



# Amazon Cold Chain Inbound Optimization



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## Background

Cold-chain logistics refers to the transportation and handling of temperature controlled products and it involves unique requirements that set this process apart.

## Problem Statement

Amazon's current Freight Inbound (AFI) Network for Cold Chain delivery is dependant on third party shippers and managed by suppliers. This is not cost effective and prevents them from managing their inbound cold supply chain.

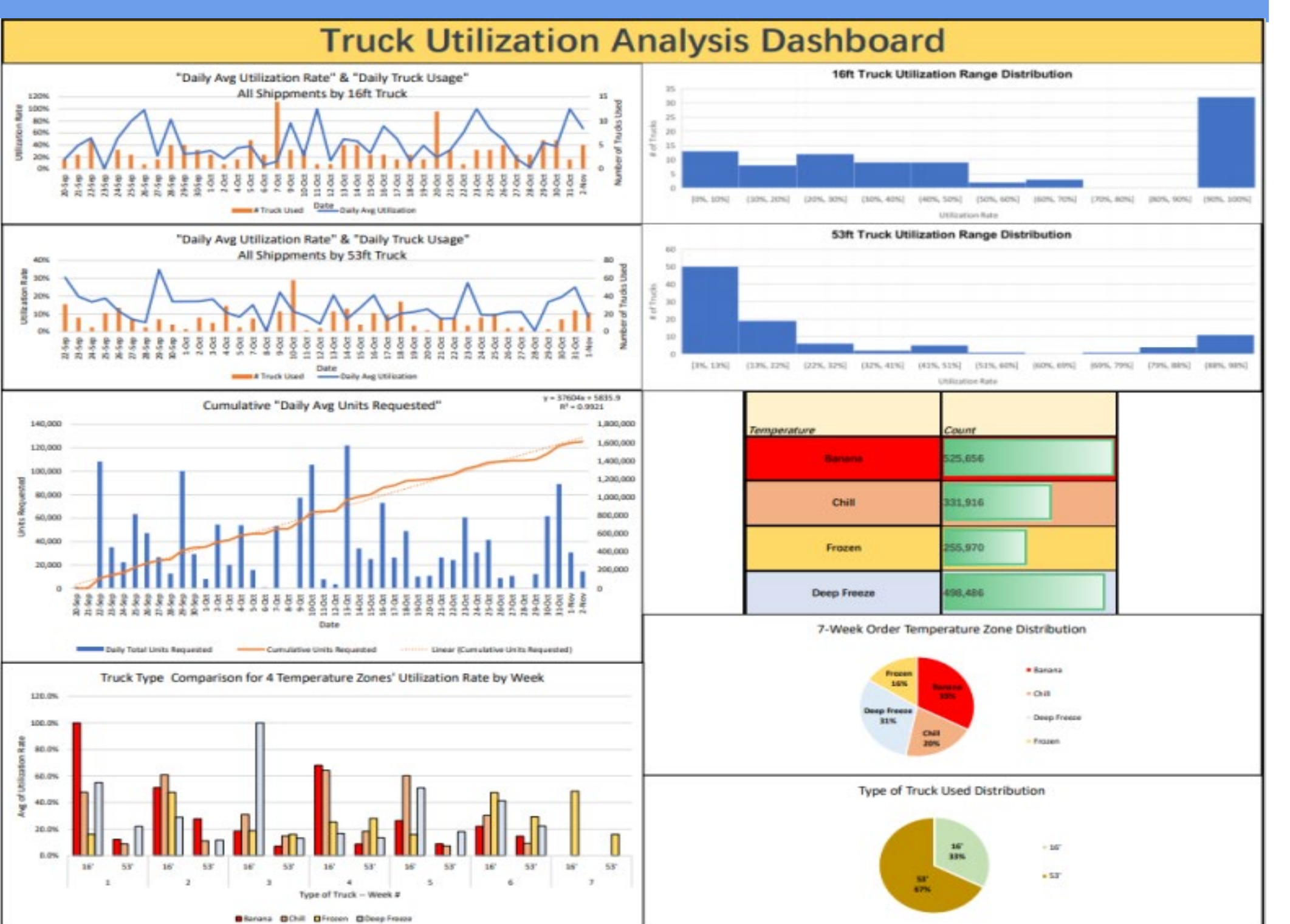
## Objective

Create an **AUTOMATED OPTIMIZATION TOOL** for inbound cold-chain transportation network that process the input variables, and generates the most cost efficient execution plan for inbound deliveries based on constraints.

