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Operations Research in logistics, supply chain management and warehousing in the retail industry

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ABSTRACT

This paper analyses the applications of Operations Research in various forms and techniques in the sector of Retailing, Indian and International. Retailing is the fastest growing sector with a lot of scope for improvement. The expectations of the customers from this sector are very high and so in order to sustain, the firms need to satisfy the demands efficiently. Along with this they also need to maintain their costs and at the same time generate higher revenues. To establish our points, we will be focusing on the few main aspects of Retailing such as Logistics, Supply Chain Management, and Warehousing and thus show how Operations Research techniques like transportation, simulation, and the analytical model can be used to decrease costs, hence making more profits and improving efficiency in totality.

Keywords— *Retail, Operations Research, Warehousing, Logistics, Supply Chain Management, Minimization, Efficiency*

1. INTRODUCTION

Operations Research is an analytical method of troubleshooting and decision making. It is widely used by many organizations, small scale and large scale. Here, various problems are dealt with the help of mathematics and are supported by logical reasoning. They are resolved step by step and the progress can be seen in each step. For example, Business Problems (real world applications), Generic Problems (using a certain method and solving mathematically), Modelling Problems (using a set of rules and notations), Algorithm (procedure of steps followed, uncertain outcomes) also known as the layers of the Abstract ladder are used to solve the diverse, unrelated problems. All of this happens with the help of various problem-solving and efficiency increasing techniques in order to obtain good, lasting results.

Operations Research is also very closely linked to the two terms of "minimization" and "optimization". Application of Operations Research can be seen in various fields like government, commercial, industrial-based in order to intensify the management and enhance day to day operations and plan better policies which benefit all the stakeholders. Now narrowing down a bit and having a specific focus on the very dynamic and the fastest growing industry of the world, i.e. the Retail Industry, we notice that the various crucial functions that are performed are performed in the process of retailing are greatly dependent on the results obtained by Operations Research.

The objective of our paper is to thus clearly portray the concepts like Logistics, Warehousing, Supply Chain Management in the Retail Industry and how they are backed up by Operations Research, thus justifying the topic of Application of Operations Research. It needs to be noted that in order to solve the problems convincingly, appreciation of the problems is required with a clear understanding of the functions of retailing. The Retail Industry can be explained as how the manufacturers of the goods and services, make them available to the ultimate customer. And due to the huge size of the sector and the high competition prevailing, each one involved wants to do the best of his abilities in order to gain the best possible results. Thus we will investigate the continual merchandise management, adaptation to the environment, good supply facility, reduced costs of the retail sector with the help of the concepts of Operations Research.

2. LITERATURE REVIEW

Xiang Li (2014) in the paper provides an insight into current operational research management of logistics and supply chain. He first clarifies the concept of logistics and supply chain management in this paper, which defines the scope of related research papers. The core of this paper are several issues in this field with examples to show how these researches contribute from different research angles.

Jitendra Singh (2014) in the paper focuses on the role of supply chain management in the extensively growing retail sector of our country. Industries today in order to sustain, be cost-effective and still generate huge profits are redefining and reorganizing themselves. So, in this regard there is total responsibility of supply chain management to make it a success.

John Baxter (1951) defines that there are 3 main fields of retailing that are covered by operations research, consumer behaviour, store operations and merchandise handling. There is a general pattern in consumer behaviour which can be analysed and broken down into frequency distributions based on the number of shoppers at different times of the day, on different days of the week and at different seasons of the year.

Andrzej Szymonik (2012) focuses on the various types of packaging from the perspective of logistics. The efficiency and effectiveness of moving goods in the supply chain as per the design, customer's requirements and regulations applicable fulfil the requirements and provide with a rational solution when required. Here, Operations Research plays a crucial role in determining and comparing various alternatives depending upon the size, structure and objective of the organisation.

C. Thaller et al (2012) analyses the logistics research in India and the current topics being discussed in the field of logistics. The research paper mainly focuses on optimization of logistics nodes, integration of various centres and risk evaluation of logistics chain. It depicts the aspect of logistics networks and clusters consisting of various government bodies. The author somehow neglects the already established organisations for the purpose of in-depth study of logistics and supply chain management in accordance to Operations Research and how the sector is gaining a continuous growth in all aspects.

