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Creative People, Practical Solutions.

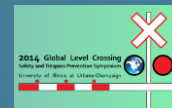
Applied Simulation for Rail Crossing Economics and Safety Analysis

Hao Zhou

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2014 Global Level Crossing
Safety and Trespass Prevention Symposium



Agenda

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

Motivation

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- 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

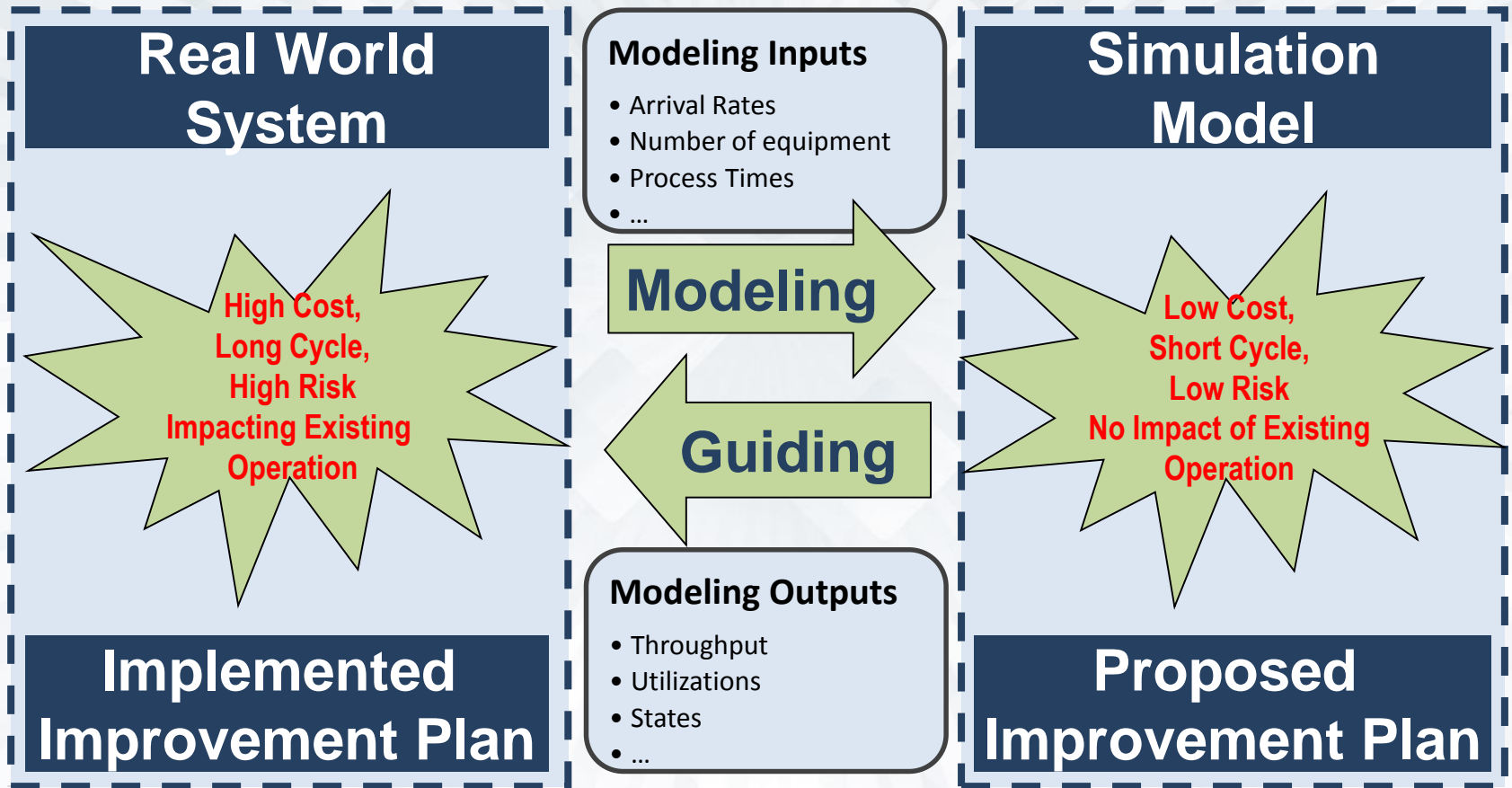
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Why Simulation?

