

Impact of Freight Consolidation on Logistics Cost and Emissions



SCM Master students - 2019



Ajay Mohan



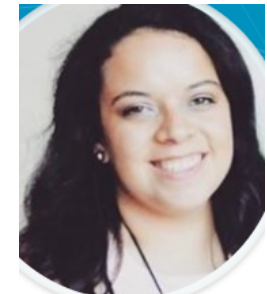
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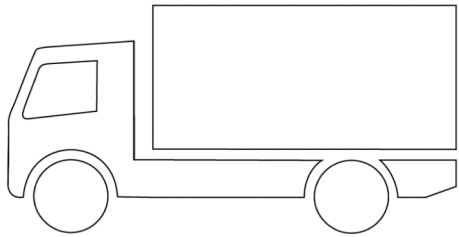


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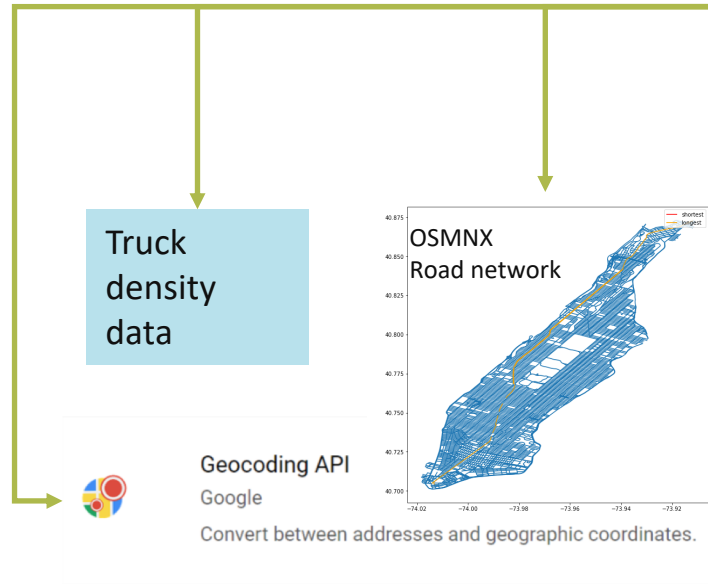
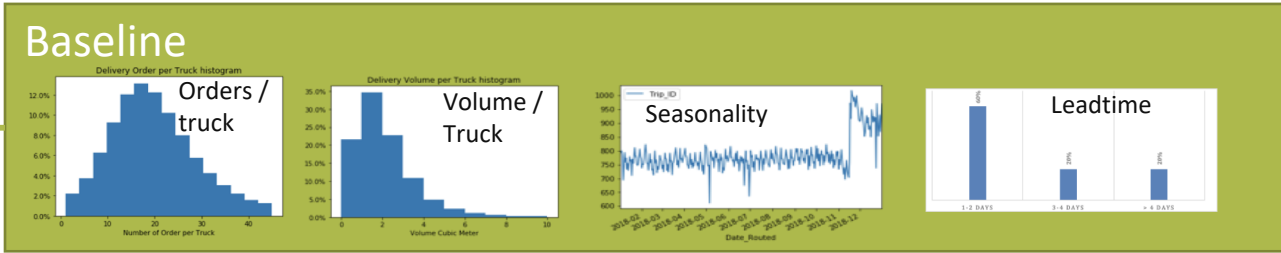
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Visiting Student

Research Questions



- Our research partner is a big Mexican retailer with omnichannel network
- If a customer is willing to wait, are there opportunities to consolidate shipments and improve route utilization?
- Impact of consolidation on Carbon Dioxide (CO₂) emissions and logistics costs for omnichannel home delivery?
- Are there any other upstream savings opportunities because of additional lead time that retailers can benefit from e.g. inventory pooling / warehouse transfers?