## Assumptions

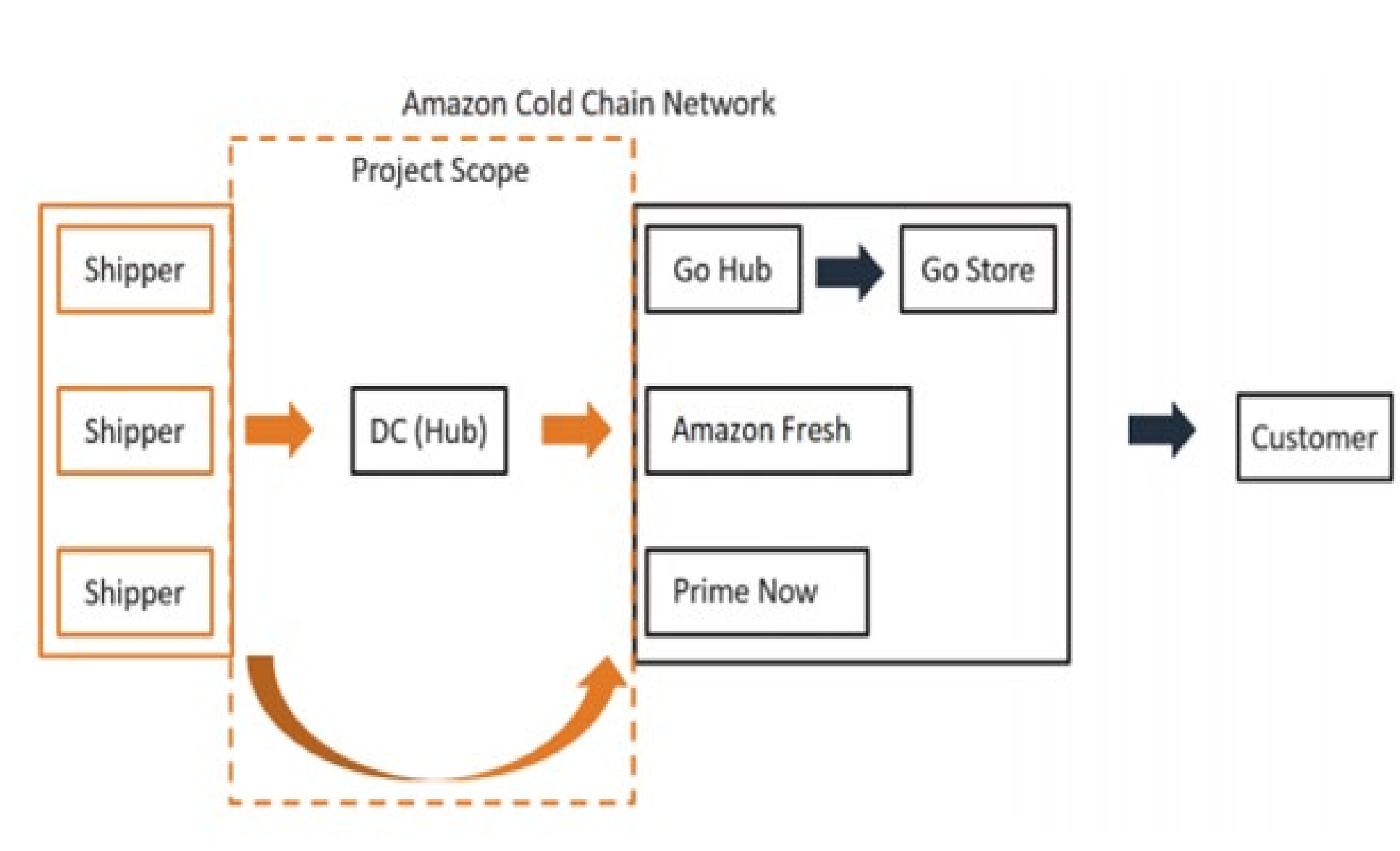
- One DC (Hub), multiple shippers and receiving sites
- Static cost coefficients
- Single temperature zone per truck
- Uniform item dimensions across temperature zone
- Unlimited crossdock capacity
- Ideal transportation (No stops/traffic/accidents)

