# Operations Research and Value Engineering - Role in Decision Making and Productivity Improvement

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**Abstract**
In today's highly competitive business environment it has become a truism only the fittest survive. Organizations invest in many different aspects of managing their business in order to remain competitive. Operations research and Value Engineering is a key strategic factor for increasing organizational productivity and for better utilization of resources. Operations Research has gained significance in applications like Lean production, Six-sigma quality management, Benchmarking, Just-in-time (JIT) inventory techniques. The growth of global markets and the resulting increase in competition have highlighted the need for Operation Research. To survive and lead the today is highly competitive and demand driven market, pressure is on management to make economical decisions. Value Engineering can reduce product cost by reducing the unnecessary cost associated with the product. It explores each part of Value Engineering for successful application of the technique. The present paper is an attempt to highlight the significance of Operation Research and Value Engineering in business and industry.

**Keywords**
Operations Research, Simulation, Value Engineering, Function

## I. Operations Research Approach

Operations Research (OR) is one of the popular managerial decision science tools used by profit and nonprofit organizations. As the global environment becomes fiercely competitive, Operations Research has gained significance in applications like world-class Manufacturing systems(WCM), Lean production, Six-sigma quality management, Benchmarking, Just-in-time (JIT) inventory techniques. The growth of global markets and the resulting increase in competition have highlighted the need for Operation Research. In order to be competitive, businesses must meet the challenges present in a global market by offering products and services that offer good value to their customers. Good value is a combination of low cost, high quality, rapid availability and real time information on these. In order to enhance the role of operational research and speed up the process and methodologies of different stakeholders, they should work closely and complement each other's effort. In this process, the academicians should take the lead in the design, development and demonstration of sustainable operational research models. Industry should support this initiative and accelerate the transmission of this methodology. This would ensure wealth creation in the short term, and sustainable development in the long term. Given that O.R. 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 O.R. 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.

## II. Significance of Operations Research

Because of Operation Research's 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 specialists and this is an indication that Operation Research can also contribute towards the improvement in the social life and areas of global need.

The Operation Research approach is particularly useful in balancing conflicting objectives (goals or interests) where there are many alternative courses of action available to the decision-makers. In a theoretical sense, the optimum decision must be one that is best for the organization as a whole it is often called the global optimum. A decision that is best for one or more sections of the organization is usually called sub optimum decision. Operation Research attempts to resolve the conflicts of interest among various sections of the organization and seeks the optimal solution which may not be acceptable to one department but is in the interest of the organization as a whole. Operation Research is concerned with providing the decision-maker with decision aids (or rules) derived from:

- A total system orientation,
- Scientific methods of investigation, and
- Models of reality, generally based on quantitative measurement and techniques.

Besides its use in industry, this new technique was also utilized in a number of socio-economic problems which came up after the war. 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 of information, socio-economic fields and national planning.

## III. Techniques Used in Operations Research

### A. Linear Programming

Linear programming arose as a mathematical model developed during Second World War to plan expenditures and returns in order to reduce costs to the army and increase losses to the enemy. In Operation Research optimization means to find out the maximum profit and minimum loss[1] in any deal which we can done in Quantitative Techniques, in this we can narrowing our choices to the very best when there are virtually immeasurable feasible options. 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.

### B. Simulation

In this technique of Operations Research we can make the model of a real situation and then perform the various experiments on this

rough sculpt. Generally it is used in uncertain conditions where we want to conduct a real experiment through this model to know more about different situations which we use in this artificial model. The actual exercise of building a simulation model reveals previously unapparent relationships and provides a systematic way to analyzing the situation. Marine fisheries are highly complex and stochastic. A simulation model, therefore, is required. Simulation-based optimization utilizes the simulation model in obtaining the objective function values of a particular fishing schedule. The decision support system for fishery management will assist the government agencies and the fishing industry to use sound data and management science techniques in making policy decisions for fishing activities. Transferable rights to fish have proved a reliable and effective means of creating incentives to conserve marine resources. By strengthening individual fishing rights under flexible quota management systems make a significant contribution to conserving fish stocks, to reducing excess capacity and to raising the profitability of the fisheries industry.

### C. Queuing Theory

Some real time examples for this case can be customers waiting in the queue in banks or to buy groceries in departmental stores. Queuing System is used in situations where the queue is formed (for example customers waiting for service, aircrafts waiting for landing, jobs waiting for processing in the computer system, etc). The objective here is minimizing the cost of waiting without increasing the cost of servicing. Simulation [2] represents the full extent of the models covering all perceivable systems, which incorporate characteristics of a queue.

