Mid Mile Delivery – Fleet Mechanism
Over View On Route Plan, Vehicle Scheduling and Trip Tracking – Correlation with Driver Behavior

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Abstract: The paper mainly focuses on the inferences that drawn from the driver behavior that were generated due to the gap between the mid mile delivery and the supply chain performance in perspective of middle level logistic companies in India. As the mid mile delivery is very crucial and critical in supply chain as it covers the major portion of the supply chain by transporting the goods between the warehouses to retail/general stores. The drivers of India are facing a lot of problems in mid mile delivery like lack of proper route map, Lack of visualization towards fuel consumption. The middle level logistic firms are also facing problems like vehicle scheduling and vehicle tracking and poor route planning preparation which results in the improper design of the supply chain that leads to the financial losses for the logistics firms.

Key Words: — ***Driver behavior, mid-mile delivery, route planning, vehicle scheduling, vehicle tracking, fuel consumption visibility, and cost optimization strategies.***

I. INTRODUCTION

1.1 Mid mile delivery

The mid mile delivery is the crucial part in the supply chain as it carries the goods from the warehouses to the local distribution center where the drivers are the most important element in the distribution line as the driver carries the goods to the list of shipment centers.

1.1.1 Problems in Mid mile delivery:

- Visibility of shipment locations – Trip tracking
- Poor route planning
- Insignificant usage of fuel
- No proper vehicle scheduling

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1.1.2 Indian Mid Mile delivery:

CITY TYPE	PIN LOCATIONS	SHIPMENT VOLUME
Tier – 1	1500 – 2000	20 %
Tier – 2	5000 – 6000	40 %
Remainder	22000	40 %

Consumer electronics	55 %
Apparel, Shoe, Jewelry	25 %

COMPANY	DAILY SHIPMENT
Amazon	3 million orders
Flip Kart	2.5 million orders
Meesho, Shopclues, Snapdeal	2.5 million orders

1.2 Cost of Shipment

Operating a warehouse or sorting center, whether in-house or outsourced, costs roughly 10 rupees each cargo, bringing the total logistics cost per shipment to around 75 rupees. Warehousing and fulfilment center costs, which add another 20 to 25 rupees each shipment, are not included.

To address the First-mile or Last-mile challenge, the majority of new enterprises have created warehouse management software, sorting robots, an order management layer, and a delivery fleet of thousands of delivery employees. While more employment and more pay for delivery boys have occurred, the system's overall efficiency has remained poor.

At the end of the day, it's a human who delivers the products, and technology can only improve efficiency so much. In a single run, a delivery child may make 20–25 deliveries, for a total of 40–50 deliveries each day.

1.3 Vehicle Tracking

The vehicle tracking enables the firm to visualize the location of their vehicle

Advantages

- Can trace the vehicle location
- Can handle the incidents like accident, heavy traffic, toll charges
- Can see the vehicle break down
- Can visualize the driver shipment pattern

1.4 Vehicle Scheduling

The vehicle scheduling enables the firm to schedule the vehicle for a shipment delivery that is least utilized so that the efficiency of vehicle utilization of a particular firm will increases.

1.5 Route Planning

The route planning enables the firm to design a critical path that is the shortest distance path so that driver can reach the shipment location in fast with less fuel utilization.

1.6 Driver Behavior

The driver behavior towards a shipment is influenced by the following parameters,

- route icon
- Proper order list of shipment locations
- Balanced vehicle scheduling
- Proper tracking of vehicle to understand the vehicle performance and condition.

1.7 Objective

- Examine the relationship between route design, vehicle scheduling, trip tracking, and supply chain performance.
- To see how drivers react to logistics sector leaders' inputs.

II. RESEARCH METHODOLOGY

This is the primary data collected during my internship that includes the data regarding the distances between the ware house and the shipment locations, the reliability test analysis.

This is the data obtained through my personal survey methods and questionnaire forms designed by me.

