



# INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X

Impact factor: 4.295

(Volume 5, Issue 5)

Available online at: [www.ijariit.com](http://www.ijariit.com)

## Study of operations research in warehouse and logistics

Sanjana Eswar

[sanjana.eswar166@gmail.com](mailto:sanjana.eswar166@gmail.com)

Anil Surendra Modi School of  
Commerce, NMIMS University,  
Mumbai, Maharashtra

Shantanu Maharshi

[shantanu.m2000@gmail.com](mailto:shantanu.m2000@gmail.com)

Anil Surendra Modi School of  
Commerce, NMIMS University,  
Mumbai, Maharashtra

Shivam Poojari

[shivam.poojari.29@gmail.com](mailto:shivam.poojari.29@gmail.com)

Anil Surendra Modi School of  
Commerce, NMIMS University,  
Mumbai, Maharashtra

Shreyas Narain Tyagi

[shreyasnaraintyagi5@gmail.com](mailto:shreyasnaraintyagi5@gmail.com)

Anil Surendra Modi School of  
Commerce, NMIMS University,  
Mumbai, Maharashtra

Shrishti Gupta

[shrishtigupta05@gmail.com](mailto:shrishtigupta05@gmail.com)

Anil Surendra Modi School of  
Commerce, NMIMS University,  
Mumbai, Maharashtra

### ABSTRACT

*Logistics and warehousing is an important part of an industry. It is required in almost every industry, few of those being automobile and defense. This paper highlights the methods and the types of logistics as well as it discusses the problems and issues faced. It also mentions and discusses all the methods to minimize cost and how some of the methods can be problematic. Green Logistics are also mentioned as they are quite important in the point of view of CSR activities as well as the environment and the goodwill they protect.*

**Keywords**— Logistics, Warehousing, Green Logistics, Operations Research, Warehousing

### 1. INTRODUCTION

The global warehousing and logistics market reached a value of US\$ 1,171 Billion in 2017. The global logistics market in its present state has come about as a result of an amalgamation of supply-side and demand-side trends. The rapid proliferation of trade agreements among various nations is the major demand driver of the global logistics market. Additionally, the initiatives aimed at increasing global trade activities have expanded the demand for logistics and warehousing in order to keep pace with the rising needs of importers and exporters.

Warehousing is the act of storing goods that will be sold or distributed later. While a small, home-based business might be warehousing products in a spare room, basement, or garage, larger businesses typically own or rent space in a building that is specifically designed for storage. On the other hand, Logistics refers to the process of planning and coordinating resources and services from the point of origin to the point of consumption. This process provides efficient and effective transportation and storage of goods and services. The major components of logistics involved in the proper functioning of an organization or a business include inventory management, inbound and outbound transportation, material handling, warehousing, etc. In recent years, the industry has benefitted from the advancements made in technology, integration, globalization, legislation, and confederations.

Some problems often faced by the companies and even the people with a specialization in the same are the organizing of their operations, time and space. This is where Operations Research comes in handy.

Operations Research (OR) is an analytical method of problem-solving and decision-making that is useful in the management of organizations. In operations research, problems are broken down into basic components and then solved in defined steps by mathematical analysis. The process of operations research can be broadly broken down into the following steps:

- Identifying a problem that needs to be solved.
- Constructing a model around the problem that resembles the real world and variables.
- Using the model to derive solutions to the problem.
- Testing each solution on the model and analyzing its success.
- Implementing the solution to the actual problem.

## **2. OVERVIEW OF THE INDUSTRY**

Fierce competition in today's global market, the increased expectations of the customer and the cost-cutting measures have forced business enterprises to focus attention on logistics industry. It is found that between 12 and 20% of the final retail price of current consumer goods is associated with logistics cost. (The three major cost components of logistics operations are inventory carrying, transportation, and administration.) The industry represents a significant part of the economy, as they generally constitute 10-15% of the GDP of a country.

