

Application Of Operation Research in Logistics

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Abstract:

This study examines the use of Operations Research in retailing, both domestic and international, in various forms and methodologies. The retail industry is one of the fastest-growing and most promising. Customers in this industry have high expectations, and thus companies need to be able to meet those demands effectively in order to remain viable. The company must also keep costs under control while increasing income. Logistics, Supply Chain Management, and Warehousing are some of the most important parts of retailing, so we'll focus on them to show how Operations Research techniques like transportation, simulations and the analytical model can be used to reduce costs, thus increasing profits and overall efficiency. Logistics is the management of the flow of goods between the point of origin and the point of consumption in order to meet some requirements, for example, of customers or corporations. The resources managed in logistics can include physical items, such as food, materials, animals, equipment, and liquids, as well as abstract items, such as time, information, particles, and energy. The logistics of physical items usually involves the integration of information flow, material handling, production, packaging, inventory, transportation, warehousing, and often security. The complexity of logistics can be modeled, analyzed, visualized, and optimized by dedicated simulation software. The minimization of the use of resources is a common motivation in logistics for import and export.

Keywords — *OR, Operation research, Logistics, Supply chain, retail.*

INTRODUCTION

For the objective of making better judgments, Operational Research is a scientific study of operations. Operational Research is both a craft and a scientific discipline. It's a branch of science that examines problems, their formulation, solutions, and the subsequent development of sound judgments. Analysis of complicated real-world situations with the purpose of enhancing or optimising performance is a common use of this technique. Using operational research methodologies in logistics is the focus of this article. The most commonly used methods in logistics include the theory of charts and grids, particular methods for transportation, distribution, and mathematical programming (most often used is linear programming). A plant's moodiness and the efficiency of its logistics processes can both be considerably influenced by the methods described

above. [1] As a competitive advantage, operational research (operational research) is emphasised by the article, which underlines the relevance of university graduates' familiarity with operational research methodologies (operational research).

If you're going to be able to meet your customers' needs by providing them with a high-quality product, then you need to have a well-planned and well-executed logistics strategy in place. Association for the Advancement of Supply Chain Management The French word "Loger," which denotes the skill of supplying or moving armies, is the root of the English word "logistics." It was originally developed as a military strategy, but it has since found its way into the world of marketing management. [2] Because of the rise in transportation costs, technological advances, globalisation, and retail power, logistics has become increasingly important in recent years. One of the most important factors in facilitating global trade is logistics. There are several logistic

suppliers offering supply chain services, both globally and locally. They use the Internet and IT technology to keep track of data and information as goods and commodities move through the supply chain. Logistics is all about reducing costs, reducing capital, and most importantly, improving customer service. In logistics, demand forecasting, distribution communication, inventory handling material, processing multiple orders, warehouse selection, and procurement and packaging all fall under the umbrella of logistics. One of the most fundamental yet critical functions of logistics is to ensure that goods and services are made available to those who need them.[3] A retailer's primary role today is to respond to known customer demand by controlling product availability. They are in charge of all aspects of the supply chain, from production to consumption, including planning and organising. There are two sides to every coin, so to speak, to the retail logistics and supply chain change we've seen in the last few years. [4]

FEATURES OF OR DECISION-MAKING -

Every company in the industrial sector has to deal with a wide range of issues in order to come up with the best potential answer. With the use of OR methodologies, OR strives to help executives find the best possible answer. Improved decision-making abilities and a greater understanding of the problem lead to better control, better coordination and better systems, as well as better decisions as a result of the use of decision-making tools. [5]

- Scientific Approach - In order to better understand and address complicated issues, OR makes use of a variety of scientific approaches, techniques, and instruments. In this technique, there is no room for guesswork or the decision maker's personal prejudice.
- System Approach - Each proposal should be evaluated in terms of its impact on all subsystems of the system and the system as a whole in order to track all of the significant and indirect effects on the system.

