Equipping Nolan Transportation Group: Providing Tools to Aid with Rapid Growth

Alexander Bolen, Sean Hartrich,
Zoya Mahmood, Sarah Stevens,
Victor Tonelli Rohlfs, James Michael Wiggins,
Jonathan Elijah Williams, Nathanael Williams

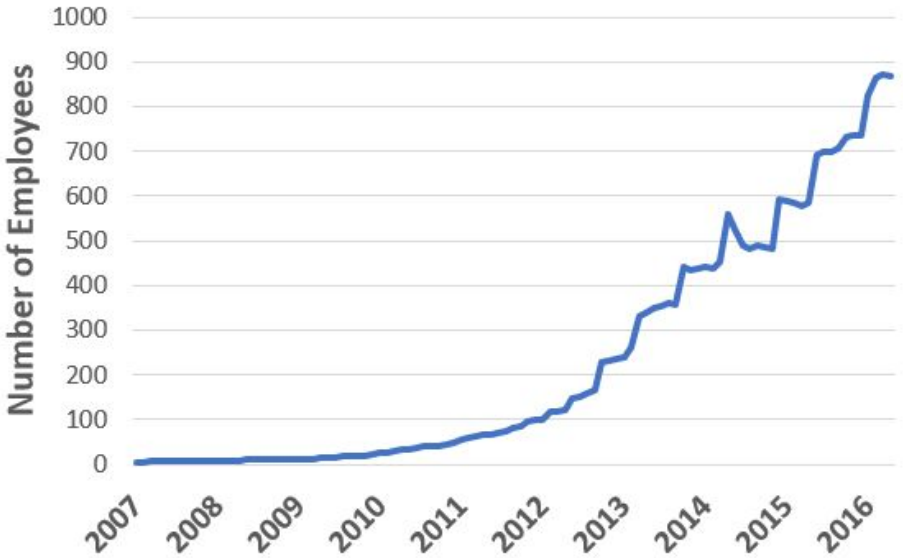
April 12, 2018

Team 20 contact: team20gatech@gmail.com
Client contact: Bert Brunsting bert.brunsting@ntgfreight.com
Advisor: Prof. Andrea Laliberte alaliberte@gatech.edu

This presentation has been created as a part of a student design project at the Georgia Institute of Technology.

Who is Nolan Transportation Group (NTG)?

- Logistics services provider
- Small, fast-growing company
  - 2-year AJC Top Workplace
  - Inc. 5000 Fastest-Growing Private Companies
  - 110% growth since 2016

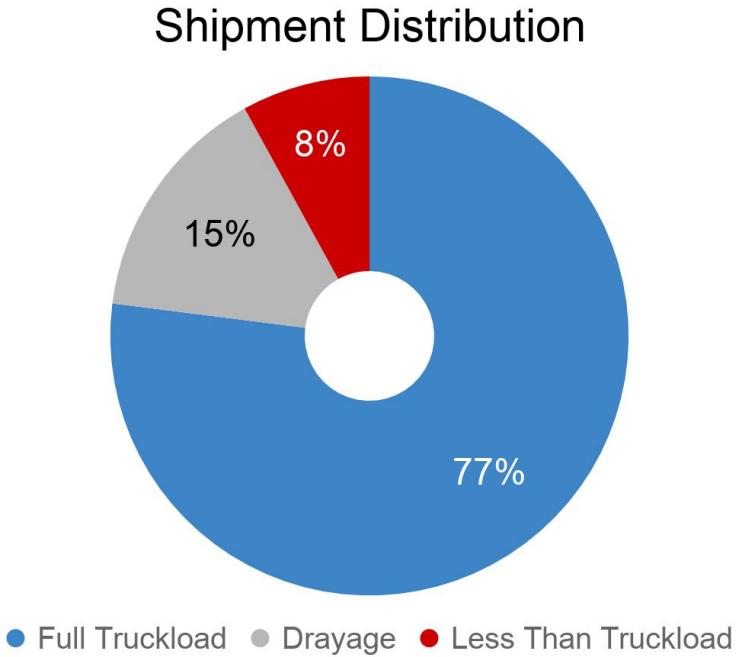


Goal:

Refine the infrastructure of new and rapidly growing products

Who is Nolan Transportation Group (NTG)?

- Logistics services provider
- Small, fast-growing company
  - 2-year AJC Top Workplace
  - Inc. 5000 Fastest-Growing Private Companies
  - 110% growth since 2016



Goal:

Refine the infrastructure of new and rapidly growing products

Project Overview

Atlanta Enterprise

Team to service top FTL customers

- Suboptimal employee distribution
- Recommendations to improve performance

Less-Than-Truckload

Shipments with small volumes of freight

- Outsource LTL and partial orders
- Combining LTL loads into FTL shipments

Drayage

Import and export shipments

- Ship each delivery as a separate trip
- Match import trips to export trips

NTG

Atlanta Enterprise

Who?

- Atlanta Enterprise is a new team within NTG
- Serves top 5 customers
- Follows FTL shipments from order placement to delivery

What?

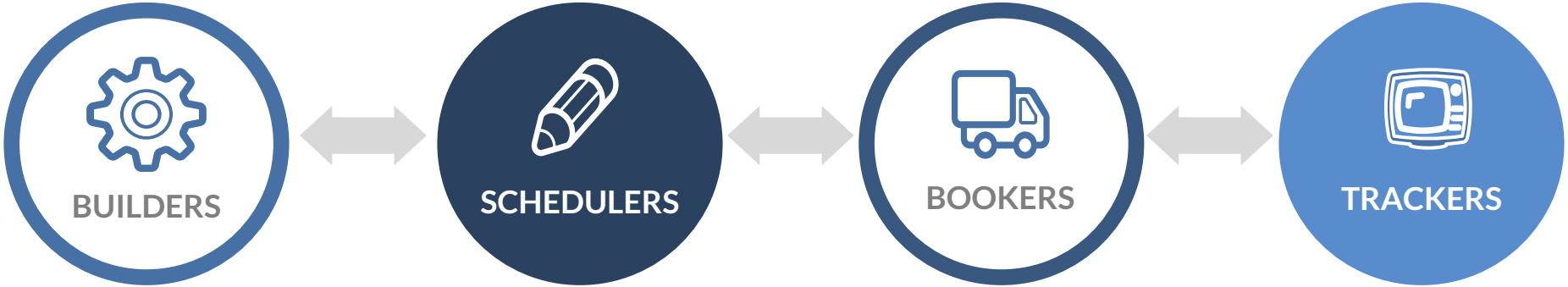
- Assessing current utilization of employees
- Evaluating present number of employees in each role
- Increasing throughput

Why?

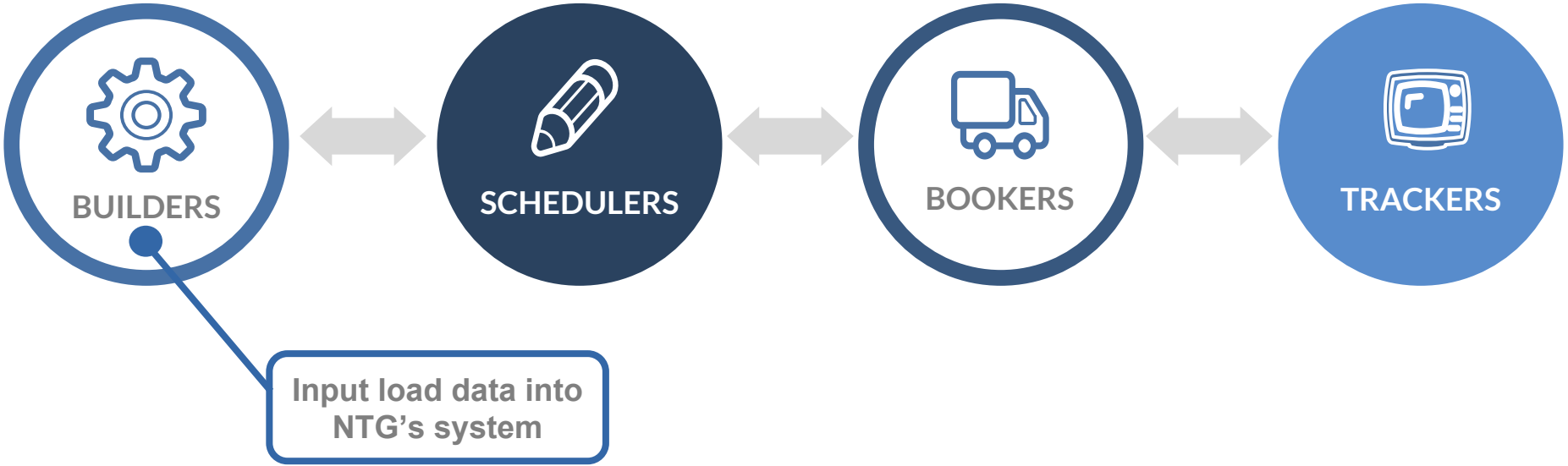
- Use Atlanta Enterprise as a model for new/existing teams
- Deliver highest level of customer service

Atlanta Enterprise - System

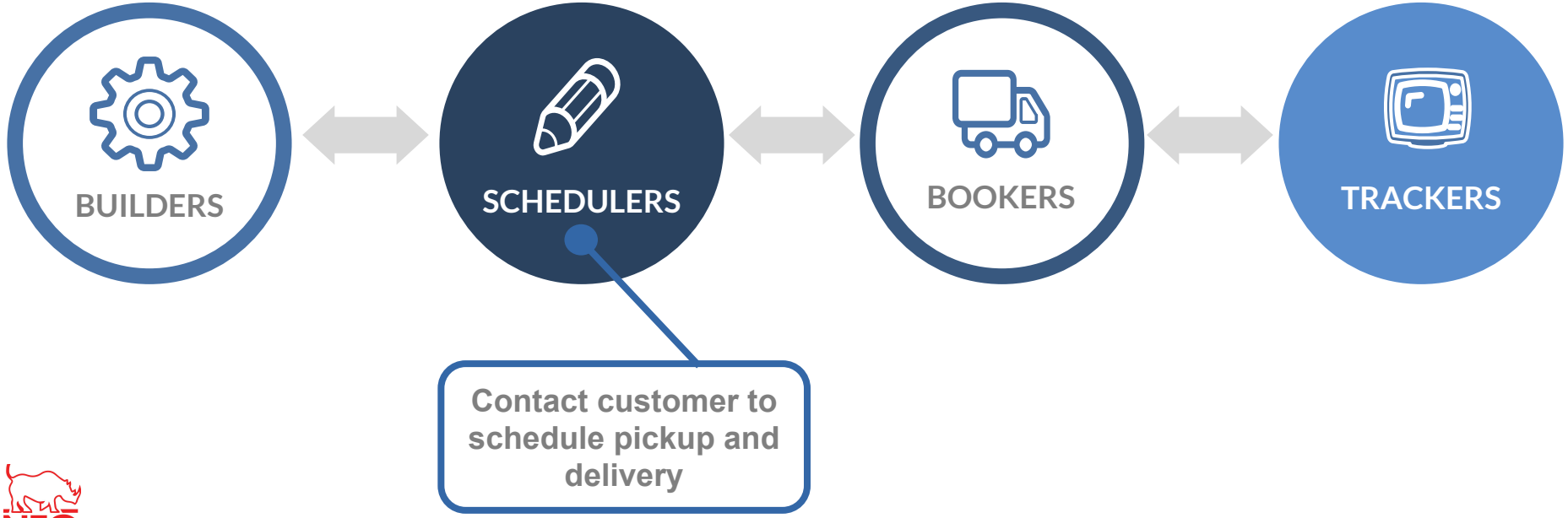
System | Model Results | Recommendations