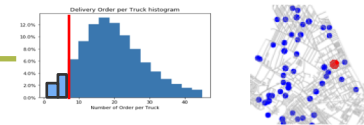
METHODOLOGY



Delivery Clustering for 6 selected DC: Culiacan; Leon, Hermosillo, Laguna, Monterrey, Tecamac



Model consolidation for high density and low density

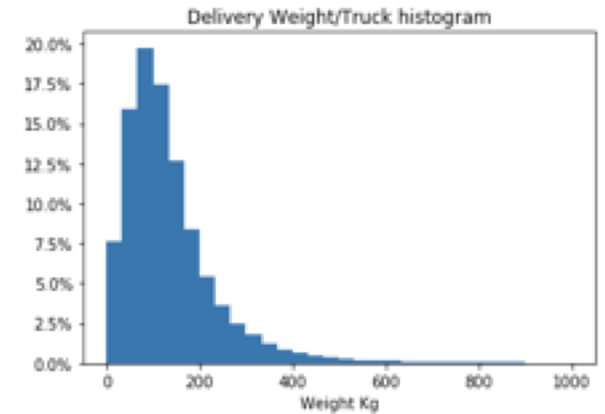
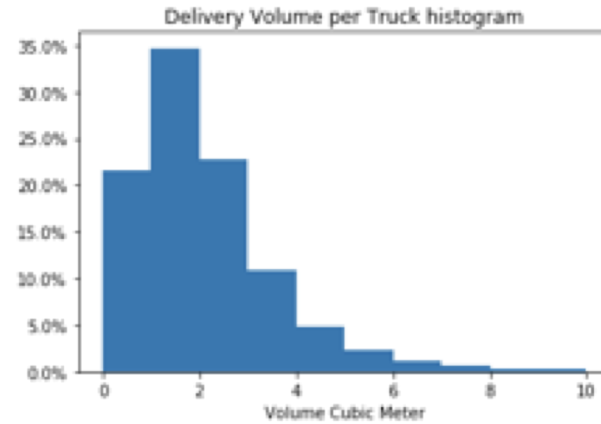
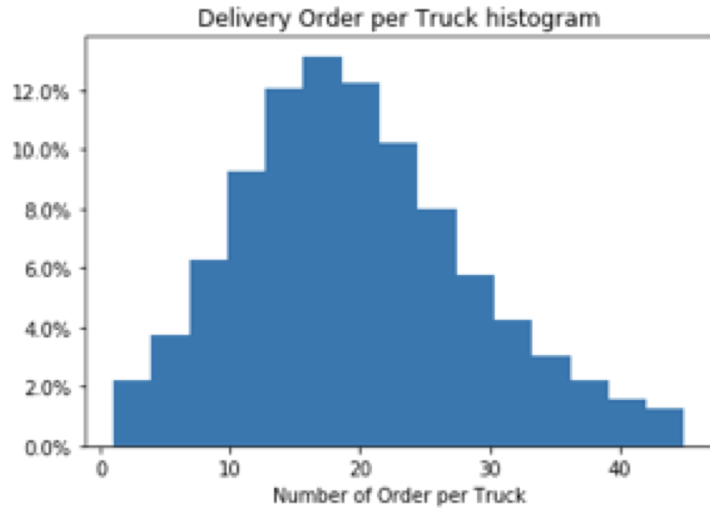


$$\text{Constraint: } \frac{K_{tsp(i)}}{S_{tsp(i)}} * \sqrt{An} + T_{d(i)} * n \leq T_k$$

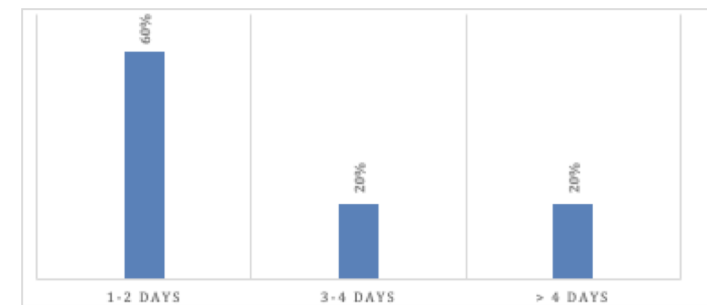
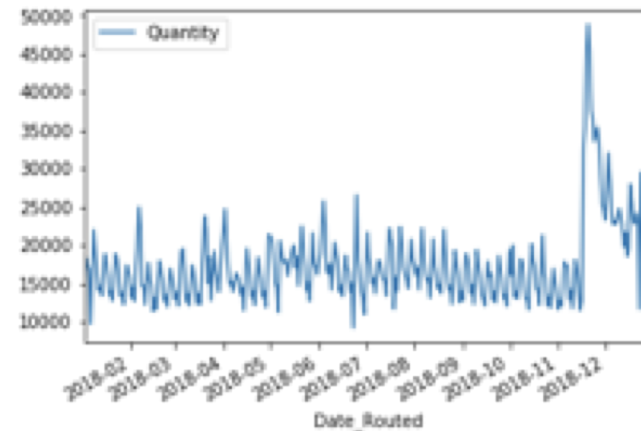
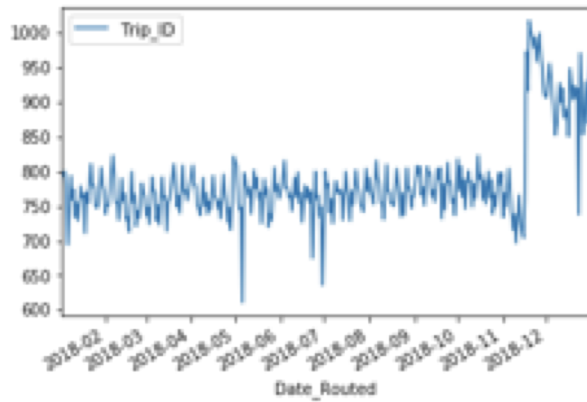