## Truck Analysis Dashboard

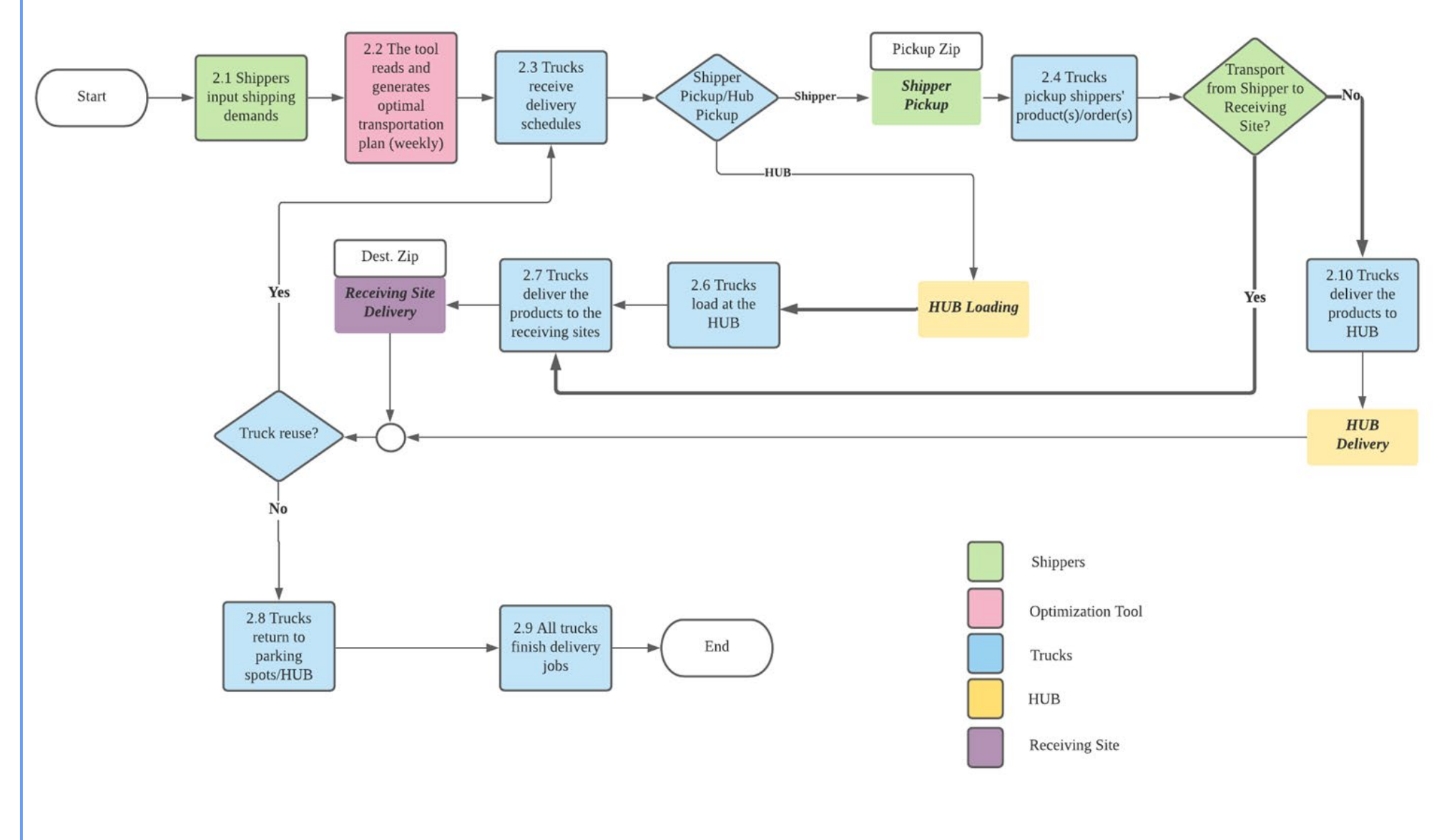


**Truck Analysis :**  
The tool is able to find the optimal # of 16' & 53' trucks which saves delivery cost by over **40 - 60%**. Utilization Analysis could be a good reference for resource allocation.

