Domestic Inbound Freight Optimization

FINAL PRESENTATION

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Project Description

• ~200 suppliers
• ~30 shipments/day
Direct vs. Consolidated

Direct Route

Consolidated Route

Overview
Route Generation
Route Reduction
Optimization
Project Value
Overview

Problem

Domestic inbound freight costs:
• Infrequent change of transportation mode
• Routes manually consolidated

Deliverables

Open source tool:
• Assign transportation modes
• Consolidate shipment routes

Value Added

• Average transportation cost savings of 11.3% per week
## Order Information

<table>
<thead>
<tr>
<th>Supplier ID</th>
<th>Zip Code</th>
<th>Weight (lbs)</th>
<th>Floor Spots</th>
<th>Cube (m³)</th>
<th>Delivery Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>55358</td>
<td>29000</td>
<td>16</td>
<td>85</td>
<td>12/3/2012</td>
</tr>
<tr>
<td>B</td>
<td>53038</td>
<td>15000</td>
<td>14</td>
<td>35</td>
<td>12/3/2012</td>
</tr>
<tr>
<td>C</td>
<td>54842</td>
<td>2500</td>
<td>4</td>
<td>15</td>
<td>12/4/2012</td>
</tr>
<tr>
<td>D</td>
<td>47130</td>
<td>12000</td>
<td>20</td>
<td>70</td>
<td>12/4/2012</td>
</tr>
<tr>
<td>E</td>
<td>54150</td>
<td>30000</td>
<td>13</td>
<td>75</td>
<td>12/6/2012</td>
</tr>
</tbody>
</table>
Methodology

Route Generation

Route Reduction

Optimization Model
### Route Consolidation

#### Floor spots usage in week

<table>
<thead>
<tr>
<th>Supplier ID</th>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>10</td>
<td>15</td>
<td>5</td>
<td>12</td>
<td>17</td>
</tr>
<tr>
<td>B</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>C</td>
<td>9</td>
<td>9</td>
<td>10</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>D</td>
<td>20</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>E</td>
<td>10</td>
<td>10</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>F</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>15</td>
</tr>
</tbody>
</table>

- **Consolidation across days**
- **Consolidation across suppliers**
- **Consolidation across days and suppliers**
Group Selection
Capacity Constraints

40,000 lbs
Max Capacity

Weight

13 x 2 Floor Spots

48" x 48" = 1 Floor Spot

Volume
Cost Calculation

**Less-than Truckload**
- Estimates from 3PL
- Inputs:
  - Origin zip code
  - Destination zip code
  - Weight
  - Date of shipment

**Truckload**
- Road distance based on zip codes
- Mileage rates for regions
- $75 stoppage fee
- Average national fuel cost
Optimization Model

**Input**
- Set of routes
- Cost of each route

**Optimization**
\[
\begin{align*}
\min & \sum_{i=1}^{n} C_i \cdot X_i \\
\text{s.t.} & \sum_{i \in I_s} X_i = 1 \quad \forall S \\
& X_i \text{ is binary}
\end{align*}
\]

- \( S = \text{Subset of all suppliers} \)
- \( I_s = \text{Subset of all routes that pass through supplier } S \)

**Output**
- Optimized total transportation cost
- Optimal routes
# Incompatible Routes

<table>
<thead>
<tr>
<th>Supplier ID</th>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>B</td>
<td>4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Overview | Route Generation | Route Reduction | Optimization | Project Value

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**Steps for Incompatible Routes:**

1. **Monday:**
   - Supplier A
   - Route: 1

2. **Tuesday:**
   - Supplier B
   - Route: 2

3. **Wednesday:**
   - Supplier A
   - Route: 3

**Note:**
- Incompatible routes are highlighted with different colors.
- The routes are optimized to minimize conflicts.
Optimization Process

Inputs → Optimization

Are all routes compatible?

Yes → Model Solved

No → Generate constraints dynamically
Example

Overview
Route Generation
Route Reduction
Optimization
Project Value

: TL
: LTL
Value Added

Week 1: $13,916
Week 2: $30,339
Week 3: $2,152

KMA Cost
Optimized Cost
Deliverables

Excel Macro

Route Generation Program

Overview
Route Generation
Route Reduction
Optimization
Project Value
Summary

Objective
- Reducing domestic inbound freight cost

Methodology
- Route Generation
- Route Reduction
- Optimization model

Deliverables
- Assign transportation modes
- Consolidate shipments

Value Added
- Average savings of 11.3% per week
Thank You

Questions?