Innovation in Port Efficiency:

“Processes, Simulations and Modeling for better Terminal Operations, Planning & Congestion Mitigation”

Udo Mehlberg – Port of Tacoma
Terminal Operations and Capacity Simulations
Port of Tacoma 2006
Simulation Projects

- **1994 First simulation project**
  - Intermodal Yard – NIM & SIM throughput Capacity
  - Port Intermodal Infrastructure Planning
  - Used consultant for project

- **2004 Acquired simulation software from ISL**
  - SCUSY – Simulation of Container Unit Handling systems
  - CAPS – Capacity Planning System

- **2005 Joint development with ISL**
  - IYCAPS – Intermodal Yard Capacity Planning System
Yard Space Utilization
Berthing Times

Crane Requirements – Utilization

- Berthing Times
- Crane Requirements – Utilization

[Graphs showing berthing times and crane utilization percentages]
Intermodal Yard Capacity Planning System
Problem:
Given a demand forecast and a conceptual IY layout, what are the efficiencies and bottlenecks for the proposed facility?
No Programming is required in order to run a Simulation and achieve Results
IYCAPS Data Requirements

- REU Types
- Train Types
- Processes
- Tracks
- Track Connections
- Productivity
- Options – Measurement (meter/feet)
- Input Distributions – annual, monthly, daily, hourly throughput, train types
Train Length - Determination

- Unknown types of cars per Train
- Three types of cars with varying length of each car
- Train length determined by adding up car length on per train basis at time of load planning
- While number of TEUs per train may be constant, train length varies greatly
# Number of Configurations by Car Type

<table>
<thead>
<tr>
<th>Type of Car</th>
<th>Number of Cars</th>
<th>Number of Types handled in 2006</th>
<th>Number of Car Configurations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flat Car &quot;P&quot;</td>
<td>11,841</td>
<td>16</td>
<td>21</td>
</tr>
<tr>
<td>Spine Car &quot;Q&quot;</td>
<td>13,189</td>
<td>6</td>
<td>13</td>
</tr>
<tr>
<td>Stack Car &quot;S&quot;</td>
<td>50,940</td>
<td>38</td>
<td>43</td>
</tr>
</tbody>
</table>
Train Length - Determination

- Create new unit which allows train length determination based on the number of TEU shipped:
  
  **R E U**
  
  Rail Equivalent Unit
Train Length - Determination

- Establish total number of cars by type
- Establish total length of cars by type
- Establish total number of wells by type
- Establish average number of wells per car by type
- Establish average length of well per car by type
- Establish number of TEU per well by type of car
- Name this unit REU
Train Length - Determination

- Determine distribution of car types arriving/departing from intermodal yard
- Apply number of TEU shipped per train and let the system determine the train length
## REU Determination

<table>
<thead>
<tr>
<th>Type of Car *</th>
<th>No Cars</th>
<th>% of Total</th>
<th>Total length Feet</th>
<th>Avg. Car Length</th>
<th>Total No of REU</th>
<th>Avg. No REU/Car</th>
<th>Avg. REU length</th>
<th>No TEU per REU</th>
<th>Total No of TEU</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>11,067</td>
<td>13.8</td>
<td>1,052,924</td>
<td>95.1</td>
<td>21,232</td>
<td>1.92</td>
<td>46.6</td>
<td>2</td>
<td>42,464</td>
</tr>
<tr>
<td>Q</td>
<td>17,283</td>
<td>21.7</td>
<td>3,298,030</td>
<td>190.8</td>
<td>56,116</td>
<td>3.25</td>
<td>58.8</td>
<td>2</td>
<td>112,232</td>
</tr>
<tr>
<td>S</td>
<td>51,447</td>
<td>64.5</td>
<td>10,079,286</td>
<td>195.9</td>
<td>146,814</td>
<td>2.85</td>
<td>68.7</td>
<td>4</td>
<td>587,256</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>79,797</td>
<td>100</td>
<td><strong>14,430,240</strong></td>
<td><strong>224,162</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>741,952</strong></td>
</tr>
</tbody>
</table>

*Car Type Data and No of Cars from UMLER file of 2/1/2007*
Stack Cars – single well on one platform

Single platform = 1 REU
Average REU length = 64.7 Ft
Average TEU per REU = 4
Spine Car Platform = 1 REU

Average REU length = 58.7 Ft
Average TEU per REU = 2
Flat Car Types

Flatcar – from 2 to 4 TEU

= 1 REU

Average REU Length = 47 Ft
Average TEU per REU = 2
IYCAPS Results Reporting

- Productivity Analysis
  - Equipment type and number
  - Shifts
  - Safety rules for adjacent working tracks
IYCAPS Results Reporting

- **Throughput**
  - Evaluation of container moves per train type

- **Train Schedule**
  - List of all train arrivals with among others – arrival and departure time, train length and container movements. Using the multiple runs function the last train schedule is listed

- **Train schedule Parameters**
  - Shows the seasonal arrival distribution and weekly peak times
IYCAPS Results Reporting

- **Train type evaluation**
  - Overview of the time stamps a train passes through during its stay in the intermodal yard

- **Track evaluation**
  - Overview of the throughput, utilization and performance of operations regarding tracks

- **Track utilization**
  - Graphic evaluation of the track utilization over a one year period
Time Stamps of a Train’s Stay in the Intermodal Yard
Track Utilization over a one Year Period
IYCAPS Results Reporting

- Simultaneous utilization of tracks
  - Track allocation regarding their proportional availability for the trains

- Connection Point evaluation
  - Information about bottlenecks in regards to track allocation

- Train Dwell/Delay
  - Graphic evaluation of the length of stay for each train type
Simultaneously used Tacks

![Bar chart showing the share of time for various numbers of simultaneously used tracks.](chart.png)
Average Hours in IY
IYCAPS Results Reporting

- Productivity Analysis
  - Equipment type and number
  - Shifts
  - Safety rules for adjacent working tracks

IYCAPS is an evaluation tool. It will not give you the answer if you have no clue what you are doing.
For further information about IYCAPS please contact:

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Thank You

May I answer any questions?