## Inbound Transportation Network



## Inbound Transportation Routing Logic



## Inbound Optimization Methodology

### Input Variables & Constraints

- Pickup Zip Code
- Delivery Zip Code
- Pickup Time Window
- Delivery Time Window
- Temperature zone
- Unit counts
- # of Available Trucks

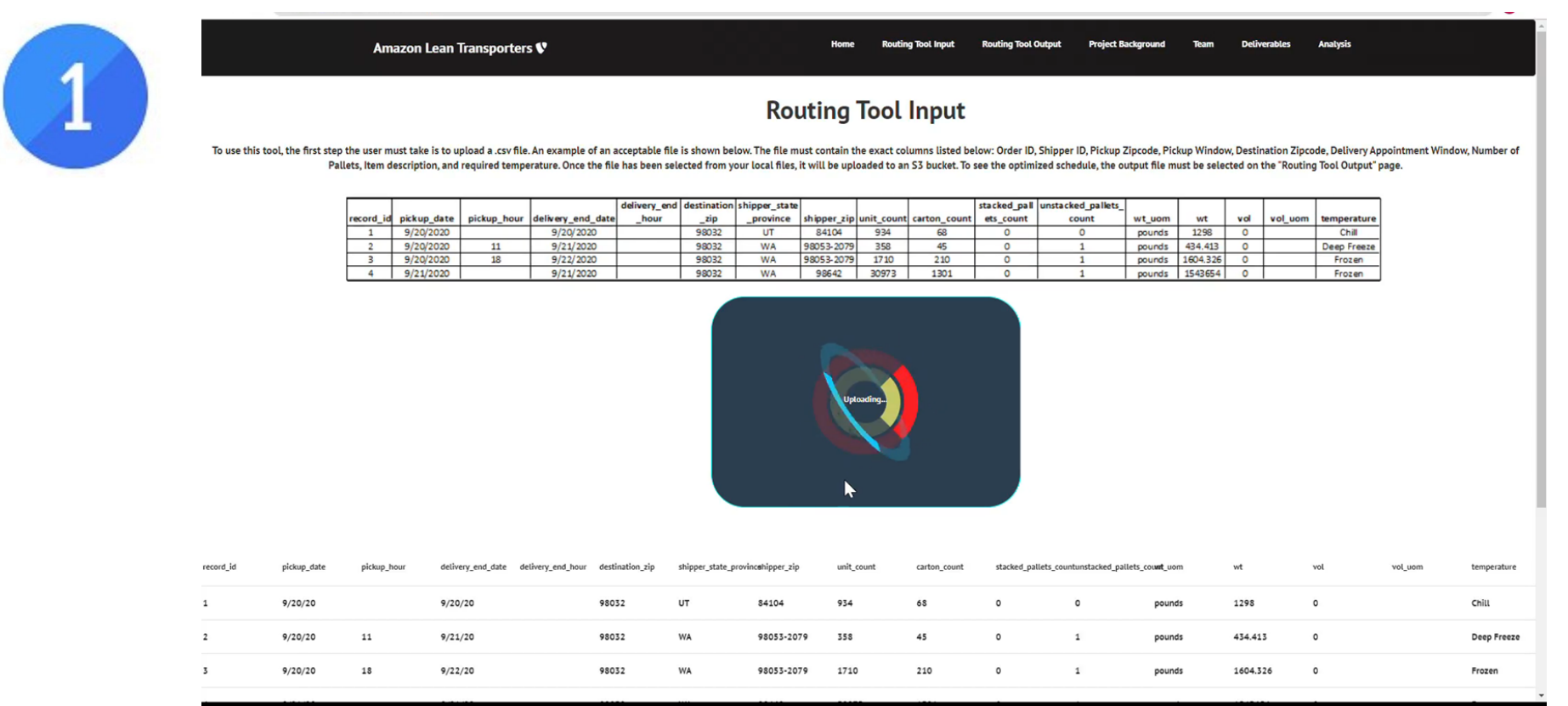
### Optimization Engine

- Calculate the routing plan from shipper to HUB
- Calculate the routing plan from HUB to receiving site
- Extra Truck Estimation Function if no feasible solution

