Optimization of Fueling Policy

Norfolk Southern Corporation

Finalist Presentation **– Wednesday, May 5, 2010**

David Chen
Susan Curry
Aldren Lobo
Yatong Lu
Tom Minderman
Matthew Thornton
Sheng-Bo Zhu

Dr. Shabbir Ahmed
(Advisor)

Company Background

Overall	Our Project
▪ 4th largest freight railroad ▪ $10.7 billion revenue in 2008 ▪ 22 eastern US states and D.C. served ▪ 21,000 miles of track	▪ 500 total routes ▪ 5,300 locomotives ▪ 25 stations: 32 fueling locations

Overview

Problem

- Sub-optimal Fueling Policy

Methodology

- Data Analysis
- Simulation Based Optimization Model

Solution

- Optimal Fueling Policy
- Annual Value Added - $8 million

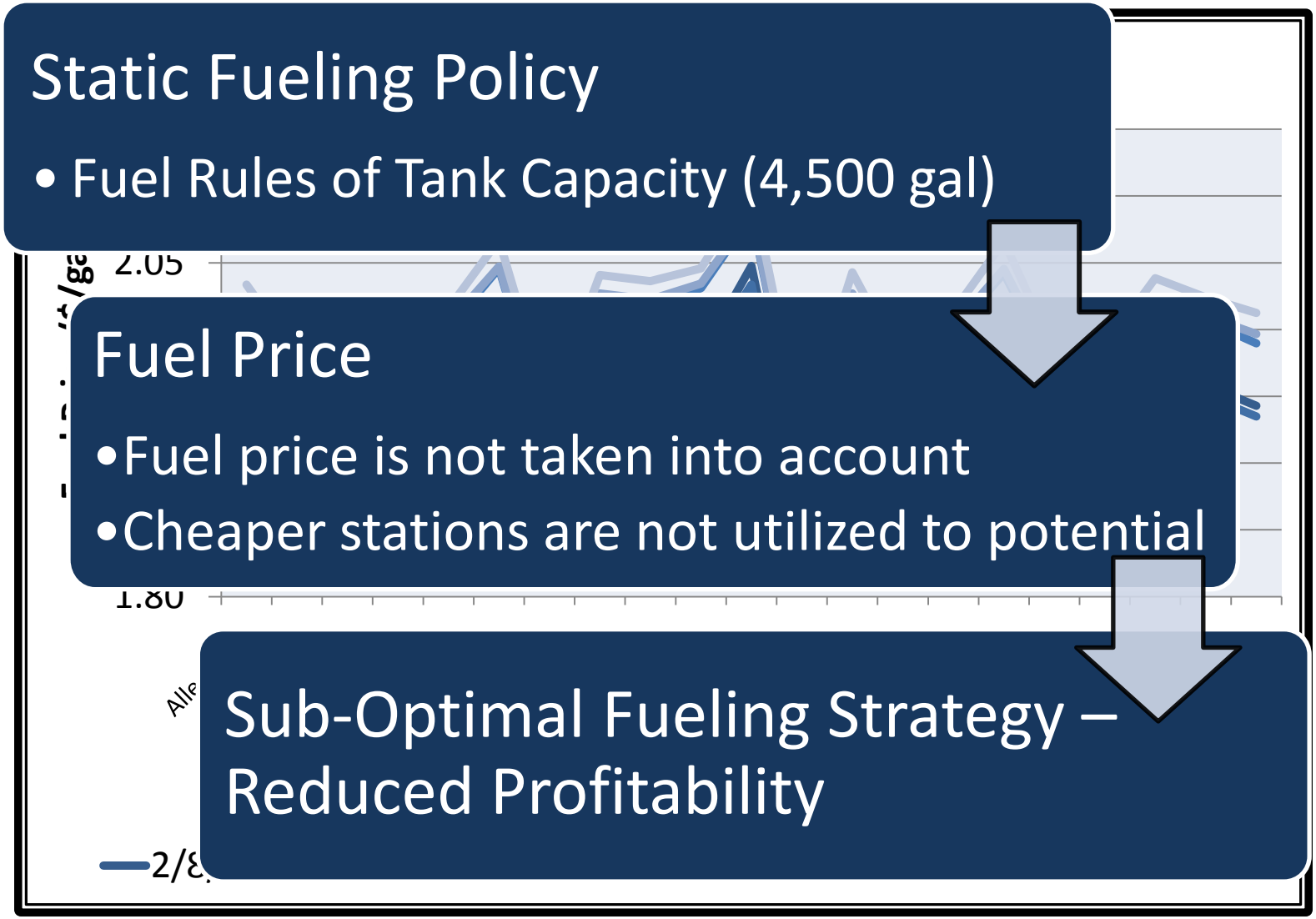
Deliverables

- Tool to Create Future Fueling Policy
- User Manual

Problem

Static Fueling Policy

- Fuel Rules of Tank Capacity (4,500 gal)

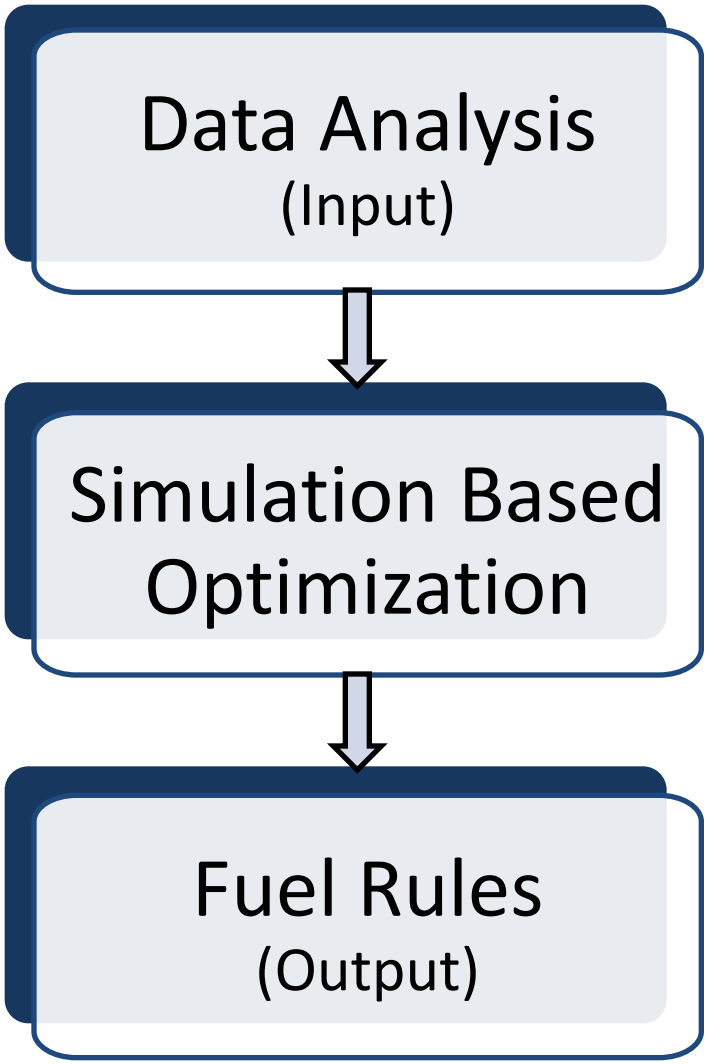


Fuel Price

- Fuel price is not taken into account
- Cheaper stations are not utilized to potential