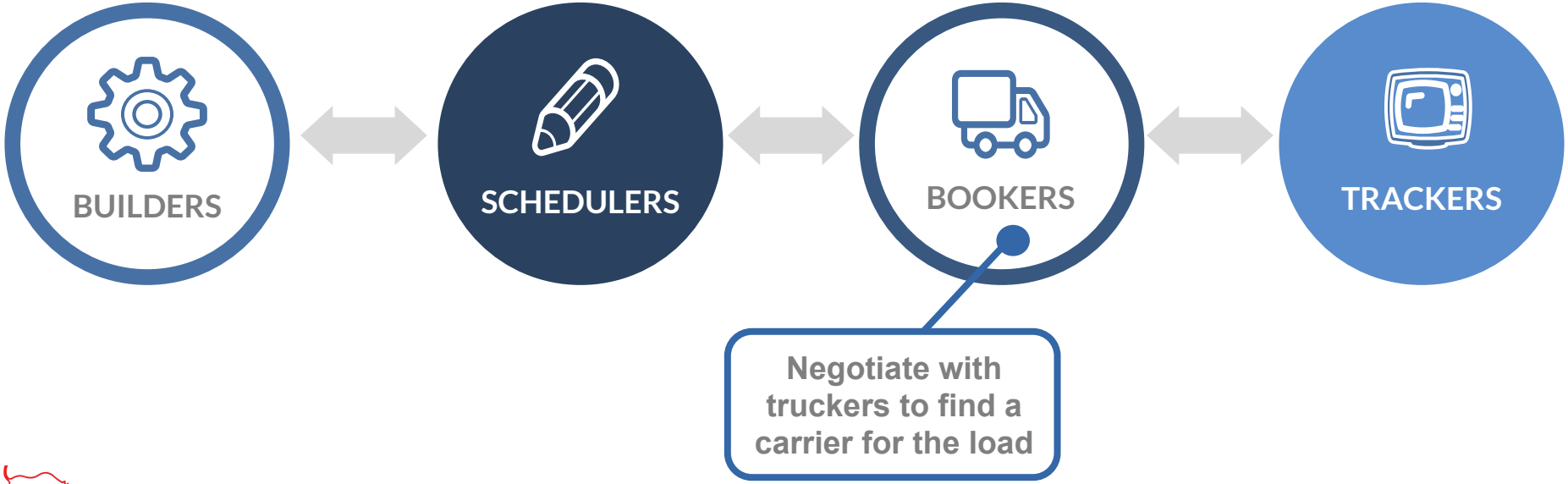
Atlanta Enterprise - System



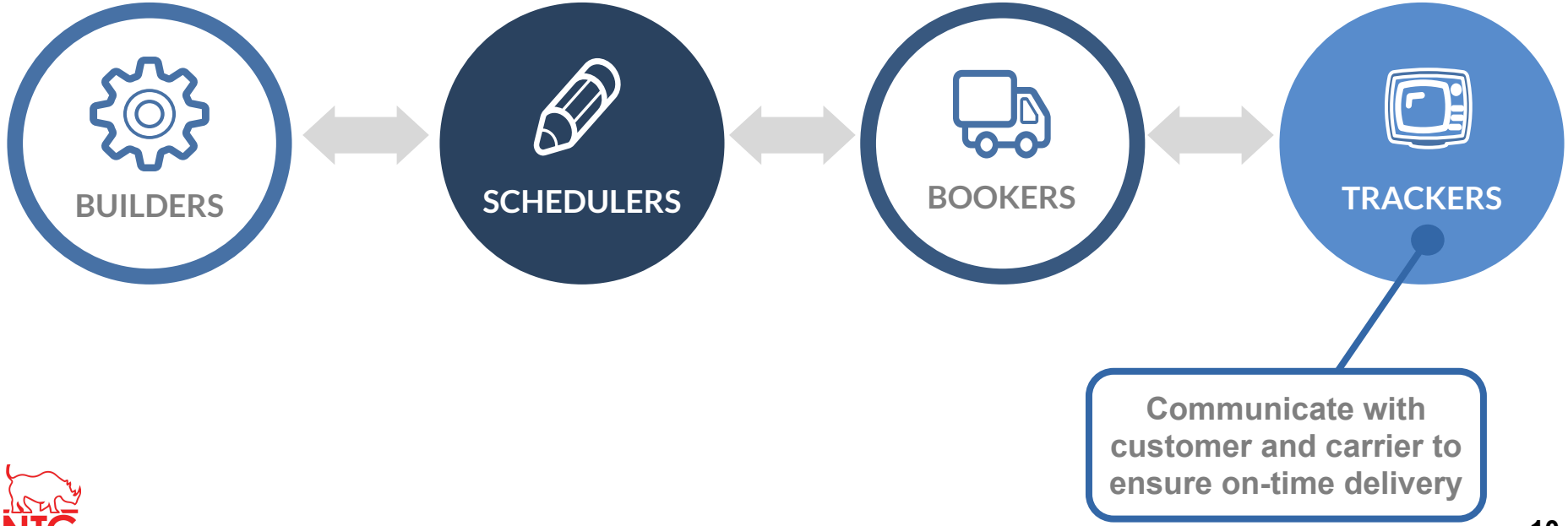
Atlanta Enterprise - System



Atlanta Enterprise - System

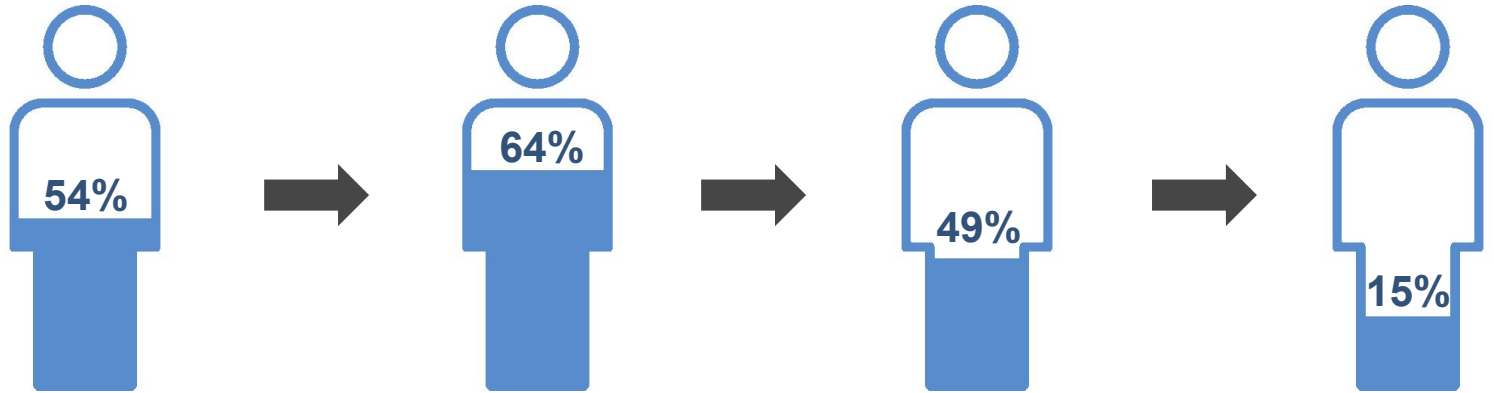


Atlanta Enterprise - System



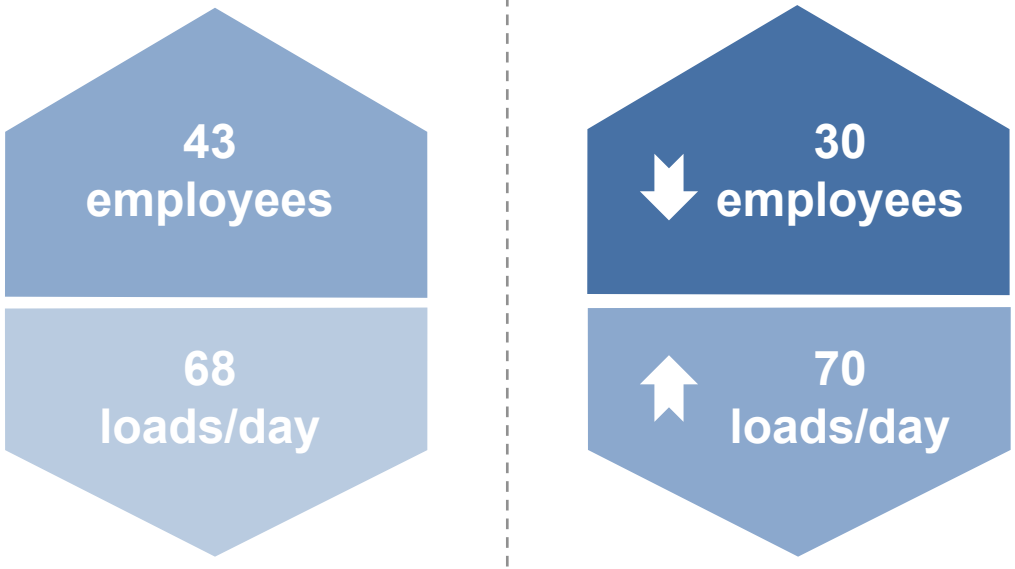
Atlanta Enterprise - Model Results

Staff Utilization
(# People in Role)



Builders (3) → Schedulers (2) → Bookers (20) → Trackers (18)

Atlanta Enterprise - Model Results



Atlanta Enterprise - Recommendations

Role	Current	Proposed
Builder	3	**4**
Scheduler	2	**4**
Booker	20	**13**
Tracker	18	**9**

NTG

Atlanta Enterprise - Recommendations

Based on observation:

- Cross-train schedulers and builders
- Improve communication between roles
- Provide better tools for load booking

Less-Than-Truckload

Current System:

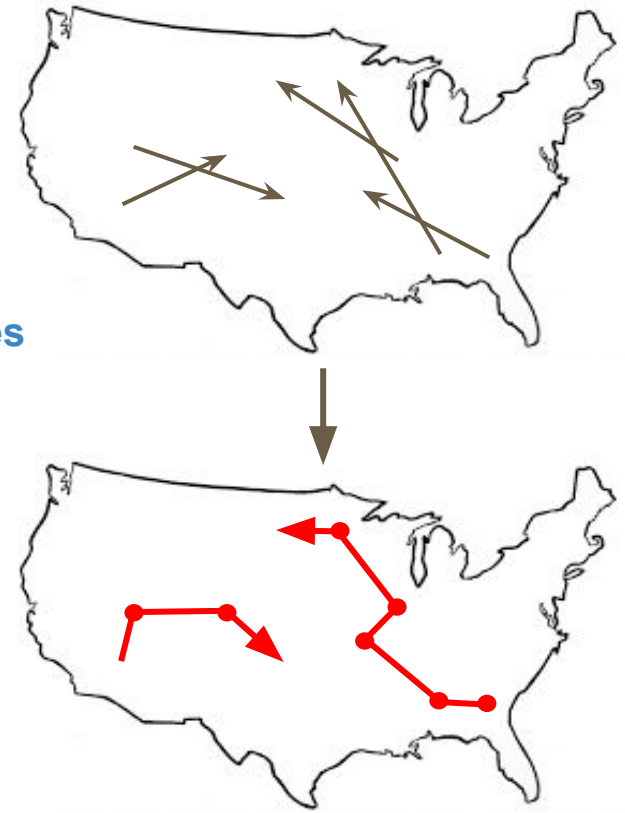
- ~1,500 shipments per month
- Provided as service for customers

