
Saia, Inc.

Determining System Trailer Fleet Size and Terminal Assignment

MAY 2, 2012

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OVERVIEW

Problem

Determine system trailer fleet size, mix, and terminal assignments

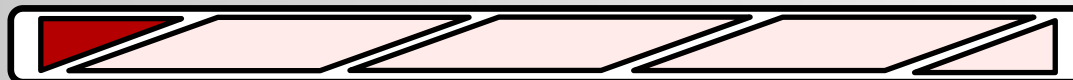
Approach

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

Introduction Design Strategy Application Results Valuation



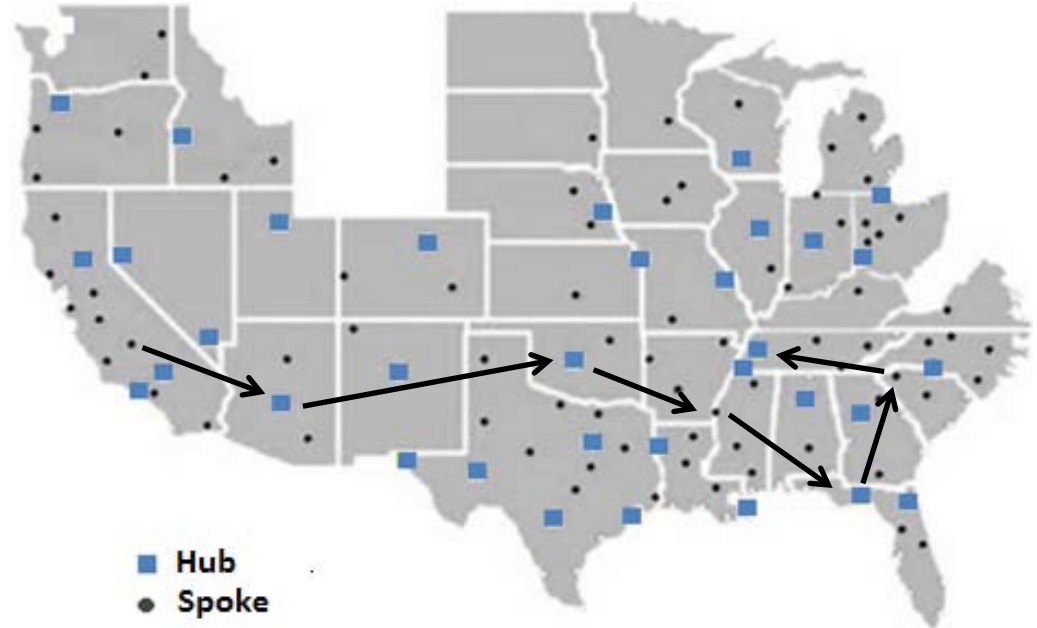
COMPANY BACKGROUND

Nationwide Network

- 148 terminals
- 34 hub, 114 spoke

Network Movement

- Multi-terminal interaction
- Over 10,000 trailers
- 16 trailer types
- Multiple acquisitions



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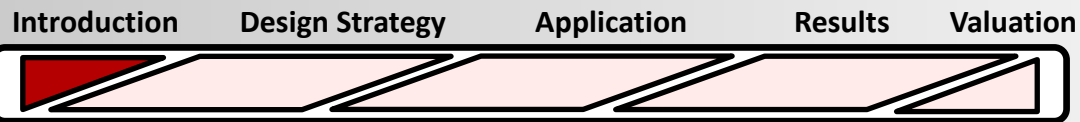
SAIA'S OPERATIONS



Trailer type preferences

Linehaul: Logistics and standard pups (28')