The European market for the logistics industry can be categorized as matured and crowded with several globally strong logistics players. The 3PL penetration rate in Europe is also estimated to be high, at 10%. It is estimated that about 11.6 million jobs are involved in logistics in this region. Having such matured market, there is only limited scope for new entrants in Europe. In the US, the European players have started establishing strong US networks. The US appears as the home ground of global giants of logistics players, with a reported 3PL penetration rate of 8%. In 2000, total business logistics costs exceeded US\$ 1 trillion and accounted for 10.1% of the country's GDP. The breakdown of the total logistics cost for the US is as follows:

In the east, the strong presence of local players in Japan resulted in a difficult market entry in this region. Likewise, the consolidation in Australian logistics markets has resulted in large domestic logistics companies, which also limits the scope for new entrants. The story is however different in Asia. There are no dominant integrated logistics players, and the Third-Party Logistics (3PL) and Fourth-Party Logistics (4PL) service providers are still growing concepts in Asia. As such, there is an urge for local players to expand capabilities and move into unoccupied space before the global players dominate the market. In addition, Asia is expected to show tremendous growth in logistics market and to account for over 50% of world cargo in 20 years' time. China and India specifically are the two leading logistics markets in Asia which are forecasted to grow more than 40% annually in this decade. As of the year 2000, the annual logistics cost for China was estimated to be more than US\$ 200 billion and the 3PL service providers accounted for about 2% of the Logistics market. The logistics cost in China was recorded to be 20% of GDP, and by the first quarter of 2004, the proportion increased to 21.4%. India, the second-fastest economy in Asia after China, with estimated GDP growth rate of 7.2% for 2004 and with the value of logistics market estimated at 13% of GDP, is expected to be at least US\$ 50 billion worth of logistics industry and still growing. As such, the logistics industry in India has emerging opportunities and is poised for continued significant growth in the coming years especially in the Fast Moving Container Goods (FMCG), textiles, retail, automotive and pharmaceutical.

## **3. RESEARCH OBJECTIVES**

- To find out how operations research can be used for cost-cutting and cost controlling.
- To find how operations research can be used for inventory decisions.
- To find how operations research can be used for quantitative decisions.
- To find how operations research can be used for inventory control.
- To find how operations research can help decided the mode of transportation.
- To find if operations research can be used for the development of an environmentally friendly model of transportation.

## **4. METHODOLOGY**

For this paper, we have depended on the use of secondary data. We have used published research papers available as reference and a valuable source of information and learning resources. We have studied the research papers and understood different aspects in which operations research is applicable in the warehousing and logistics industry.

## **5. LITERATURE REVIEW**

Warehousing and logistics complement each other while various industries also consider both of them to be a subset of each other such as healthcare, grocery, equipment, Agriculture, etc. are some of the classic examples where both have been used efficiently. Allocation and analytical simulation play a major role while testing the optimality. The product life cycle is another common term that also plays a major role in warehousing logistics and supply chain management. Efficient utilization of space and designing various desired routes for a problem would be the main concern while performing activities as cost of the goods and their nature such as perishability also is a concern. A variable amount of capacity must be allocated so that adopting various methodologies becomes an anchor in improving the business solutions thereafter attained. Requirements of customers' and companies' needs are of utmost concern when it considers the flow of goods and the duration. Logistics aims at providing on-time delivery of goods and services, to and fro from a factory to the end consumer, utilizing cost-effective methods of transport and state of the art technology, in order to maximize efficiency. Warehousing adds value to operations by having the right quantity of products available at the right time at the right place. In the complete logistics value chain, warehousing forms a very important link. A contiguous period scheduling approach using the transportation model is known as Contiguous Cells Transportation Algorithm and a multi-objective transportation problem.

