i=1,2,\dots,n \text{ (Column sum)}$$

and $x_{ij} \geq 0$ for all i and j .

To applying transportation algorithm for solving TP we have to make a Mathematical model for this LPP.

VI. GROWTH OF OPERATION RESEARCH IN DIFFERENT SECTORS

The terminology “Operation Research” is somewhat misleading, since it is not only concerned with operations, but has applications involving research in different areas and fields. Operation research is the discipline of applying advanced analytical methods to help make better decisions. By using techniques such as mathematical modelling to analyze complex situations, operations research in the Indian context is clear. It is not only important, it is even critical, given the size and magnitude of the tasks ahead to transform India as a developed nation. In order to achieve this goal, we need a responsive and accountable government to promote a positive environment of OR applications. It is hoped that the Indian democracy would lead to this. It is believed that the globalizations would further accelerate this transition.

TYPICAL APPLICATIONS OF OR:

- Capital budgeting.
- Asset allocation.
- Portfolio selection.
- Fraud prevention, Anti-Money Laundering.
- Benchmarking.
- Marketing channel optimization, customer segmentation.
- Direct marketing campaigns
- Supply chain planning
- Distribution, routing, scheduling, Traffic flow optimization.
- Resource allocation, Staff allocation.
- Inventory planning
- Retail planning, Merchandise optimization
- Product mix and blending, Industrial waste reduction.

VII. CHALLENGES IN OPERATION RESEARCH:

A transportation problem is challenging and time consuming. Thus, such approach towards performance improvement may or may not be economically feasible for some organizations. Numerous studies are conducted on development of more effective and efficient heuristic and exact algorithms that can solve large scale optimization problems. OR is a quantitative problem solving technique: hence data plays important, if not the most important role in producing high quality and executable solutions. Unfortunately, many organizations tend to focus heavily on physical system implementation and give little or no education on education and training. Regardless, employees are often reprimanded for not entering the data correctly and the quality of hardware and software is questioned for poor data integrity. Sustainment is as important implementation. Organization can lack knowledge of performing his or her job, attaining and implementing the world’s greatest system is meaningless.

VIII. CONCLUSION

Another name for managers is decision makers. To survive and lead the today’s highly competitive and demand driven market, pressure is on management to make economical decisions. One of the essential managerial skills is ability to allocate and utilize resources in the efforts of achieving the optimal performance efficiently. In some cases such as small-case low complexity environment, decision based on intuition with minimal quantitative basis may be reasonably acceptable and practical in achieving the goal of the organization. However, for a large-scale system, both quantitative and qualitative analyses are required to make the most economical decisions. Using operation Research techniques including Linear Programming, transportation Problem, Discrete Event Simulation and Queuing Theory, organization leaders can make high quality decisions must have fundamental knowledge of such tools to acquire right resources and to make the most economically sound decisions for the company as a whole.

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