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ASTUDYONROUTE PLANNING IN LOGISTICS, USING LOAD DISTANCE MODEL

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Abstract

The study aimed to identify how route planning for logistic companies can efficiently implemented. Route Planning explains basic transportation strategies and frameworks, as well as crucial functional needs, while considering contemporary changes in distribution planning.

Companies may save mileage, fuel use, and carbon emissions by using a route planning system that calculates the most effective routes. Businesses may better recognize unforeseen deviations and communicate proactively to improve service and customer satisfaction since route planning is linked to real vehicle tracking.

Route planning systems define the sequences in which the selected transport vehicles must serve the demand points with the necessary amounts of commodities at the appropriate time. Transportation is a critical component of logistic management.

A complete literature study in a specific context is supplied, together with a discussion of possibly applicable strategies to be used.

The major goal of this research is to reduce the cost and plan effective route planning which lead to high productivity and high profitability and leads to customer satisfaction. In this research route planning is done with the help of Load Distance Method which enhances the smooth execution of product delivery with a minimum cost and time.

Key Words:Operations, Operationsmanagement,Logistics,Route planning,Logistics management, Load Distance Method , Supply Chain Management

1. INTRODUCTION

ISSN PRINT 2319 1775 Online 2320 7876
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Modern route planning and optimization systems are changing the way businesses carry out delivery and logistics operations. Customers were happy if businesses offered home delivery ten years ago and were willing to wait a few days for it. It would take hours to manually plan a route with multiple stops, and it wasn't always economical or efficient. With the rise of the e-commerce sector, customer expectations have shifted in terms of delivery windows that can range from a few hours to same-day delivery. As a result, route planning and optimization of the optimal route incorporating multiple stops is now required. Traditional route planning techniques cannot handle real-time events that affect businesses on a daily basis.

To make logistics efficient and profitable for business, planning and scheduling have now become complex processes such as taking into account factors such as traffic, weather, customer satisfaction, delivering on-time orders to customers and improving the route to the highest delivery point, and many more. Using strategic planning, businesses can monitor continual changes affecting the distribution network in real time, allowing delivery schedules to be adjusted to suit best results and business planning.

Customers in the digital age want deliveries to be dependable, quick, and transparent; they want to be able to trace a delivery even if it just takes a few hours to arrive. Route planning can assist in meeting this need.

To achieve a competitive advantage, several firms use route-planning tools. To increase delivery agility, these computerised technologies examine merchandise, persons, trucks, rules, and potential routes. This digital system can adapt to last-minute changes in transportation, driver, or route availability thanks to machine learning and artificial intelligence.

Route planning is the process of calculating the most efficient mode of transportation or transfers between multiple stops. Route planning is used to determine which route is the most cost-effective when is moving from one location to another. In general, logistics or transportation companies use applications/software to plan routes and compile the necessary routes.

Now let us understand howmodern tools changes the route planning for logistics companies.

Route Optimizer is a powerful logistics engine that helps optimize the delivery process. Route optimization is the process of using smart technology to determine the fastest and most efficient

ISSN PRINT 2319 1775 Online 2320 7876
 UGC CARE Listed (Group -I) Journal Volume 11, Iss 10, 2022

route. Planning software enhances the planning process with traffic classification, historical data interpretation, cost optimization, mileage reduction and other features.

Route planners can use logistics solutions to manage fleets, provide driver guidance, add bulk shipments, increase productivity and achieve agreement (SLA) compliance. These systems can process temporary orders as well as scheduled orders. Instant redirection, or dynamic redirection, is another business feature demanded by customers to accommodate changes. It provides a central hub to plan and monitor all projects in real time.

As the company's routing has to become more and more complex, choosing a real-time logistics solution is crucial to create a way to improve delivery efficiency and save costs.

In India, the logistics business is extremely fragmented, with a huge number of unregulated firms. While the extremely fragmented Indian logistics business need greater organisation, there is also a need to lower logistics costs to 10% by 2022 from around 14% currently. Organized players hold about 10-15% of the $215 billion Indian logistics business. The top five logistics companies of India are as follows:

CONCOR (Container Corporation of India Ltd.) is the indisputable industry leader, with the largest network of 61 ICDs/CFSs in India (59 terminals and 2 strategic tie-ups).

Blue Dart Express is another Indian logistics firm that specialises in courier delivery. Blue Dart Aviation, a subsidiary freight airline, operates in South Asian nations.

