Applied Simulation for Rail Crossing Economics and Safety Analysis

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2014 Global Level Crossing Safety and Trespass Prevention Symposium
Agenda

• Motivation
• Simulation Tool Used: FlexTerm
• Case studies
• Conclusions
Motivation

• Developing a simulation tool to support rail crossing analysis, including:
  – Calculate rail crossing delay
  – Analyze impact to local traffic
  – Support rail crossing economics

• Applying simulation to container terminal intermodal projects
  – Compare different proposed improvement solutions
  – Mitigate safety concerns
  – Visualize complicated rail operations
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Why Simulation?

Real World System
- High Cost, Long Cycle, High Risk Impacting Existing Operation

Implemented Improvement Plan

Modeling Inputs
- Arrival Rates
- Number of equipment
- Process Times
- ...

Guiding

Modeling Outputs
- Throughput
- Utilizations
- States
- ...

Simulation Model
- Low Cost, Short Cycle, Low Risk No Impact of Existing Operation

Proposed Improvement Plan
The Tool Used: FlexTerm

- FlexTerm is a proprietary commercially available simulation tool specialized for ports, terminals, and intermodal yards
- Developed from widely-used discrete event 3D simulation software FlexSim
Why FlexTerm?

• Drag and drop 3D objects to easily create any dynamic process simulation model
• Realistic 3D visualization of complicated logistic systems
• Multiple types of statistical variation
• Perform fast pace simulation study
• Efficient statistics collection and presentation
Rail Module and Its Applications

- Rail crossing simulation
- Rail logistics simulation
- Rail crossing economics
- Rail safety analysis
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Case Study 1: Introduction

A mega-sized container terminal needs to bring longer trains to meet increased intermodal yard throughput demand. The terminal needs to consider the best expansion strategy:

• to minimize the impact on highway traffic at rail crossings
• to meet the state transportation regulations
• to select the best alternative to reduce the initial and operational costs
Scenario One
Scenario Two
Impact on Local Traffic – A Cost Model

- Indirect cost
  - Rerouting cost
  - Demurrage cost
- Direct cost

Value of time per car = Average vehicle occupancy * 50% * Average wage rate
= 1.55 * 0.5 * $22.33 = $17.31 per hour

Value of time per truck = Average vehicle occupancy * 100% * Average truck driver compensation
= 1.11 * 1 * $16.28 = $18.07 per hour

For example, a 6 lane major highway, an hour delay for 1000 vehicles will have:
Direct Cost = 900*$17.31 + 100*$18.07 = $17k
Implementation Strategy

Intermodal Management Strategy

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<th>HW1</th>
<th>HW2</th>
<th>HW3</th>
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Case Study 2: Background

- Terminal intermodal yard expansion brings upgraded working track layout and new rail crossings. Terminal need to consider the new rail crossing in order to let two trains unload simultaneously.
Case Study 2
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Conclusions

• Dynamic and statistical behavior modeled in simulation gives more accurate and confident results
• Simulation can validate rail crossing economical impact, address safety concerns, and help optimize rail yard expansion strategies
• 3D visualization from simulation can help decision-makers observe and better understand the rail system, train switching/cut/connect sequencing, and compare different alternatives
• FlexTerm is an unique tool that can provide in-depth rail system analysis
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