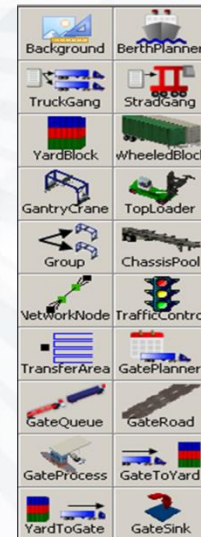
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The Tool Used: FlexTerm

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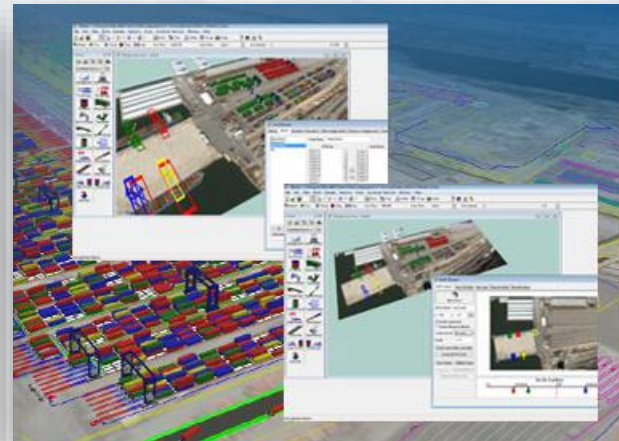
- FlexTerm is a proprietary commercially available simulation tool specialized for ports, terminals, and intermodal yards
- Developed from widely-used discrete event 3D simulation software FlexSim



Why FlexTerm?

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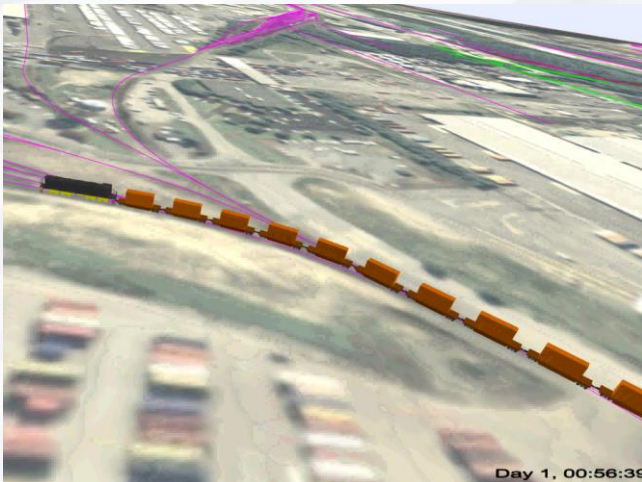
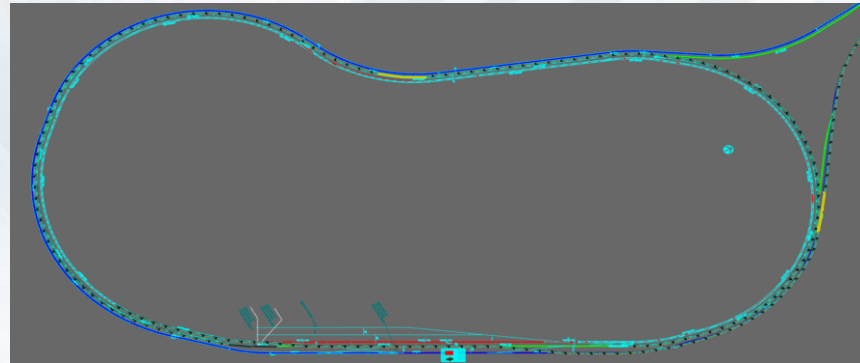
- Drag and drop 3D objects to easily create any dynamic process simulation model
- Realistic 3D visualization of complicated logistic systems
- Multiple types of statistical variation
- Perform fast pace simulation study
- Efficient statistics collection and presentation



Rail Module and Its Applications

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- Rail crossing simulation
- Rail logistics simulation
- Rail crossing economics
- Rail safety analysis



