

ROLE OF OPERATION RESEARCH METHODS IN TRENDS OF LOGISTICS AND TRANSPORTATION

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Abstract:

OR has been instrumental in making transportation processes more efficient, and companies compete to tackle complex logistics and transport problems in a way that has been competitive since its beginning. To improve decision-making, OR as a discipline of systemic nature has tackled the complexity of issues and interconnections among systems components. This study intends to view how OR methods are used in the latest transportation and logistics trends.

Different Era's of the growth of OR's contributions to transportation and logistics with the development of information and communication technology (ICT) has been presented. This study filled a gap in the existing literature by describing the latest prevailing trends using OR methods in the context of transportation and logistics and the previous study. Results indicate that operational research is more important now than ever before, and can support new technologies and trends.

Introduction:

Before computers were invented, transportation and logistics problems had to be handled, and operations research (OR) became a discipline devoted to the development of models and techniques to assist decision making.

OR has helped to make transport process well-organized and make the businesses able to deal with challenging transport and logistics issues in a competitive manner since its inception. To enhance decision making, OR as a systemic discipline has taken the complexity of issues and connections among system components. The OR techniques have depended on computers and data availability. More data and computing power have made OR techniques more powerful.

Technology has changed, and so has OR. It has also generated new problems and possibilities for researchers in OR as well as transportation and logistics systems.

To demonstrate how OR's contributions to transportation and logistics have changed with new challenges and technology, this article will illustrate how current developments in this area are generating new possibilities.

Involvement of operational research has revolutionized the world globally and has impact upon the latest decision making regarding transportation and logistics.

The operational research technique is based on statistical and analytical process which is highly needed to meet the new trends in this area (Takai, 2009). This study aims to explore three techniques or methods which contribute to meet the new trends and challenges in the area of logistics and transportation

Aim of the study:

This study intends to view the OR methods used in latest trends of transportation and logistics and provides the insight into this area along with techniques of operational research.

Literature review:

Background of, Transportation and logistics:

According to (Singh et al, 2014), supply chain management plays a vital part in our country's rapidly expanding retail industry. Nowadays, industries are reinventing and restructuring themselves to remain profitable and cost-efficient.

Transportation and logistics issues have a long history. OR has only gradually contributed to their solution, together with the rise of automated systems.

Szymonik(2014) examines packaging from a logistical viewpoint. The efficiency and effectiveness of transporting products through the supply chain is feasible with proper planning, decision making and as per the design of customer needs. Depending on the organization's size, structure, and goal, Operations Research helps to determine and compare different options.

Transportation and logistics have a significant history and has been known by its achievements. The railroad was invented in 1869, the aircraft in 1903. The sea container, invented in 1956, which has put the impact upon the marine transports drastically.

Nowadays, logistics is seen as a business or accompany objective that makes products accessible when and where required. Moreover, transportation management is a part of logistics and has been known for years. And yet people as well as objects must be transported. People used to walk, ride horses, or go by ship. Nowadays, many modes of travel are accessible with varying costs and luxury.

Normally, carriage transportation issues have been different from human transport issues Moreover, although the private sector is responsible for freight or carriage transportation, the public sector is responsible for designing the infrastructure for human or passenger transportation.

OR has helped to optimize bus and rail fleets by coordinating routes, timetables, and crews to aid both freight and passengers transportation in a structured or systematic manner.

Operational Research:

Operations Research (OR) is a field that applies sophisticated analytical techniques to assist make better choices. Operations research is also referred to as management science or analytics.

According to Strickland (2015), Operational academics and practitioners have long examined transportation and logistics issues. Operations Research is a problem-solving and decision-making approach. Many organizations, big and small, utilize it. Various issues are solved using mathematics and rational reasoning. They are solved step by step, with progress shown. Like Business Issues (real world applications), the levels of the Abstract Ladder are utilized to address various, interrelated issues. Various problem-solving and efficiency-boosting methods are used to get excellent, long-lasting outcomes.

Takai(2009) surveyed the efficacy of Operations Research for rational supply chain and logistics planning and functioning. The study analyses the changing structure of global business operations, including more sophisticated and geographically broader international logistics. The article also discusses supply chain and logistics difficulties, as well as the role of Operations Research in future issues. OR (operations Research) was created as a technique that corresponds to technical research. It is used to effectively make new military technologies like radar, night fighters

and underwater mines in The United Kingdom during the last stage of World War II. The concept was then transferred to the United States where it is now called operations research. This acronym refers to tactical operation research. It provides a wide range in achievement, including frontline military operations and logistical support. This technology was then made accessible to the private sector and became the OR of today. There are many definitions of OR. However, OR can be described as a method in which social and corporate activities produce goods and services. The system of these basic activities is built as a mathematical model. Problems regarding the operation of the system are then analyzed using mathematical tools that are appropriate to the purpose to find the best solution. The problem solving and derivation are done using a variety of techniques such as statistical and mathematical analyses, system simulations, optimization algorithms, and other methods. OR was closely linked to logistic problems from the beginning of its development. Many of the core technologies used in the initial stages have been applied to logistics planning today. These technologies include basic technologies for demand forecasting, inventory analysis, determination of the optimum order quantity (economical order quantity), shortest route planning, mathematical programming methods, resource allocation problems, optimal locations problems, queuing theory and discrete simulation. These technologies were used to solve problems (Takai, 2009)