Eizo Takai (2009) conducted a survey to describe the effectiveness of Operations Research for rational planning and working of supply chain and logistics by optimization methods. The paper examines the various structural changes occurring, including more complex and geographically wider international logistics associated with global corporate activities. The paper also focuses on concepts and problems of supply chain and logistics and the proper roles of Operations Research in solving the future issues.

U. S. Army Logistics Management Center (1961) goes back into 1940s stating the era where the usage of operations research was introduced in Logistics during the World War II where it helped to solve a broad range of Military Problems.
The army logistics management was interested in the means of obtaining increased use of Operations Research methods in accomplishing in-house logistics studies and in the evaluation of contractual studies. It concludes by that logistics problem can be most effectively resolved by combining the features of the staff study with the tools and techniques of Operations Research

3. METHODOLOGY

The methodology used is qualitative in nature, wherein the research is based on secondary data collected via various sources such as magazines, newspaper, articles, e-journal and research papers. The research paper contains aspects of supply chain management and logistics in the retail industry as proven by studies done by various authors.

4. RESEARCH OBJECTIVES

a) To understand the application of operations research in the retail industry.
b) To analyse the supply chain management processes followed by the organized retail sector.
c) To study the importance of effective warehousing in the retail industry.
d) To understand the operational logistics used for efficient management of retail stores.
e) To analyse the Global and Indian retail industry in terms of its operations research.

5. BODY OF CONTEXT

5.1 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. 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.

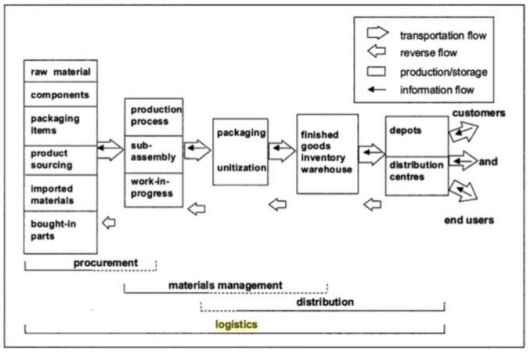

Fig. 1: Key components of logistics

Linear programming problems are often compiled due to two needs which arise during procurement which is as follows:

- It has an objective which has to be accomplished
- These problems usually may have multiple alternate options: An example of this would be picking the right supplier within the budget and time constraint.
- The situation demands certain confusions.
- There is one optimal solution which is the best route to follow. And there may also be alternative optimal solutions considering various suppliers providing sensible and beneficial deals. The factors will have to be considered in the process (example: price, quality, etc.). Hence linear programming problem as a methodology can be easily used to make the entire process of procurement logistics more efficient.

5.2 Supply Chain Management

The role of supply chain in organized retail industry is very significant for on it depends the growth of this sector. Supply chain decisions are divided into two major categories: strategic and operational, this is further divided into four major decisions, which are: location, production, inventory and transportation. Supply chain management is highly dependent on effective operational output of these decision factors in order to optimize the store operation of the firms. In order to achieve the most profitable results firms plan and formulate numerous solutions in order to find out the most optimal solution which would cost lowest via application of various operational research theories like transportation problem given by Frank Hitchcock to find the optimal route for transporting merchandise from warehouses to retail outlets, Simplex by George Dantzig to understand the profitability of merchandise in order to decide the quantity of production and assignment problems by Ford and Fulkerson to assign the tasks to workforce in an effective, efficient and productive manner.

In Indian organised retail sector supply chain management plays a very crucial role as the Indian customer demands a variety of products at affordable prices and it is upon the supply chain management to ensure that the firm is able to cater to the demands of its customers be it price, service or the adaptation to the dynamic business environment. One of the most significant factors that facilitates the supply chain management is infrastructure. Infrastructure in supply chain management mainly includes the means of transportation for movement of goods and services. In India road, rail and air links are not sufficient, which leads to time lag in transportation of merchandises and thus causes loss to the firms. While the organized retail sector is coming up with various methods to maximize profits, the transportation problem is still relevant for which greater requires a deeper operational research in order to minimize transportation costs and time. Thus, while Indian retail industry is evolving for better, it still faces trivial problems which in the long run can lead to heavy losses.