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Case Study 1: Introduction

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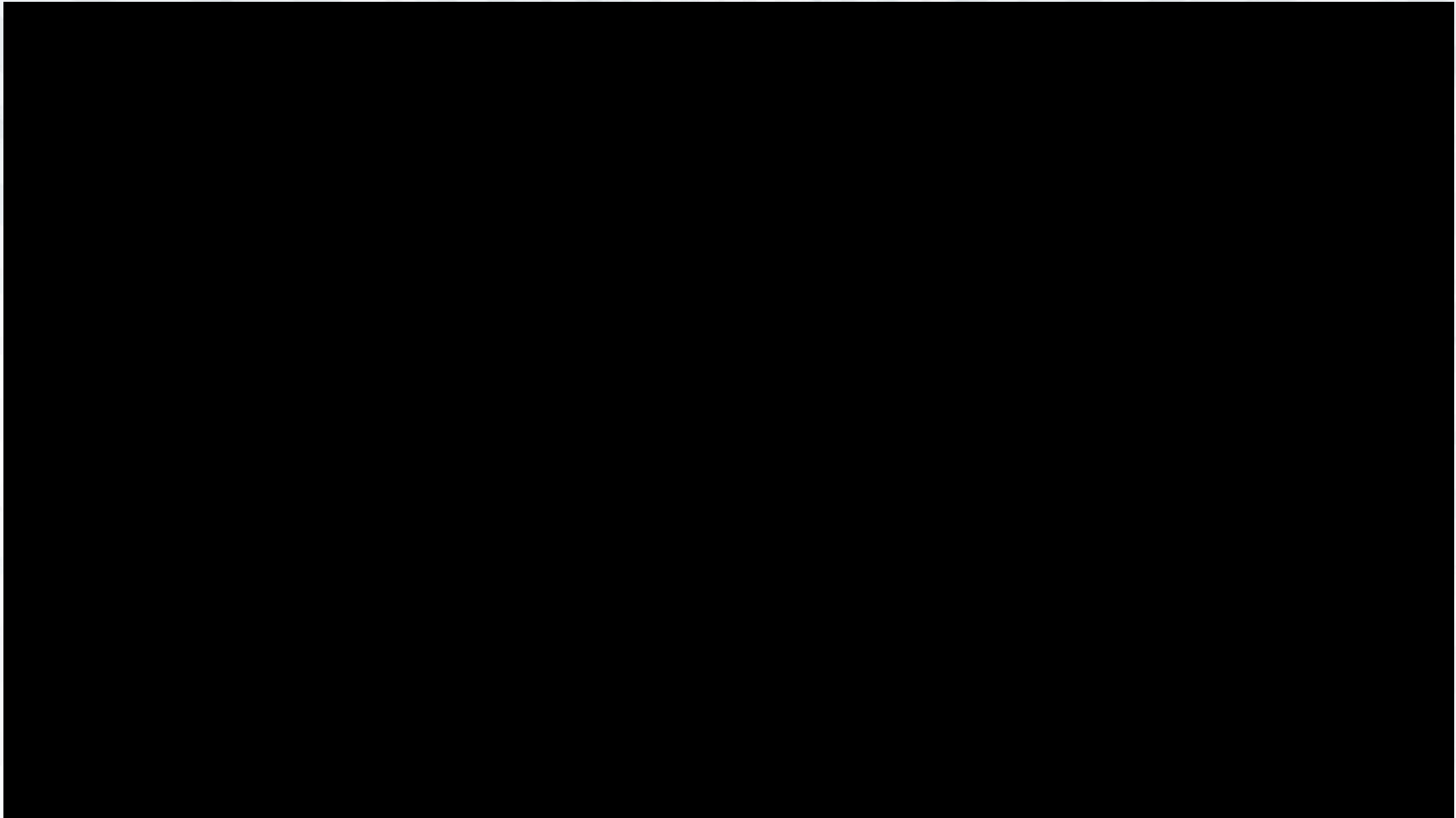
A mega-sized container terminal needs to bring longer trains to meet increased intermodal yard throughput demand