TCI Express Ltd. was founded in 1996 as one of the Transport Corporation of India's most important businesses (TCI). This division provides domestic and international courier services through road, rail, and air, as well as various value-added services. In addition, it offers E-commerce delivery services in India.

Allcargo Logistics Ltd is an Indian logistics firm based in Mumbai that was founded in 1993. It is the largest publicly traded logistics firm in India.

ISSN PRINT 2319 1775 Online 2320 7876
 UGC CARE Listed (Group -I) Journal Volume 11, Iss 10, 2022

Aegis Logistics Ltd is a market leader in oil and gas logistics. The company's services include product sourcing, storage and port operations, organising road and pipeline transportation, shipping, and integrated supply chain management.

2. LITERATURE REVIEW

M. Košíček, R. Tesař, F. Dařena, R. Malo, A. Motyčka (November 30, 2011) in their paper Route Planning Module as a part of Supply Chain Management Systemlooked at a route planning system that may be used as part of a Supply Chain Management information system or as a standalone. It covers basic techniques and frameworks for transportation concerns, as well as key functional necessities, while taking contemporary developments in distributing management under consideration. As a result, the results of fundamental features and other system components are provided. Every top-level function of the transportation planning module focuses on a major challenge in the transportation planning process. Some functions are essential throughout both the supplying and distributing periods. The data necessary for the system's functioning can be gathered from a company data base or from the input, which is arranged in a predefined manner. The essential functions presented include supply administration, which is one of the most important parts of the transportation management process, management of shipped products for trying to add, updating, removing, and retrieving items for transportation, managerial staff of destination points and vehicle location, and route creation, which is the most important and complicated part. The module is meant to be a self-contained (standalone) application that is linked to other corporate systems. The intended approach is compatible with a wide range of current trends and techniques, including JIT. The publication is the outcome of a cooperative effort between the authors and a vendor of corporate information systems.

Kennesaw State University (April 28, 2011) in their paper Delivery Route Optimization explored that"The Carrier Company" is a service that transports motorbike equipment all through the South East of the United States. They have over 38 routes, each with an assigned driver that distributes supplies to their clients twice a day. The majority of the company's time and resources are devoted to delivering items to its valued customers. Due to COVID-19, the Carrier Company has recently had a variety of challenges, including new drivers not understanding the routes and so taking too long to deliver the products. The group determined that the issue at hand was a TSP (Traveling Salesman Problem) that needed to be addressed because there was only one driver and

he would be delivering the whole route on his own. The software computes the most optimum sequence to deliver the products via taking the quickest distance from the Distribution Hub to all of the awaiting clients. The application also computes alternative approaches to account for traffic, construction, natural catastrophes, or any other form of crisis that may cause delivery timings to be delayed. A cost-benefit analysis was performed to assess the cost effectiveness of the new programme to the existing technique. The new programme would save nearly $5,000 per year in total. The route chosen for our programme was the shortest and most succinct route that the firm delivers to, which gave us a bottom limit for how much we should expect to save if we applied this programme to all 38 other routes. If the total yearly savings from this route are applied to the other routes, The Carrier Company can expect annual savings of up to $200,000. Given these potential savings, we propose that the Carrier Company execute the new streamlined programme on all of its delivery routes.

A paper from European Centre for Research Training and Development UK (April 25, 2018) in their paperStudy on Transportation and Distribution Strategies for a Logistics Center studied thatStorage, transportation, and distribution are crucial functions in modern logistics firms that have a substantial impact on their operations and earnings. Through a case study of a logistics operations, this paper evaluates and formulates transportation and distribution methods for a logistics center. The continue to examine to enable optimal transportation of the shipper's products to the destination via the logistics center, allowing the organization to deliver competent and efficient logistics service to its customers. Integer programming is firstly used to perform quantity allocation of commodities in all production locations with the lowest transportation costs in order to meet all needs in all demand sites. Following that, transportation routes are established in line with the integer programming findings, and vehicle demand is determined, taking into consideration public vehicle resources.