Design Approach:

Consolidate LTL and Partial shipments into pooled routes

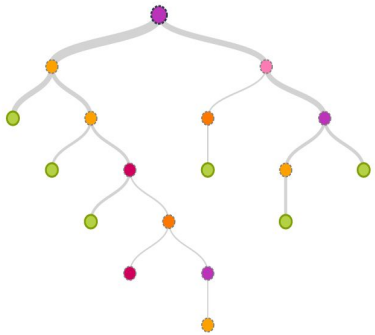
Benefits:

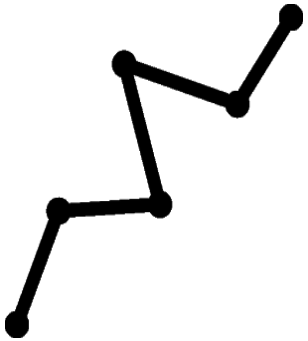
- Improved customer service and profit (FTL vs. LTL)
  - Confirmed delivery date
  - Cost savings passed onto customer
- Improved infrastructure will support rapid growth



LTL - Methodology

Clustering	Shortest Path IP	Cost Comparison
Cluster shipments with preliminary constraints	Solve for optimal order of nodes	Keep profitable routes





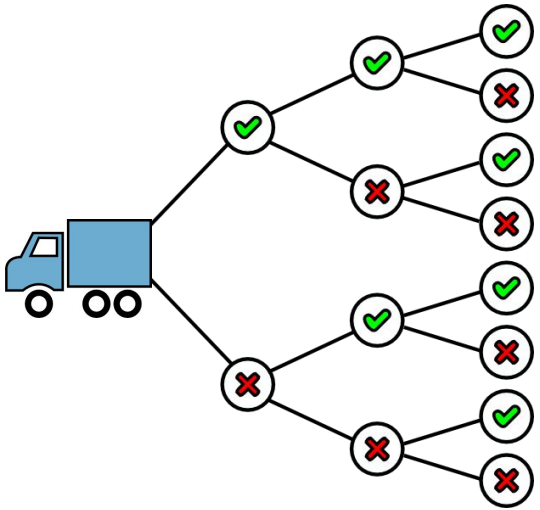
LTL - Clustering

Matching Criteria

- Location Hubs
- Active Loads
- Type of Equipment

Decision Tree

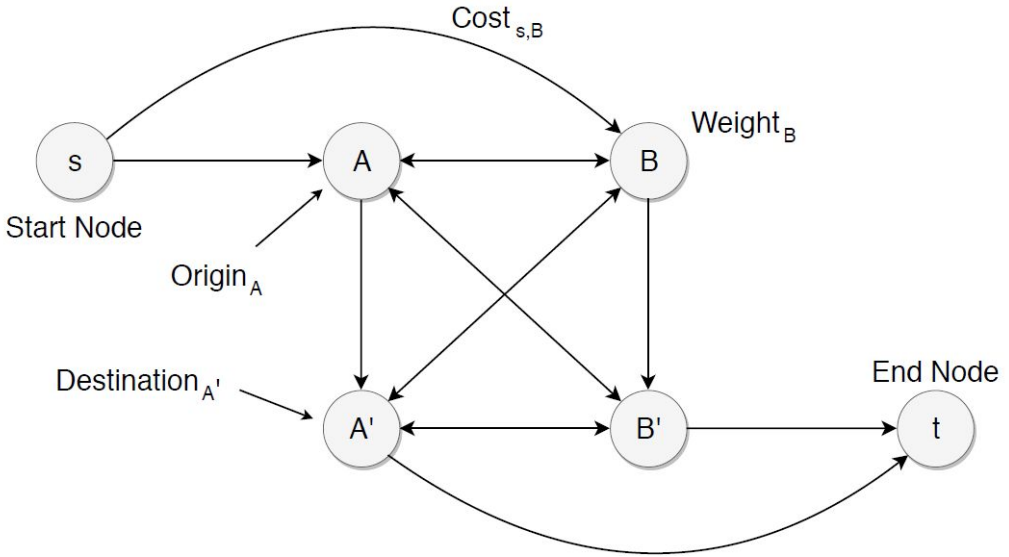
Clusters shipments into feasible routes



LTL - Shortest Path IP

Constraints:

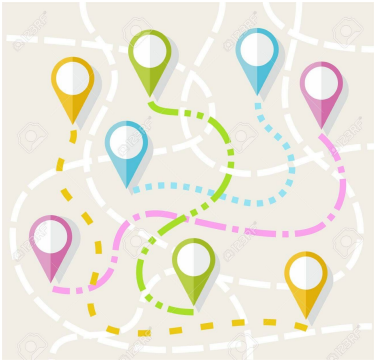
- Visit All Nodes Once
- Origin Before Destination
- Capacity of Truck
- IP Solution Gives Node Order



LTL - Cost Comparison

Cost of Combined Route

$\leq$

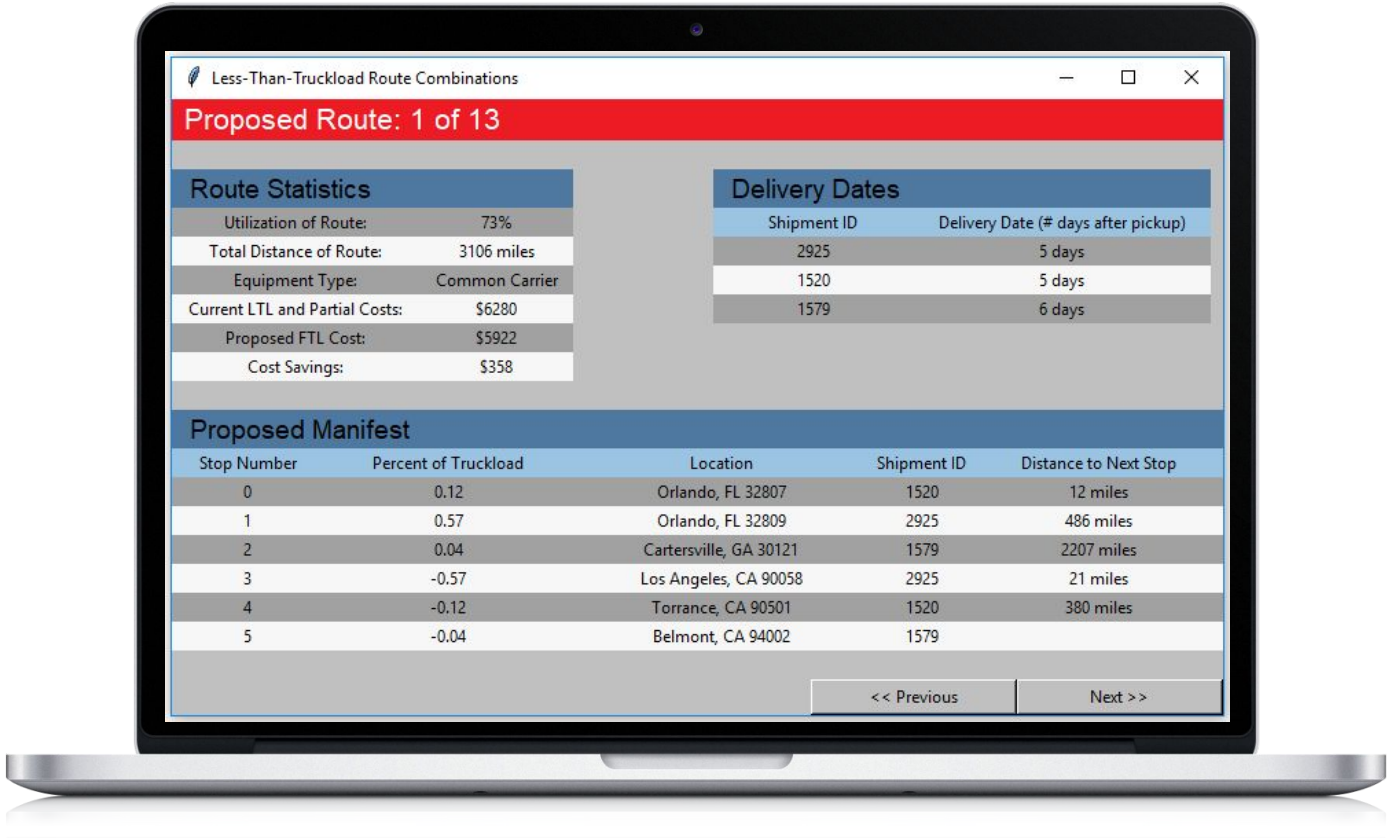


Total Cost of Individual Shipments

Cost of FTL Route = Lane Rate x Total Distance + Per-Stop Cost

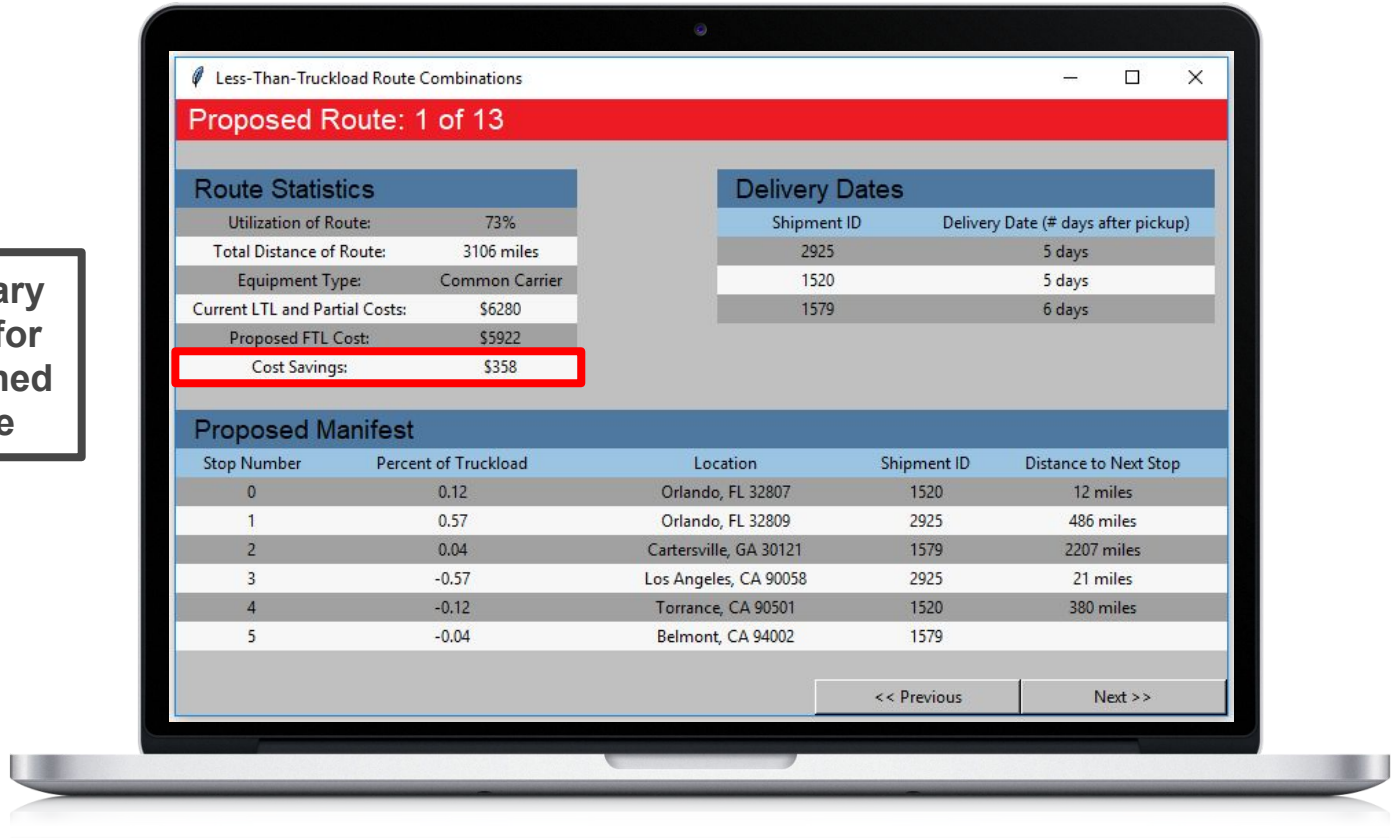
Cost of Partial Route = FTL Cost x Percent of Truck Space Required