## **6. FINDINGS**

- Warehousing comes in almost all sizes and associates with almost everything such as grocery, healthcare, etc. It is utmost necessity of identifying and improving methods and designs for efficient allocation and operation with the help of the entire range of analytical and simulation models. Warehousing and logistics management considers various imperatives and set of managerial practices that include consideration of all stages across the entire value chain for each product and a multidisciplinary perspective covering the complete product life-cycle. These models can also be classified as throughout, storage and warehouse design models. Among these capacity models are comprised of vehicle routing problems also termed as order picking policies which can be equally divided into two different policies of batching and picking policies sometimes it also includes assignment and dynamic

control policies. Objective functions also include minimization of handling material cost as well as inventory holding and reordering cost. Optimal warehouse-size or maximizing space utilization is found by storage capacity models.

- Organizations usually adopt numerous businesses up gradation in methodology to improve the efficiency of business performance. Logistics has been considered to be a crucial factor for companies to mainly attain competitive edge. Logistics has been receiving attention from the 1980s and many authors have brought concern the importance of conceptual frameworks and clear definition constructs on logistics management. Its termed as the flow of goods between point of flow and consumption to meet the requirements of customers and corporations. They include physical materials such as food healthcare animal's equipment as well as liquids and some of the abstract items such as time and particles. We can easily identify that the focus of logistics is mainly focused on product flow it also has a prominent focus towards storage transportation distribution and processing. Logistics can be also classified under the head of green logistics which takes into consideration all the environmental factors for sustaining Eco-environmental conservation. A typical feature of logistics is the reverse logistics in which we can really identify the quality of the received used products. Research sometimes may limit itself as the nature of some products such as perishable and fashion products some modern topics may also count city and emergency logistics.
- Use of transportation problems in Iron and Steel Plant to minimize Raw Material Costs. It is very important to optimize costs in any industry to increase profit margins, so as to sustain in the long run as one cannot drastically increase the demand for its products but can work towards optimizing its cost structure internally. It is important to study the iron and steel industry as it is a major contributor to the GDP, creates employment opportunities and one of the bulk exported products. The main aim of our study is to analyze the demand for raw materials of the company's various iron production plants along with its supply from various source locations across India. This would help the company to cut down its production costs, thereby making it more efficient and helping it to attain a competitive edge over its competitors. The paper proposes a contiguous period scheduling approach using transportation model known as Contiguous Cells Transportation Algorithm and a multi-objective transportation problem. The main objective is to minimize total transportation costs and delivery time. The transportation problems arising due to miscalculated selection of suppliers and stock houses have been going on for years. The methodology used is a general mathematical model. In our study, we have found out the feasible transportation costs through various methods such as Northwest Corner rule, Least Cost Method, Vogel's Approximation method and further reduced the answer obtained through it to its optimal transportation cost using What's Best Solver in excel. It can be concluded from the above study that the most effective way to find out a feasible solution is the Least Cost Method. But this is not the optimal cost structure. The optimal cost structure is obtained from Solver.
- Logistics: Current trends and future growth in warehousing, packaging and port handling. Logistics and Supply Chain is a key element for the functioning of any business, and it is fragmented into various segments. Warehousing, Transportation, and Packaging are some of the important segments, which contribute majorly in storing, transporting and delivery of goods. Logistics aims at providing on-time delivery of goods and services, to and fro from a factory to the end consumer, utilizing cost-effective methods of transport and state of the art technology, in order to maximize efficiency. Warehousing adds value to operations by having the right quantity of products available at the right time at the right place. In the complete logistics value chain, warehousing forms a very important link. It accounts for 5% of the Indian logistics market. The size of the Indian warehousing industry is pegged at about INR560 billion has given this sector a move in the direction of further maturity with new technology interventions, automated material handling devices and standards. India's warehousing technology market is growing steadily, with the upswing in demand from the logistics, retail, and manufacturing sectors, as well as through government promotion. An increase in IT adoption and knowledge infrastructure is seen to provide a boost to the growth and maturity of warehousing players in India. Improved connectivity of the cities with the ports and various logistics parks are now being given primary focus. India is taking a step towards becoming a world-renowned destination for establishing and expanding businesses. Considering all the above-mentioned factors, we can almost be certain that logistics will play a major role in the projected economic development of India.

