WHITEPAPER

Locus

Captive vs Outsourced Fleet:

Math behind Transportation and Distribution

Executive Summary

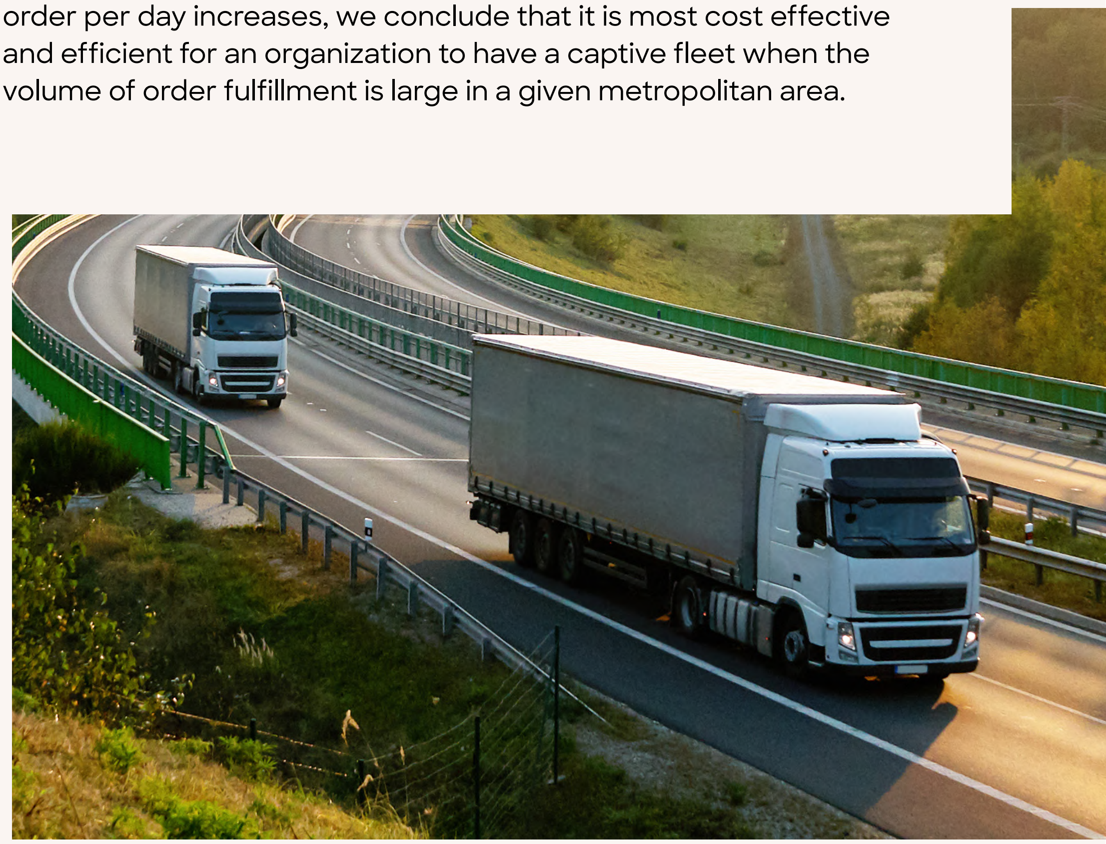
In this paper, we simulate multiple scenarios in which these two factors are tested for optimality in both captive and outsourced fleet. The study intends to identify the optimal alternative among owning a fleet and outsourcing to 3PL players.

Post our study on variation in different metrics of last-mile distribution with increase in the number of orders served per day, we observed that, **if the orders served per day exceeds 3500 in a given Metropolitan area in the United States, captive fleet is a cost optimal alternative to outsourcing last-mile distribution.** We also estimate that it would approximately take eight and half years to recover the cost of acquiring the fleet to serve around 4000 - 5000 orders per day and reach the break even point for the investment on the captive fleet.

Our study concluded that the distance traveled to serve an order is inversely proportional to the number of orders served per day. Also, with drop in other costs like money spent on driver wages as the order per day increases, we conclude that it is most cost effective and efficient for an organization to have a captive fleet when the volume of order fulfillment is large in a given metropolitan area.

Key Insights

The decision of owning a fleet versus outsourcing transportation and distribution is one of the most contemplated decisions in the supply chain space. While there is a tradeoff between each of these choices executives make, cost and efficiency are two major factors that are considered.



Introduction

Transportation and Distribution has been a volatile industry for a long time. The United States trucking industry has seen 12 recessions since 1972, twice that of the overall economy. A report from Barron's points out that a lot of times (50%), when the trucking industry was in recession, the economy continued to expand. The cause of these recessions are particularly interesting.

There has been a constant surge in demand for trucking capacity in the United States in the recent past. For example, between March 2019-March 2020 the trucking demand has increased by 150% and there was a double-digit percentage increase in the spot market rates, indicating that the surge in demand is much larger than the available capacity of the trucking industry2. This has been the case multiple times in the past, and this is the phenomenon that has been pushing the trucking industry into recession often. During the demand surge periods, 3PL companies tend to add capacities, and given the cyclical nature of the demand in the market, the demand decreases with time resulting in losses to the 3PL companies.