LTL - User Interface



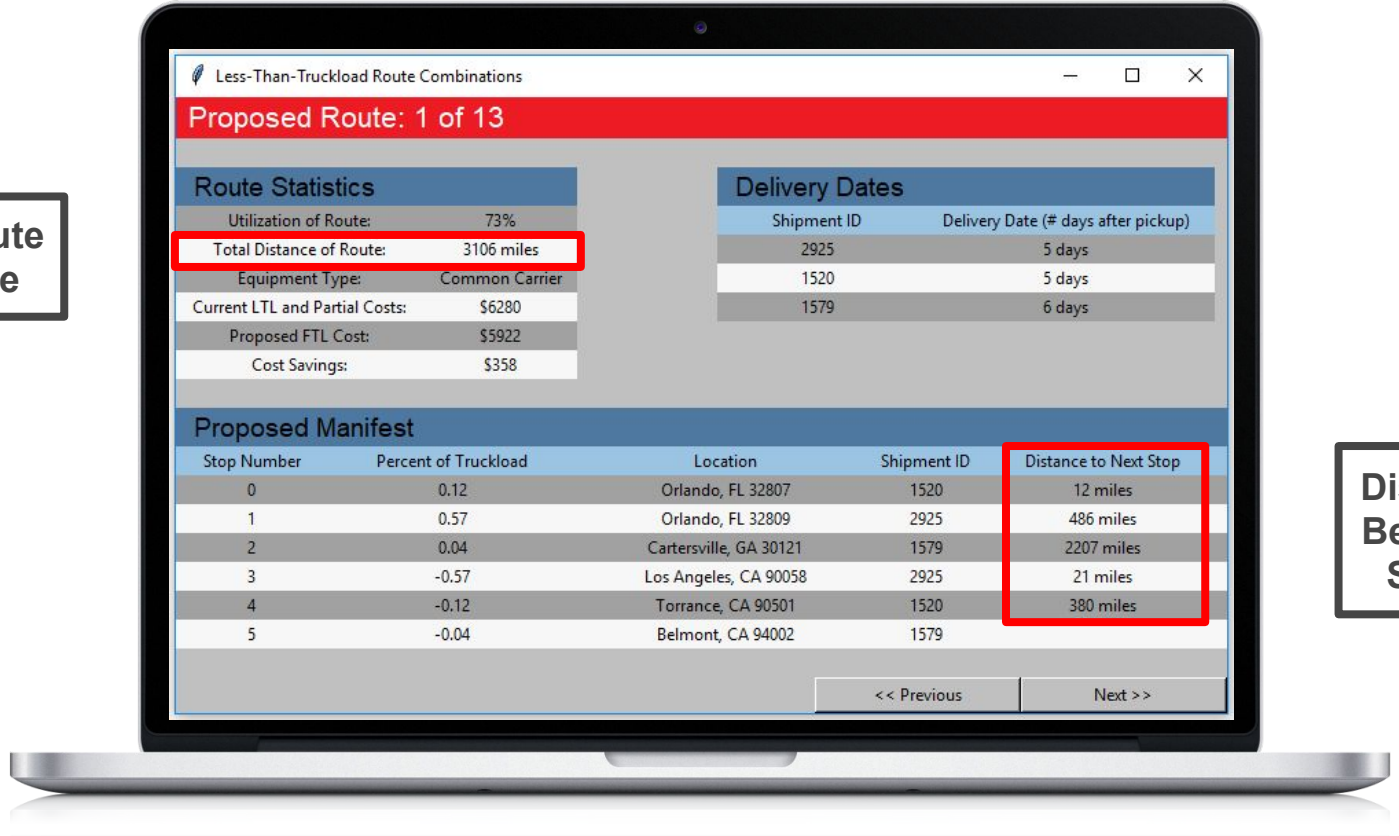
LTL - User Interface

Monetary Value for Combined Route



LTL - User Interface

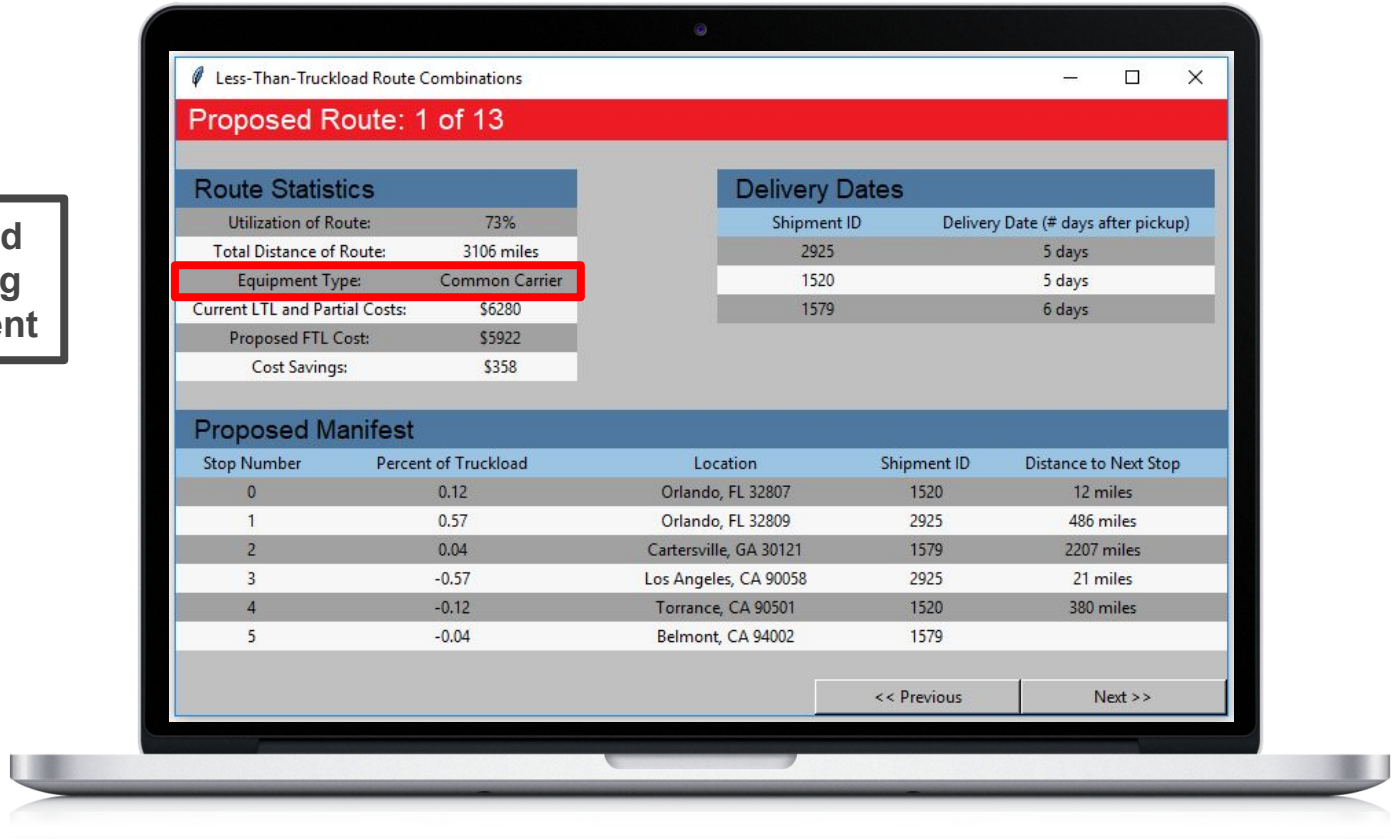
Total Route Distance



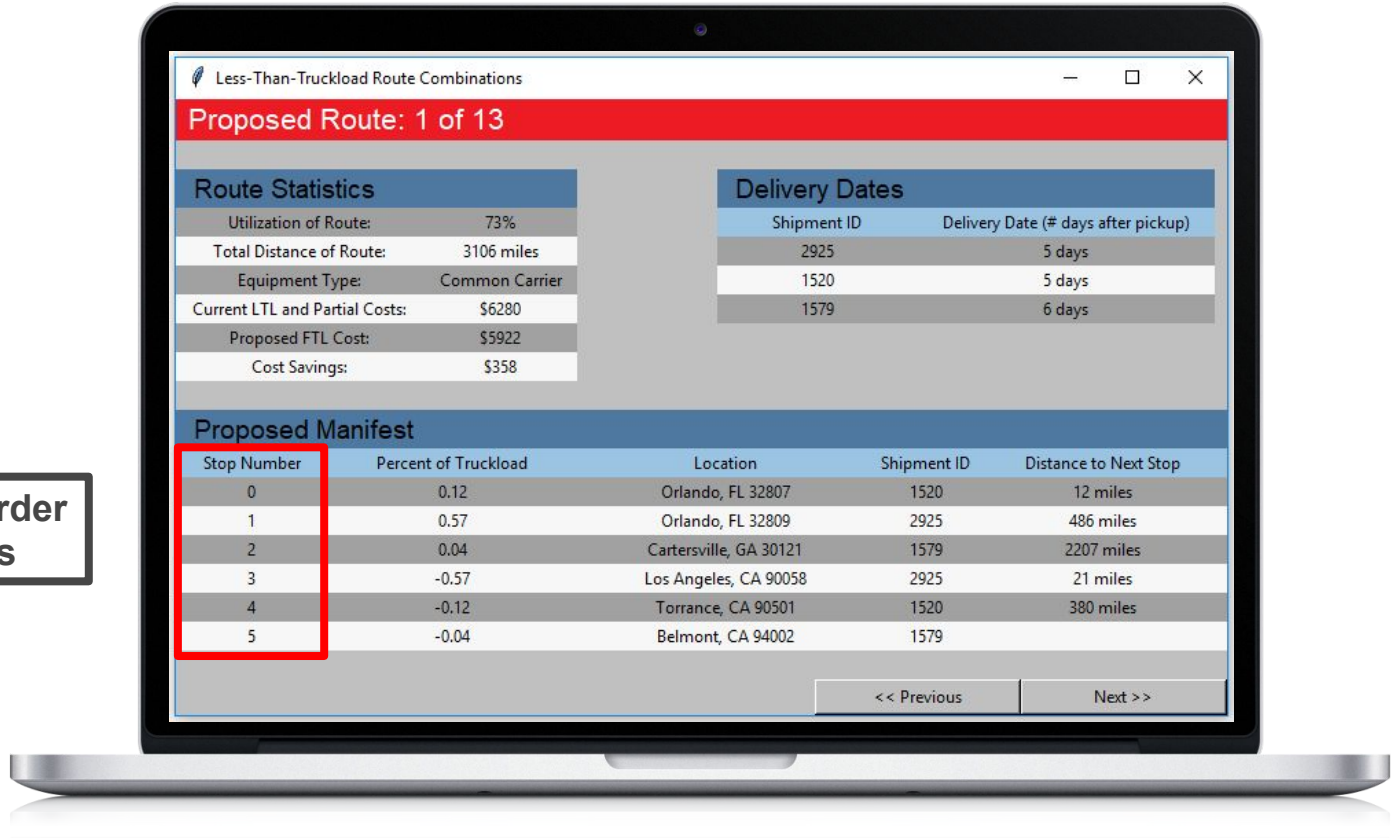
Distance Between Stops

LTL - User Interface

Required Shipping Equipment

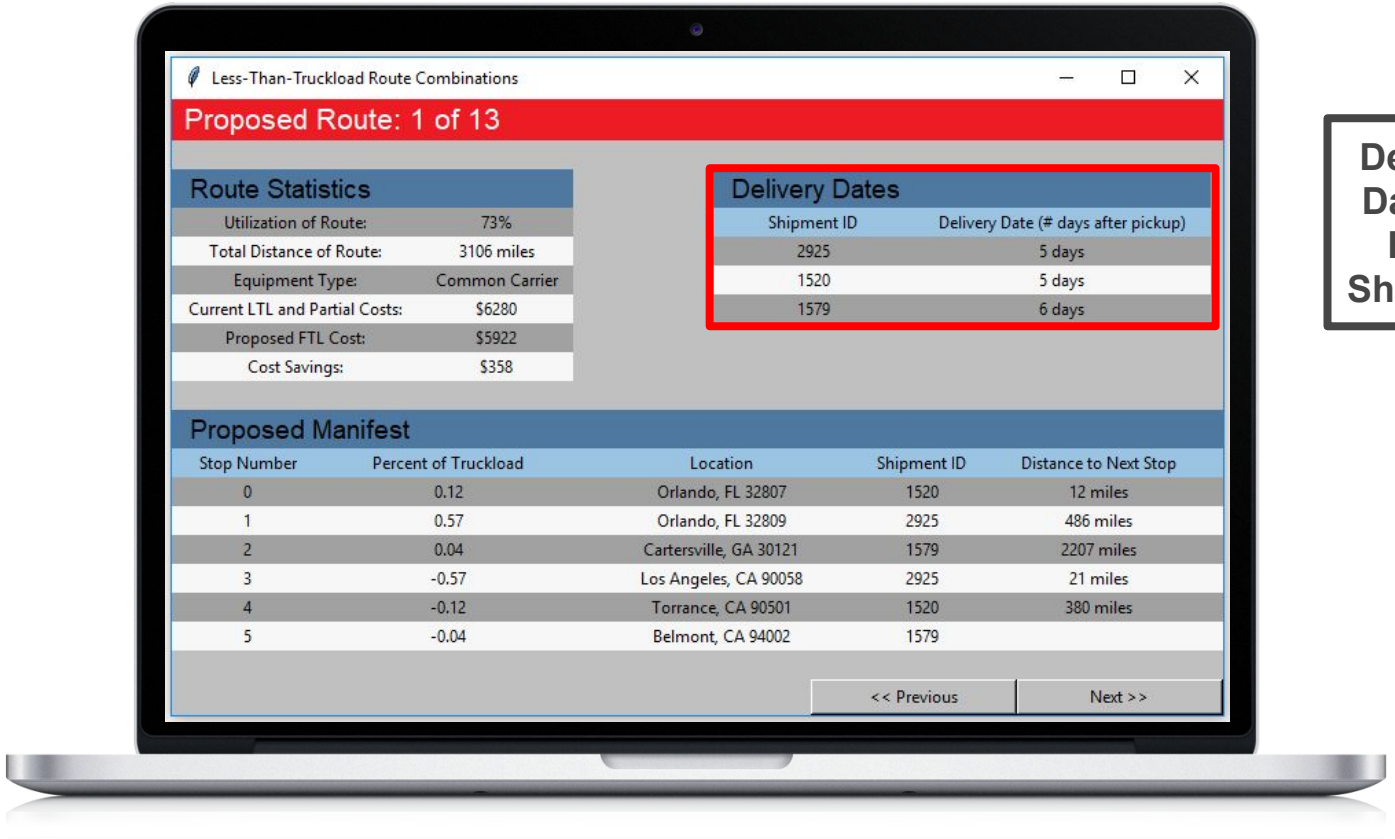


LTL - User Interface



Optimal Order of Stops

LTL - User Interface

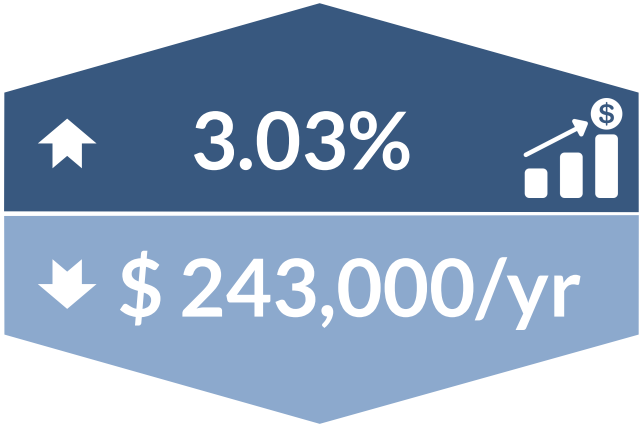


Delivery Date for Each Shipment

LTL - Valuation

What is it worth now?

- Simulated over 2017-2018 data
- Cost of implementation:
  - Gurobi license = $14,000 investment
  - Negotiator = $60,000/year



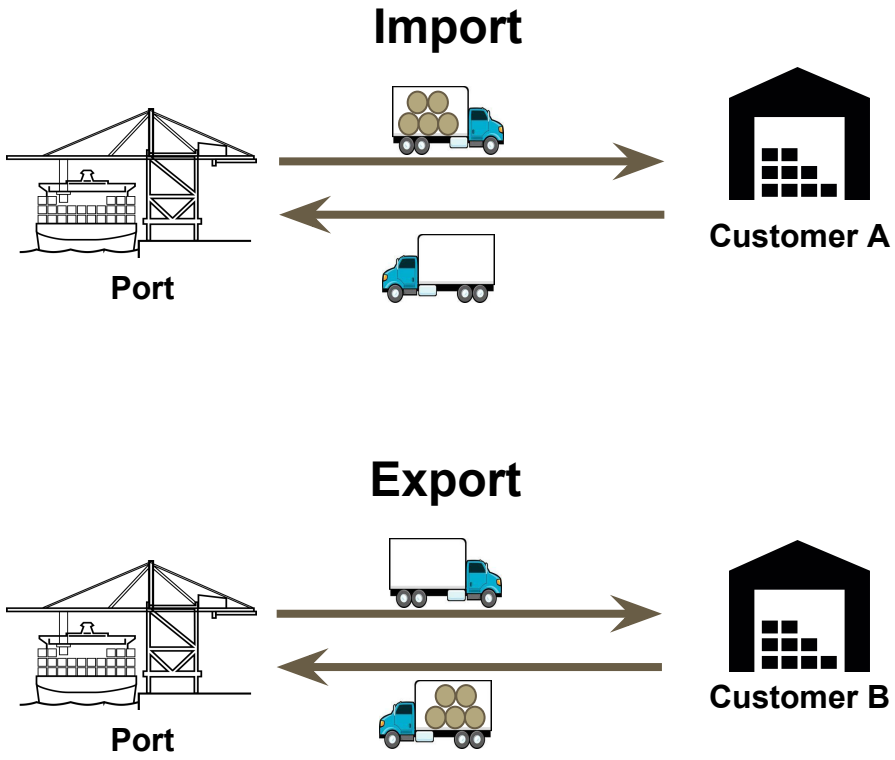
Additional Potential