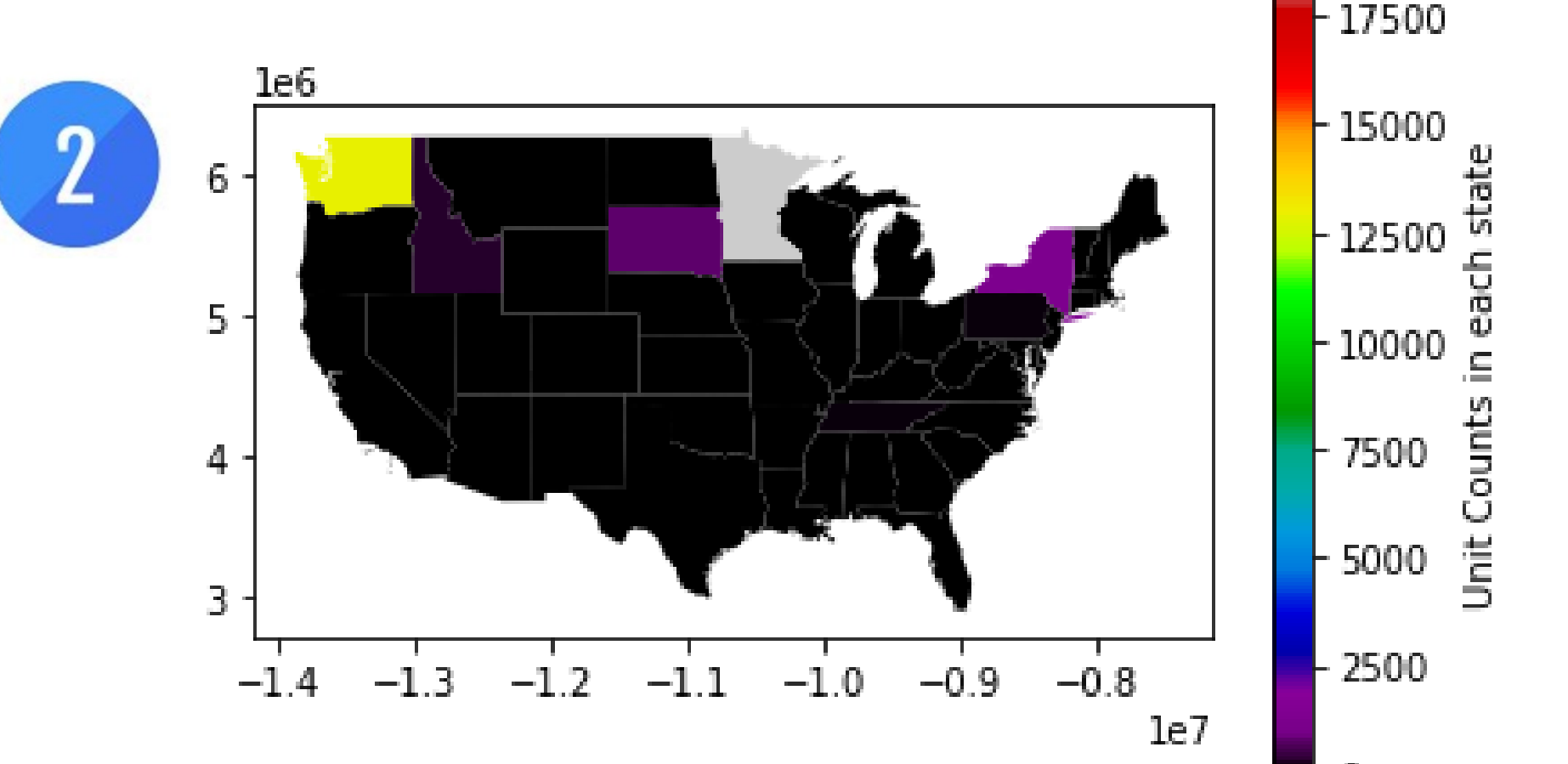