The most frequently used methods within logistics are theory of charts and grids, special methods to solve transportation tasks, distribution problems and natural methods of mathematical programming (most often used is linear programming). Referred methods can significantly influence the production process at plants and improve the management and planning of the logistics processes. The importance of operational research methods is highlighted in these scenarios. Operations research is also used for a competitive advantage. Commonly used methods for logistics are:

- a) Methods for analysis of the logistics process and material movement.
- b) Mathematical methods of operational analysis.
- c) Graphical methods
- d) Simulation methods- simulation can be used for designing the new system, as well as the analysis and elimination of weak and unnecessary or cost inducing points in the production system.
- e) Methods for planning and forecasting procedures for future planning periods.

## 6.1 Methods

- **Graph and networks theory:** Methods of graph theory are also used for modeling transport systems. Many of the real systems can be represented as graphs, which consist of joints and edges. All transport networks can be drawn into collection of joints and edges. Joints in the network are interpreted as distribution centers and edges are seen as a connector between them. Graphic presentation of the real system is very illustrative and easy to understand even for laymen in the area of mathematical modeling. Models of this type are applied often. Methods of graph theory are also applied for determining optimal flows in networks to optimize the transport service, for example, traveling salesman problems. These methods are needed for an accurate representation of the various procedures and processes in the analysis of the material and information flows.
- **Linear Programming:** models and methods are used to solve the tasks, for which are typical multivariable solutions and which can be determined from different variables. The subject of LP is the solution of linear optimization problems, which are a special case of the general problems of mathematical programming. Among the methods for solving LP, the special methods for solving distribution problems are mostly used in logistics, for example, the northwest corner method, index method, Vogel approximation method, modified method of Hungary method.

- **Methods of network analysis:** Network analysis is a part of mathematical programming. Its theoretical basis is graph theory and probability theory. The research subject is the design, implementation, and application of mathematical models of complex set of activities (projects) forming a follow-up process. There are technological and organizational relations among these activities. It means that activity may begin only after the completion of some other activities. Network analysis is used in the preparation, planning, management; coordination and control of complex tasks in various areas of economic activity where it is needed to analyze or optimize any network of interconnected and related items that have some connection between them.

## **7. 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.

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.

### **7.1 Transportation**

With respect to the environment, transportation is the most visible aspect of supply chains.

- **Mode choice:** One of the main choices in transport is the mode of transportation, viz. transport by plane, ship, truck, rail, barge or pipelines. Each mode has different characteristics in terms of costs, transit time, accessibility, and also different environmental performance.
- However, the choices are limited, as the transport mode is often determined by the type of product (e.g. liquid, bulk or package) and the distance to be traveled. In case of intercontinental supply chains, the main choice is between air and sea. For continental chains, it is mostly between truck, airplane, train or short sea ship. This is where OR is used. They find which the best choice of delivery is and mode of transport is optimal.
- **Products and inventories: life cycle-** A supply chain is also characterized by the products it supplies. The environmental aspects can be taken into account when choosing between different versions of the same product, even at the level of the individual customer. Moreover, by measuring and publishing the environmental performance of a product, manufacturers are more likely to make "greener" products.
- **Supply and transport chain design-** transportation and facilities can be combined in a supply or transport chain, ensuring that customer requirements are fulfilled. The choices of each driver should be made by addressing the following aspects:
  - a) - sourcing: where do they get products from (which country)
  - b) - determination of production and distribution concepts
  - c) - determination of the type, number, and location of facilities
  - d) - choice of transportation means
  - e) - choice of the transportation speed - choice of the transportation concept
- **Sourcing-** The sourcing of products directly determines the need for transportation. The provision of many cheap products from Asia has created huge transportation streams to Europe and the US. Nearby alternatives, like Mexico for the US and Turkey for the EU could also be used. Differences in wages are the main drivers for the difference in product costs, but many other factors also play a role.
- **Supply chain planning and control-** on the tactical side, with time horizons of a quarter to a year, several key decisions have to be made, such as forecasting, production capacity planning, inventory control, and marketing operations, including pricing strategies. The environmental aspects due to pricing, supply chain planning, and procurement are considered.