Data type	primary
Methods of finding data	Survey, questionnaires
Groups	Drivers and fleet owners

III. LITERATURE REVIEW

We examine why these characteristics lead to the persistence of ageing fleets, excessive fleet sizes, low fleet homogeneity, and service delays, all of which are concerns that humanitarian fleet managers deal with on a daily basis as they attempt to improve service standards **(martinez, 2012)**. Proper fleet management is critical to a company's overall transportation management performance. The study examines fleet management from a strategic standpoint **(Redmer, 2022).** Despite the fact that sophisticated fleet management systems (FMSs) are becoming more widely used in third-party logistics (3PL) firms, little is known about how to use them to improve transportation energy efficiency **(Zhang, 2021).** Mathematical models and computer algorithms have been created to optimize and simulate the operation of transportation fleets with the goal of cost efficiency in order to fulfil client demand **(Bielli, 2011).**

HYPOTHESIS

H0 – NULL HYPOTHESIS

There is a NO association between route plan, vehicle

scheduling, trip tracking and supply chain performance.

H1 – ALTERNATE HYPOTHESIS

There is association between route plan, vehicle scheduling, trip tracking and supply chain performance.

TESTING HYPOTHESIS

DATA (youtube, 2020)

3.1 Critical Path Method

ACTIVITY LOCATION TO LOCATION DELIVERY	1-2	1-3	2-4	3-4	3-5	4-9	5-6	5-7	6-8	7-8	8-10	9-10
TIME FOR SHIPMENT (DAYS)	4	1	1	1	6	5	4	8	1	2	5	7

1-WARE HOUSE

2-SHIPMENT LOCATION 2

3-SHIPMENT LOCATION 3

4-SHIPMENT LOCATION 4

5-SHIPMENT LOCATION 5

6-SHIPMENT LOCATION 6

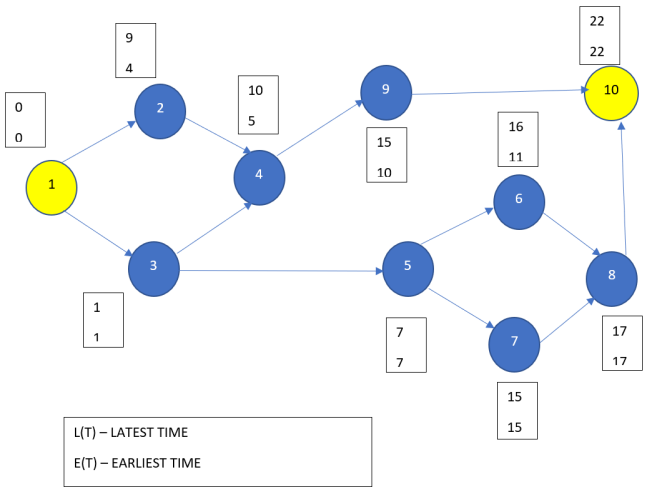
7-SHIPMENT LOCATION 7

8-SHIPMENT LOCATION 8

9-SHIPMENT LOCATION 9

10-SHIPMENT LOCATION 10

3.2 Warehouse to Shipment Location 10



3.2.1 Finding Critical Path – Shortest Distance:

- Used to find the shortest path
- Short distance- less fuel consumption and more vehicle utilization
- Results in fast shipments and less delay

FORWARD PATH COMPUTATION

E(J) = MAX (I) [E(J) + D(IJ)]

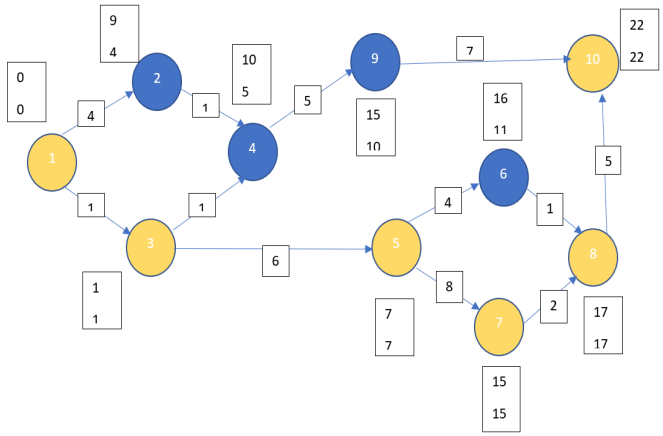
BACKWARD PATH COMPUTATION

L(J) = MIN (J) [L(J) – D(IJ)]