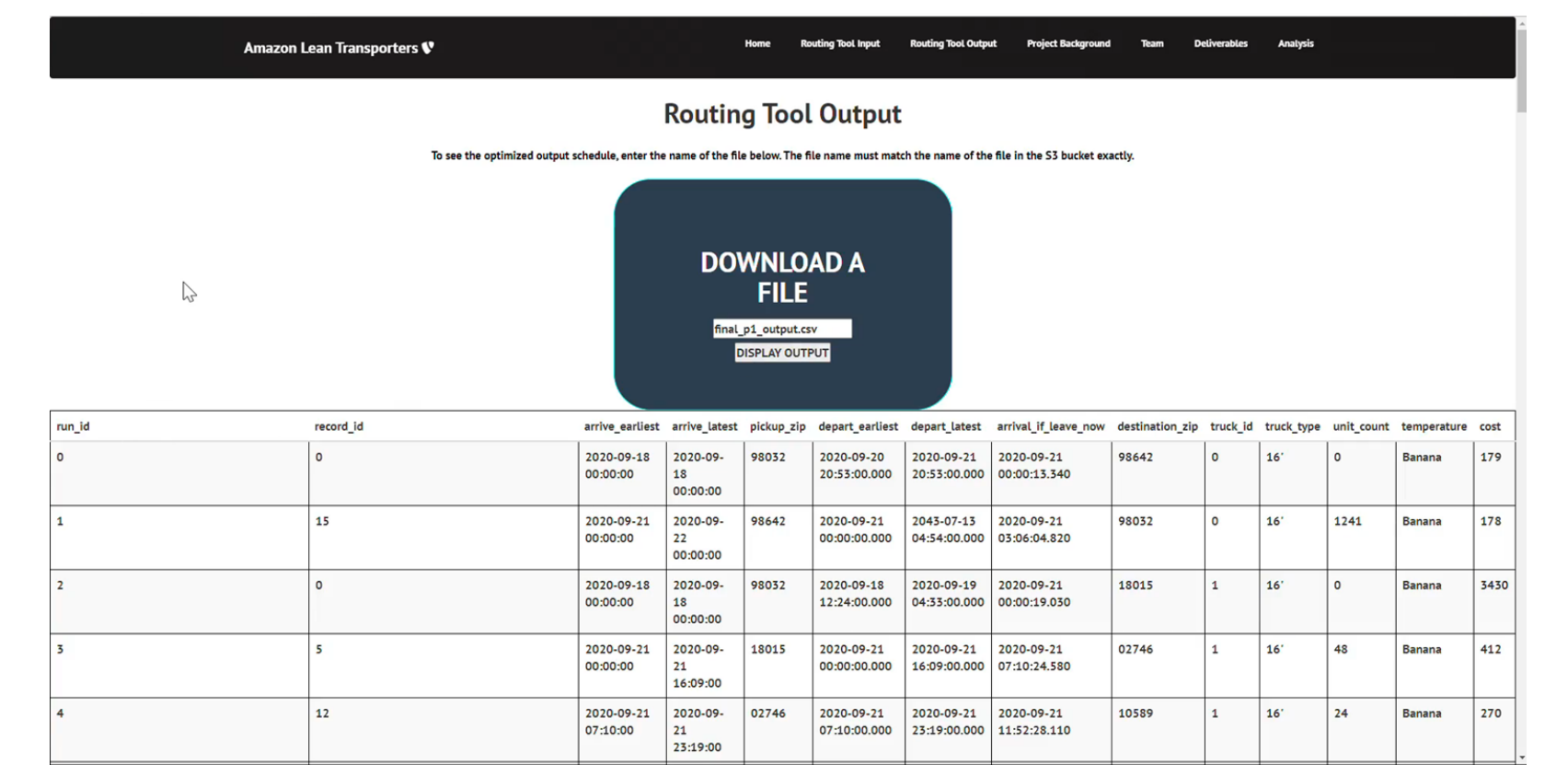
### Executable Plan