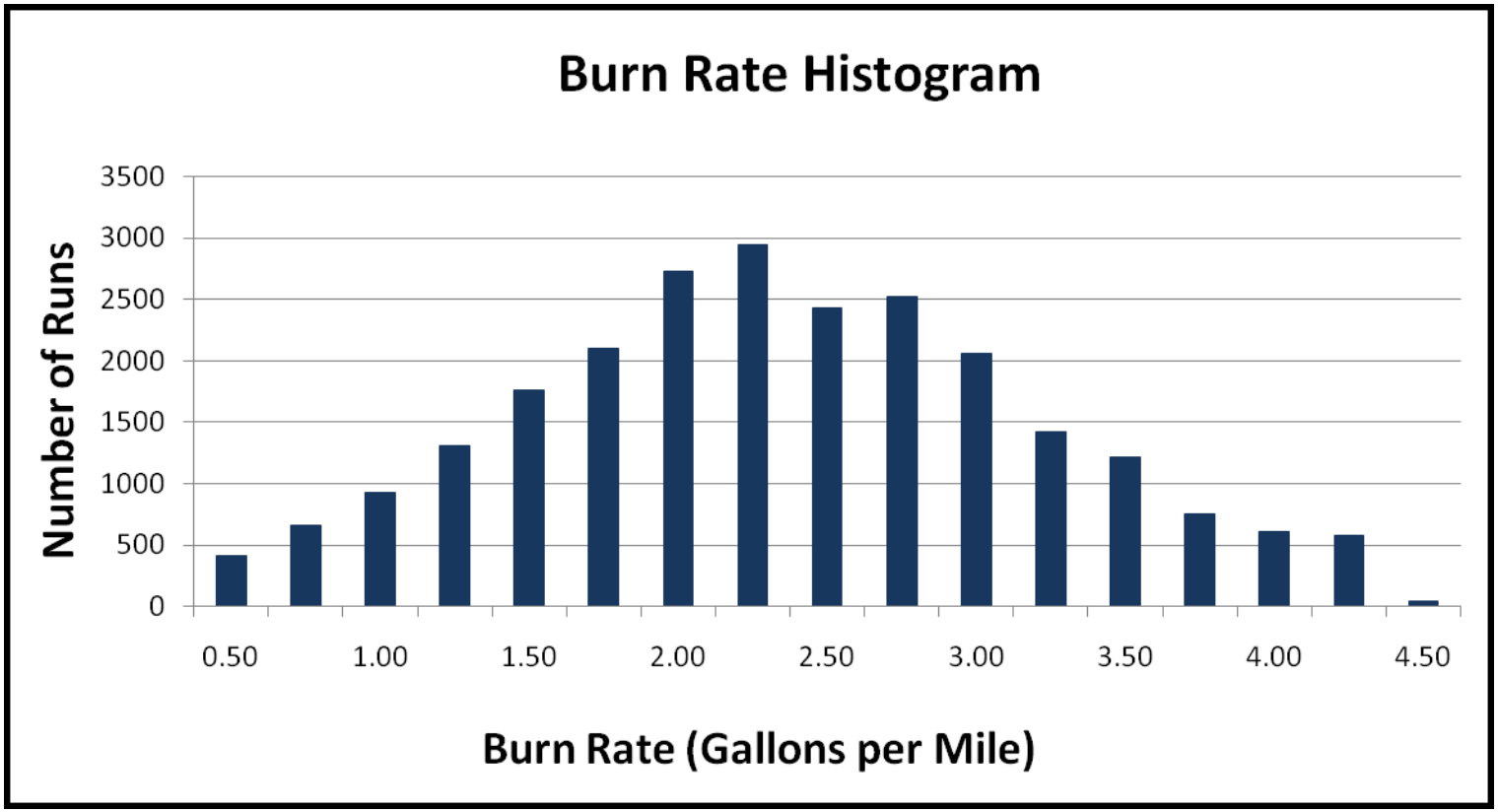
Sub-Optimal Fueling Strategy – Reduced Profitability

Methodology



- Fuel Expense
- Schedule
- Burn Rate

Methodology – Burn Rate



24,000 Runs

300-day time frame

Average = 2.47 gal/mi.