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



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

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NETWORK MODEL

Model Strategy

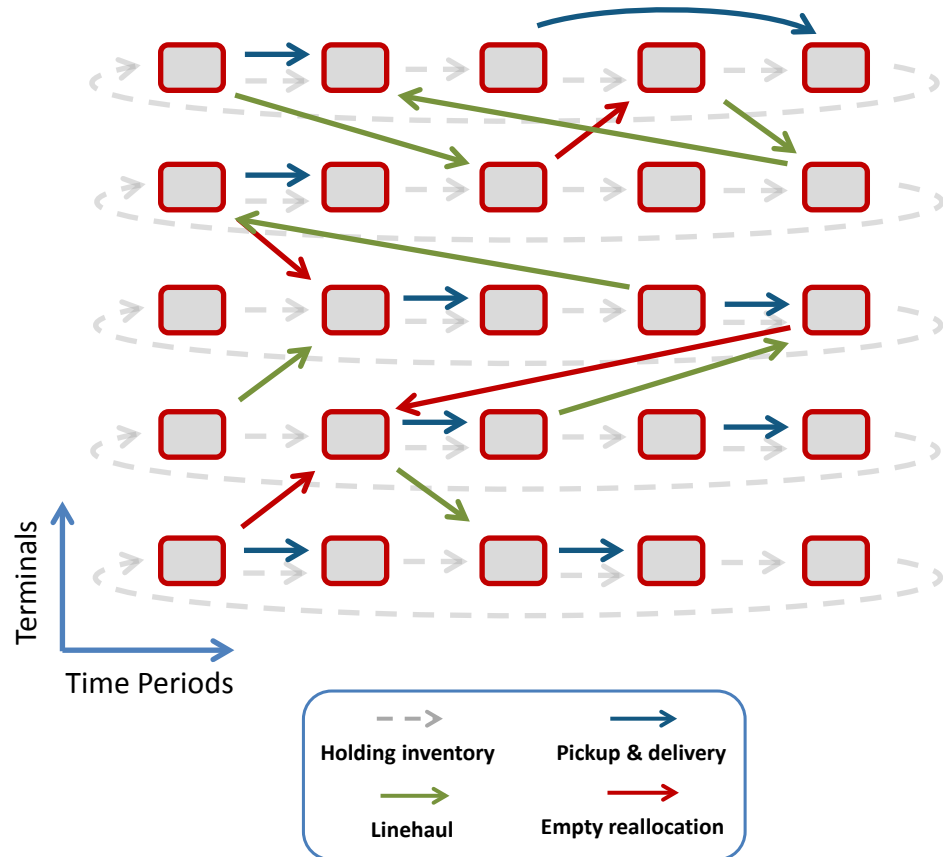
One minimum cost network flow problem per trailer type

Known information

Fleet size by type

Assignment to terminal

Type for each linehaul movement



Minimize cost of empty movements to cover all loaded movements

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NETWORK MODEL (cont.)

Model Strategy

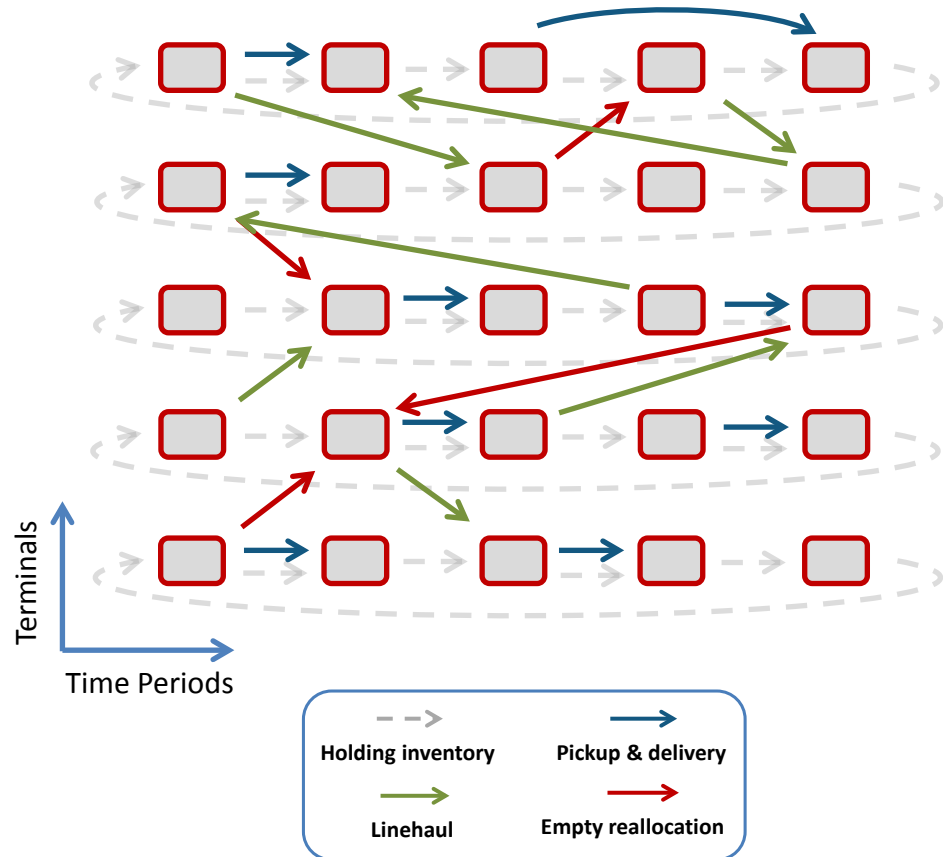
One integer program per trailer type

Known information

~~Fleet size by type~~

~~Assignment to terminal~~

Type for each linehaul movement



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NETWORK MODEL (cont.)