- Use of Computers - The models of OR require a lot of computation, hence computers are required to run them. Complicated problems requiring a large number of calculations can be handled by computers. [6]

There are many ways to improve and optimise the flow of information and commodities within an entire firm, but logistics focuses on identifying and specifying the necessary resources to do so. Logistics, as a result, takes on an integrative role. "Logistics is a discipline that focuses on the overall optimization, coordination, and synchronisation of all activities, and it can be broadly defined as such. It is required for the final (synergistic) effects to be achieved through activity chaining." [7]. Logistics, by definition, encompasses a wide range of activities.

OR has been defined in a variety of ways. The term is used to describe a methodology whereby the activities of corporations and social organisations producing goods and services are understood as a system that outputs results when inputs are given, the system of those basic activities is constructed as a mathematical model, and problems regarding the operational methods of the system are analysed using mathematical tools conforming to the purpose in order to produce the optimum answer. [8]

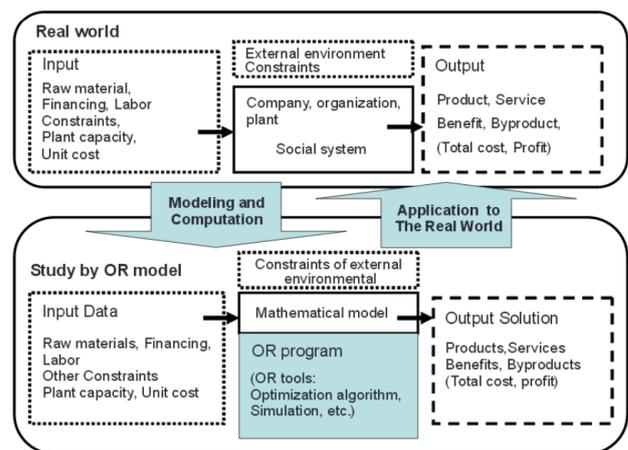


Fig. 1: Concept of study by OR model

In the real world, a wide range of methods, including as mathematical and statistical analysis, system simulations, and optimization algorithms, are used to identify problems and derive solutions.

SCOPE OF OPERATIONAL RESEARCH

1. National plans and budget.
2. Health care services and National Health Programs.
3. Government development and public sector unit.
4. Industrial establishment and private sector unit.
5. National defense services.
6. Research and development in engineering.
7. Public works department.
8. Business management.
9. Agriculture and irrigation projects.
10. Education and training.
11. Transport and communication

LOGISTICS

“Logistics is the process of planning, implementing and controlling the efficient, effective flow and storage of goods, services and related information from point of origin to point of consumption for the purpose of conforming the customer requirement.” - Council of Supply Chain Management Professionals. The word logistics comes from the French word “Loger” which means the art of supply or movement of the armies. It was started late back as a military concept but it is also used in Marketing Management. In the recent times, Logistics has gained importance due to various reasons being, increase in transportation cost, Change in Technology, Globalisation, Growing power of retailers etc. Logistics is one of the major contributors enabling global trade. Various logistic providers at various levels like global and local, offer supply chain services. Internet and IT technology are the two aspects helping them manage data and information with the flow of goods and materials.[9] The basic aim of logistics sums up to cost reduction, capital reduction and most importantly, service improvisation. Logistics has a very huge scope of demand forecasting,

distribution communication, managing inventory handling material, processing various orders, warehouse selections, and finally procurement and packaging.

One of the basic yet important function of logistics is to make the merchandise and services available to the place where there is demand for the product. Today, retailers are the most active controllers of product supply in reaction to known customer demand. They manage, organize and control the supply chain from production to consumption. This is the essence of the retail logistics and supply chain transformation that has taken place and hence we can say that logistics and supply chain management are the two sides of a coin.