'The Amazon effect' has evolved consumer behavior over time, and the rise of omnichannel fulfillment has set expectations of same-day delivery of most CPG and fresh food products. A retail or E-commerce company that cannot secure trucking capacity during demand-supply imbalance in the 3PL industry, fails to serve its customers and loses out to its competitors.

This often occurring demand-supply imbalance in the trucking industry has forced giants like Amazon, Walmart, Target, and IKEA to re-evaluate their end-to-end supply chain network and identify nodes/activities which can be performed in-house, instead of outsourcing. In the 22nd Annual Third-Party Logistics Survey 2018 - 83% of the respondents mentioned that they outsource transportation to 3PL providers. However, in 2020, the percentage of respondents who outsourced transportation to 3PL providers has reduced to 73%.

While long haul transportation is direct in nature with limited scope for cost optimization, last-mile deliveries are the deal breakers in many supply chains in terms of costs, due to their complexities. As a share of total cost of shipping, last-mile deliveries are estimated to comprise 53% of the overall cost. An optimized last-mile delivery network would make the supply chain efficient by both minimizing cost-to-serve and by ensuring maximum customer satisfaction through hassle-free delivery.

In this white paper, we explore different metrics of Transportation focusing on last-mile deliveries to identify a break-even point post which owning a captive/in-house fleet would be a cost optimal and efficient alternative over outsourcing to 3PL providers.

Objective

The objective of this whitepaper is to enable businesses to make smart and informed decisions on their fleet requirement for the last-mile movement. We start with understanding the impact of the increase in the number of orders on distance traveled and journey time, and eventually, the cost of operations. This activity is repeated for outsourced and in-house fleet operating models.

The following metrics were explored with respect to an increase in the number of orders/day:

1) Change in number of miles per order (for in-house)
2) Operational costs for outsourced and captive fleet models
3) Break even point and further extrapolation

New York Metropolitan area has been chosen for this study, implying, the geographic and cost data for various entities of the New York metro area has been factored into the calculations to make the model relatable with various retail, 3PL/4PL and E-commerce businesses that operate in the area. New York was chosen due to the following reasons:

- High internet penetration
- Willingness/openness to try a model of online shopping
- High population density, implying majority of the zip codes would be a part of the analysis

Key Insights

A combination of real-time constraints, on-ground data, research data and assumptions have been used to calculate the total transport cost.

Study approach

Since the business models and operational processes are different for in-house and outsourced transportation, different approaches have been used to perform the study. A combination of real-time constraints, on-ground data, research data and assumptions have been used to calculate the total transport cost.

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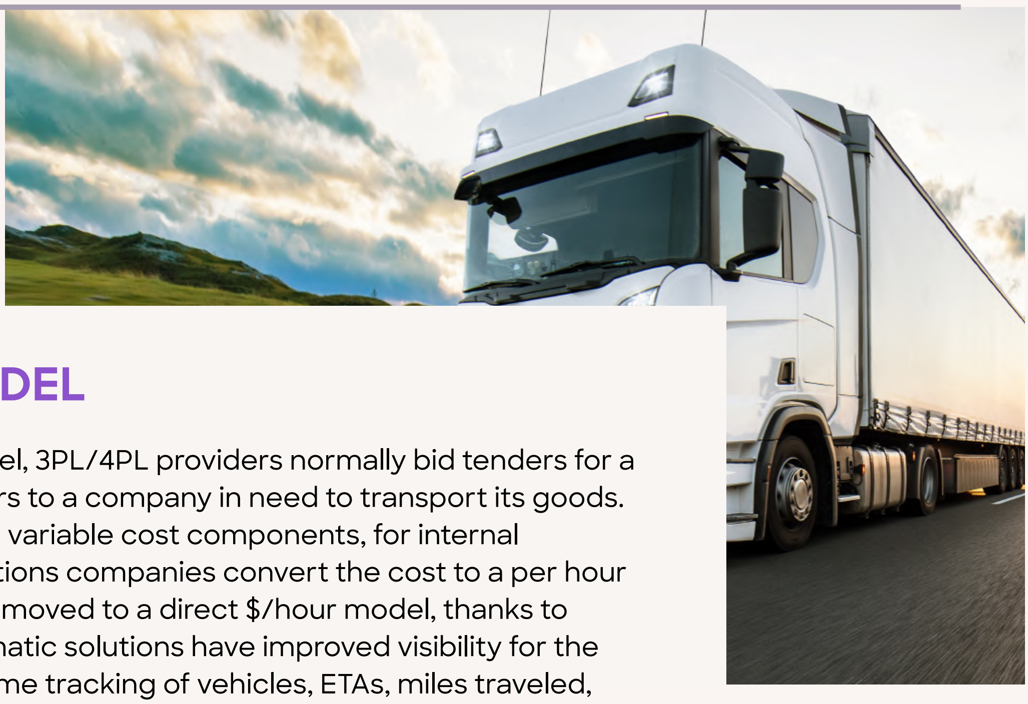

OUTSOURCED MODEL

In the last-mile fulfillment model, 3PL/4PL providers normally bid tenders for a given route or number of orders to a company in need to transport its goods. While the tender has fixed and variable cost components, for internal consumption and cost calculations companies convert the cost to a per hour basis. Few providers have also moved to a direct $/hour model, thanks to technology intervention. Telematic solutions have improved visibility for the shippers enabling them real-time tracking of vehicles, ETAs, miles traveled, hours spent, electronic proof of deliveries, etc. However the penetration of visibility technology in the 3PL industry is still not significant.

