A Queuing Analysis for The Bridge Of The Americas (BOTA)

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Statement of Problem

• Long waiting times at the Bridge Of The Americas (BOTA) is a critical issue faced by El Paso-Juarez community

• This problem has a direct impact on the economy, environment and quality of life of this community
Proposed Solution

• Propose a more efficient use of the existing resources
• Create a set of rules that would help to accomplish the goal
Problem Structure

Collect Data

Generate Queuing Model

Build Preliminary Simulation Model

Problem: Long waiting times

Statistical Analysis Data

Verify Queuing Model

Validated Simulation Model

Inter-arrival and Service Time
Methodology

*Inspection Types:*

– Type I: Driver remains in car while officer asks regular questions
– Type II: Open trunk or officer taps the vehicle
– Type III: Further inspection required
Methodology

- **Arrival Pattern**
  - Estimation using historical data

- **Service Pattern**
  - Collect Inspection Times (Videotape) at BOTA
Results

Validation

Number of vehicles in the queue

Time of the day (20 min periods)

FM Globo
Simulation

Graph showing the number of vehicles in the queue over time.
## Results

<table>
<thead>
<tr>
<th>24 Hr. Clock</th>
<th>Arrival Rate</th>
<th>Cars in the Queue</th>
<th>Expected Waiting Time (min)</th>
<th>FM Globo</th>
<th>Little's Formula</th>
<th>Type I</th>
<th>Type II</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 : 03</td>
<td>29.96</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>25.48</td>
<td>103.09</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>32.94</td>
<td>81.17</td>
</tr>
</tbody>
</table>

*Image depicts a simulation software interface showing metrics for different scenarios.*
Results

Inspection Booths

Secondary Facilities
Current Alternatives

1. Standardization of Type I inspection time
   - Type I: 23 sec
   - Type II: 103 & 81 sec.

2. 10 Inspection booths open and 8 secondary facility spaces.

3. 9 Inspection booths open with 8 secondary facility spaces (2 Officers).
Preliminary Results

Comparison of Alternatives

<table>
<thead>
<tr>
<th>Time of the Day</th>
<th>Expected Waiting Time (min)</th>
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<tbody>
<tr>
<td>5:40</td>
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<tr>
<td>6:40</td>
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<td>7:40</td>
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<td>8:40</td>
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<tr>
<td>20:00</td>
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<tr>
<td>21:00</td>
<td></td>
</tr>
</tbody>
</table>

Legend:
- Current System
- Std. Time
- current_1hr_early
- 10pri_8sec
- 9pri_8sec_2op
Preliminary Results

Percent of Utilization
(Alternative 1)
Conclusions

• Conspicuous lack of information

• A methodology to analyze complex queueing systems was developed.

• The model developed is only a preliminary model to test methodology.

• Waiting Times at BOTA can be reduced significantly if existing resources are used more efficiently.
Caveats

• One week of information only (inspection times)
• Weekends not considered
• No reliable information on profile of arrivals
• Information on current percent of secondary inspection not available
Questions