OR is also related to the words “minimization” and “optimization”. Applications of Operations Research may be found in government, commercial, and industrial sectors to improve management, daily operations, and develop better policies that benefit all stakeholders (Xing et al., 2013)

The growth of OR's contributions to transportation and logistics has paralleled the development of information and communication technology (ICT). The main historical stages are as follows:

Era of 1960s and 70s:

Transport meant movement and shipment, while logistics was a newer field that related to inventory control in this era. During the same time, new programming languages emerged. The very first compiler of FORTRAN was delivered in 1957.

Era of 1980s:

It is the study of transportation era (common carriers and private fleets) and Period of rail and marine shipping. In the early 1980s, home computers with productivity, programming, and gaming applications were created.

Era of 1990s:

This era covers the transportation of people as well as merchandise. Supply chain management has been developed to meet the needs of operations as well as suppliers involved in the supply chain management process. Transport and logistics have evolved to deal with a broader variety of problems in recent years.

Era of 2000-2010:

The field of transportation and logistics has a wide range of uses that are constantly escalating. With each passing year, it seems that the conventional fence between freight or carriage and human transportation is becoming weaker. It is possible to quantify the academic results of transportation and logistics research by looking at the number of papers published and the number of conferences held. Following the study's inspiration from real-world problems, models and algorithms were developed and implemented in software packages utilized by commercial and public sector organizations. There were two OR/MS Today studies that showed this impact. One looked at supply chain management software (Aksoy and Derbez, 2003) while the other looked at vehicle routing problems (Janice Partyka

. Use of big data with IOT:

Big data now outstrips supply chain management in Google searches. This reflects the increasing notion that vast amounts of data are important to companies and services. For many applications, data generation speed is as essential as data volume. Huge data allows managers and decision makers to know more and make better choices. Operational researchers understand this. However big data is opening up new possibilities for operational researchers, particularly in transportation and logistics. Whereas big data is a general term, and statistics analyst are in fierce competition, (Davenport et al.,2012) by information into better decision making and performance.

The Internet of Things (IoT) enables items to be detected and controlled remotely via a network, allowing for closer physical and digital integration. It uses embedded technology to identify things and can interoperate with the current Internet infrastructure. A widely dispersed network of devices interacting with humans and other devices will result from the IoT (Gubbi et al., 2013)

Trends in supply chain management:

Technological advancements are enabling huge capital companies to link and cooperate on cross-border transit, storage and monitoring of products and services.

List of the recent technologies has been given which have a great potential effect on operations:

- Improving global logistics efficiency and sustainability by transforming physical handling, transport, storage and supply.
- Having Consistent IT standards provide supply chain transparency and efficiency, allowing for more effective cooperation.
- Handling of Large data volumes provide better view for future outcomes, and increased operational efficiency
- A wide range of business model and process flexibility is provided by cloud-based services which aids in SPM
- Use Greater supply chain security (less fraud); less bottlenecks (third party certification); reduced mistakes (no more paper paperwork); and increased efficiency.
- Use Automatic system cause reduction in human force by improving efficiency in timely delivery and management of warehouse.
- Acquiring Self-directed vehicles minimize the requirement for human input in transportation, delivery, and storage may significantly reduce costs and optimize assets.
- Use of Advanced drones, allowing for better inventory management, monitoring, and efficient delivery.
- The use of 3D printing on-site lowers the need to ship final products and allocates transportation burdens to lower-volume raw materials, which saves transportation costs. (Aynscough et al., 2021)

Trends in Logistics and Transportation:

The year 2020 heralded a major shift in almost every sector on the planet. Last but not least, transportation and logistics are important considerations. Due to the large number of individuals who remained at homegrown to aid in the containment of COVID-19, the need for contact-free supply and accessibility increased dramatically.

The repercussions of previous year's reforms are still being recognized. Through 2021, they will be the driving force behind new and unexpected developments. Logistical and transportation services both make important contributions to the economy of their respective countries. FedEx express earned \$7.1 billion in freight revenue by September of last year.

The last year has demonstrated how important transportation and logistics are to society's smooth functioning. It's also changed the way of doing the things.