The underlying cost equation for outsourced model (for one day) is given below,

Total Transportation Cost per day = (Cost/hour in $) * Total journey time in hours

Total journey time in hours = Total orders to be delivered / Number of orders delivered in 1 hour

- Based on our internal data points from the NA market, we have estimated the number of packages delivered in one hour to be:

For <2000 orders/day = 7 packages delivered/hour

For <4000 orders/day = 8 packages delivered/hour

For <5000 orders/day = 9 packages delivered/hour

- Total orders to be delivered on a day will be a variable here

We have observed that with an increase in the order density, delivery rates have improved. The number of packages delivered per hour on a given day within a certain area, when the orders are below 2000, approximates to 7 orders, and it is upto 8 orders if the number of orders served in a day is below 4000. When orders served per day crosses the 4000 mark, the rate improves to 9 packages. Data across various third party logistics players operating in the US were collated. The most popular players in the market are mentioned below:

Amazon: $ 18-25

Door Dash: $ 12-16

Postmates: $10-14

Based on these numbers, we have assumed the cost/hour to be $20 (All inclusive)

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IN-HOUSE MODEL

A company decides to own or lease its fleet, majorly due to the following reasons:

1) Complex operations
2) A high number of dispatches on a daily basis
3) Need for higher control and visibility on the operations
4) To enhance customer service

The underlying cost equation for a captive fleet (for one day) is given below,

Total Transportation Cost = Fixed cost + Variable costs (Either per mile or per hour)

- Fixed cost = Vehicle lease or one-time investment cost that the company has to incur
- Variable costs include

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Driver salary: $17/hour

Maintenance costs: $0.21/mile

Insurance costs: $0.08/mile

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VARIABLE COST COMPONENTS

Driver salaries/wages are generally paid on an hourly basis. 17$/hour is an above average estimate for the NY area.

Regular maintenance

When a vehicle is being deployed/used one would have to account for periodic maintenance costs. These costs are to be borne by the company if the vehicle is in-house. Outsourced fleet contracts generally add this component within their fixed cost. For the current analysis, distance-based pricing has been considered.

Truck insurance premium

Vehicle insurance is one of the major cost components and a government mandate. For the current analysis, distance-based pricing has been considered.

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EXCEPTIONS

Fuel cost components are not included for both outsourced and in-house models as there are a large number of variables involved:

- Fuel programs are different across industries/companies

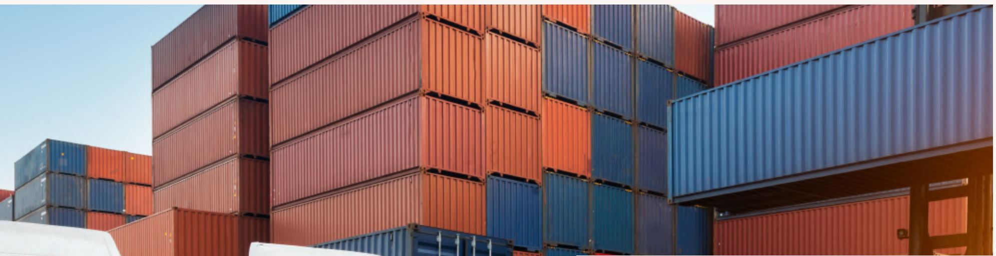
Distance-based fuel program

Percentage (of linehaul) based fuel program

- Fuel consumption varies with the type of vehicle that is being used. For example, “Amazon Flex” employs vehicles of varied shapes and sizes and their hourly charge is inclusive of fuel - this model is very prevalent.

The fixed cost component is not added to the cost at this stage, but is used as a metric later to calculate the break even point. At this point, the equation would be

Total Transportation cost = Sum of Variable costs

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TRUCK TYPES

Box trucks of varying sizes are typically deployed in last-mile operations and the following table lists the most common box trucks along with their costs and capacities.

Table 1: Common Box Trucks with Cost and Capacities

Truck type/class	Dry van (cost in $)		Refrigerated (cost in $)		Weight Capacity	Length of truck
	Min.	Max.	Min.	Max.	In Pounds	In Feet
Light duty class 2	25000	45000	35000	55000	6001- 10000	12 - 14
Light duty class 3	25000	45000	35000	55000	10001-14000	12 - 14
Medium duty class 4 trucks	35000	50000	45000	60000	14001-16000	16 - 18
Medium duty class 5 trucks	45000	70000	55000	80000	16001-19500	16 - 18
Medium duty class 6 trucks	50000	90000	60000	100000	19501-26000	16 - 18

For this study we have chosen Light duty class 2 non-refrigerated trucks at $35,000 for a one-time purchase.

We are assuming that the online order density is proportional to the population density of the metropolitan area.

Order and Demography Relationship

We are assuming that the online order density is proportional to the population density of the metropolitan area. This implies that, as the number of orders on a given day increases, the zones with higher population density are contributing to it more than the low density zones and vice versa.

We have considered every zip code within the New York Metropolitan area as an independent zone for this study. Based on the US census data (2018), we have chosen the top 204 highly populated zip codes that comprise a little more than 80% of the total population of the NY area. For the scope of this study, the zones will be restricted to these 204 Zip Codes.

