Saia, Inc.

Determining System Trailer Fleet Size and Terminal Assignment

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OVERVIEW

Problem
Determine system trailer fleet size, mix, and terminal assignments

Approach
Developed a network-based time-expanded IP optimization model; Derived results from repeated applications over several weeks of historical data

Result
Reduced fleet size by 15%; cost savings of $1.66M / $1.8M
COMPANY BACKGROUND

Nationwide Network
• 148 terminals
• 34 hub, 114 spoke

Network Movement
• Multi-terminal interaction
• Over 10,000 trailers
• 16 trailer types
• Multiple acquisitions
SAIA’S OPERATIONS

Trailer type preferences

**Linehaul**: Logistics and standard pups (28’)

**P&D**: Logistics, standard, and liftgate vans (48’ & 53’)

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<th>Design Strategy</th>
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PROBLEM DETAILS

Determine system trailer fleet size, mix, and terminal assignments

Challenges
- Many interchangeable trailer types
- Unpredictable trailer availability

Opportunities
- Trailers can be used for both linehaul and P&D
- Increase in reallocations leads to smaller fleet
NETWORK MODEL

Model Strategy

One minimum cost network flow problem per trailer type

Known information

Fleet size by type

Assignment to terminal

Type for each linehaul movement

Minimize cost of empty movements to cover all loaded movements

Introduction Design Strategy Application Results Valuation
NETWORK MODEL (cont.)

Model Strategy

- One integer program per trailer type

Known information

- Fleet size by type
- Assignment to terminal
- Type for each linehaul movement

Minimizes fleet depreciation cost
NETWORK MODEL (cont.)

Model Strategy

One joint, multi-commodity integer program

Known information

- Fleet size by type
- Assignment to terminal
- Type for each linehaul movement

Makes linehaul trailer type choices
MODEL SIMPLIFICATIONS

Model:
750 million variables

8 million variables

6 million variables

3.4 million variables

Empty trailer reallocation periods
Reality: Between any times
Model: Once a day

Empty trailer reallocation distance limit
Reality: Between any terminals
Model: Terminal distances < 550 miles

Number of trailer types
Reality: 16 types
Model: 9 groups
1. Input historical data into model
2. Determine partial lane selections
3. Re-input historical data with lane selections set
4. Calculate final fleet size
MODEL USE CASES

Zero Budget ($0)
Uses current fleet size and mix; emphasis on trailer assignments

Restricted Budget ($X)
Decides purchasing strategy and determines improved fleet size and assignments

Unrestricted Budget
Provides ideal fleet size, mix and assignments to terminals
RESULTS: FLEET SIZE

- **Current Fleet**: 2,347 x 48’ vans
- **Zero Budget**: 1,294 x 48’ vans
- **Unrestricted Budget**: 1,298 x 48’ vans
OPPORTUNITY ANALYSIS

Dual Usage

- Vans for linehaul
- Pups for P&D

Empty Trailer Reallocation

- Current System
- Model

Introduction Design Strategy Application Results Valuation
## VALUATION

<table>
<thead>
<tr>
<th></th>
<th>Current fleet</th>
<th>Zero budget</th>
<th>Unrestricted budget</th>
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</thead>
<tbody>
<tr>
<td>Number of trailers</td>
<td>11,605</td>
<td>8,485</td>
<td>9,287</td>
</tr>
<tr>
<td>Weekly depreciation</td>
<td>$330 K</td>
<td>$247 K</td>
<td>$266 K</td>
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<tr>
<td>Annual depreciation</td>
<td>$17.16 M</td>
<td>$12.84 M</td>
<td>$13.83 M</td>
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<tr>
<td>Savings</td>
<td>--</td>
<td>$4.32 M</td>
<td>$3.33 M</td>
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</tbody>
</table>

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<tbody>
<tr>
<td>Weekly reallocation miles</td>
<td>735 K</td>
<td>765 K</td>
<td>752 K</td>
</tr>
<tr>
<td>Annual reallocation costs</td>
<td>$66.52 M</td>
<td>$69.18 M</td>
<td>$68.05 M</td>
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<tr>
<td>Costs</td>
<td>--</td>
<td>$2.66 M</td>
<td>$1.53 M</td>
</tr>
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VALUATION (cont.)

Trailer depreciation savings

$1.66 M / $1.80 M annually

Weekly: $83 K / $64 K
Annually: $4.32 M / $3.33 M

Empty trailer reallocation costs

Weekly: ($51 K) / ($29 K)
Annually: ($2.66 M) / ($1.53 M)
SUMMARY

- Fleet size, mix, and terminal allocations
- Dual usage and empty reallocations

Approach
- Network-based time-expanded IP optimization model

Deliverables
- Prototype software with user manual
- Trailer fleet recommendations

Value added
- Reduced trailer fleet
- $1.66 M / $1.80 M savings annually