Fig. 2: Retail supply chain process circle

Talking about the world economy, supply chain management deals with various firms and also individuals, that too from various countries. This greatly requires the company's collaboration in various tariff policies, trade laws, and politics, maintaining the quality and thus maintaining relations globally. Being a long and tedious process global supply chain management requires constant attention and daily updates based on the changes in the global economy. Time difference is one of the major sources of concerns when it comes to global retailing as firms must always be cautious of time zones on order to maintain healthy international relations.

Global retail industry faces daily problems of transporting materials from all over the world, assigning jobs to individual on both local and international levels, and optimization of supplies. The industry focuses on operation research techniques of transportation, assignment, networking and simplex in order to optimize its supply chain management. Transportation problem is used by the firms to find out the optimum supply demand analysis which would minimize cost, while assignment problem is used to assign jobs to local and global employees in order to maximize productivity. Global retail firms use networking and simplex methods to optimize the production and flow of good from place to another such that it maximizes the profits. Thus, global retail industry is evolving as one of the major giant businesses of the world, and with proper optimization of supply chain management it can minimize the cost to as low as zero.

5.3 Warehousing

To ensure a smooth retail process, there is a need for us to study the distribution network design by integrating the transportation and the inventory cost function. There will be a noticeable tradeoff between inventory cost, the direct shipment cost and the cost of the location in such a set up. The main task here is in determining the number of warehouses required, location of the warehouses keeping in mind the various aspects, and the task of estimating the inventory policies for these warehouses and the retailers. Thus, Operations Research here helps us in minimizing the cost of all the three i.e. inventory, location and the transportation. Thus, we hereby focus on the dynamics of how a warehouse plays a significant role in retailing and how it is always supported by Operations Research.

To solve these problems and have long-lasting sustainable solutions, application of operations research is used to a great extent as it majorly focuses of reducing costs and improving efficiency. Firstly, talking about warehouse layouts, they have a direct impact on the cost and also decide the storage capacity and thus the transportation cost. Operations Research in retailing covers the consumer and the retailer's behavior and helps them in adapting with these habits in the best possible way. Basically, merchandise being handled so as to obtain greater efficiency and lower the costs. Though retail is the fastest growing industry, they have to comply with many rules and procedures, and if they fail to do so it can result in penalties. Storage capacity models that are a part of Operations Research find the adequate warehouse size or the maximum space required. Also various other features like rack orientation, space allocation form the purview of warehouse design models. "Previous surveys on the use of operational research methods in warehouses were conducted by (L.F.Gelders, 1985) who concluded that the most practical approach to studying the complexities of a warehousing system is to combine analytical and simulation models."

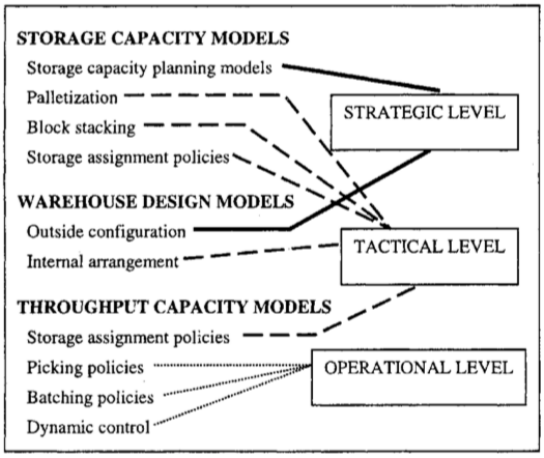

Fig. 3: A taxonomy of warehousing decision models

The above figure shows the categorization of various warehousing decision models and proposes a second classification based on a strategic, tactical and operational decision framework. The strategic decisions have a long lasting impact on profitability and so they are not seen frequently hence the use of sophisticated analytical and simulation models. On the other hand, operational decisions tend to occur frequently and keep on recurring they require algorithms which yield beneficial solutions. There has also been a continuous improvement in the efficiency of orders collections through better warehouse layouts and storage systems formed under the compact storage systems of AS/R (Automated Storage and Retrieval) and AVS/R (Autonomous Vehicle-based Storage and Retrieval) which are gaining attention. Furthermore due to the onset of e-commerce, e-commerce warehouse operations have to cope with large volatile situations in customer order quantities and have to manage returns efficiently. Hence, optimal policies for traditional manual warehouses may not be suitable for e-commerce warehouses. For this existing gap, *Albert H. Schrotenboer, Susanne Wruck, Kees Jan Roodbergen, Marjolein Veenstra and Arjan S. Dijkstra* studied the optimal pick-up routes in their paper titled *Order Picker Routing with Product Returns and Interaction Delays* using a hybrid genetic algorithm. This algorithm decides routes for contemporaneous pickups of products orders in a particular period and also delivery of returned products by the customers to the proper storage warehouses.