Based on the US census data (2018), we have chosen the top 204 highly populated zip codes that comprise a little more than 80% of the total population of the NY area.

For example: “Queens" with the zip ‘11368’ contributes 1.11% to the overall population of the New York Metro area. So for every 100 orders generated in NY, 11368 would have 1.11 orders originating from it. If the orders increase to 1000, the zip 11368 would have 11.1 orders originating from it and so on.

Figure 1: 1000 Orders Distributed across New York Metropolitan Area

Figure 2: 5000 Orders Distributed across New York Metropolitan Area

06

WAREHOUSE/ DISTRIBUTION CENTRE

For this study, one warehouse is chosen, to service all the customers. It is located in ‘Brooklyn’ (Zip:11231) as it is one the most densely populated areas. Since the number of orders will be increased in the study to understand the impact on associated KPIs, the capacity of this warehouse has been assumed to be high enough to accommodate all the orders - from a theoretical standpoint.

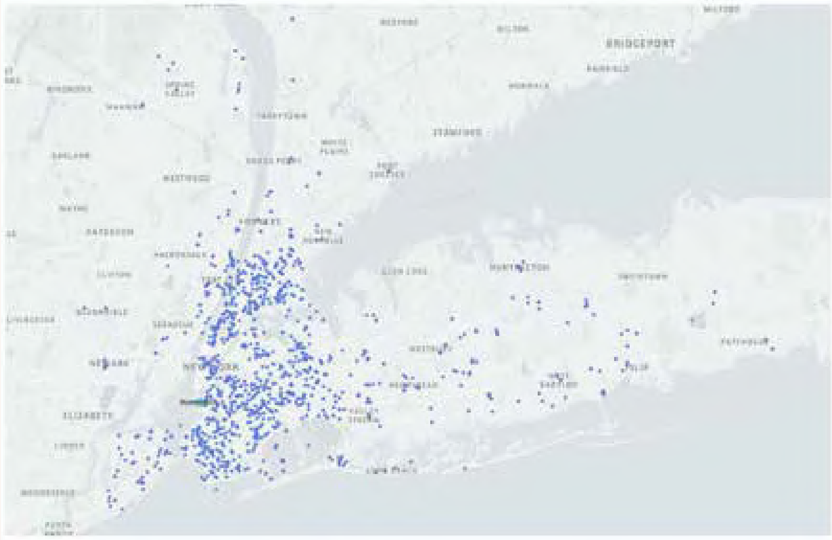


Figure 3: Homebase is chosen at Brooklyn (Zip: 11231)

Solution Modelling

1) Solution modelling is performed at a day level and is extrapolated to month, for break even calculations.

2) Delivery locations were generated randomly across the 204 zip codes of the New York Metropolitan area:

- Delivery points are not entirely unique, and have some overlaps (we can think of it as the same residential complex placing multiple orders on a given day)
- Number of orders are proportional to the population density associated with the zip code

3) For outsourced fleet type, calculations were directly performed based on the formula discussed earlier.

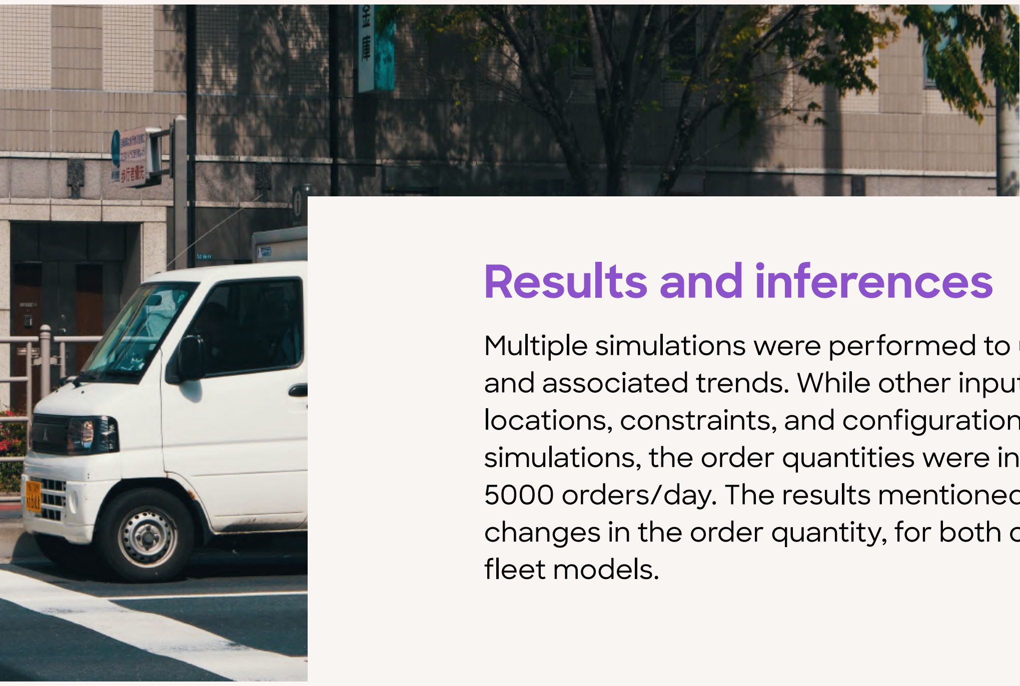
4) For in-house fleet type, Locus' proprietary ***routing planning and optimization*** algorithm "Dispatcher" was deployed with the following functions and constraints:

- Optimization based on distance travelled and journey time
- Order clubbing to service maximum number of orders in the time available and to incorporate high vehicle utilisation
- Operating hours - 07:00 - 19:00 Hrs
- Vehicle speed is fixed to 25 miles/hour as an upper limit and it adjusts based on real-time traffic conditions
- The deployed vehicle type has a capacity to hold 15 orders in one Full truck load.