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

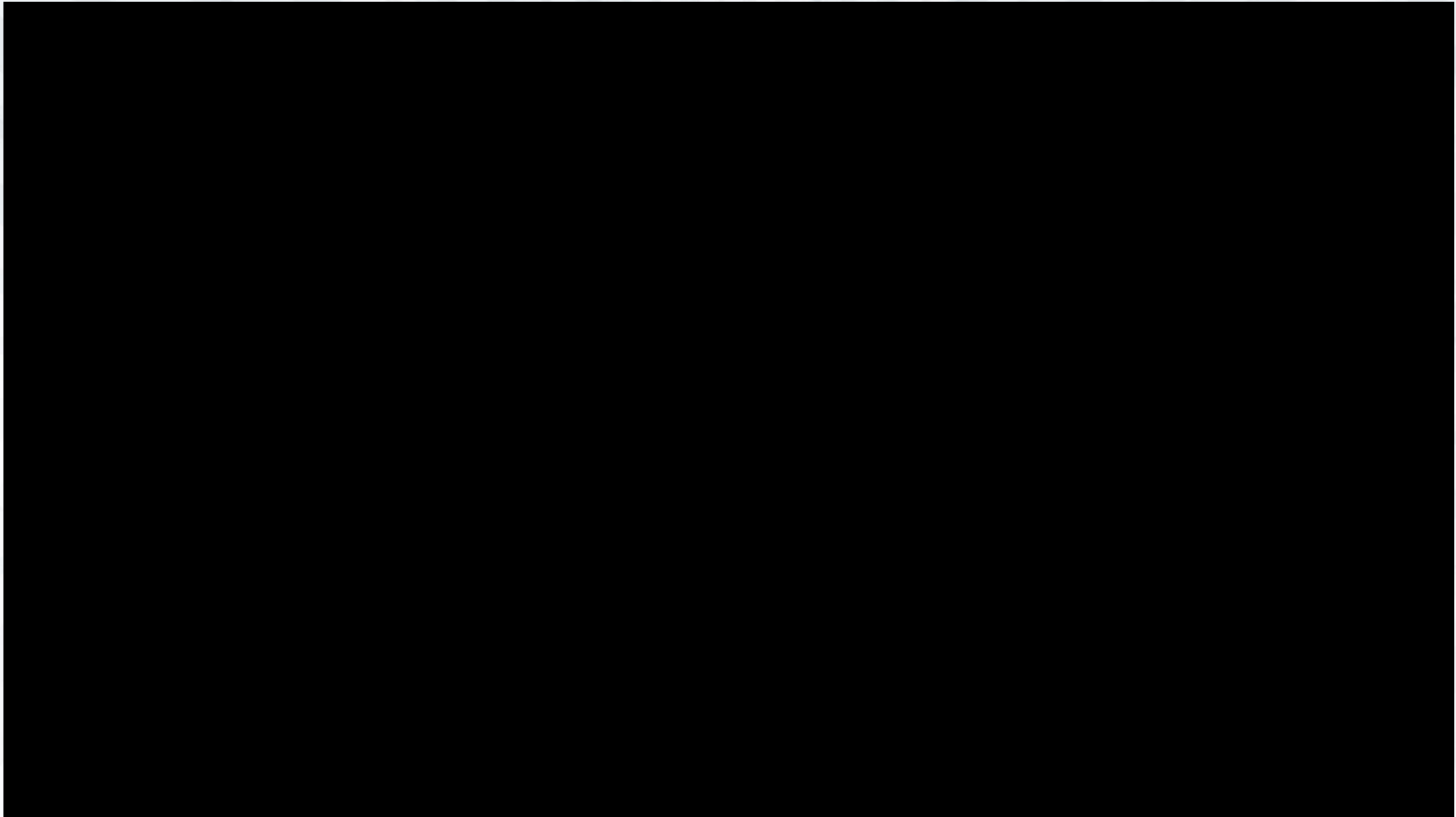
Scenario One

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Scenario Two

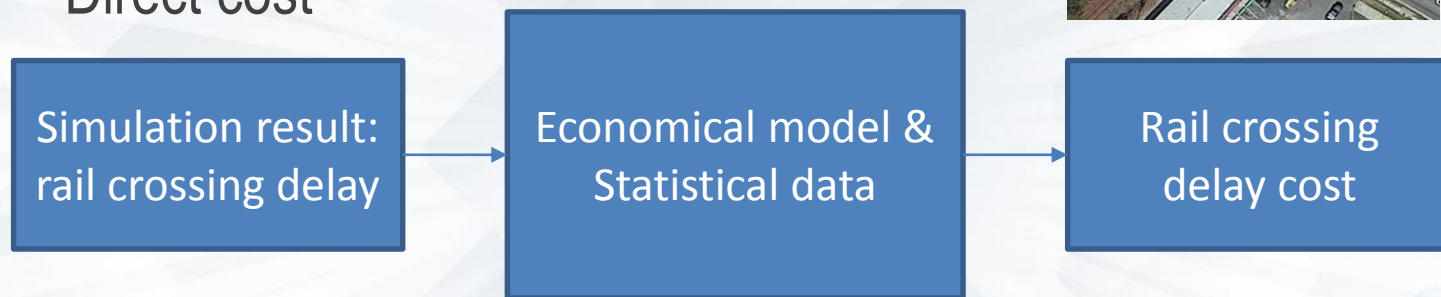
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Impact on Local Traffic – A Cost Model