3.3 Critical Path Table

ACTIVITY	TIME D(IJ)	EARLIEST START E(I)	EARLIEST FINISH E(F) = E(I) + D(IJ)	LATEST START L(S) = L(J) – D(IJ)	LATEST FINISH L(F)	TOTAL FLOAT TF(IJ) L(S) – E(I)
1 TO 2	4	0	4	5	9	5
1 TO 3	1	0	1	0	1	0
2 TO 4	1	4	5	9	10	5
3 TO 4	1	1	2	9	10	8
3 TO 5	6	1	7	1	7	0
4 TO 9	5	5	10	10	15	5
5 TO 6	4	7	11	12	16	5
5 TO 7	8	7	15	7	15	0
6 TO 8	1	11	12	16	17	5
7 TO 8	2	15	17	15	17	0
8 TO 10	5	17	22	17	22	0
9 TO 10	7	10	17	15	22	5

3.4 TS Food Plant to Shipment Location 10



3.5 Critical Path Condition

TOTAL FLOAT FOR PARTICULAR ACTIVITY = 0

ACTIVITY	**FLOAT TIME = 0**
1 TO 3	0

3 TO 5	0
5 TO 7	0
7 TO 8	0
8 TO 10	0

3.6 Critical Path – From TS Food to Shipment Location 10

- 1-3-5-7-8-10 = 1 + 6 + 8 + 2 + 5 = **22 DAYS**

NOTE

- ❖ IF THERE IS NO CRITICAL PATH (SHORTEST DISTANCE), THE DRIVER WILL FOLLOW IRREGULAR PATTERN WHICH RESULTS IN DELAY IN DELIVERY AND EXCESS FUEL CONSUMPTION.

3.6.1 Trip Tracking:

- Shows the vehicle location
- Visibility towards the vehicle incidents and actions
- Control of action towards vehicle breakdown
- Can see the driver movements and actions

3.6.2 Vehicle Scheduling:

Consider 5 vehicles

Vehicle A, B, C, D, E

SCHEDULED VEHICLE LIST

DAY 1	DAY 2	DAY 3	DAY 4
A	B	B	C

UTILIZATION

A	25 %
B	50 %
C	25 %
D	0 %

WITH SCHEDULING SOFTWARE

DAY 1	DAY 2	DAY 3	DAY 4
A	B	C	D

A	**25 %**
B	**25 %**
C	**25 %**
D	**25 %**

- Due to the improper visualization on vehicle availability the executives will assign the same vehicle for multiple times.
- The vehicle scheduling software / technique will allow the executives for proper scheduling of vehicles that results in efficient vehicle utilization.

3.7 Statement

The analysis shows that the trip tracking, scheduling, route plan are the main factors that drives the efficiency of supply chain by,

- Reducing the long paths
- Clear route plan
- Enhances the speed of delivery
- Pre intimation to drivers about vehicle assigning
- Efficient utilization of vehicle

IV. THE DRIVER'S RESPONSE TO SOFTWARE INPUTS

4.1 Critical record analysis on real time operations, meeting with vehicle drivers

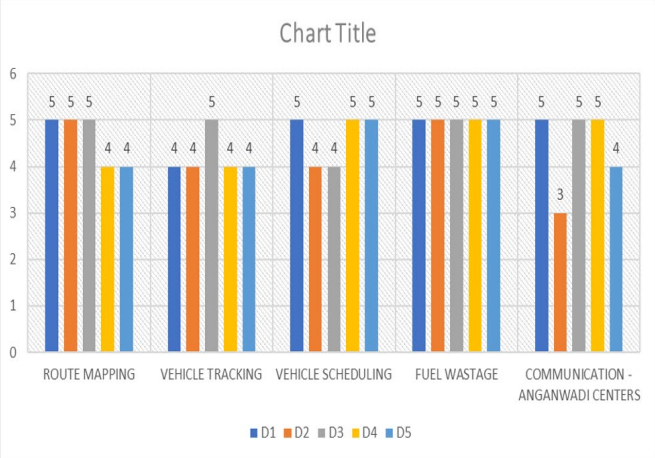
This was the data obtained through the meeting with the DEPO DRIVERS (WITH 5 DRIVERS) [each having a union consisting of 25 drivers]