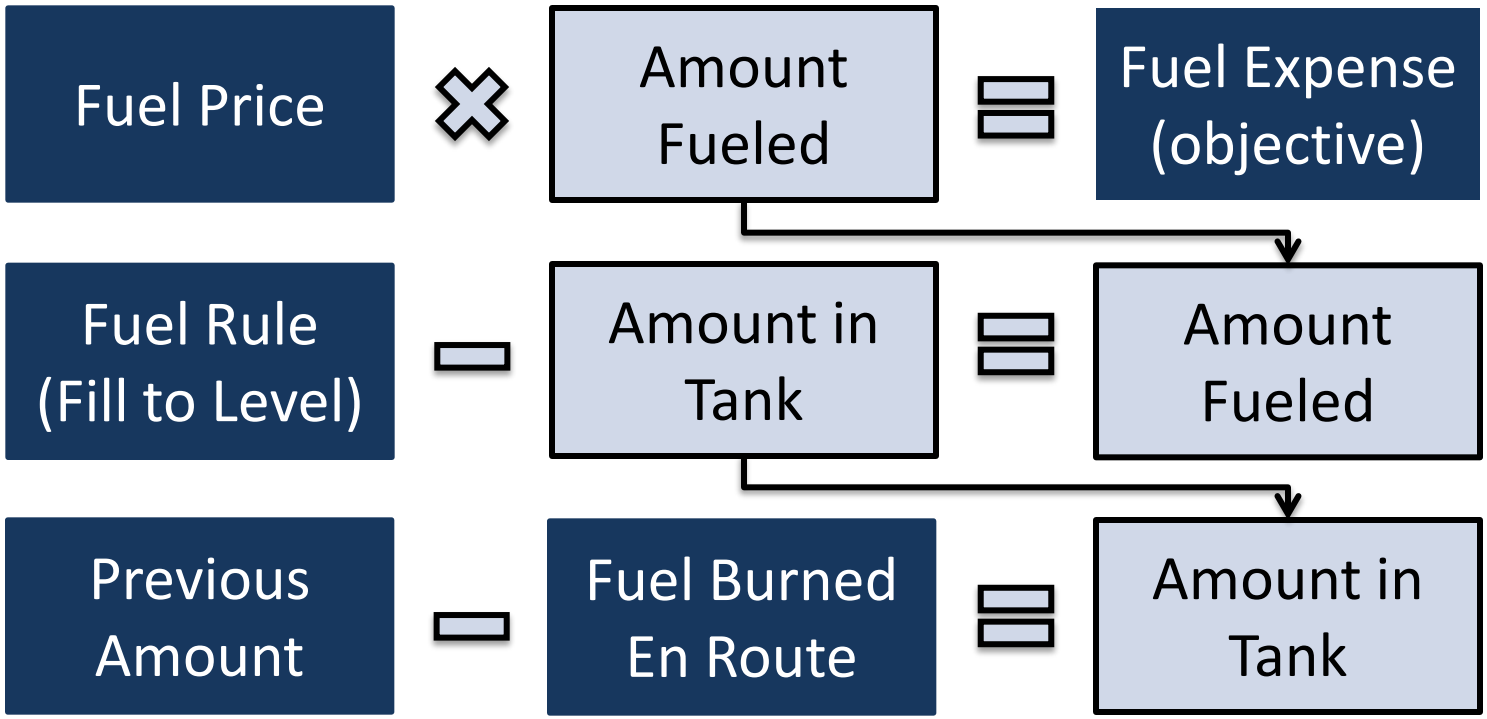
Standard deviation = 0.86 gal/mi.