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- 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**

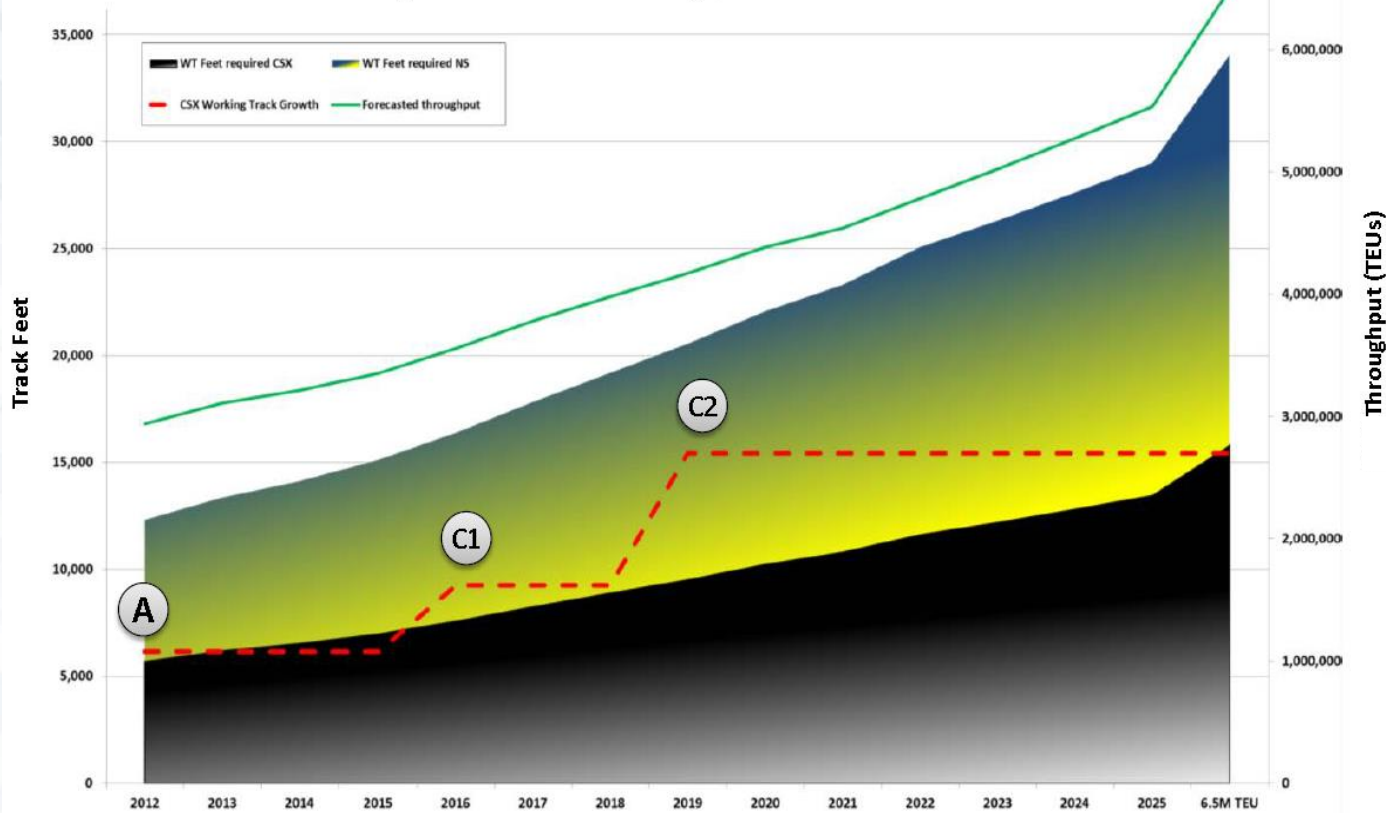
For example, a 6 lane major highway, an hour delay for 1000 vehicles will have:

Direct Cost = 900*\$17.31 + 100*\$18.07 = \$17k

Implementation Strategy

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Intermodal Management Strategy