Key Insights

For in-house fleet type, Locus' proprietary ***routing planning and optimization*** algorithm "Dispatcher" was deployed

Figure 4: Optimized routes by Locus Dispatcher to serve 5000 orders by an in - house fleet



Results and inferences

Multiple simulations were performed to understand the objectives and associated trends. While other input parameters like geographic locations, constraints, and configurations were fixed for all the simulations, the order quantities were increased from 1000 upto 5000 orders/day. The results mentioned below are based on the changes in the order quantity, for both outsourced and in-house fleet models.

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WAREHOUSE/ DISTRIBUTION CENTRE

This relationship is confined to in-house fleet type, because the planners have control over their fleet. We found that the distance traveled to deliver an order is inversely proportional to the number of orders. Implying, as the number of orders to be delivered (for a given geography) increases, the distance travelled to deliver one order decreases, and vice versa.

This relationship can be explained by understanding the impact of order density. Consider a vehicle that travels 5 miles from point A to point B to deliver 10 orders, in BAU conditions. The distance traveled per order in this case is 0.5 miles. Due to an inflated demand for reasons like festive season, special discount sale or an internet trend, the truck has to now deliver 15 orders from point A to Point B. The distance traveled per order in this case becomes 0.3 miles.

Figure 5 below depicts the distance (miles)/order vs the number of orders based on our simulation results for an in-house fleet type.

It can be inferred that, for an in-house fleet, the distance traveled (which in turn affects the journey time) is the key metric that controls the cost of operations.

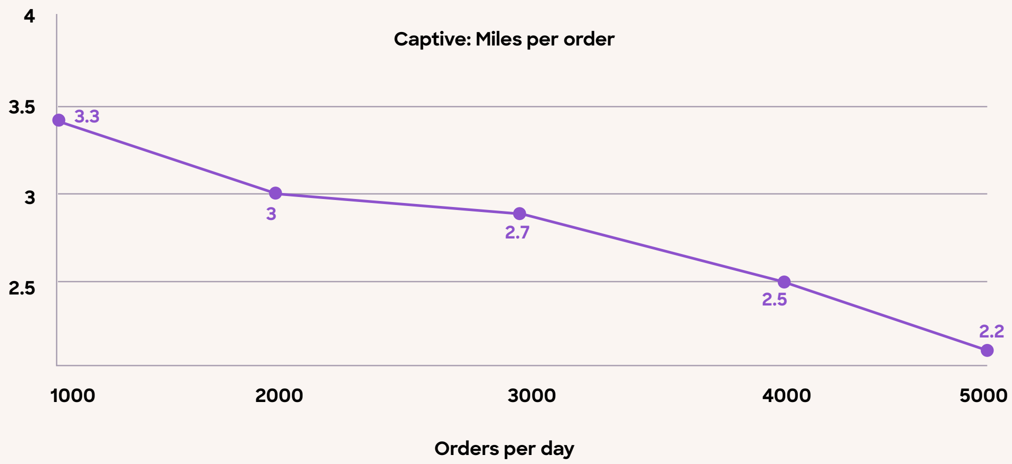

Figure 5: Relationship between Distance/Order with Number of Orders/day

It can be inferred that, for an in-house fleet, the distance traveled (which in turn affects the journey time) is the key metric that controls the cost of operations.

Another interesting metric applicable for both in-house and outsourced fleet types is the number of packages delivered per hour. With an increase in the number of orders, the number of packages delivered per hour increases. Figure 6 below depicts the change of orders delivered per hour vs the number of orders.