Model Strategy

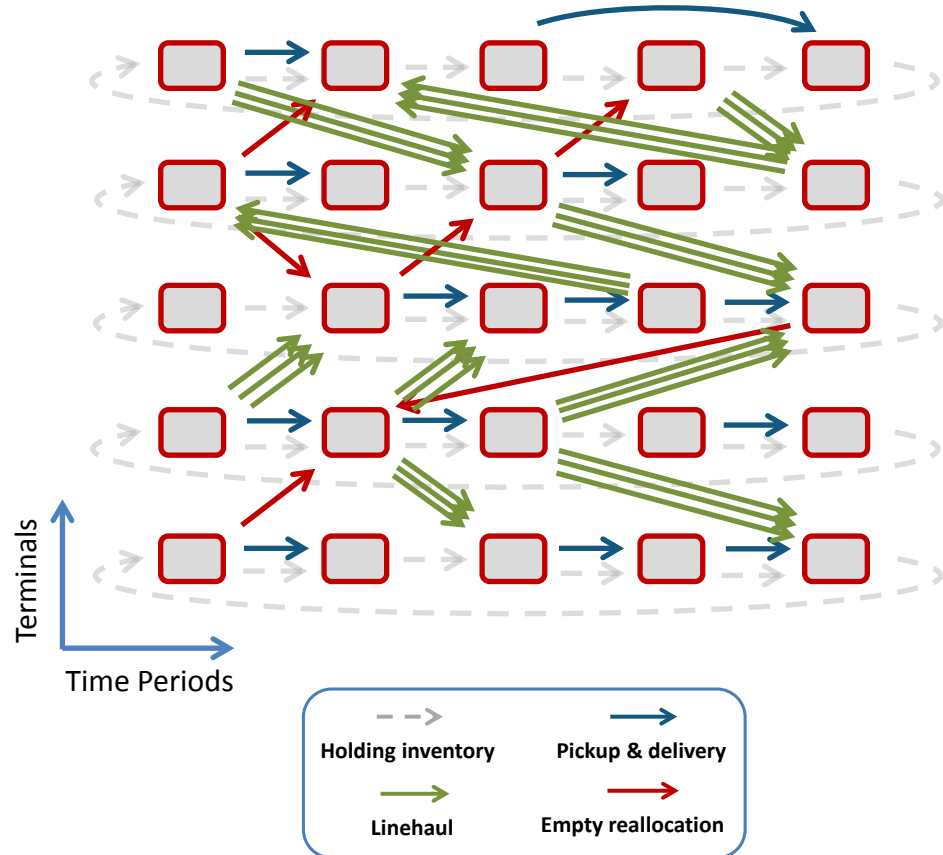
One joint, multi-commodity integer program

Known information

~~Fleet size by type~~

~~Assignment to terminal~~

~~Type for each linehaul movement~~



Makes linehaul trailer type choices

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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

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MODEL APPLICATION

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

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MODEL USE CASES

Zero Budget (\$0)

Uses current fleet size and mix; emphasis on trailer assignments

Restricted Budget (\$X)