Ondrej Stopka, Karel Jeřábek and Mária Stopková in their research paper Using the Operations Research Methods to Address Distribution Tasks at a City Logistics Scalereviewed that the book provides an overview and specification of existing Operations Research methodologies for their use in solving distribution challenges, namely improving delivery routes at the city logistics scale. First, a complete literature evaluation in a specific context is developed, followed by a discussion of possibly applicable approaches to be used. The goal of this manuscript is to identify the most appropriate and beneficial methods for their implementation in order to solve the vehicle routing problem (abbreviated VRP) at a City logistics scale and related

optimization operations; that is, to actively sought the relatively short possible routes during the customer's delivery activities. It is vital to note that appropriate distributing (pick-up and delivery) activities may be described as graphs on defined transport networks, allowing the various tools of graph theory to be used. As the core notion of transport theory, a specific transport network is defined as a finite collection of vertices and edges indicating a network's architecture of roadways. Each network must be coherent, which means that there must be at least one path linking each vertex pair. Each network edge and vertex is specified by a specific value or combination of values, such as the length, the time it requires to pass, and the volume of work that needs to be done on the network.

Rajeshwari Chatterjee, Christoph Greulich, Stefan Edelkamp in their paper Optimizing Last Mile Delivery using Public Transport with Multi-Agent based Controlanalysedthat to enhance the pick-up and delivery problem, the majority of research in the discipline of Operations Research has focused on optimization techniques. Most studies try to address the vehicle routing problem, allowing for optimum delivery orders, vehicles, and so on. This article focuses on establishing a system model that leverages a city's existing Public Transportation facility to deliver small and medium-sized packaged products, so eliminating further aggravating urban congestion and helping to diminish greenhouse gas emissions. The study looks at the viability of the proposed multi-agent based simulation model in terms of cost, time, and energy usage. The Dijkstra Shortest Path algorithm and Nested Monte Carlo Search have been used to construct a tour plan for intermodal distribution of commodities using the Dijkstra Shortest Path algorithm and Nested Monte Carlo Search. The tour's quality is dictated by the accuracy of the search algorithm used for plan development and route planning. In terms of energy efficiency, the research shows that using public transportation has a clear advantage over existing delivery methods.

3. OBJECTIVES OF THE STUDY

1. To study the best location for distribution hub
2. Build a model for facility Location Planning Using the load distance method.

4. RESEARCH METHODOLGY

Data collection tool:

ISSN PRINT 2319 1775 Online 2320 7876
 UGC CARE Listed (Group -I) Journal Volume 11, Iss 10, 2022

Secondary data was gathered using various books, journals and internet. The data which is collected was used to understand the different parameters.

Research Design:

The procedures and methods used to conduct scientific research are included in a research design. By incorporating the many study components in a logical and coherent manner, the overall strategy chosen by the researcher ensures that the research subject is appropriately handled.

Data Collecting:

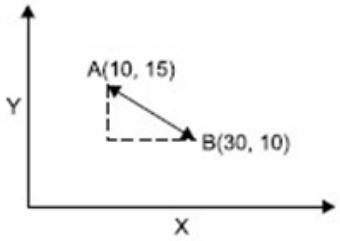
The systematic approach to data collecting and analysis is the foundation for any research's validity. The study only makes use of secondary data, which was collected from a variety of periodicals, books, past theses, credible websites, and band textbooks.

The research technique is a concise plan of study that guides us in gathering and analyzing data. Load Distance method which is a mathematical model is used for Route Planning for logistics. The load-distance approach is a mathematical model that is used to evaluate sites based on proximity. The goal is to choose a site that reduces total weighted loads travelling into and out of the facility. The distance between two points is represented on a map by assigning the points to grid coordinates. Time, rather than distance, is an alternate strategy. Secondary information is being gathered. We used secondary data in this study, which was acquired and collected from books, journals, company reports, webpages, blogs, and other sources.

Steps in Load Distance Method:

- Find the relative grid position of all the existing and perspective locations.
- Find the load at each location. This can be the number of people served or the amount of goods to be transported.
- Measure the distance of the perspective locations from each of the existing locations.
- Find the product of load and the distance from each facility locations.
- Find the sum of the product for each perspective locations.
- Select the smallest value of the sum as the most suitable location.
- Distance D_{AB} can be Actual, Euclidean, or Rectilinear.