- Focus on high concentration lanes
- Actively grow LTL business

Drayage

Current System:

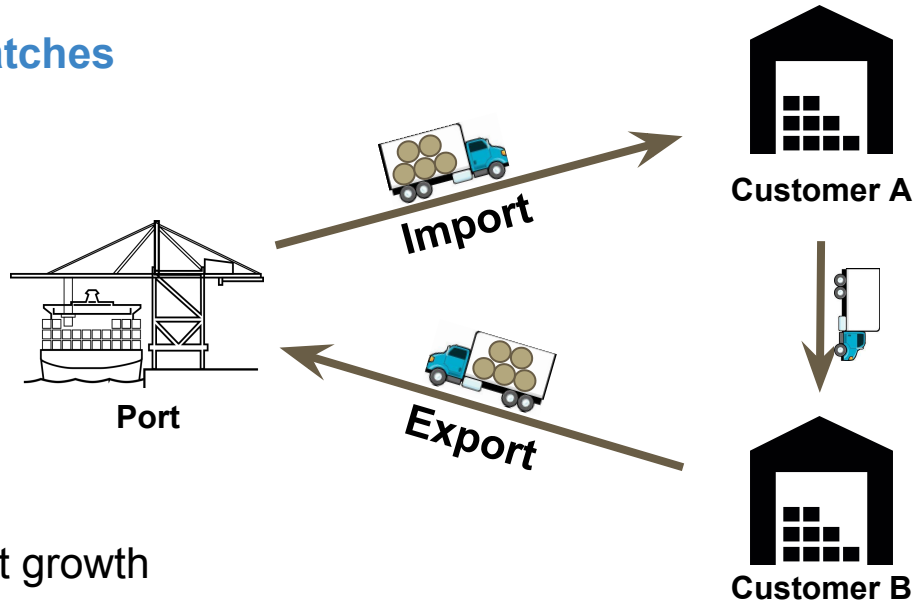
- ~3000 shipments/month
- Only 15% margin on typical trip
- Less than 5 matches/month



Drayage - Objective

Design Approach:

Systematically find Import-Export matches

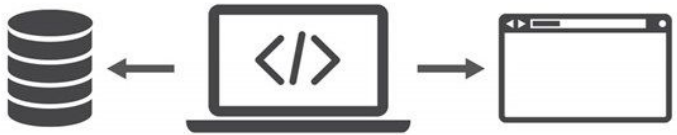


Benefits:

- Cost savings
- Reduced travel distance
- Improved infrastructure will support growth

Drayage - Methodology

Input Load	Pairing (API)	Divergence Document
Booker creates new load in Freight Hawk	API returns possible matches for pending loads	Booker finalizes merged route



Drayage - Input Load

Input Load | Pairing (API) | Divergence Document

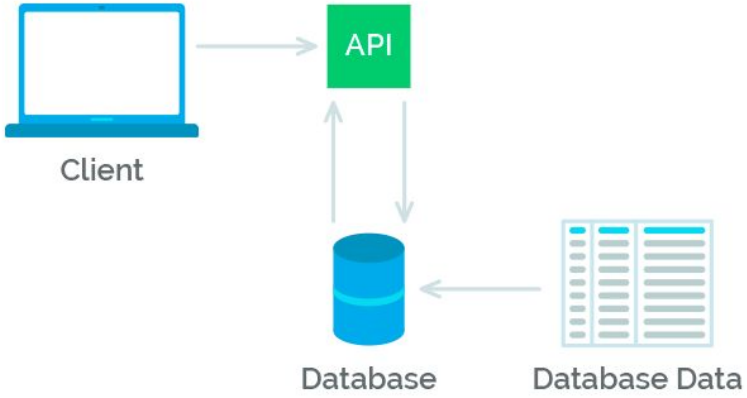
Drayage - Pairing Algorithm (API)