### D. 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". This presentation is 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 sources and a number of destinations. The transportation problem, received this name because many of its applications involve determining how to optimally transport goods.

A special class of linear programming problem is Transportation Problem, where the objective is to minimize the cost of distributing a product from a number of sources (e.g. factories) to a number of destinations (e.g. warehouses) 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.

### E. Project Management with PERT (Project Evaluation and Review Techniques) and CPM (Critical Path method)

CPM/PERT is based on the s that a small set of activities, which make up the longest path through the activity network control the entire project. If these "critical" activities could be identified and assigned to responsible persons, management resources could be optimally used by concentrating on the few activities, which determine the fate of the entire project.

Non-critical activities can be rescheduled and resources for them can be reallocated flexibly, without affecting the whole project. Both are project management techniques, which have been created out of the need of Western industrial and military establishments to plan, schedule and control complex projects.

### F. Decision Analysis: Decision analysis refers to a set of quantitative methods for analyzing decisions that use expected utility as the criterion for identifying the preferred alternative.

Decision analysis provides tools for quantitatively analyzing decisions with uncertainty and/or multiple conflicting objectives, and these tools can be especially useful when there is limited directly relevant data so that expert judgment plays a significant role in the decision making process[3].It provides a systematic quantitative approach to making better decisions, rather than a description of how unaided decisions are made.

## IV. Role of Computers in Solving Operation Research Problems

The advent of computers accelerated the wide use of Operation Research techniques for solving complex business problems faced by managers and administrators in business and government. The automation of computational algorithm allows decision-makers to concentrate on problem's formulation and the interpretation of the solutions. Major computer manufacturers and vendor have developed software packages for the various computer systems providing computational support for problems to be solved by the application of Operation Research techniques [4]. Some academic departments in different universities have also produced software packages for solving various Operation Research problems. Computer manufacturers like IBM, CDC, Honeywell, UNIVAC, ICL, etc. have invested substantial amount in developing software programs for solving the optimizing, scheduling, inventory, simulation and other Operation Research problems. Also large scale simulations are possible only through computers by using GPSS software packages.

## V. Value Engineering

Value Engineering is a systematic and structured approach for improving projects, products, and processes. VM, which is also known as value engineering, is used to analyze and improve manufacturing products and processes, design and construction projects, and business and administrative processes. VE helps achieve an optimum balance between function, performance, quality, safety, and cost. The proper balance results in the maximum value for the project. It is an organized way of thinking or looking at an item or a process through a functional approach. It involves an objective appraisal of functions performed by parts, components, products, equipment, procedures, and services; and so on anything, that costs money. Value methodology is commonly applied under the names Value Analysis (VA), Value Engineering (VE), and Value Management (VM). These terms can be used interchangeably with value methodology throughout the places according to the need of the situation. [6,7] Value engineering provides the maximum opportunity to improve the public investment by quality enhancement or life-cycle cost saving."

Value analysis is a problem-solving system implemented by the use of a specific set of techniques, a body of knowledge, and a group of learned skills. It is an organized creative approach that has

for its purpose the efficient identification of unnecessary cost, i.e., cost that provides neither quality nor use nor life nor appearance nor customer features. When applied to products, this approach assists in the orderly utilization of better approaches, alternative materials, newer processes, and abilities of specialized suppliers. It focuses engineering, manufacturing, and purchasing attention on one objective-equivalent performance for lower cost. Having this focus, it provides systematic procedures for accomplishing its objectives efficiently and with assurance. When applied to services, this approach assists in the more precise determination of "What are we trying to do?" in the form of solvable problems, a thorough collection and penetrating analysis of information and assumptions surrounding the service, viable alternatives from the creative mental processes, with skillful sorting and development of better approaches from the "judgment" and "development" parts of the problem solving system. Value analysis approaches may assist all branches of an enterprise engineering, manufacturing, procurement, marketing, and management by securing better answers to their specific problems in supplying what the customer wants at lower production costs. Quite commonly, 15 to 25 per cent and very often much more of manufacturing costs can be made unnecessary without any reduction in customer values by the use of this problem-solving system in the significant decision areas. Results accomplished are far greater. It improves the effectiveness of work that has been conventionally performed as it questions and probes into the very purpose, design, method of manufacture, etc., of the product with a view to pinpointing unnecessary costs, obvious and hidden which can be eliminated without adversely affecting quality, efficiency and other customer features.

## VI. VE Job Plan

The VE methodology (job plan) can be applied to any subject or problem. It is a vehicle to carry the project from inception to conclusion. By adhering to certain formalities, the VE job plan ensures that consideration is given to all necessary facets of the problem. It is conducted in five sequential phases (which may overlap in practice) as follows:

**Step 1:** Selecting a product or service for study: The product selected should be one which accounts for a high proportion of the organization's costs, since the greatest cost saving should be obtained from high cost areas. The choice should also consider the 'life cycle' stage of the product as a product reaching the end of its marketable life is unlikely to offer scope for substantial savings.