In Logistics, Linear Programming is generally used to find the optimum allocating resources among competing activities problems. Linear programming is a mathematical model which represents alternate solutions, which in turn helps in finding the best possible alternative within the constraints provided to us. LPP can be applied in the process of procurement to cut down costs or maintaining a budget while not compromising necessities.[10]

OPERATIONS RESEARCH IN MANUFACTURING LOGISTICS

Ever-increasing customer expectations and fierce competition in global markets force manufacturing companies to continuously enhance competitiveness to stay profitable. In recent years, they have realized that manufacturing logistics has a considerable potential to reduce costs, improve customer service and provide them with a competitive advantage. Operations research tools help researchers to analyse the data to improve productivity and efficiency, helping firms cut costs and maximize profits. This is done by software that develops quantitative models and analyse them, helping researchers to draw conclusions about the model and understand the scenario in the industry.[11]

Operations Research (OR) is an umbrella term, covering a wide range of techniques that are based on different quantitative models.

Some of the widely used techniques are:

- Linear programming,
- Discrete-event simulation,
- Queuing theory,
- Inventory theory.

LINEAR PROGRAMMING:

It is the process of taking various linear inequalities relating to some situation and finding the best value obtainable under that condition. It is used to help make decisions about allocation of resources

Discrete-event simulation: Discrete event simulation (DES) and system dynamics (SD) are two modelling approaches widely used as decision support tools in logistics. DES is mostly used at an operational/tactical level.

Queuing Theory: Queuing theory is a major topic of applied mathematics that deals with the phenomenon of waiting and arises from the use of powerful mathematical analysis to describe production processes.

Inventory Theory: OR techniques have successfully supported several key issues in inventory management. It is concerned with the use of OR techniques to support tactical and operational decisions related to controlling inventories of raw materials, components, and finished goods.

GREEN LOGISTICS

OR in green logistics is not just restricted to one particular sector but it aims to incorporate as many sectors as possible. Although OR has been instrumental in improving logistics in the pre-mentioned sectors, it cannot be said that these techniques are limited and defined. Just as the markets, demand, etc. keep changing, OR will also keep evolving overtime to keep up with the new market trends.[12]

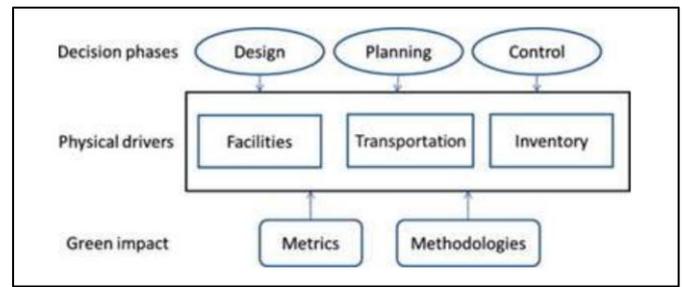


Fig.2: Green Logistics

Green Logistics for sustainable development are as follows: The three pillars of Sustainable Development can be applied to green logistics. Economic, social and environmental. These three dimensions should go hand in hand but they usually don't. The economic dimension is purely quantitative in nature and might not go along with the social and environmental. It is focused on the efficient use of resources and achieving a return on investment. The social dimension refers to both individual and organizational levels. It is emphasized that the social dimension of sustainable development is emerging as the key challenge in sustainable development, due to the fact that companies have to involve a wide range of stakeholders with different goals, demands, and opinions that may interpret the same situation differently. The environmental dimension includes the set of objectives, plans, and mechanisms that promote greater environmental responsibility and encourage the development and diffusion of environmentally friendly technologies and most of the sustainability research has focused on this dimension.[13]

DISADVANTAGES OF OPERATIONS RESEARCH

- **Costly:** Operations research is very costly. This happens because the mathematical models have to be made to take decisions and solve problems to reach the optimum level. Companies have to invest in making models, which involves huge costs.
- **Complexity:** OR problems are complex since there are particular devotions in the solutions. It

becomes difficult for frontline managers to analyze the answers. They are the ones who are the action takers who have very basic knowledge or order quantities and transport schedules. There is a gap between the specialist and the manager.