- Now a days, digitized items, processes, or systems are known as 'digital twins'. Their capacity to aid, to organize and to respond to unexpected events is unique. Use of digital twins has drastically made a new trend in logistics. It provides better knowledge and capacity to identify opportunities and dangers. A digital twin receives real-time data from sensors and equipment connected to the Internet of Things, allowing it to

keep up with global operations.. Rapid mitigation of unplanned hazards and Worst-case situations may be tested safely. Best of all, the data gathered may improve a company's end line. None of these technologies are in their early stages. Both provide significant value for system optimization and business process transformation.

- Expectations are here to see further growth in online sales due to improved speed, ease, and virus-free surfing. In 2023, there will be 300 million internet consumers in the US, or 91 percent of the population! Greater online sales imply more demand for storage, shipping, and delivery services. This development represents a huge potential for transportation and logistics. Businesses that wish to stay up with demand must expand. As ecommerce grows, so the need to recruit, train, and retain new people rises. Only 9% of European freight drivers are under the age of 25. Poor image, unclear career path, and safety concerns are among the problems preventing companies from recruiting talent. To take advantage of ecommerce, businesses must solve labor shortages.
- By having only one planet to live, reduction in CO₂ emissions is mandatory. The world's footprint is shrinking, but transportation emissions are rising. To reduce these emissions a structured operational management is necessary now a days, you can buy a battery or a hydrogen vehicle Breytner, in the Netherlands which is the world's first zero-emission trucking
- This trend would wish to stay up with the anticipated increase in transportation and logistics. In the epidemic, research has been shifted toward digital learning.
- By giving online training and making the people skilled will ease the management of logistics operations and transportation handling. A new world of online has provided the platform to all at home to learn the quick methods in order to gain the efficient management (Markovic, 2021)

Techniques of Operations Research

- **Linear Programming (LP)** is a mathematical method for allocating limited resources to meet multiple requests while achieving a goal.
- The **transportation issue** is a specialized version of linear programming where the goal is to reduce the cost of transporting a product from one source to another.
- A issue involving the assignment of n distinct facilities to n separate tasks is called an **assignment problem**.
- The existence of a random group of consumers requesting a service indicates a **queuing problem**. This theory helps to calculate the anticipated queue size, expected queue wait time, expected server idle time, etc. Thus, this idea may be used to reduce the length and duration of a wait with little effort.
- It is used to make decisions when there are multiple opponents (i.e., players). In **game theory**, two or more people with distinct goals affect the game's result. The game theory assumes that each participant seeks to maximize profits and minimize losses.
- It deals with acquiring, storing, and **managing inventory** to guarantee its availability and reduce waste and losses. It helps managers to determine reordering time, level, and amount.
- **Goal programming** is another method which may help an organization to achieve several, different goals.
- Another method is **simulation** which is all about of conducting experiments on a model of a specific scenario. It is utilized when a genuine research or experiment may be too precarious, difficult, or time consuming
- Nonlinear programming methods work well when the target function or certain limitations are not linear. Non-linearity may be induced by variables like bulk purchase discounts.
- Digitalization or automatic methods work well when one or more variables are integral. Number of vehicles in a fleet, generators in a power plant, etc.

- **Dynamic programming** is a technique for addressing issues that need choices at many stages. All issues in this category have one thing in common: current choices affect future eras.
- **Replacement methods** address the issue of replacing equipment, people, or capital assets owing to inefficiency, failure, or breakdown.

It's an operations research technique adapted from electrical communications. It measures the efficiency of information flow inside a system and helps to improve communication. (Techniques of Operations Research, Operational Research Methods)

Analysis of the literature:

Now a day's optimization and minimization of cost and resources is necessary to achieve the desire revenue and to enhance the business efficiency. Logistics acts as a key component from start to end and delivers the desired product to the consumer. Operational research evaluates the cost reduction process and helps in problem solving and decision making by deriving the appropriate strategies. Above mentioned operational methods or techniques plays a vital role to meet with the trends of logistics and transportation and act as a precursor in supply chain management. This study brought the information from old latest that provides the sufficient information in the area of supply chain and logistics in a view of operational methods by collecting the data that was available on different sources.

Conclusion:

This recent descriptive study revealed that recent technology and automotive advancements are quickly altering supply chain management and transportation. Economic pressure compels businesses to become more efficient and effective by using new technologies. The aim of sustainability is to satisfy current demands without jeopardizing upcoming generations' capacity to fulfil their requirements. Due to the massive economic and environmental impacts of logistics and transportation, new business possibilities are anticipated to quickly alter transportation and logistics.

OR has contributed a lot to supply chain management and transportation issues, and new research challenges will need additional contributions. This article highlighted several significant developments and operational research methods that impact upon logistics and transport process Consolidation of commodities and passengers on the same transport is already occurring. In exchange for a small charge, consumers may transport the products of other customers. Results have concluded that Operational research is more important than ever and can promote new technologies and new trends. In future, further study may be conducted to find out the empirical and analytical approach on these variables in connection with other variables to check the significant relationships, correlation or association.

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