Using Trips as proxy and convert to fuel saving

BASELINE METRICS



Conclusion 1: Current vehicle utilization is low for volume and weight. Operation time is the main constraint

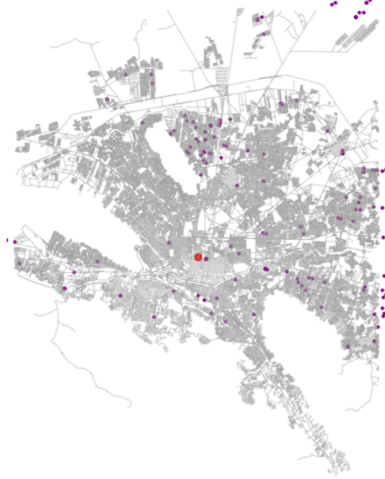


Conclusion 2: Volume has seasonality during Nov-Dec and 60% of volume is delivered within 2 days

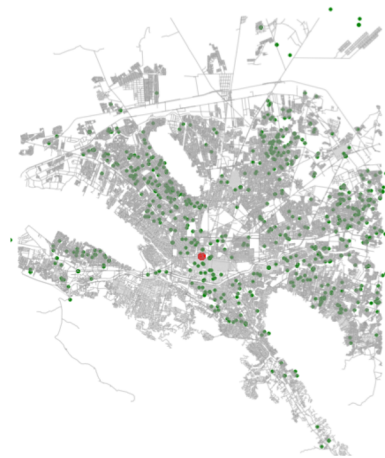
DELIVERY ZONE ANALYSIS

Monterrey - High, Medium and Low volume zones (by Orders per truck)