Input Load | Pairing (API) | Divergence Document

Overview:

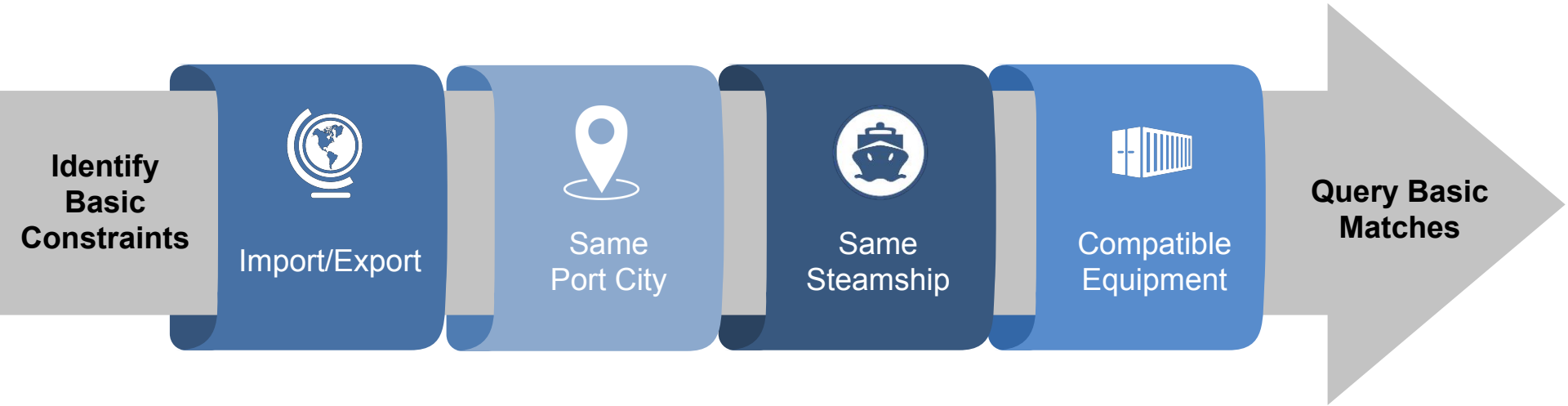
1. Pulls load details
2. Matches basic criteria
3. Filters with complex constraints
4. Sorts matches
5. Returns results

REST API Design



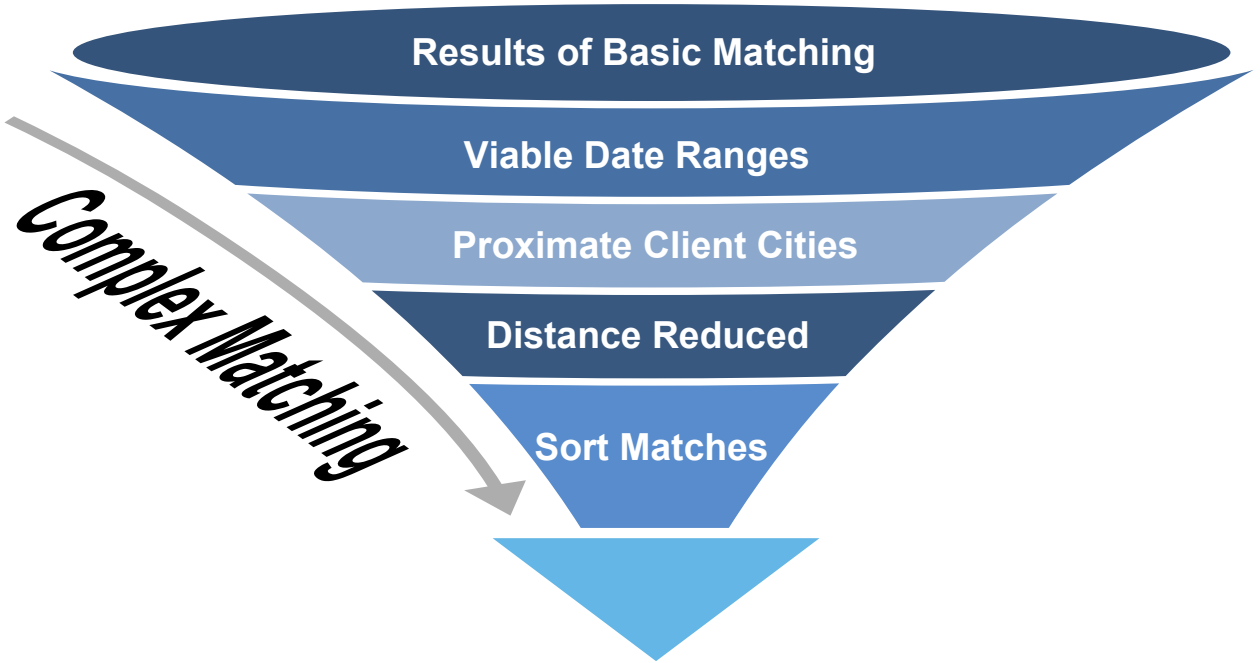
Drayage - Basic Pairing (API)

Input Load | Pairing (API) | Divergence Document



Drayage - Complex Pairing (API)

Input Load | Pairing (API) | Divergence Document



Returns Sorted Matches

Drayage - Divergence Document

Input Load | Pairing (API) | Divergence Document

Booker will then:

- Receive list of matches
- Decide on best pair
- File Divergence Document

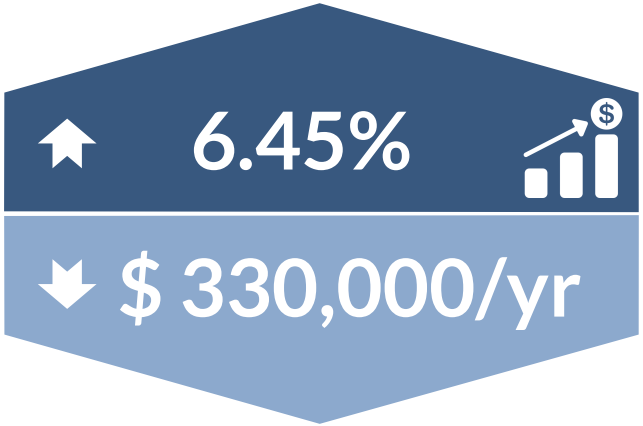
  → Legally combines Import-Export loads

Booker updates carrier with combined route

Drayage - Valuation

What is it worth now?

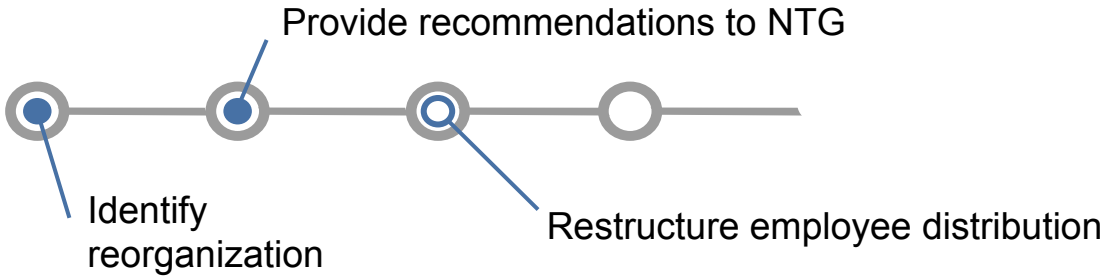
- ~55 matches/month (based on 2017-2018 data)
- ~$500 saved per match ($27,500/month)
- 6.45% Drayage profit increase

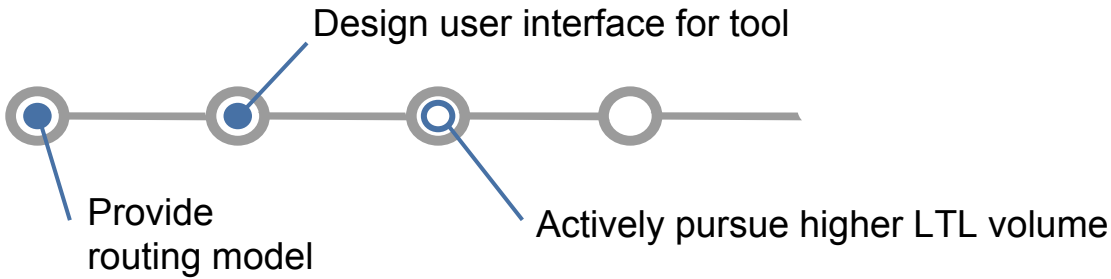


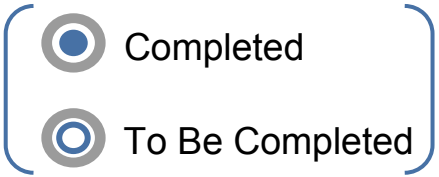
Additional Potential

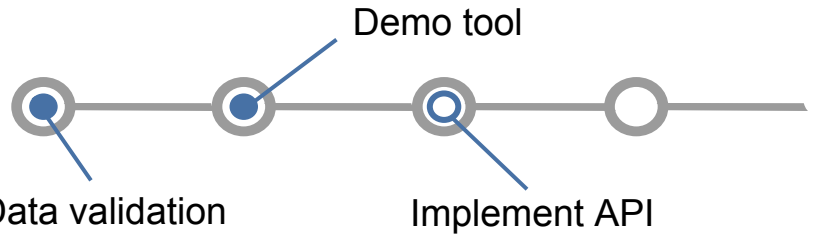
- Focus on high-matching lanes/steamship lines
- Attract more business with lowest rates