- Qualitative v/s Quantitative factors: OR only takes into consideration the quantitative factors such as the costs and mathematical figures. It ignores factors that are non-quantitative. Factors like strikes, holidays, and medical emergencies are all examples of the same. Factors that cannot be quantified do not hold any place in OR.
- Dependence on electronic computers: The optimal solutions in an OR problem are solved taking into consideration all factors. In reality taking them into consideration and expressing them as numerical values can be a difficult task. Vast calculations are used for the same which require computers.
- Implementation: This is the most important part. It is delicate and must take into account the complexities of humans and their behavior patterns.

REVIEW OF LITERATURE

Supply chain design (SCN) is a long-term strategic decision that can be affected by a number of tactical and operational decisions (such inventory and transportation rules) at both the tactical and operational levels [14]. A network's overall optimality may be compromised if the variables in each component's optimization aren't taken into account due to the interdependence among them. However, if too many choice factors are included in the mathematical model, the model's usefulness is reduced. For real-world and large-scale systems, however, simulation is a better option since it can provide a more user-friendly perspective of the total system, but it is not a suitable tool for optimization. To overcome these shortcomings, new ways must be developed.

A thorough assessment of facility location issues was conducted by Melo and colleagues [15] and explored the potential of integrating facility location decisions with variables from the other SC elements. To date, there has been no thorough evaluation of the various research articles on inventories that propose mathematical and simulation models for resolving real-world problems. A possible explanation is that inventory models have recently been used as a complementing component of integrated mathematical models, but conventional/standalone approaches are no longer popular.

According to Ballou and al [16], there are three coordination levels inside the Supply chain: In addition to inter-organizational coordination of supply chain operations between enterprises, intra-organizational coordination of the company's logistic processes is also important.

Logistics outsourcing is often referred to as "outsourcing" in the same way that outsourcing is referred to. Outsourcing logistics is defined by Ivanov and Massou Franzil in [17] as "the fact that the full supply chain, previously domestically ensured, or only a part of it, with an ultimate transfer of resources, over a long term period, to an external provider, with a performance goal »." This term, which includes a strategic component, distinguishes itself from commonly associated and misunderstood concepts such as subcontracting, transmission, and so on.

OBJECTIVES

The goal of this research is to get a better knowledge of the gaps and limitations of current OR methodologies in the manufacturing, procurement, healthcare, and green logistics sectors by looking at the logistics business from the perspective of operations research.

RESEARCH METHODOLOGY

The research is based on secondary data obtained from numerous sources, such as periodicals, newspapers, articles, e-journals, and research

papers. The technique is qualitative in nature. The retail industry's supply chain and logistics are discussed in detail in this study by a variety of authors.

RESULT AND DISCUSSION

A supply chain is depicted in Fig 3. Supply chain refers to the network of businesses, information, and products/services (raw materials, components, finished items) that connects all the enterprises involved in the process from production to final consumption. [18]

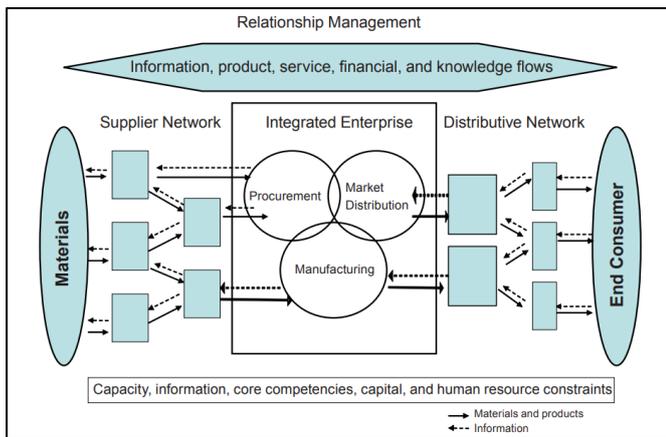


Fig. 3: Generalized supply chain model

Product flows from upstream to downstream are depicted with solid arrows, whereas knowledge flows from downstream to upstream are depicted with broken arrows in this diagram. Supply chains are bound by its members' abilities, such as manufacturing or processing capacity, specialisations, information, capital, and people resources (amongst other things). [19]

Fig 4 shows the major issues in logistics existing among the major stakeholders in a supply chain.