High



Medium



Low

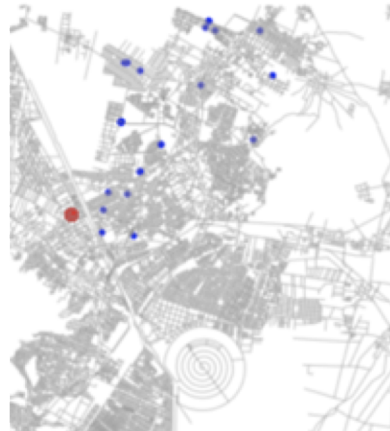


Monterrey have many medium utilization truck

Tecamac (Mexico City) - High, Medium and Low volume zones



High

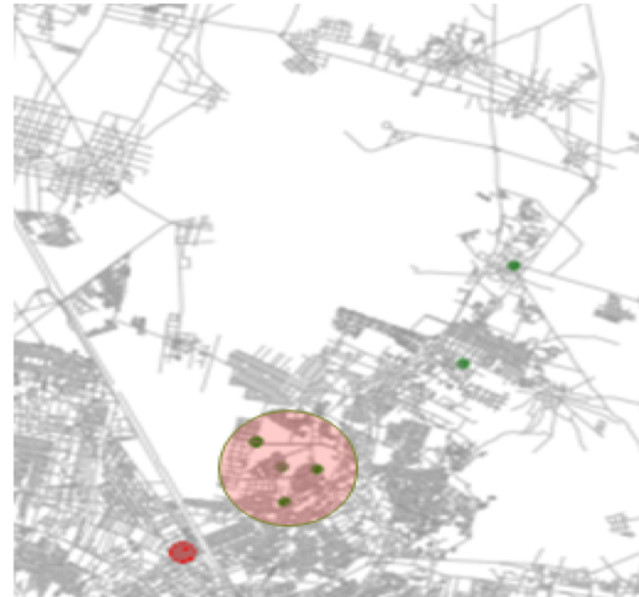
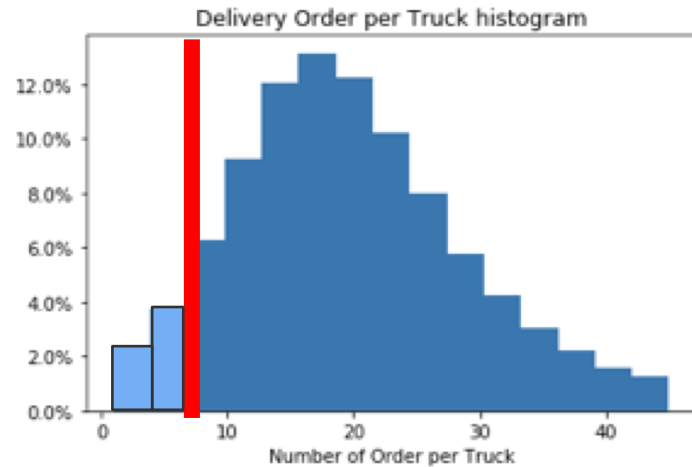


Medium



Low

Remove Low Utilization by Policy Enhancement



Low Density Zone

Count Delivery order in low volume trucks

City	Date	5/7/18	5/8/18	5/9/18	5/10/18	5/11/18	5/12/18	Grand Total
ACOLMAN		5	5					10
CD VALLES						6		6
ECATEPEC DE MOR				4			11	15
HUACHINANGO				3				3
HUEJUTLA DE REY						1		1
TAMAZUNCHALE			5		10			15
TAMPICO							6	6
TANTOYUCA			4		5		5	14
TECAMAC		1					6	7
TIZAYUCA		5		4			2	11
XICOTEPEC DE JU		6						6
Grand Total		17	9	16	5	17	30	94

- Not dispatching trucks with low utilization.
 - Delay routes
 - Merge routes
 - Estimate saving 6% of truck move.
- In our example there are 94 orders carry by low utilization truck from TECAMAC in one week.

Increase time per truck with less frequent deliveries



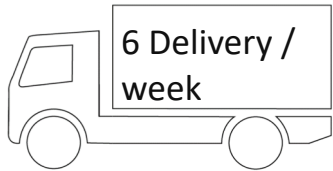
Medium Density
Orders per truck between 7 and 17

Medium Density Zone

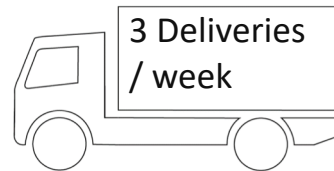


High Density \geq 18 orders per truck

High Density Zone

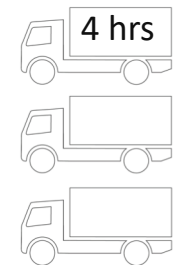


With customer willing to wait. Rationalize the frequency of delivery
- 13 to 19% saving



By Increasing time spend on last mile

- Less truck is required to handle all delivery
- Estimate 12-26% saving



RECOMMENDATIONS

- Operational
 - Improve low utilized routes through consolidation.
 - Reduce delivery frequency given longer lead-times.
 - Increase route length for last mile delivery

- Future Opportunities
 - Work on improving geocode data quality
 - Up-stream DC inventory analysis with longer lead-time

Saving Opportunity



Maximum: 32 %
trips reduced
(combining
options)



2.14 Million Liters
Diesel



2.35 Million USD



5.76 Million Kg

Thanks!