Infrastructure Implementation



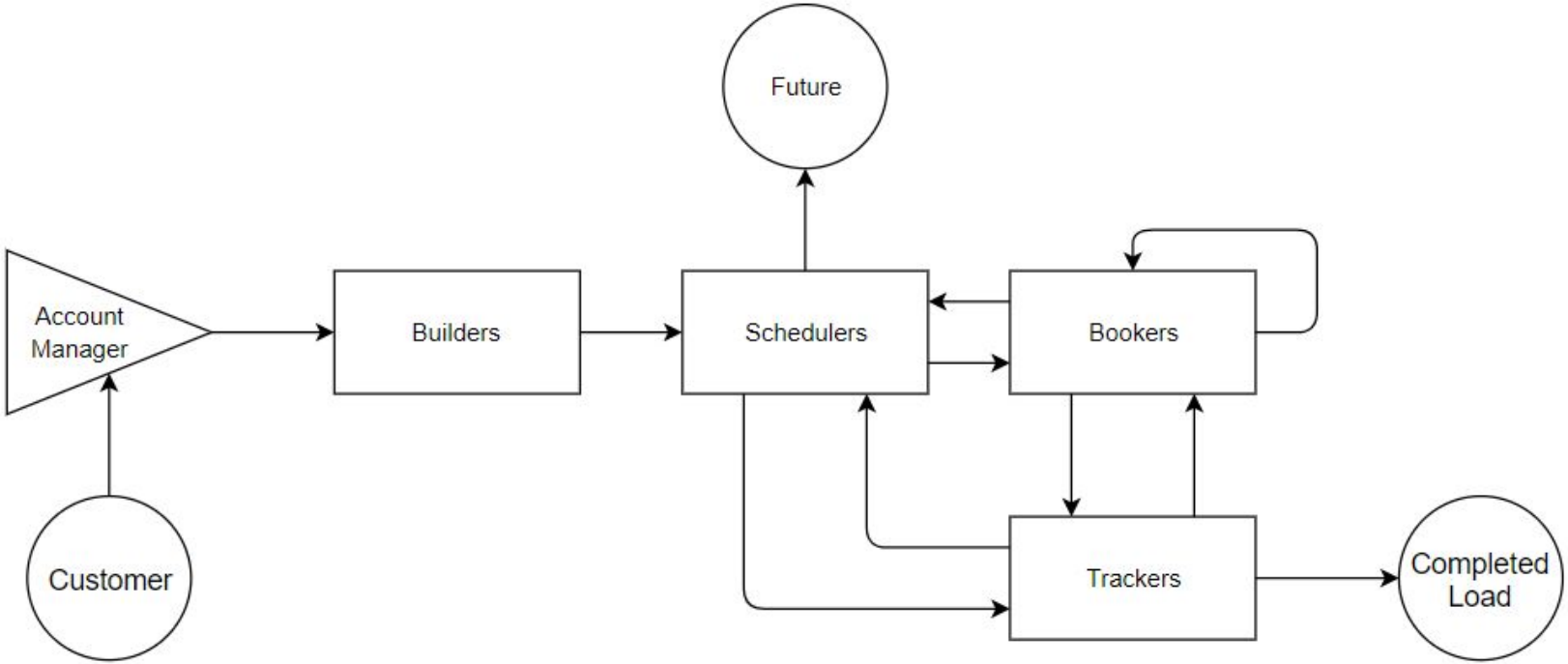




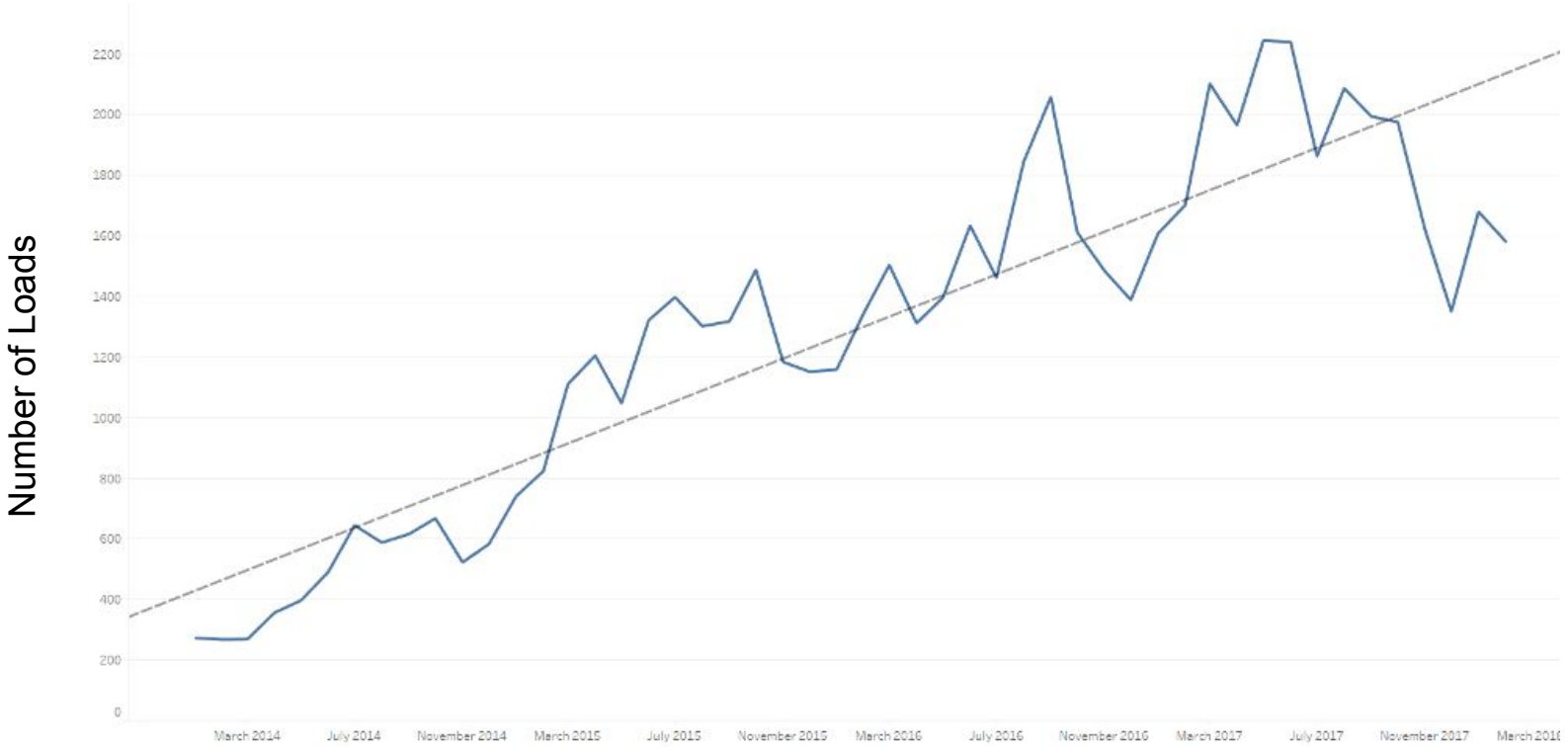



CHARGING FORWARD.
NTG DELIVERS.

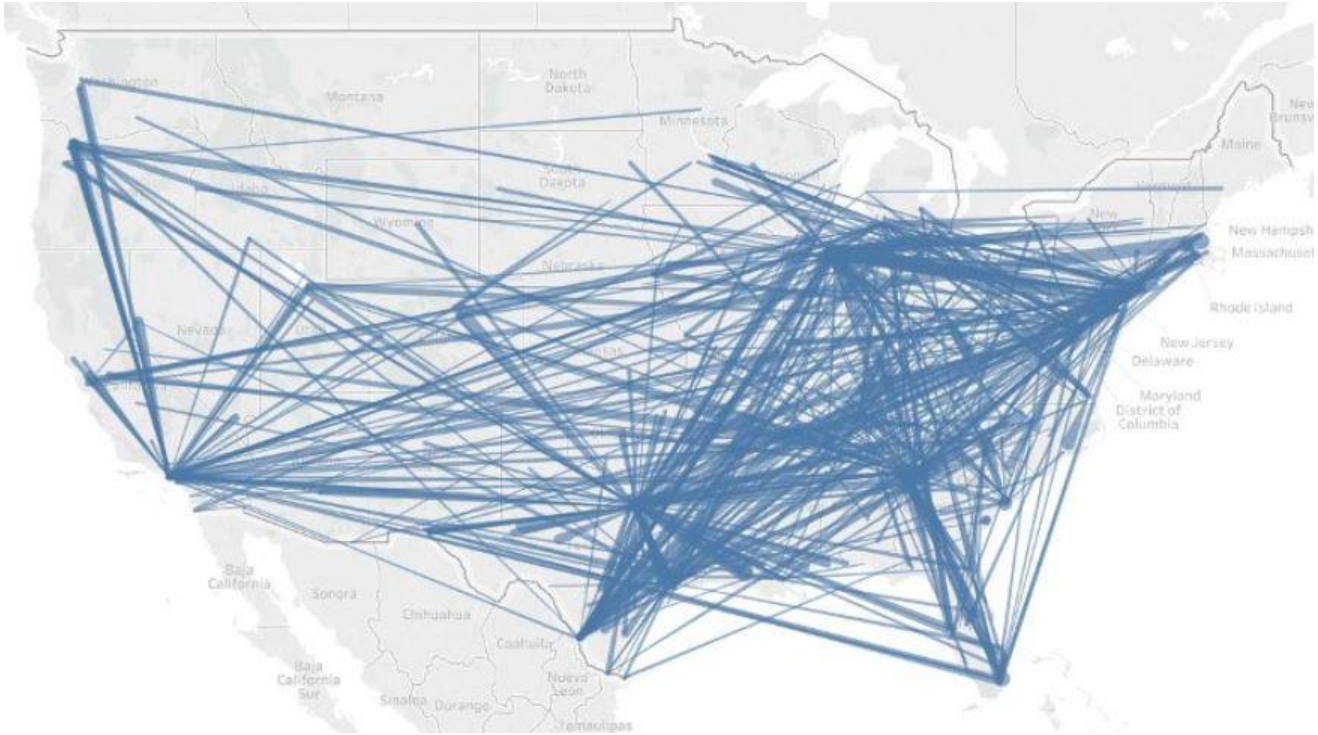
Appendix A - Atlanta Enterprise Workflow



Appendix B - LTL Growth



Appendix B - LTL Common Travel Paths



LTL travel paths with origin-destination combinations of four or more loads in 2017

Appendix B - LTL IP Formulation Part 1

Node Set Definitions:

n : number of deliveries (origin / destination pairs) satisfied in a single route

s : start node (inserted before the beginning of the route)

t : end node (inserted after the end of the route)

$V = \{1, 2, \dots, n, n+1, n+2, \dots, 2n, s, t\}$: shortest path nodes ordered such that $(i, n+i)$ is the origin / destination pair for a delivery that needs to be routed, $\forall\, i = 1, \dots, n$

$m = 2n + 2$: total number of nodes

$O = \{0, 1, \dots, m-2, m-1\}$: orders for the nodes in the route

Decision Variables:

$y_{i,j}$: 1 if the arc i to j is used in the route, 0 otherwise, $\forall\, i, j \in V$

$x_{i,k}$: 1 if node i in the route is visited in order k in the route, 0 otherwise, $\forall\, i \in V, \forall\, k \in O$

Appendix B - LTL IP Formulation Part 2

Parameter Values:

M : arbitrarily large constant (can be thought of as infinite, but must be represented as a finite number when included in programming)

$c_{i,j}$: arc cost to go from node i to node j, $\forall\, i,j = 1,\dots,2n, \quad i \neq j$

$c_{s,j} = 0$: allows any node to start the route, $\forall\, j = 1,\dots,2n$

$c_{i,t} = 0$: allows any node to end the route, $\forall\, i = 1,\dots,2n$

$c_{i,i} = M$: eliminates the possibility of going from one node to itself $\forall\, i \in V$

$c_{i,s} = M$: does not allow an arc entering the start node to be selected, $\forall\, i = 1,\dots,2n$

$c_{t,j} = M$: does not allow an arc departing the end node to be selected, $\forall\, j = 1,\dots,2n$

$c_{s,t} = M$: does not allow an arc from the start node to the end node to be selected

$c_{t,s} = M$: does not allow an arc from the end node to the start node to be selected

Q : capacity of a truck

q_i : quantity picked up at a node (negative if dropped off)

Appendix B - LTL IP Formulation Part 3

Decision Variables

$$x_{i,k} = \begin{cases} 1, & \text{if node } i \text{ is visited in order } k \text{ in the route} \\ 0, & \text{otherwise} \end{cases}$$

$$y_{i,j} = \begin{cases} 1, & \text{if arc } i \text{ to } j \text{ is used in the route} \\ 0, & \text{otherwise} \end{cases}$$

