TriMet Light Rail Simulation Study for On-Time Performance Improvement

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Topics of Discussion

- History and Role of TriMet Simulation
- Calibrating the System Simulation Model
- Performance Results for Existing Network
  - Identifying operationally problematic areas
- Concepts for Operational Improvement
- Results, Conclusions and Takeaways
Expansion of the MAX System

TRIMET Rail System

1986
1998
2001
2004
2009
2015
TriMet Simulation History

• 1994-5: Gated crossing near intersection
• 1995-7: MAX Transit Mall capacity analysis
• 1996-7: N/S DEIS Transit Mall and Steel Bridge
• 1999: Airport Extensions Operations Analysis
• 2002-4: South Corridor SDEIS CBD capacity analysis & North Corridor Operations
• 2010: Orange Line Shared transitway analysis
• MAX system became too complex for analysis by inspection or calculation
• On-Time Performance declined
• Value and impact of improvements and changes could not be determined
  – Alignments, signals, schedules, extensions
• A system wide simulation model was needed
TrainOps rail simulation model of MAX:

- Track alignment, including
  - Platforms, switches, speeds, grades & curves
- Signal locations and logic
- Complete Operating Plan with yard moves
- Vehicle type, tractive effort and ridership
Variability

- Dwell time variability based on log-normal distribution of station specific dwell data
- Incorporates adjacent intersection delay
MAX System Simulation
## Results: On-Time Performance

<table>
<thead>
<tr>
<th>Line</th>
<th>Real World OTP</th>
<th>Calibrated Baseline Simulated OTP</th>
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</thead>
<tbody>
<tr>
<td>Blue</td>
<td>83.2%</td>
<td>83.7%</td>
</tr>
<tr>
<td>Red</td>
<td>85.9%</td>
<td>84.5%</td>
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<tr>
<td>Green</td>
<td>86.8%</td>
<td>87.9%</td>
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<tr>
<td>Yellow</td>
<td>85.3%</td>
<td>87.8%</td>
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<tr>
<td>Orange</td>
<td>88.0%</td>
<td>88.0%</td>
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<tr>
<td>Overall</td>
<td>85.10%</td>
<td>85.58%</td>
</tr>
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</table>
Results: Signal Delay by Location

Cleveland Outbound

- Blue Line
- Red Line
- Green Line
- Yellow Line

Locations:
- Rose
- Coliseum
- Grand
- 7th
- Lloyd
- B22
- B30
- B34
- 4150:0-1:0e
- 4200:0-1:0e
- 4250:0-1:0e
- 4300:0-1:0e
- 4350:0-1:0e
- Hollywood TC
- Gateway TC
- Ruby Junction
- Cleveland

Delay Times (in minutes):
- Hollywood TC: 1:00
- Gateway TC: 0:45
- Ruby Junction: 0:30
- Cleveland: 0:15

Note: The chart shows the signal delay for different locations in the Cleveland Outbound area, with specific times and lines indicated.
Results: Schedule Adherence
Areas Prone to Delay: Gateway

- Red Line to Airport
- Green Line to Clackamas
- Blue Line to Portland City Center
- Blue Line to Gresham
- Green Line to Clackamas
Areas Prone to Delay: Sullivan’s Gulch
Areas Prone to Delay: Steel Bridge

Trains Delayed (on Left) and Cause of Delay (on Right)
Steel Bridge Area
Workshop conducted with LTK and multiple departments within TriMet.

Goal: Brainstorm ways to improve MAX OTP
– Informed by results of baseline simulation

Result: 10 Concepts for Operational Improvement
Concept 3: Move Gateway Operator Changes

- 10 Blue and Green Line MAX Trips have daily operator changes at Gateway
- Dwell of two minutes required for change
- Operator changes moved to adjacent stations that are not system capacity constraints
- Long Gateway dwells eliminated to improve train flow
• Eliminate Red Line single track constraints and crossover conflicts at Gateway
• New track to serve inbound trains on new alignment
• New station constructed near existing one
• New track connects to inbound Banfield Line
Concept 11: Yamhill Loop Track

Steel Bridge

Yamhill Loop
## Results of Concepts for Operational Improvement

### On-Time Performance Summary of Concepts for Operational Improvement

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<tr>
<th>Concept</th>
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<th>Red</th>
<th>Green</th>
<th>Yellow</th>
<th>Orange</th>
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<th>Δ from Existing</th>
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<tr>
<td>Existing</td>
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<td>84.46</td>
<td>87.96</td>
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<td>88.04</td>
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<td>84.35</td>
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Operations Simulation was crucial to:

- Accurately modeling MAX operations
- Identifying the network’s underperforming areas
- Developing concepts to improve OTP
- Determining the effectiveness of each concept
- Identifying synergies with concept combinations