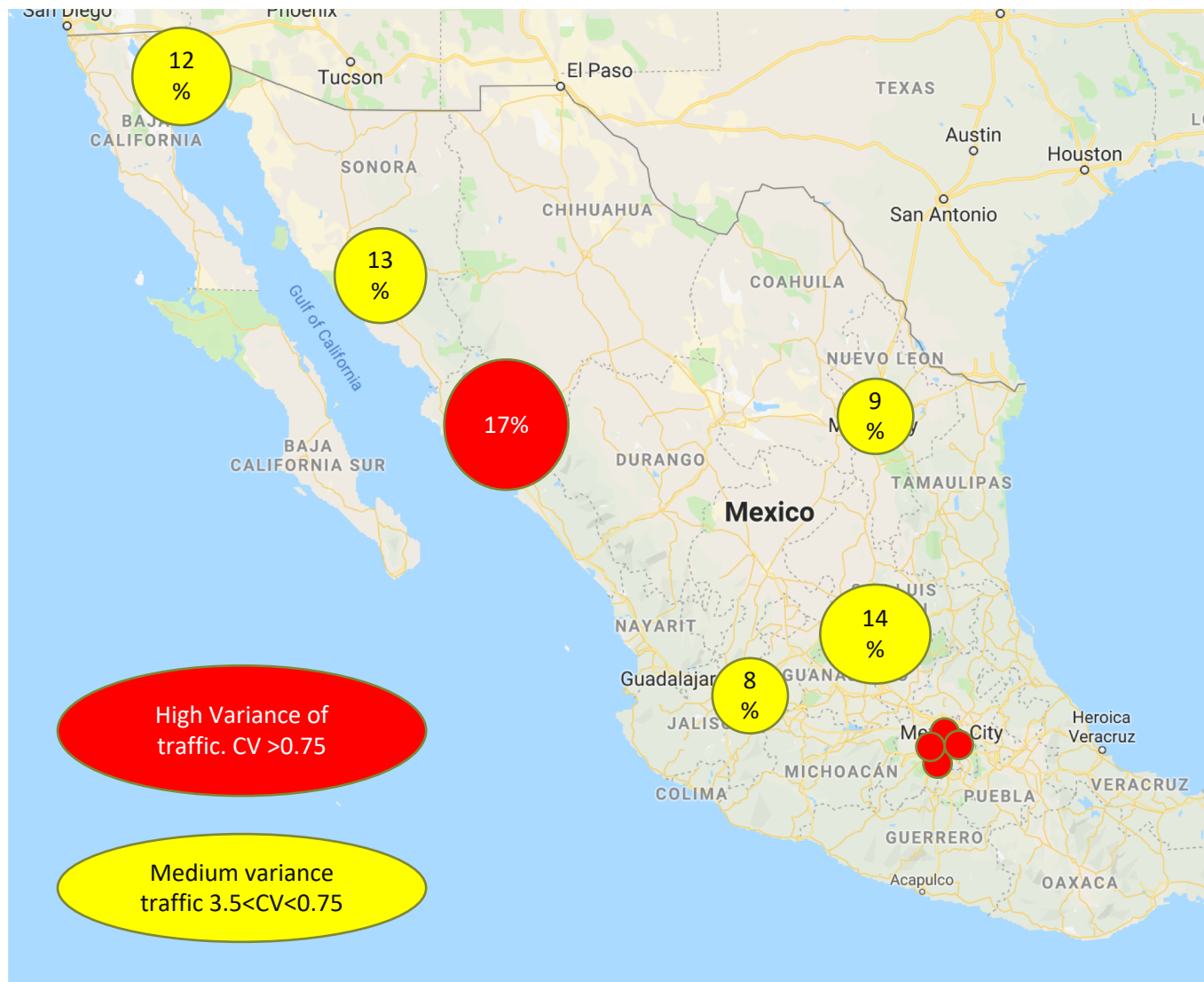
Questions?

Name

email@[mit.edu](mailto:email@mit.edu)

<http://sustainablelogistics.mit.edu>

Backup: Additional study on upstream inventory



- Coppel have intra DC traffic from each DC to all other DC, the top 6 DC shipping out are
 - Culiacan
 - Leon
 - Hermosillo
 - Laguna
 - Monterrey
 - Guadalajara
- We recommend holding inventory in centralized location and pull by regional DC to reduce inter DC traffic
- 15% potential saving on inter DC

Back-up Limitations

- Only 60% of record could get accurate Geocode from Google API.
- Could not run all Geocode due to Google API limitation, we only run 6 DC for 1 week, roughly 30K records.
- Currently there is no logical grouping other than City name in the data for demand analysis or automated consolidation
- The benefit is base on the weekly data we analysis