Year	HW1	HW2	HW3	Capacity (TF)	Access Cost	Yard Costs	Total Costs *	Annual Delay Cost
2013	85	60	0	6,165	\$0	\$0	\$0	\$18M
2016	17	17	17	9,300	\$23M	\$4M	\$27M	\$6M
2019	0	0	0	16,200	\$49M	\$3M	\$52M**	\$0M



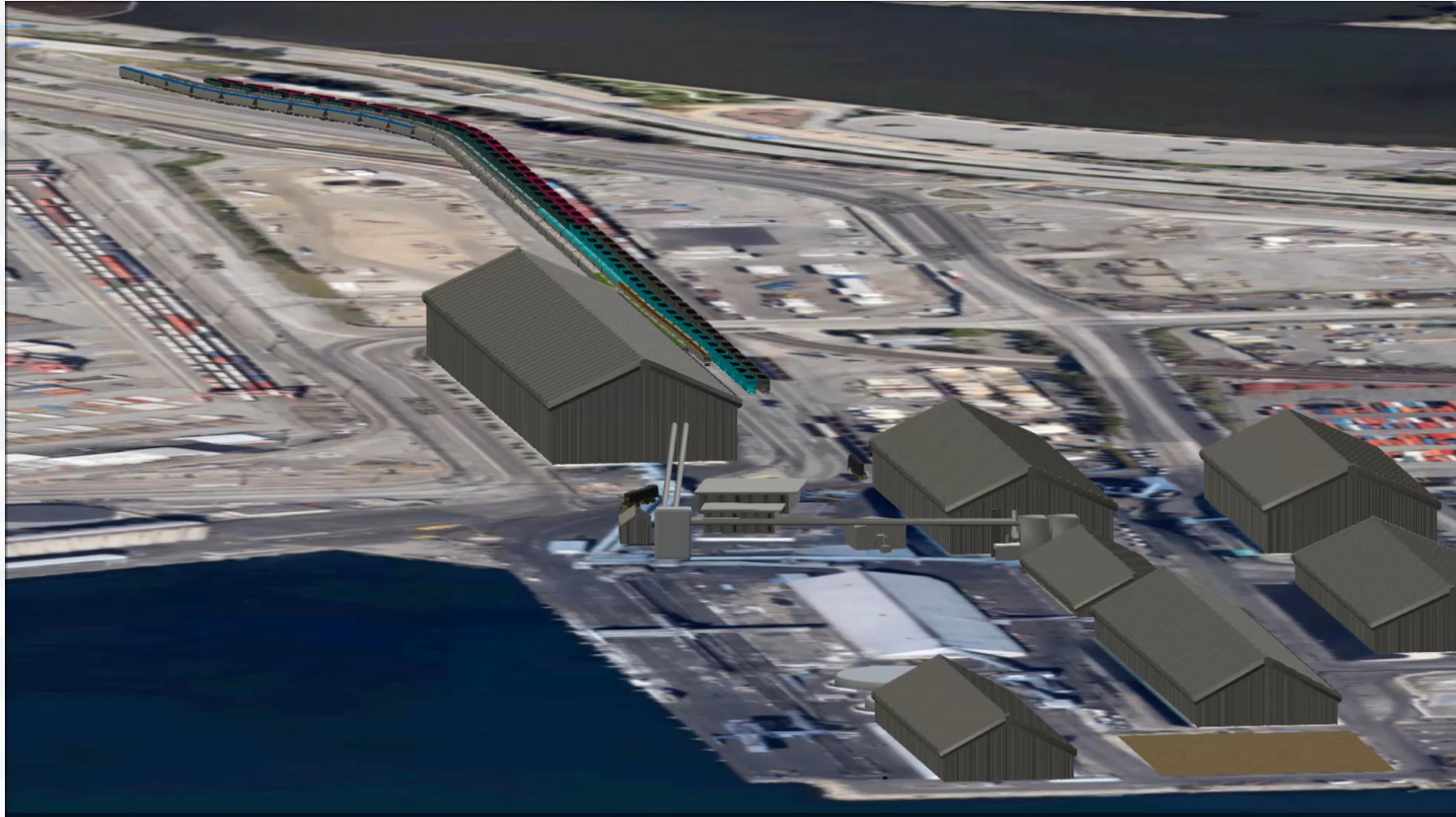
Case Study 2: Background

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- 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

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- 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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