- Optimize delivery route
- Calculate number of each type of truck needed
- Find Total cost for each order
- Recommend alternative routing plan

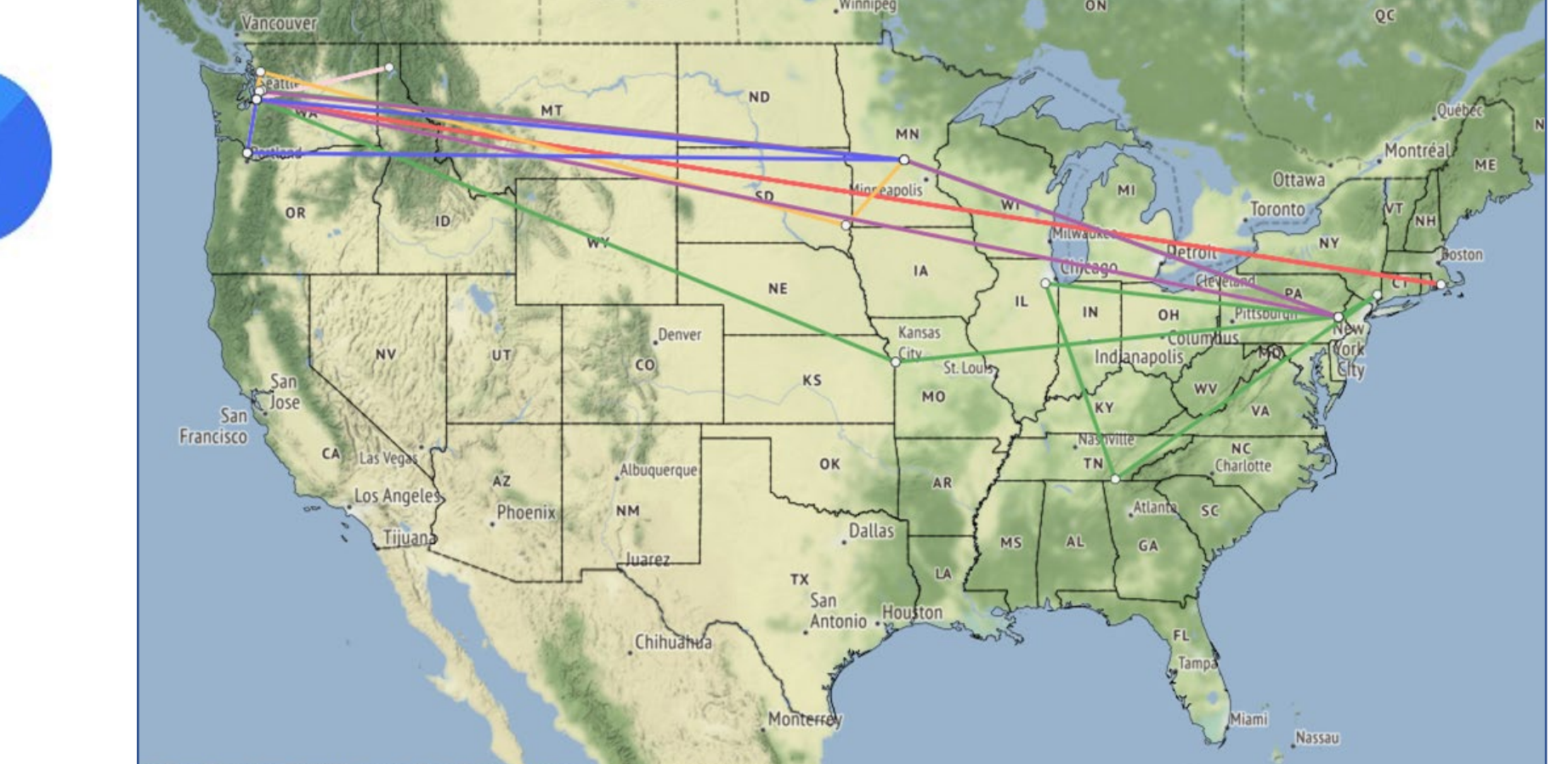
## Deliverables



User Interface that allows for upload of a CSV File that contains shipping demand information and outputs the optimized routing schedule.



Display the initial demand on a map (order density)



Display optimized shipping routes

## Validation Process

Compared our results against the results from RoOT (Route Optimization Tool) developed by VillageReach and the ISE Department at University of Washington.