ISSN PRINT 2319 1775 Online 2320 7876
 UGC CARE Listed (Group -I) Journal Volume 11, Iss 10, 2022



D_{AB} = distance between points A & B

X_A=x- coordinate of point A a row

Y_A=y - coordinate of point A

X_B=x- coordinate of point B

Y_B=y- coordinate of point B

Formula to calculate distance.

$$D_{AB} = \sqrt{(X_A - X_B)^2 + (Y_A - Y_B)^2}$$

Formula to calculate Load Distance Method.

$$D_{AB} = | X_A - X_B | + | Y_A - Y_B |$$

5. ANALYSIS OF DATA

For Research purpose we have selected Andheri as a sample town.

The areas have been selected on the basis of high-density population with the help of heat map. So, there is a high probability to get the high numbers of order from these selected areas of Andheri. So, the data we have is distance in km's and the population of the selected area.

Now, we have to have to identify the best facility location to be setup in such area that the orders from the facility location to the customer (home) would be easily delivered at a minimum cost and with least time.

Formula to calculate distance.

$$D_{AB} = \sqrt{(X_A - X_B)^2 + (Y_A - Y_B)^2}$$

Formula to calculate load distance method.

ISSN PRINT 2319 1775 Online 2320 7876
 UGC CARE Listed (Group -I) Journal Volume 11, Iss 10, 2022

$D_{AB} = | X_A - X_B | + | Y_A - Y_B |$

But in our case, we don't have to find distance using formula we already have distance. The following tables are calculated using Load Distance Method.

Table No. 1.1

AREAS OF ANDHERI	DISTANCE in km	POPULATION in 000's	PLACE RENT IN Rs. (1000 sqft)	NO. Of GARAGES	NO. OF PETROL PUMPS	LOAD DISTANCE
marol	0	13	25000	4	4	0
Sakinaka	3.8	13.8	20000	5	2	10488000
Gundavli	4	25.1	23000	3	1	6927600
Chakala	2.9	13.8	26000	5	1	5202600
Sahar	3.9	11.5	21000	3	1	2825550
Amboli	5.5	17.8	23000	2	1	4503400
D.N Nagar	6.1	17.3	25000	3	1	7914750
Azad Nagar	6.6	19.6	25000	3	1	9702000
Lokhandwala Complex	7.1	18.3	26000	2	2	13512720
Versova Village	6.9	63.6	23000	1	1	10093320
						71169940

Table No. 1.2

AREAS OF ANDHERI	DISTANCE	POPULATION in 000's	PLACE RENT (1000 sqft)	NO. Of GARAGES	NO. OF PETROL PUMPS	LOAD DISTANCE
marol	3.8	13	25000	4	4	19760000
Sakinaka	0	13.8	20000	5	2	0
Gundavli	4.9	25.1	23000	3	1	8486310
Chakala	4.1	13.8	26000	5	1	7355400
Sahar	3.6	11.5	21000	3	1	2608200
Amboli	6.1	17.8	23000	2	1	4994680
D.N Nagar	6.5	17.3	25000	3	1	8433750
Azad Nagar	7	19.6	25000	3	1	10290000
Lokhandwala Complex	7.5	18.3	26000	2	2	14274000
Versova Village	7.2	63.6	23000	1	1	10532160
						86734500

ISSN PRINT 2319 1775 Online 2320 7876
 UGC CARE Listed (Group -I) Journal Volume 11, Iss 10, 2022

Table No. 1.3

AREAS OF ANDHERI	DISTANCE	POPULATION in 000's	PLACE RENT (1000 sqft)	NO. Of GARAGES	NO. OF PETROL PUMPS	LOAD DISTANCE
marol	2.9	13	25000	4	4	15080000
Sakinaka	4.2	13.8	20000	5	2	11592000
Gundavli	0	25.1	23000	3	1	0
Chakala	2.9	13.8	26000	5	1	5202600
Sahar	4.3	11.5	21000	3	1	3115350
Amboli	3.9	17.8	23000	2	1	3193320
D.N Nagar	4.1	17.3	25000	3	1	5319750
Azad Nagar	5.1	19.6	25000	3	1	7497000
Lokhandwala Complex	6.1	18.3	26000	2	2	11609520
Versova Village	5.9	63.6	23000	1	1	8630520
						71240060