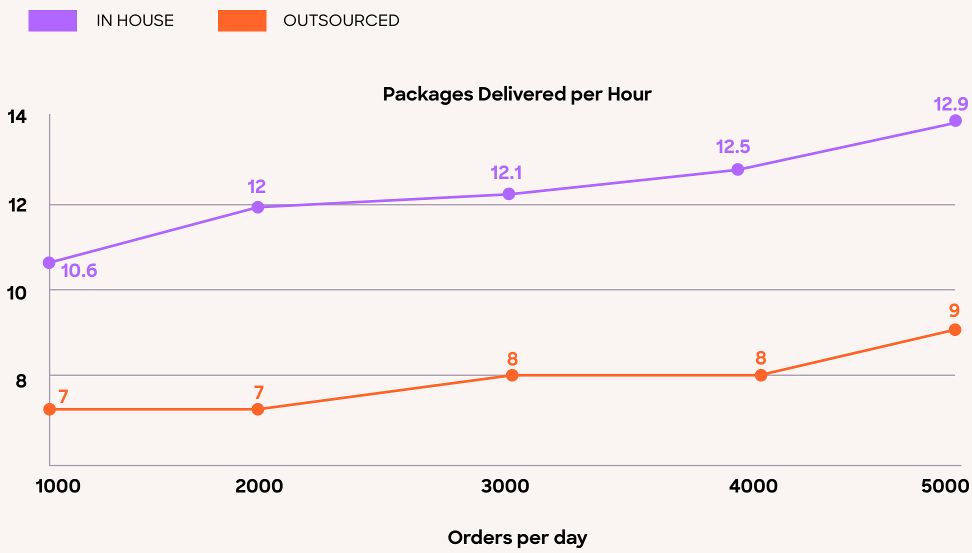

Figure 6: Relationship between Packages delivered/hour with number of Orders/day

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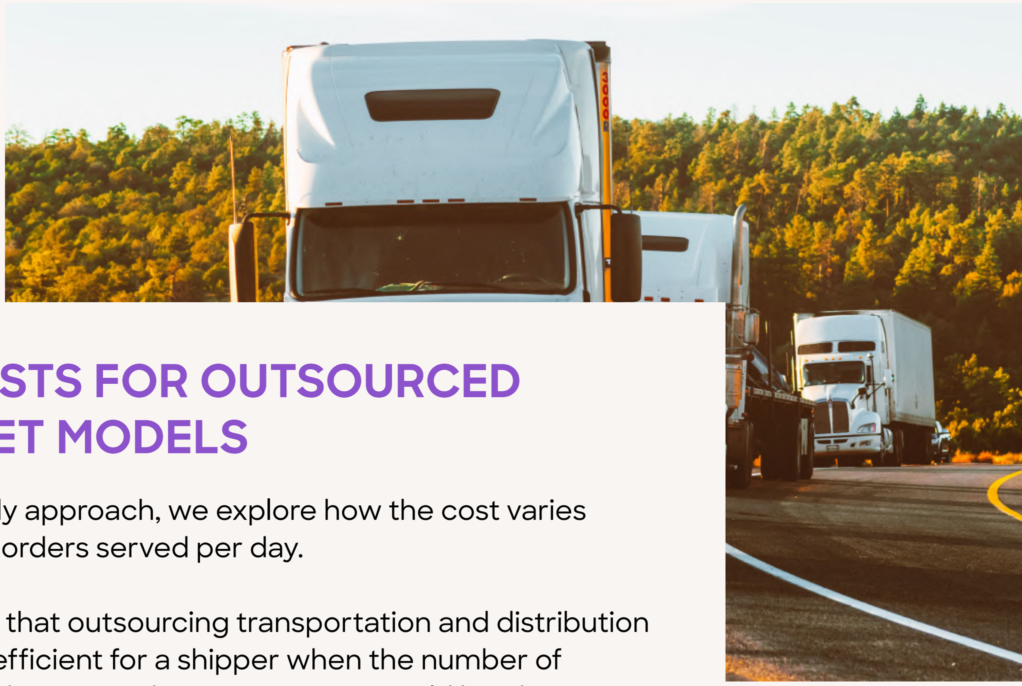

OPERATIONAL COSTS FOR OUTSOURCED AND CAPTIVE FLEET MODELS

As explained earlier in our study approach, we explore how the cost varies with respect to the number of orders served per day.

It can be inferred from figure 7 that outsourcing transportation and distribution to a 3PL player would be cost efficient for a shipper when the number of orders are low, staying true to the notion that outsourcing would be cheaper. However, as the number of orders served per day gradually increases, we can see that there is a point after which the cost incurred by in-house logistics is on the lower side than the transportation cost spent on an outsourced fleet.

Figure 7: Cost per day for outsourcing and captive model

As figure 7 depicts, when 1000 orders are served per day, outsourced operations would cost 14% ($423) lesser than in-house logistics, when 2000 orders are served per day captive would cost 4% ($254) higher than outsourced, and this trend continues until a point i.e. approximately 3500 orders per day after which in-house logistics would turn positive when compared to outsourced. At 5000 orders served per day, the outsourcing model would cost 4% higher than a captive fleet.

We also observed that an outsourced model would require more vehicles compared to an in-house fleet to serve the same number of orders.

The primary reason for this is hours of service. When the trucks are in-house, it gives the company a greater degree of autonomy and flexibility to operate, whereas in an outsourced model hours of service are fixed for a day, thereby restraining the flexibility of operations. Another reason for the increased efficiency is the usage of Locus Dispatcher solution which enables better packing and truck utilization by order clubbing. One can observe that the number of trucks deployed for serving 1000 orders in captive is 25% lesser than the outsourced and the gap widens to as much as 51% when serving 5000 orders and above. The magnitude of impact that this metric has on cost of operations would be high on a monthly or at a quarterly level.