**Step 2:** Obtaining and recording information: Questions include: what is the product or service supposed to do? Does it succeed? Are there alternative ways of making or providing it? What do these alternatives cost?

**Step 3:** Analyzing the information and evaluating the product:. Each aspect of the product or service should be analyzed. Any cost reductions must be achieved without the loss of use or esteem value. (Or at least, cost savings must exceed any loss in value suffered, and customers would then have to be compensated for the loss in use or esteem value in the form of a lower selling price.) Questions for the analysis stage might be:

- Are all the parts necessary?
- Can the parts be obtained or made at a lower cost?
- Can standardized parts be used?
- Does the value provided by each feature justify its cost?

**Step 4:** Considering alternatives: Following analysis, a variety of options can be devised. This is the 'new ideas' stage of the study, and alternative options would mix ideas for eliminating unnecessary parts or features or standardizing certain components or features.

**Step 5:** Selecting of the least cost alternative: Comparing the costs (and other aspect of value) of each alternative

**Step 6:** Recommendation: Recommending the preferred alternative to the decision makers for approval

**Step 7:** Implementation and follow-up: Planning and co-ordination of an approved and accepted value analysis proposal. The VA team should review the implementation and, where appropriate, improve the new product or method in the light of practical experience.

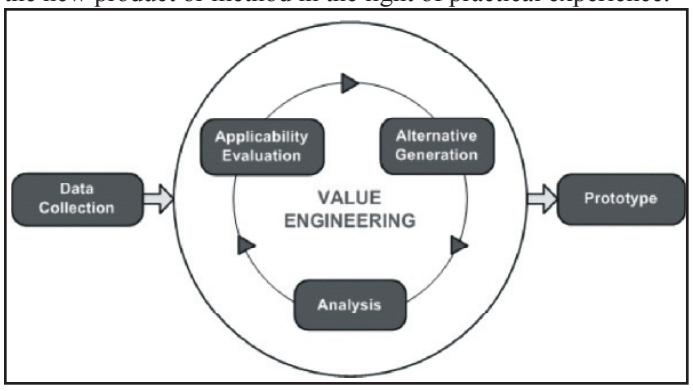


Fig. 1: VE Methodology

## V. Application of Value Engineering

Value Engineering can be applied universally, i.e., to everything materials, methods, processes, services, etc., where it is intended to bring about economics [8-9]. One should naturally start with items where the maximum annual saving can be achieved. This immediately suggests that items whose total annual consumption in Rupees is high should receive top priorities in the application of Value Analysis. In the same manner, scarce materials, imported materials, or those difficult to obtain should also receive the attention of the value analyst. Bearing this in mind, Value Analysis can be systematically applied to categories of items, such as those listed below in order to bring about substantial cost reduction[10].

- Capital goods, plant equipment, machinery, tools and appliances.
- Raw and semi-processed material, including fuel;
- Sub-contracted parts, components, sub-assemblies, etc.;
- Purchased parts, components, sub-assemblies, etc.,
- Maintenance, repairs, and operational items;
- Finishing items such as paints, oils, varnishes, etc.
- Packing materials and packaging;
- Printing and Stationery items;
- Power, water supply, compressed air, steam and other utilities (services)
- Materials handling and transportation costs [11-12]

## VI. Conclusion

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 appropriately in the efforts of achieving the optimal performance efficiently. In some cases such as small-scale 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 (i.e. intuition, experience, common sense) analyses are required to make the most economical decisions. Using Operations Research techniques including Linear Programming, Discrete Event

Simulation and Queuing Theory, organization leaders can make high quality decisions. Operations managers are not expected to be experts in any decision science tools; however, he or she 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.

Value analysis or engineering is a complete system for identifying and dealing with the factors that cause uncontributing cost or effort in products, processes, or services. This system uses all existing technologies, knowledge, and skills to efficiently identify costs or efforts that do not contribute to the customer's needs and wants. Its effect is to help the "good" achieve even "better."Value Engineering is the systematic application of recognized techniques by a multi-disciplined team which identifies the function of a product or services; establishes a worth for that function; generates alternatives through the use of creative thinking; and provides the needed functions to accomplish the original intent of the project, reliably and at the lowest life-cycle without sacrificing project requirements for safety, quality, operations, maintenance and environment. There is much scope for the development of this technique and potential for competitive advantage to be gained.

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