6. PRACTICAL APPLICATION

It is very important in a retail supply chain to optimise the logistics cost. Transportation here plays an important role in the same. Since the past few years logistics has become a crucial part for the retailers all over the world, no matter how small or large their size is. Logistics has become "retail driven". Further talking about transportation, Transportation is usually ignored as a source of competitive advantage although the activities happening majorly depend upon the various factors like product's quality, quantity, delivery schedules, satisfaction, etc. and so it is recommended to have control over the distribution network. But the retailer also

needs to manage this in a cost-effective manner and that's when the concept of Operational Research's transportation comes into the picture. Focusing on various cost affecting factors like route optimisation, truck's capacity utilisation, which can be found using Operation Research techniques can help them lower the costs and increase efficiency.

7. CONCLUSION

Initially the retail was unorganized, which led to immense costs and heavy losses. With the technological evolution and increasing business awareness the focus of the industry has shifted from product-oriented market approach to consumer-oriented market approach. With the shift in market orientation retail firms aim at reducing costs and optimize production to maximize profits. In order to do so retail firms, apply various methods of operations research to find the optimal set of solutions to a given problem. The main functions of a retail firm include Supply chain management, warehousing and logistics.

- Supply chain management plays a crucial role growth of a retail firm as it ensure the supply of goods and services from manufactures to retailers. The major issue faced by the Indian organized retail industry when it comes to supply chain management is transportation of goods and services. Due to lack of proper infrastructure of road, rail and air links, the retailers face a constant issue of time lag between placing the order and estimated delivery time. While on a global scale, with outsourcing of production and manufacturing processes retailers face the problem of networking the routes and assignment of jobs. With proper application of various operations research techniques, the firms can overcome these issues and thus reduce their cost by applying one optimal method.
- Warehousing: it is imperative for the retailers to effectively manage their warehouses in order to ignore over stocking or under stocking of materials, and to maintain the costs of the products stored. With the retail approach becoming more shelf-centric, the retailers must focus on ensuring on minimizing the inventory, location and transportation costs. In order to do so retailers use operations research techniques to understand the consumer buying behaviour and obtain merchandises accordingly. The warehouse decisions are either operational, strategic or tactical in nature which ensures profitability, efficiency and effectiveness of the store. With the onset of ecommerce industry the focus of warehouse has shifted to make it easier in the firms by deciding optimal routes and closest warehouse thereby cutting costs.
- Logistics aim at reducing costs, reducing capital and service improvisations. It is logistics that ensures the effective flow of goods and services from the point of origin to the point of consumption. To grow and expand, it is vital for a retail firm to have an effective and efficient logistics management as it helps them decide the flow of goods from forecasting of demand to packaging and procurement. In retail industry logistics play a crucial role in making sure that the merchandise is available at the right place, to right people, at the right time. In order to do so, firms use the method of linear programming to find the optimal allocation of resources among competing activities. By doing so they find out on how and where to produce and allocate products such that it maximizes their profits.

Thus, retail industry while is evolving every day, it is the effective application of operations research techniques like: transportation, assignment, linear programming and networking so as to earn maximum profits.

8. RECOMMENDATIONS

Considering the changes in the way things operate and have been operating, we have successfully concluded that retail logistics and supply chains to a greater extent are dependent on operations research. There are still people who think that retail logistics is all about boxes and Lorries, this thought needs to change. No doubt that they form a crucial part but controlling data and information needs more attention and also opens topics for further research in this field. Also it needs to be presented with clarity that warehousing and transportation are not separate activities but are all integrated by the suppliers and the service providers. Contributions of GPS and RFID in retailing, keeping in mind the two main aspects of cost-effectiveness and higher satisfaction is also not much researched upon. Thus, in the coming years we believe that with the help of operations research all the challenges the industry is facing, it shall overcome with proper application

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