Key Insights

At 5000 orders served per day, the outsourcing model would cost

4% higher

than a captive fleet

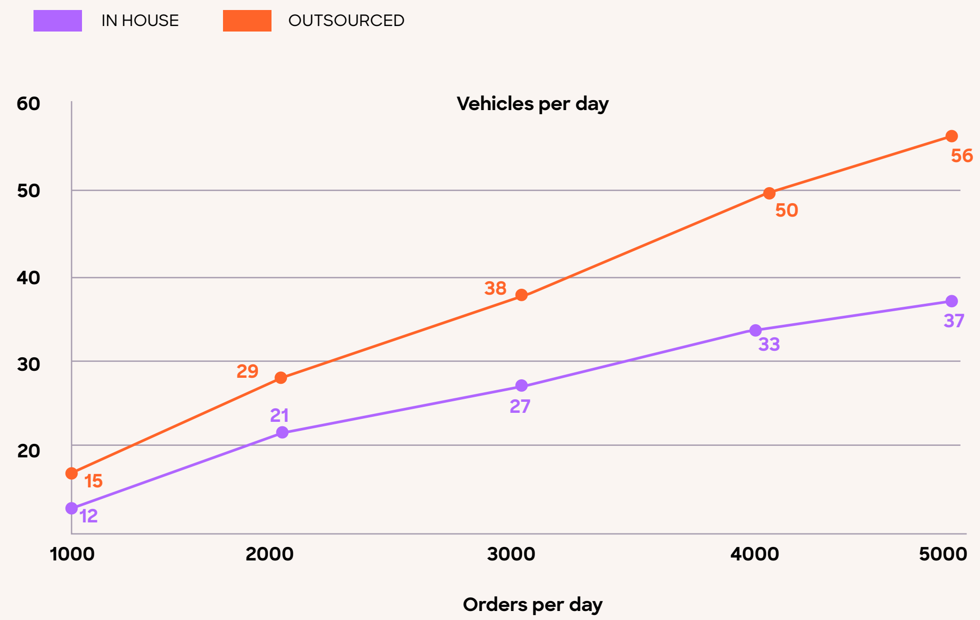

Figure 8: Number of vehicles per day in captive and outsourced fleet

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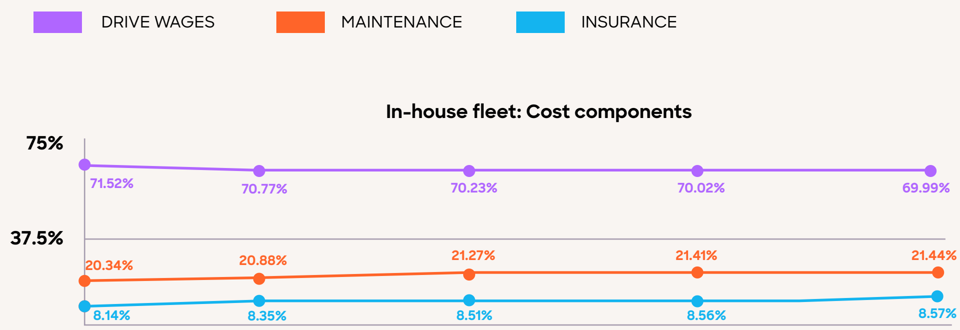
CAPTIVE FLEET'S COST COMPONENTS AND ITS VARIATION WITH ORDERS SERVED PER DAY



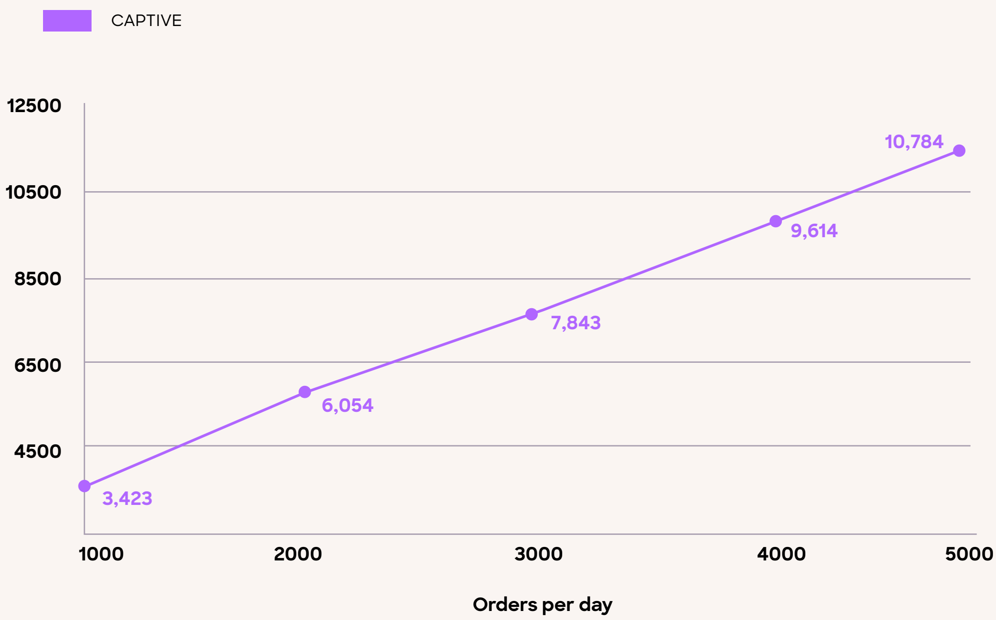
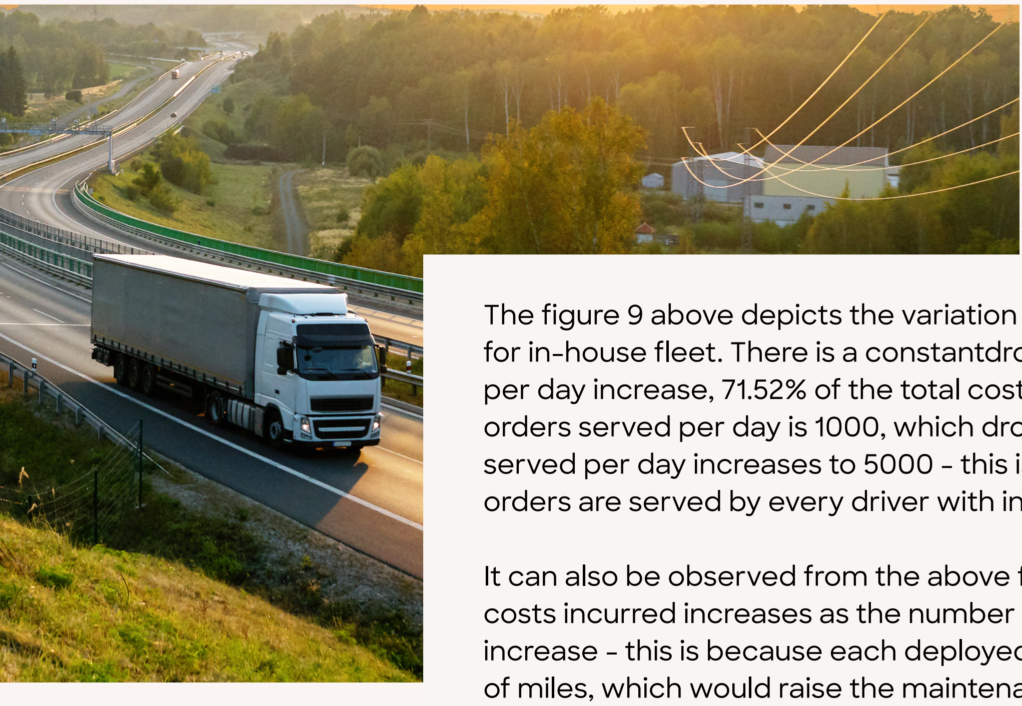