Methodology – Burn Rate

Factors Affecting Burn Rate	
Element	**Significant**
Tonnage	
Train Length	
Equipment Number	
Locomotive Type	
Origin – Destination	

Methodology – Simulation/Optimization

Initial Design Strategy – Optimization Model



Methodology – Simulation/Optimization

Route Sequences

- Generate Routes by Transition Matrix

30,000 stops
3,300 sequences

Fuel Rules

- Feasible Rules
- Lower Bound

99 Trillion Fuel Rule Combinations → Heuristic Search

Expected Cost

- Run Route Sequences
- Calculate Cost and Dispense

Optimal Fuel Rules

- Choose Fuel Rule Set with Lowest Expected Total Cost

Solution

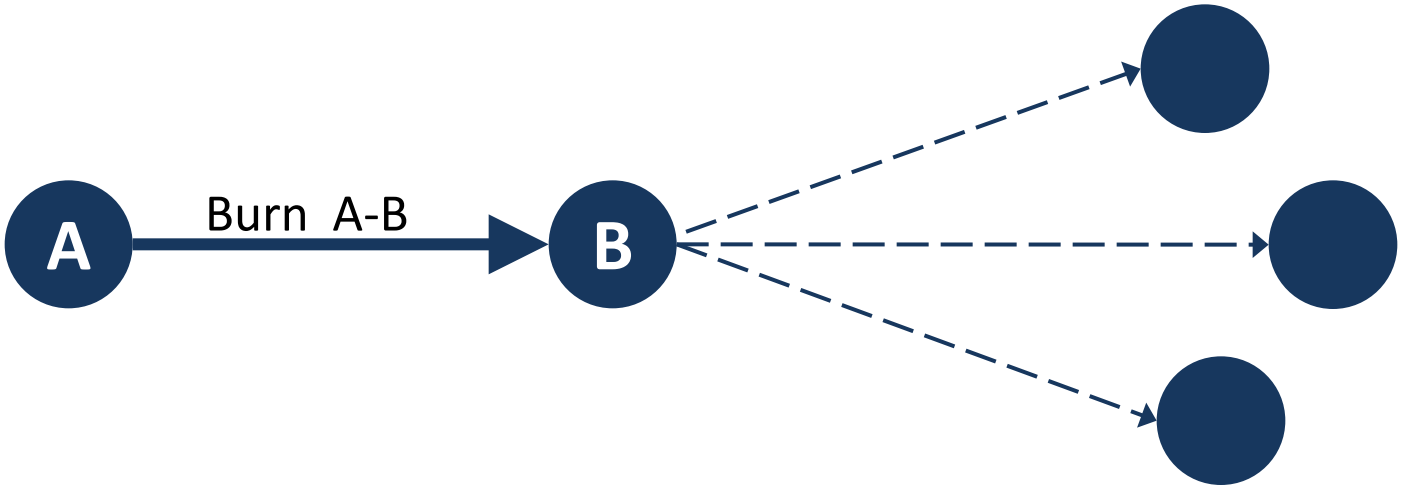
- Company Background
- Overview
- Problem
- Methodology
- Solution
- Value Added
- Deliverables
- Discussion

Value Added

Value Added	
Expected cost under current fuel rules	$ 678 M
Expected cost under recommended fuel rules	$ 670 M
Expected Annual Savings	**$ 8 M**

Value Added – Recommendation

One Station Look Ahead Policy	
$A ≥ $B	Fill Level at A = Min. Fuel to Reach B
$A < $B	Fill Level at A = Tank Capacity



Value Added – Recommendation

Value Added – One Stop Look Ahead	
Expected cost under current fuel rules	$ 678 M
Expected cost under one stop look ahead	$ 649 M
Expected Annual Savings	**$ 29 M**

Deliverables

Analysis of System	• Burn Rates
Solution	• Fuel Rules • Inventory Impact
Tool	• Create Fuel Rules in the Future
User Manual	• To Accompany Tool
Recommendation	• Dynamic Fueling Policy

Discussion

- Company Background
- Overview
- Problem
- Methodology
- Solution
- Value Added
- Deliverables
- Discussion