Constraints

Each Node Once

$$\sum_{k \in O} x_{i,k} = 1 \qquad \forall\, i \in V$$

Each Placement Once

$$\sum_{i \in V} x_{i,k} = 1 \qquad \forall\, k \in V$$

Objective Function

Minimize Cost

$$min \sum_{i \in V} \sum_{j \in V} c_{i,j} y_{i,j}$$

Relate Ordering to Arcs

$$x_{i,k} + x_{j,k+1} - 1 \leq y_{i,j} \qquad \forall\, i,j \in V, \quad \forall\, k = 1, \ldots, m-1$$

Origin Before Corresponding Destination

$$x_{i+n,k} \leq \sum_{\ell=1}^{k-1} x_{i,\ell} \qquad \forall\, k \in O$$

Appendix B - LTL IP Formulation Part 4

Constraints

Capacity

$$\sum_{\ell=1}^{k} \sum_{i \in V} q_i x_{i,\ell} \leq Q \qquad \forall\, k \in O$$

Start Node First

$$\sum_{j \in V} y_{s,j} = 1$$

$$x_{s,0} = 1$$

End Node First

$$\sum_{i \in V} y_{i,t} = 1$$

$$x_{t,m-1} = 1$$

Binary Variables

$$x_{i,k} \in \{0,1\} \qquad \forall\, i \in V, \quad \forall\, k \in O$$

$$y_{i,j} \in \{0,1\} \qquad \forall\, i,j \in V$$

Appendix B - LTL Value Calculation

	Revenue 2017	Cost 2017	Profit 2017	Margin
Actual	$10 million	$8.03 million	$1.97 million	19.7%
LTL Routing	$10 million	$7.72 million	$2.28 million	22.8%

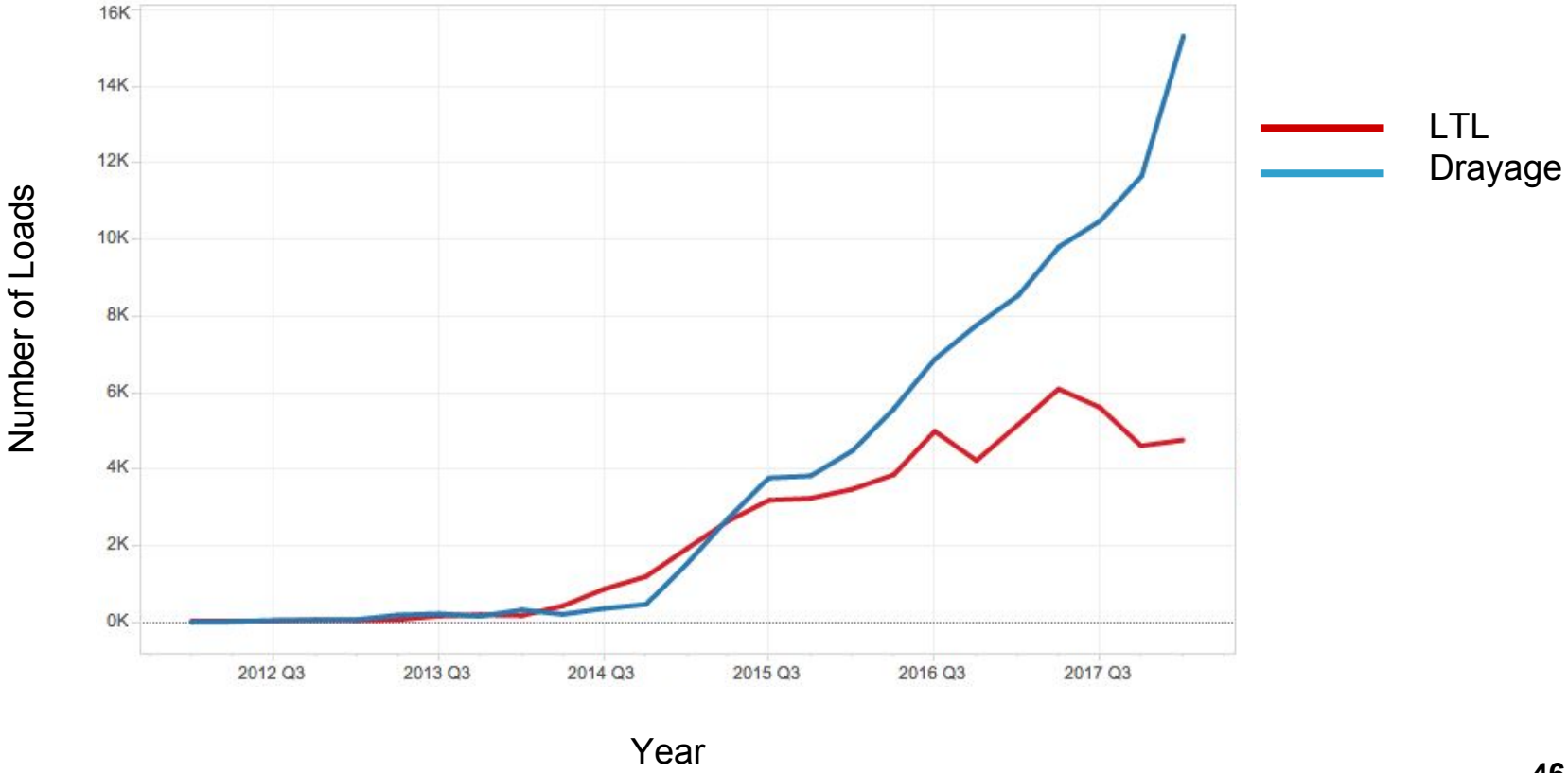
Profit Margin Increase = 22.8% - 19.7% = **3.03%**

Yearly Monetary Value = $2.28 million - $1.97 million = $303,000

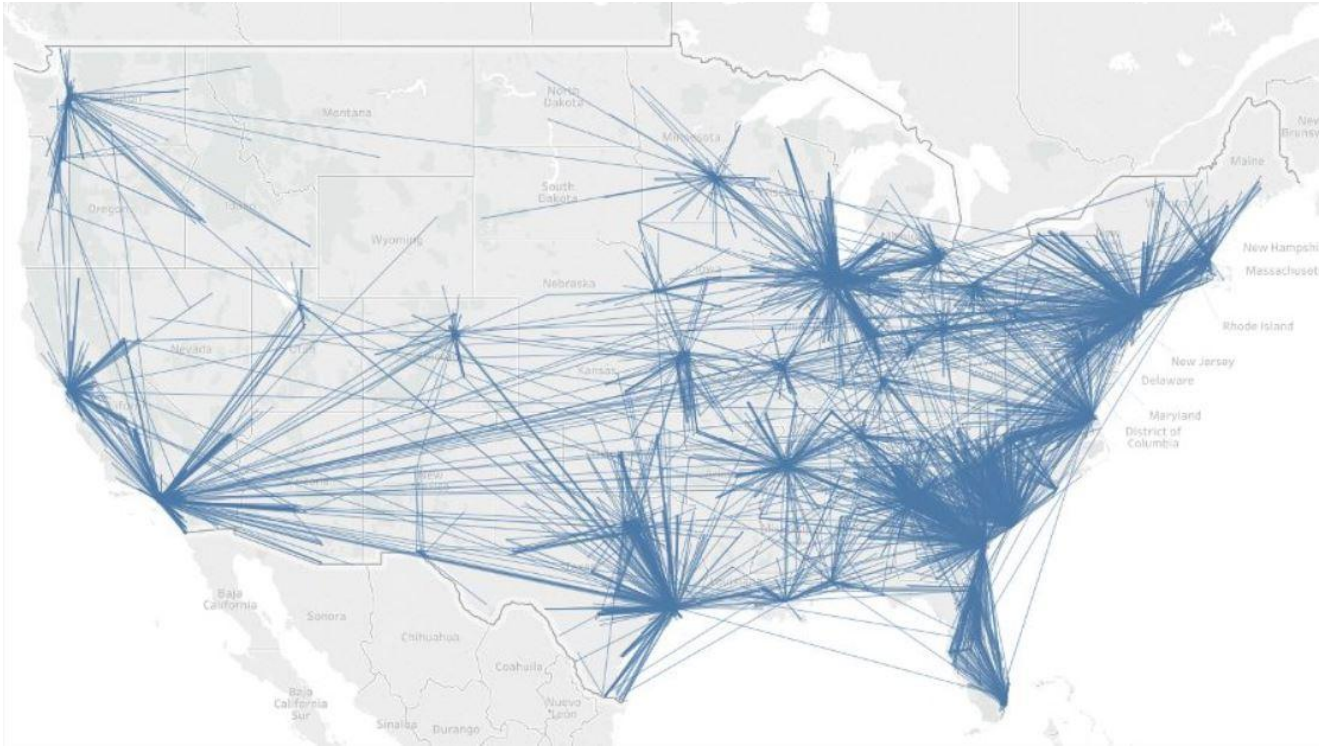
Net Yearly Value = $303,000 - $60,000 = **$243,000**

NTG

Appendix C - Drayage/LTL Growth

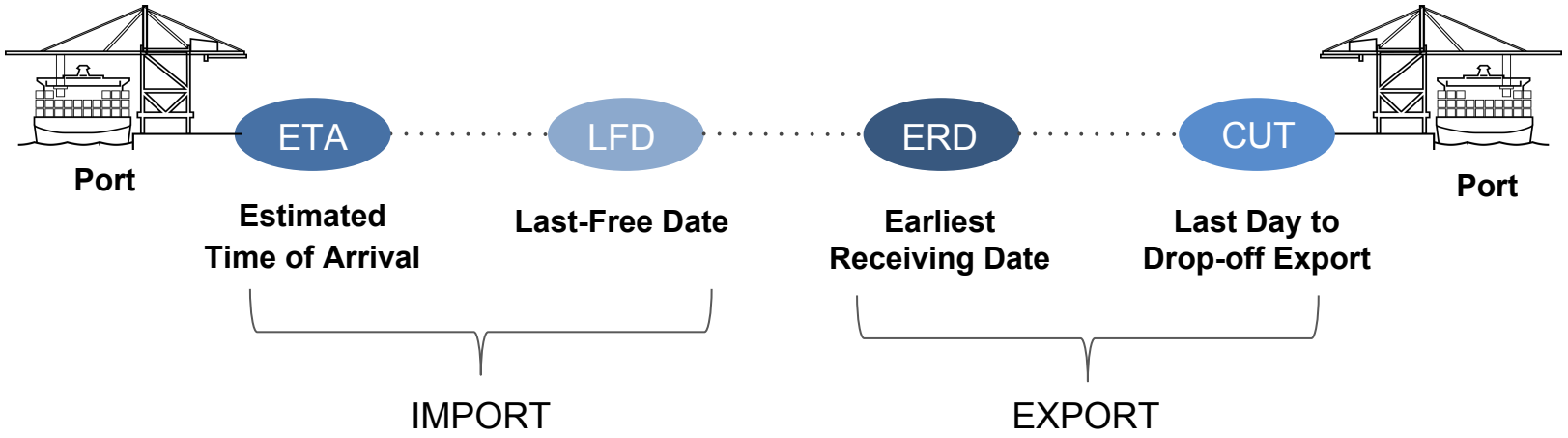


Appendix D - Drayage Travel Paths



Travel paths of drayage shipments in 2017

Appendix D - Drayage Dates



ETA must be before CUT
LFD <= 2 days from ERD