Figure 9: Cost Component of an In - house fleet



The figure 9 above depicts the variation of costs at a component level for in-house fleet. There is a constantdrop in driver wages as the orders per day increase, 71.52% of the total cost is spent on driver wages when orders served per day is 1000, which drops to 69.99% when the orders served per day increases to 5000 - this is because more number of orders are served by every driver with increase in order size.

It can also be observed from the above figure that the maintenance costs incurred increases as the number of orders served per day increase - this is because each deployed truck would run more number of miles, which would raise the maintenance costs for a vehicle as the wear and tear would be higher.

Higher orders served also inflates the insurance costs as valuation of vehicles depreciates on vehicle wear and tear.

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FURTHER EXTRAPOLATION

In all our calculations so far, we haven't considered the cost of buying a truck which is a major one - time cost component. As determined earlier, 4000 orders per day would be the break even point, post which owning an in-house fleet is cost optimal than outsourcing. In the below table, we examine the cost savings post the break even point, to deduce the total time to recover the investment on vehicles.

Table 2: Cost Savings Table post breakeven point

Number of orders per day	Number of Vehicles required	Cost savings in $				Total time to recover (in years)
		Day 1	Day 30	Day 60	Day 90	
4000	33	386	11580	23160	34740	8.3
5000	37	416	12480	24960	37440	8.6

As mentioned earlier we have chosen Light duty class 2 non-refrigerated truck costing $35,000. By the end of every quarter, the cost of a single vehicle is recovered. Thus, it would approximately take eight and half years to recover the vehicle investment cost.

Conclusion

Through this study we investigated different metrics around Transportation in the last mile and identified a break even point of number of orders served per day after which having an in-house fleet for last-mile deliveries is a cost optimal option with respect to outsourcing.

Below are the major inferences from our study,

1) For an in-house fleet, the distance traveled to serve an order (which in turn affects the journey time) is inversely proportional to the number of orders served per day, i.e. with increase in the number of orders served per day, the distance travelled per order by a vehicle owned by a company decreases. This indicates that with increase in orders per day, the cost spent on delivery is optimized.

2) With an increase in the number of orders, the number of packages delivered per hour increases in both outsourced and in-house models. However, the number of orders delivered per hour is higher when the company owns the fleet, with respect to the outsourced fleet. Also, the outsourced model would require more vehicles compared to an in-house fleet to serve the same number of orders.

Key Insights

Through this study we investigated different metrics around Transportation in the last mile and identified a break even point of number of orders served per day after which having an in-house fleet for last-mile deliveries is a cost optimal option with respect to outsourcing.

3) Outsourcing transportation and distribution to a 3PL player would be cost efficient for a shipper when the number of orders per day are low. However, as the number of orders served per day increases in a given geographic region, there is a point after which the cost incurred by in-house logistics is on the lower side than the transportation cost spent on an outsourced fleet.

4) There is a constant drop in the money spent on driver wages as the orders per day increase. However, maintenance and insurance costs increase with increase in number of orders per day.

Following our observation on the variation of above metrics with the increase in number of orders served per day, we conclude that if the orders served per day is greater than approximately 3500 in a given geographic area, captive fleet is a cost optimal alternative to outsourcing last-mile distribution.

The results in this whitepaper is a function of the input variables. With varying cost structures, the simulation results might vary for different business models and geographic clusters, altering the proposed breakeven point of approximately 3500 orders per day.

Key Insights

The results in this whitepaper is a function of the input variables, with varying cost structures

Sources

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