Table No. 1.4

AREAS OF ANDHERI	DISTANCE	POPULATION in 000's	PLACE RENT (1000 sqft)	NO. Of GARAGES	NO. OF PETROL PUMPS	LOAD DISTANCE
marol	2.9	13	25000	4	4	15080000
Sakinaka	3.4	13.8	20000	5	2	9384000
Gundavli	2.6	25.1	23000	3	1	4502940
Chakala	0	13.8	26000	5	1	0
Sahar	2.5	11.5	21000	3	1	1811250
Amboli	5.2	17.8	23000	2	1	4257760
D.N Nagar	6.1	17.3	25000	3	1	7914750
Azad Nagar	7.1	19.6	25000	3	1	10437000
Lokhandwala Complex	7.8	18.3	26000	2	2	14844960
Versova Village	7.5	63.6	23000	1	1	10971000
						79203660

Table No. 1.5

ISSN PRINT 2319 1775 Online 2320 7876
 UGC CARE Listed (Group -I) Journal Volume 11, Iss 10, 2022

AREAS OF ANDHERI	DISTANCE	POPULATION in 000's	PLACE RENT (1000 sqft)	NO. Of GARAGES	NO. OF PETROL PUMPS	LOAD DISTANCE
marol	3	13	25000	4	4	15600000
Sakinaka	5.8	13.8	20000	5	2	16008000
Gundavli	4.5	25.1	23000	3	1	7793550
Chakala	2.9	13.8	26000	5	1	5202600
Sahar	0	11.5	21000	3	1	0
Amboli	5.4	17.8	23000	2	1	4421520
D.N Nagar	6.5	17.3	25000	3	1	8433750
Azad Nagar	7.2	19.6	25000	3	1	10584000
Lokhandwala Complex	8.1	18.3	26000	2	2	15415920
Versova Village	7.6	63.6	23000	1	1	11117280
						94576620

Table No. 1.6

AREAS OF ANDHERI	DISTANCE	POPULATION in 000's	PLACE RENT (1000 sqft)	NO. Of GARAGES	NO. OF PETROL PUMPS	LOAD DISTANCE
marol	6.9	13	25000	4	4	35880000
Sakinaka	7.5	13.8	20000	5	2	20700000
Gundavli	3.2	25.1	23000	3	1	5542080
Chakala	6.1	13.8	26000	5	1	10943400
Sahar	7.3	11.5	21000	3	1	5288850
Amboli	0	17.8	23000	2	1	0
D.N Nagar	2.8	17.3	25000	3	1	3633000
Azad Nagar	1.4	19.6	25000	3	1	2058000
Lokhandwala Complex	4.5	18.3	26000	2	2	8564400
Versova Village	6	63.6	23000	1	1	8776800
						101386530

Table No. 1.7

ISSN PRINT 2319 1775 Online 2320 7876
 UGC CARE Listed (Group -I) Journal Volume 11, Iss 10, 2022

AREAS OF ANDHERI	DISTANCE	POPULATION in 000's	PLACE RENT (1000 sqft)	NO. Of GARAGES	NO. OF PETROL PUMPS	LOAD DISTANCE
marol	7.2	13	25000	4	4	37440000
Sakinaka	8.1	13.8	20000	5	2	22356000
Gundavli	4.2	25.1	23000	3	1	7273980
Chakala	6.1	13.8	26000	5	1	10943400
Sahar	7.2	11.5	21000	3	1	5216400
Amboli	2.5	17.8	23000	2	1	2047000
D.N Nagar	0	17.3	25000	3	1	0
Azad Nagar	1.9	19.6	25000	3	1	2793000
Lokhandwala Complex	3.9	18.3	26000	2	2	7422480
Versova Village	5.5	63.6	23000	1	1	8045400
						103537660

Table No. 1.8

AREAS OF ANDHERI	DISTANCE	POPULATION in 000's	PLACE RENT (1000 sqft)	NO. Of GARAGES	NO. OF PETROL PUMPS	LOAD DISTANCE
marol	3.9	13	25000	4	4	20280000
Sakinaka	4.8	13.8	20000	5	2	13248000
Gundavli	2.5	25.1	23000	3	1	4329750
Chakala	2.9	13.8	26000	5	1	5202600
Sahar	3.9	11.5	21000	3	1	2825550
Amboli	3.9	17.8	23000	2	1	3193320
D.N Nagar	5.5	17.3	25000	3	1	7136250
Azad Nagar	0	19.6	25000	3	1	0
Lokhandwala Complex	2	18.3	26000	2	2	3806400
Versova Village	3.8	63.6	23000	1	1	5558640
						65580510