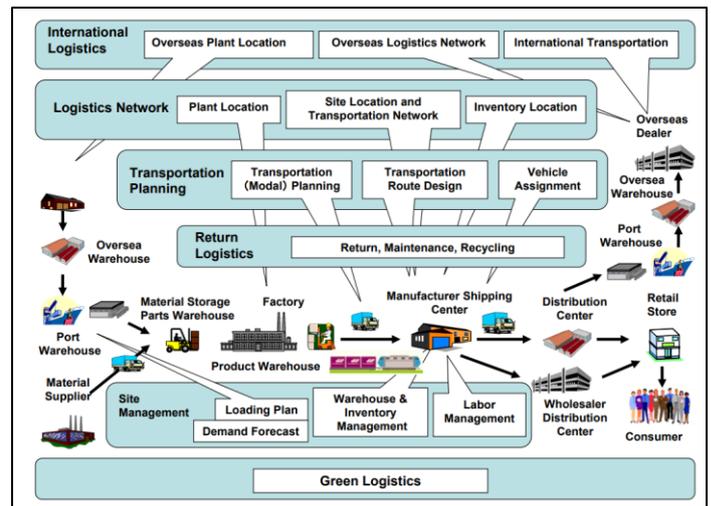


Fig. 4: Major issues in logistics planning and management

However busy actual logistics are, it is possible to see the significance of formulating plans at all operational levels and management levels, from strategic decision-making to everyday operational control[20].

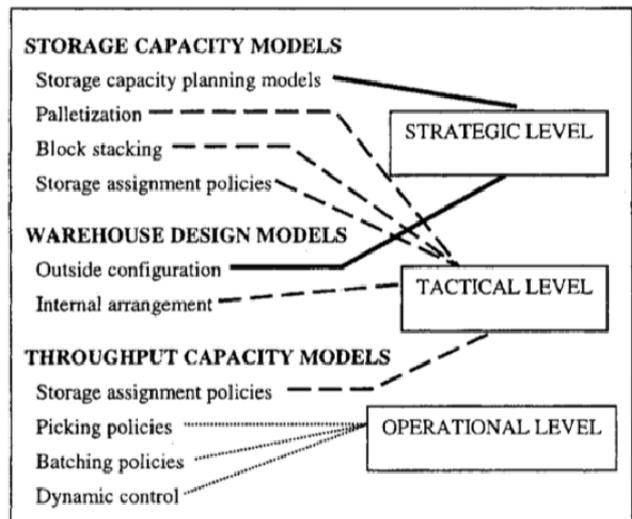


Fig. 5: A taxonomy of warehousing decision models

An further classification based on the strategic, tactical, and operational framework is proposed in the image above, which displays the categorization of several warehouse decision models. Strategic decisions have a long-term impact on profitability,

hence complex analytical and simulation models are needed. [21] For operational decisions, which must be made repeatedly and with increasing frequency, algorithms that produce good outcomes are required. Warehouse layout and storage systems, including AS/R (Automated Storage and Retrieval), AVS/R (Autonomous Vehicle-based Storage and Retrieval), which are gaining prominence, have also improved the efficiency of order collecting. [22]

CONCLUSION

It doesn't matter if you're a manufacturing company, a service provider, a multinational corporation, or a little business; logistics is at the heart of all of them. Consequently, it is vital for all managers and business school graduates to learn the core ideas of operations research (management) and logistics so that they may choose and apply the appropriate approaches for every given case. Logistics management encompasses a wide range of activities, many of which can be aided by the mathematical models we've already examined. Consider this: You'll need to choose from several methods to get a finished product to the customer's door, and minimising expenses and completing the delivery in a timely manner are critical considerations. Rather than taking a product-centric approach to marketing anymore, the industry is now more concerned with the needs of the end user. It's all about cutting costs and optimising production to maximise earnings in the new market orientation. A variety of operations research approaches are used by retail companies to identify the best possible solutions to a certain problem. Distribution, warehousing, and logistics are three of a retail company's primary responsibilities.

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