Managing Supply Chain beyond the Basics: Use of Operations Research Tools

Professor Saman Bandara

Department of Civil Engineering, University of Moratuwa

Transport and logistics is said to be the dominant factor for the development of the country's economy and the welfare of the public. A sustainable transport system yields considerable economic and social benefits where as an inefficient transport system with regard to capacity or reliability results in more economic cost or opportunity costs. In general, logistics cost can be well understood in terms of inventory carrying cost, transportation cost and logistics administration cost.

Globally, the demand for energy seems to increase 1.5% annually. Transport itself takes 26% of the global energy consumption where it is 50% in Sri Lanka. Notably 60% of the fossil fuel is consumed by transport sector. Hence efficient usage of energy has become vital. Thus the overall energy efficiency can be derived from the following formula.

Overall Energy Efficiency = Vehicle efficiency x Travel efficiency x System efficiency

Hence the improvement of efficiency is felt well in transport and logistics sector. It can be achieved by reducing the demand for motorized trips, efficient use of transport modes, and effective management of traffic flow and effective use of individual vehicles. Transport and logistical competency is highly dependent on the coordination of these four strategies thus the competitive advantage can be thought of to achieve commercial success.

To improve efficiency and to integrate the above mentioned strategies, there are theoretically operation research tools that can be applied on situations. But the reality is the industry does not show much interest on these tools as they think that they can solve the problems and run their daily routine through experience. The commonly used operation research tools are as follows:

Statistical analysis, Simulation, Linear programming, Network models, Inventory theory, PERT/CPM, Queuing theory, Non-linear programming, Dynamic programming, Game theory, Decision theory, Risk analysis

Going back to the industrial revolution era, all resources were fully used to get the best use and convenience of the mankind. But in the course of time, it resulted in specialization through increased division of labour and segmentation of management responsibilities. And now it has become well realized that resources are limited and they need to be used in an efficient manner.

Starting at World War II, Operations Research was highly used for the successful allocation of scarce resources to required activities. This concept captured the other industry as well after its successful usage at this war. Two similar disciplines were developed together as Operation Research, which deals with management of operating systems & System Engineering, which concentrate on analysis and design of systems

A problem will appear in supply chain or any business when there are some objectives to be achieved. And there will be many ways to solve that problem where as the feasible alternative will not be apparent. What the Operations Research Tools will do is that the objectives will be clearly defined, the alternatives will be identified and these alternatives will be tested against optimization.

In general the mathematical models will have set of decision variables, objective function and set of constraints. Following are some of the examples for the mathematical models that are commonly used to achieve the above mentioned purposes in the organization.

Linear programming which is concerned with allocating scarce or limited resources to known activities with the goal of maximizing or minimizing the value of a given objective function (often profit or cost).

Dynamic programming which depends upon the representation of a multi stage decision problem as a sequence of single stage problems. This can be represented in optimum allocation of available resource.

Calculus is where problems with multiple variables with or without constraints can be handled using this technique.

Network analysis will help to deal with flow of the network with respect to capacity constraints. It will help to identify the shortest paths in the network and minimum spanning tree which deals with the construction of road or path at minimum cost while ensuring all the places were visited once.

Therefore, the use of mathematical tools will help bridge the scarce resources and efficient way of usage of these resources which is a best way to manage supply chain beyond the basics.