Table No. 1.9

ISSN PRINT 2319 1775 Online 2320 7876
 UGC CARE Listed (Group -I) Journal Volume 11, Iss 10, 2022

AREAS OF ANDHERI	DISTANCE	POPULATION in 000's	PLACE RENT (1000 sqft)	NO. Of GARAGES	NO. OF PETROL PUMPS	LOAD DISTANCE
marol	7.8	13	25000	4	4	40560000
Sakinaka	8.1	13.8	20000	5	2	22356000
Gundavli	6.1	25.1	23000	3	1	10564590
Chakala	6.8	13.8	26000	5	1	12199200
Sahar	7.5	11.5	21000	3	1	5433750
Amboli	5.6	17.8	23000	2	1	4585280
D.N Nagar	2.8	17.3	25000	3	1	3633000
Azad Nagar	3.4	19.6	25000	3	1	4998000
Lokhandwala Complex	0	18.3	26000	2	2	0
Versova Village	5.5	63.6	23000	1	1	8045400
						112375220

Table No. 1.10

AREAS OF ANDHERI	DISTANCE	POPULATION in 000's	PLACE RENT (1000 sqft)	NO. Of GARAGES	NO. OF PETROL PUMPS	LOAD DISTANCE
marol	8.2	13	25000	4	4	42640000
Sakinaka	8.6	13.8	20000	5	2	23736000
Gundavli	6.8	25.1	23000	3	1	11776920
Chakala	7.7	13.8	26000	5	1	13813800
Sahar	7.9	11.5	21000	3	1	5723550
Amboli	5.7	17.8	23000	2	1	4667160
D.N Nagar	3.4	17.3	25000	3	1	4411500
Azad Nagar	4.2	19.6	25000	3	1	6174000
Lokhandwala Complex	5.5	18.3	26000	2	2	10467600
Versova Village	0	63.6	23000	1	1	0
						123410530

6. FINDINGS AND INTERPRETATION

Summing the scores for all the areas of Andheri a total load distance scores of 71169940 when the facility is located at Marol from Table no. 1.1, the scores of 86734500 when the facility is located at Sakinaka from Table no. 1.2, the scores of 71240060 when the facility is located at Gundavli

ISSN PRINT 2319 1775 Online 2320 7876
 UGC CARE Listed (Group -I) Journal Volume 11, Iss 10, 2022

from Table no. 1.3, the scores of 79203660 when the facility is located at Chakala from Table no. 1.4, the scores of 94576620 when the facility is located at Sahar from Table no. 1.5, the scores of 101386530 when the facility is located at Amboli from Table no. 1.6, the scores of 103537660 when the facility is located at D.N Nagar from Table no. 1.7, the scores of 65580510 when the facility is located at Azad Nagar from Table no. 1.8, the scores of 112375220 when the facility is located at Lokhandwala Complex from Table no. 1.9, the scores of 123410530 when the facility is located at Versova Village from Table no. 1.10. Therefore Azad Nagar will the best place for facility planning because the sum of load distance is very as compared to the sum of load distance of other areas.

7. LIMITATIONS OF THE PROJECT

Load Distance Method is calculated with help of distance, population, rent of the place, number of petrol pumps and garages available for the best facility location.The major factor that has been not taken into consideration that is peak traffic timings because the in the city like Mumbai there is huge traffic jam this will cause delay in delivering the product. Other than this the population of the areas is as per 2020 so in future the population number of the areas can be changed.

8. CONCLUSION

Route planning is core of any Logistics firm as it presents the most efficient routes to move from one place to other. An efficient route will save fuel, optimize vehicle and driver safety, and lower overall business spending. In this research Load Distance Method helped us to identify the most cost effective and efficient route by planning the facility location at such a place that it will help the execution of supply chain smoothly and with least cost and least delivery time. It is observed that lack of route planning can lead to high cost, delay of deliveries and lead to less productivity. With the help of Load Distance Model, we allocated facility location at the Azad Nagar. Which will help to plan the route very efficiently.

As a research limitation, the other factors are not included this may affect the facility location planning which can lead to problem for efficient route planning. Other factors are also important for the facility location planning like resources, roads, traffic, weather etc.

ISSN PRINT 2319 1775 Online 2320 7876
 UGC CARE Listed (Group -I) Journal Volume 11, Iss 10, 2022

The companies will save money on delivery expenses and ensure client satisfaction by delivering products to their clients faster.

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