The parameters used are,

- Route planning
- Vehicle tracking
- Vehicle and driver allotment
- Fuel wastage
- Pre intimation to shipment locations

PROBLEM FACING WITH	DRIVER 1	DRIVER 2	DRIVER 3	DRIVER 4	DRIVER 5
Route mapping	5	5	5	4	4
Vehicle tracking	4	4	5	4	4
Vehicle and driver allotment	5	4	4	5	5
Fuel wastage	5	5	5	5	5
Communication with ANGANWADI CENTERS	5	3	5	5	4
TOTAL SCORE	**24**	**21**	**24**	**23**	**22**

Score	Severity
1	Negligible
2	Partially impacting
3	Impacting
4	Critically impacting
5	Severely impacting



PROBLEM	INSIGHT / EFFECT
Drivers are not initiated with the vehicle in prior, they need to go with the vehicle assigned on spot	There is no resource planning technique / software which shows them the availability of drivers, vehicles – results in **poor vehicle scheduling**
45 % of FLEET drivers don't have smart phones	They are unable to send the GPS location, which gives trouble in **vehicle tracking**
The organizations are drawing the route manually	This again leads to **poor route mapping** where there are the problems like more Toll gates in the route, no proper road availability at remote areas
Gives the list of shipment points, where the points will not be in order	Irregular distribution of deliveries, going in the same route twice which leads to **fuel wastage**
No pre intimation to the shipment about the distribution of deliveries	**Delay** in the deliveries

4.2 CHI Square Test

4.2.1 Observed Frequencies:

	ROUTE PLANNING	SCHEDULING AND TRACKING
SUPPLY CHAIN PERFORMANCE	6	7
VEHICLE UTILIZATION	13	16

4.2.2 Expected Frequencies:

	ROUTE PLANNING	SCHEDULING AND TRACKING
SUPPLY CHAIN PERFORMANCE	6.08	6.95
VEHICLE UTILIZATION	13.60	15.43

CHI SQUARE TEST

$\chi 2 = \sum (Oi - Ei)2/Ei$

- O_i = observed value (actual value)
- E_i = expected value

CALCULATION

= ([6 – 6.08] ^2/6.08) + ([7 – 6.95] ^2/6.95) + ([13 – 13.60] ^2/13.60) +([16 – 15.43] ^2)/15.43

= 0.00105 + 0.00035 + 0.02647 + 0.02105

= 0.04892

As 0.04892 < 0.05 (significance level)

P – VALUE = 0.04892

DESCRIPTION = It indicates that null hypothesis is very unlikely

HYPOTHESIS INTERPRETATION = H0 is rejected.

It means there is a confidence of 95.108 % rejection of null hypothesis.

4.3 Findings

- The trip tracking, vehicle scheduling and route planning drives the performance of supply chain.
- The driver behavior and response are mainly based

on the inputs provided by the executives.

- The drivers place a prominent role in shipment delivery.
- The imbalanced inputs for supply chain leads to financial losses.
- The mid mile delivery mainly concentrates on route planning and scheduling.

V. CONCLUSION

The trip tracking, route planning and vehicle scheduling plays an important role in the supply chain performance as they reduce the intensity of consequences like inappropriate route mapping, poor visualization of vehicle location and inefficient usage of vehicle. The driver behavior and actions in the supply chain are more important as they are responsible for the delivery of goods to the shipment locations which gradually leads to increase in the delivery of goods to shipment locations and increases the efficiency of mid mile delivery in supply chain and enhances the sustainability.

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