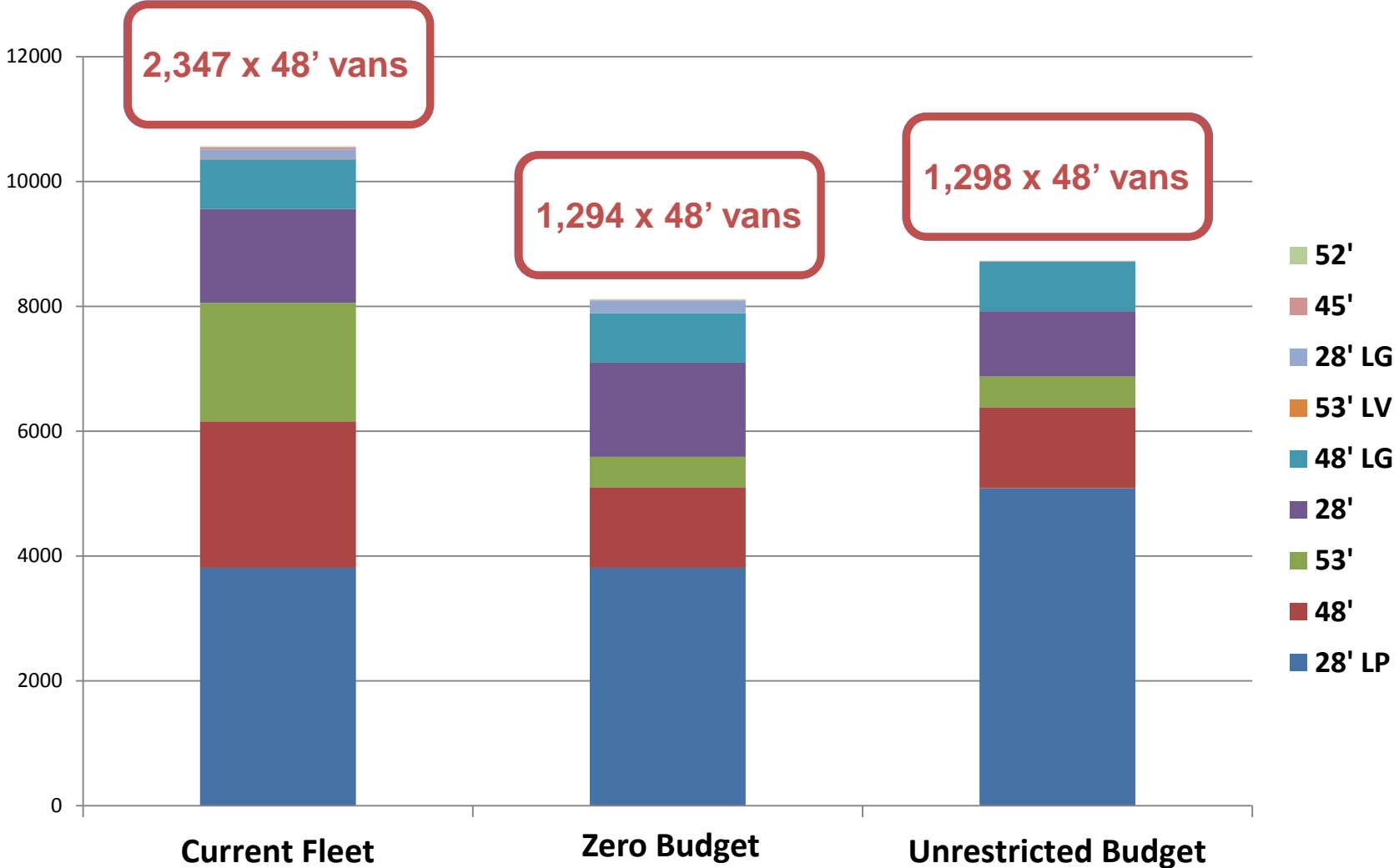
Decides purchasing strategy and determines improved fleet size and assignments

Unrestricted Budget

Provides ideal fleet size, mix and assignments to terminals



RESULTS: FLEET SIZE



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OPPORTUNITY ANALYSIS

Dual Usage

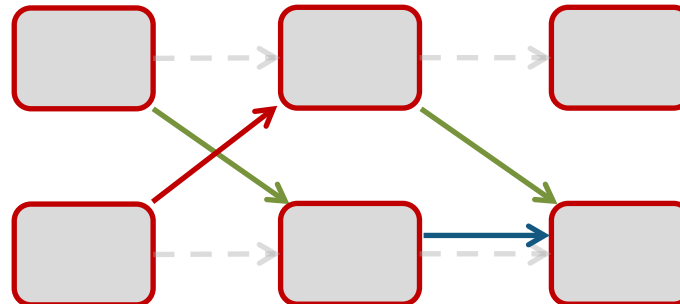
Empty Trailer Reallocation

Vans for
linehaul

Pups for
P&D

Current
System

Model



Introduction

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VALUATION

	Current fleet	Zero budget	Unrestricted budget
Number of trailers	11,605	8,485	9,287
Weekly depreciation	\$330 K	\$247 K	\$266 K
Annual depreciation	\$17.16 M	\$12.84 M	\$13.83 M
Savings	--	\$4.32 M	\$3.33 M

	Current fleet	Zero budget	Unrestricted budget
Weekly reallocation miles	735 K	765 K	752 K
Annual reallocation costs	\$66.52 M	\$69.18 M	\$68.05 M
Costs	--	\$2.66 M	\$1.53 M



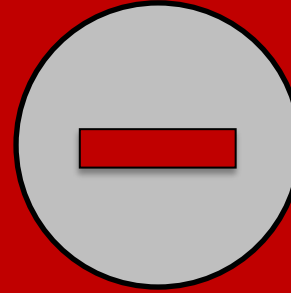
VALUATION (cont.)



**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)**

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SUMMARY

Problem

- 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