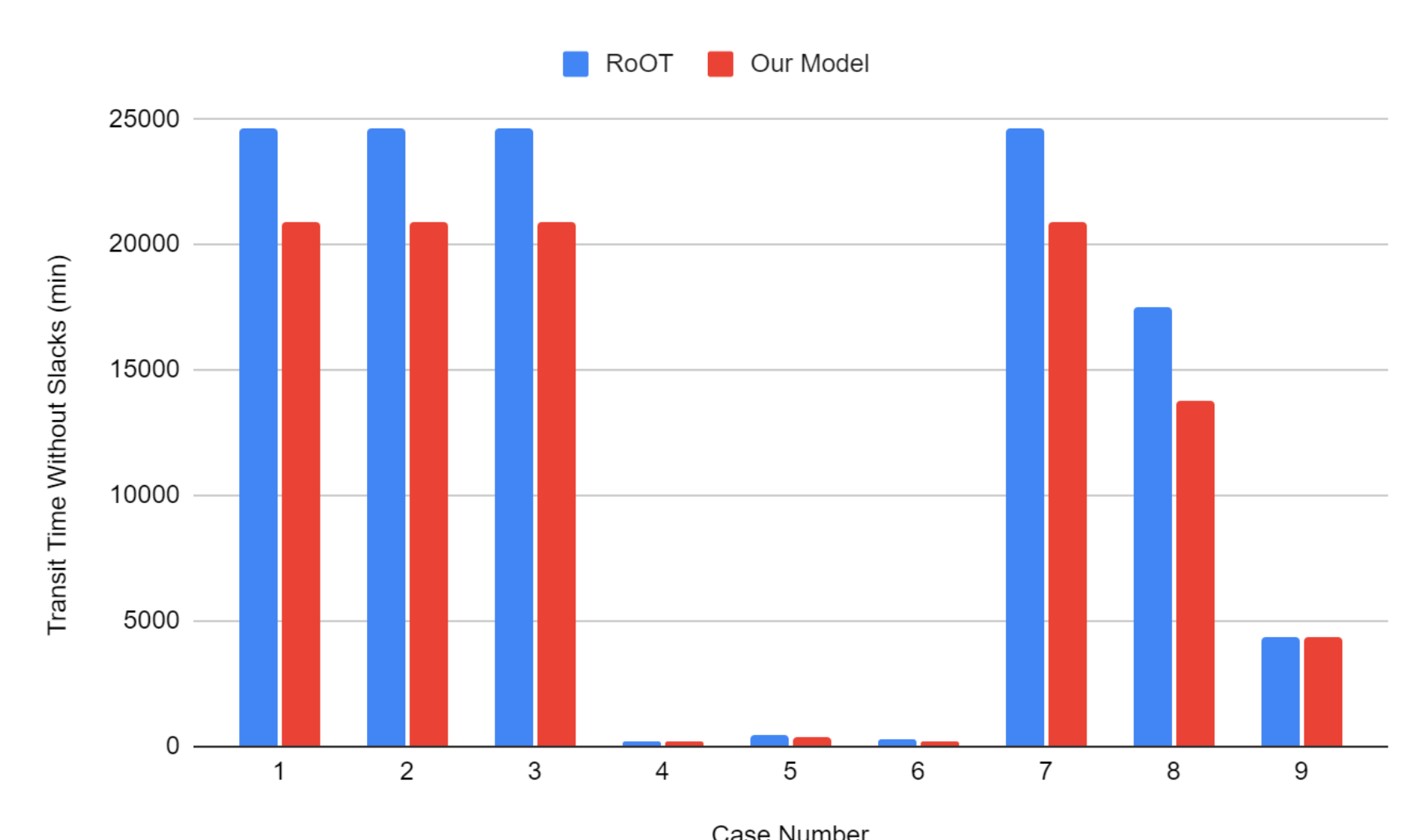
### Why RoOT?

It is accessible to us and easy to validate. It can deal with temperature constraints and the parameters used are applicable to the model we made.

### Model Comparison

Our Model	RoOT
Optimize weekly plans	Optimize one-day delivery
One temperature per truck	Multi-temperature per truck
Specific time windows for pick-up and drop-off.	No time window constraint within the one-day interval.
No additional constraint on specific number of trucks should be used	One constraint is trying to enforce all the available trucks to be used
One truck per route	One truck for multiple routes

## Validation Results



- 9 Scenarios using different input datasets and having different numbers of available trucks
- Due to the difference in the constraint, our model's results are better (shorter time) than the RoOT model

## Impact

- With the tool that we created:
- Users will have better sense of their plans and transportation process.
  - Amazon will make better decisions about their cold chain transportation.
  - Ensure products are delivered on-time and within their temperature range.
  - **Reduce costs by 40 - 60%, which will allow affordable access.**