### **7.2 Manufacturing and Procurement**

Due to increased competitiveness, manufacturers have to continuously innovate and come up with new ways to become more profitable and please the customers. Operations research helps with this by analyzing the data, cut costs and maximize profits. They develop software models and analyze different scenarios and implement the best suited. Operations research covers 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.

Procurement is a vital aspect of most sectors, especially those which are raw material intensive. Procurement involves price negotiations, delivery, making sure that the quantity in question is as per the requirements, etc. Operations research in procurement involves getting the input (raw materials) efficiently at an optimal cost. This, in turn, helps with the profitability of the company. It is no secret that global warming is increasing and humans are causing it with their carbon emissions. Using OR techniques one can understand the environmental implications of business activities. The main drivers that affect environmental change are



transportation, facilities and products and inventories. The technique used is MCDM (Multi-Criteria Decision Making), which helps in identifying synergies between cost and environmental objectives.

## 8. CONCLUSION

Modern concept of logistics and warehousing don't only include the methods of stocking and transportation but also inventory control and cost-cutting, etc. transportation problems are often used in order to solve problems regarding the cost-cutting aspect of different industries such as steel and iron as they help in finding out which warehouse and supplier must be connected and also helps in choosing the correct supplier with the least cost in order to improve profit margins. Linear programming problems can be used to help determine the quantity of inventory that should be held by the manufacturer of a certain product in order to maximize profits. assignment problems can be used in order to design a route for collection of different materials for manufacturing purposes and collection of different finished goods from different suppliers in case of retail stores. multi-criteria decision-making techniques can be used to solve problems with multiple operations research has also helped in many different companies to develop a more environmentally sustainable form of transportation as transportation place one of the key roles in the deterioration of environmental standards from the business aspect. 10 through this paper we have conclusively studied explored and understood that operations research plays a key role in the logistics and warehousing industry in today's world and continues to do so for a very long time. It is almost as important as a key pillar to any building so this industry as the entire industry depends upon quantitative decisions made in order to organize and minimize cost operations research in logistics and warehousing has still a lot of fun explored potential which will help Logistics be more economical and environmentally friendly leading to a healthy as well as a rich economy in the future.

## 9. LIMITATIONS

- **Warehouse Management:** O.R. techniques help in warehouse management to provide a solution only when all the elements related to a problem can be quantified. All relevant variables do not lend themselves to quantification. Factors that cannot be quantified find no place in O.R. models. Some warehouse factors that might affect the workers and the natural factors might not be quantifiable.
- **Transportation Costs and Time:** When the basic transportation data are subjected to frequent changes, incorporating them into the O.R. models is a costly affair. In Warehouses and in logistics frequent changes are normal which might lead to higher costs. New and different routes of transport would affect the business subsequently.
- **Legal Restrictions:** Implementation of legal decisions is a delicate task. It must take into account the complexities of human relations and behavior.
- **Dependence on Market factors:** O.R. techniques try to find out an optimal solution taking into account all the forces of demand and supply. In modern society, these factors are enormous and expressing them in quantity and establishing relationships among these require voluminous calculations that can only be handled by computers. Some warehouses might not be advanced enough for this software that can calculate the demand and supply of the market forces.

## 10. REFERENCES

- [1] Dagmar B, Natália H and Henrieta H (2015) Use of operational research methods in logistics, acadmia.edu
- [2] Li X (2014) Operations Management of Logistics and Supply Chain: Issues and Directions, Hindawi Publishing Corporation
- [3] Springer, Boston (2005) Cormier G. Operational Research Methods for Efficient Warehousing. In: Langevin A., Riopel D. (eds) Logistics Systems: Design and Optimization
- [4] Shukla H(2017) International Journal of Innovative Research in Technology and Science
- [5] (2019) An overview of aspects, issues, contributions and challenges, European Journal of Operational Research for Green Logistics