IPRO 307

- Streamlining Intermodal freight yards
- Understanding how a freight city functions
- Making the transportation of people and goods more efficient and sustainable
Team Objectives

– **MiJack- Pathfinder technology simulation**
  • (Ryan Beau-Luby, Joel Zook, Matt Wiese)

– **Define current techniques for intermodal facilities and transportation logistics at Joliet.**
  • (Bryan Slonski, Konstantin Balakirev, David Dziuba, John Bouikidis)
    – Existing Facilities
    – Truck/Train/Barge/Pipeline
    – Intra facility transportation
    – Regulations

– **Investigate alternative fuel types and applications.**
  • (Matt Cargill, Matt Kehoe, Melat Tesfaye, Chris Wiseman)
    – Availability
    – Emissions and environmental effects
    – Efficiency comparison
    – Laws, regulations, restrictions
Team Process

– Monitoring progress
  • Meeting twice a week, presenting progress each day.

– Adapting to change
  • The existing facility group has expanded to overlap with alternative fuels in creating an off site fueling station

– Obstacles overcome
  • Realization of related trends involved with urban development
    – micro -> MACRO
    • Integrating the surrounding aspects of a freight facility into a cohesive whole
  • Lack of students having experience with simulation programs
  • Obtaining data from fueling stations and freight yards
Conventional Terminal Diagram

Conceptual diagram showing truck flow in a conventional intermodal terminal. Notice that most traffic within the facility is two-way.
Truck Processes: Terminal with Pathfinders

All tractors using the Pathfinder system will have RFID tags to open the automated gate and record time of arrival and time of departure at the exit gate.

1.5/1.75 Minutes

Pathfinder Traffic Uses Automated Gate

1.75 Minutes

Drop Off Container at Pathfinder Bay

5 Minutes

1.75 Minutes

Pick Up Container at Pathfinder Bay

5 Minutes

2 Minutes

Exit Gate: Automated, Truck Departs

2 Minutes

All data pertaining to pick up or delivery is pre-arranged through the Pathfinder system prior to entering the terminal.

Outbound containers are delivered to designated corridor. Pathfinder bays, identified by numbers, ensure no miss-parked containers. The truck driver operates the Pathfinder to load the container into the designated Pathfinder bay. Blocking is automatic.

For inbound pick up, container/Pathfinder information is sent via communication software to the truck line the moment that the container is set in the Pathfinder bay.
Pathfinder Terminal Diagram

Conceptual diagram showing truck flow in a future terminal with Pathfinder technology. Notice that all traffic within the facility is one-way.
Simulation Programs
Simulation Results (custom)

Example Pathfinder(Future) Solution Simulation
~/simulation> java Simulator Pathfinder 3 80 30
****************************************************************
*                      Pathfinder Solution                     *
****************************************************************
* Settings: Railroads = 3
* Settings: Cranes Per Railroad = 1
****************************************************************
* Lifts Per Hour = 104.33
* Trucks Per Hour = 172.00
* Trains Per Hour = 0.73
* Average Truck Duration Within Terminal = 5.10 minutes
* Average Train Duration Within Terminal = 161.02 minutes
****************************************************************
Peak Oil

The Growing Gap
Regular Conventional Oil: Discovery, Production & Remaining

Billion Barrels of Oil Per Year (Gb/a)
# Alternative Fuels

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Availability</th>
<th>Cost of fuel (gal)</th>
<th>Vehicle Alterations Required</th>
<th>Processing</th>
<th>Efficiency</th>
<th>Emissions</th>
<th>Pros / Cons</th>
<th>Infrastructure</th>
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<tbody>
<tr>
<td>Vegetable Oil (WVO, SVO)</td>
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<td>Algae Fuel (biodiesel/biobutanol)</td>
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**Ethanol**

\[
\frac{1300 \times 10^3 \text{J}}{\text{mol}} \times \frac{1 \text{mol}}{46 \text{g}} \times \frac{706 \text{g}}{\text{m}^3} \times \frac{\text{m}^3}{264 \text{gal}} = 6.225 \times 10^{23} \text{J} \\
\frac{7.40 \times 10^9 \text{gal}}{1} \times \frac{57.38 \times 10^9 \text{gal}}{\text{year}} \times \frac{1.28 \times 10^8 \text{years} \times \text{plants}}{27 \text{years}} = 1.28 \times 10^8 \text{years} \times \text{plants} \\
\text{X} = 1.28 \times 10^8 \text{years} \times \text{plants} \\
\text{X} = 185185 \text{plants/year} \\
\]

**Hydrogen**

\[
\frac{286 \times 10^5 \text{J}}{\text{mol}} \times \frac{1 \text{mol}}{2 \text{g}} \times \frac{1 \text{kg}}{1000 \text{g}} \times \frac{0.0899 \text{kg}}{\text{m}^3} \times \frac{\text{m}^3}{264 \text{gal}} \times \frac{\text{gal}}{1.27 \times 10^6 \text{gal}} = 0.235 \times 10^{22} \text{J} \\
\frac{1.27 \times 10^6 \text{gal}}{1} \times \frac{2.31 \times 10^7 \text{m}^3}{\text{year}} \times \frac{\text{m}^3}{264 \text{gal}} \times \frac{\text{gal}}{1.27 \times 10^6 \text{gal}} = 2.08 \times 10^5 \text{years} \times \text{plants} \\
\text{X} = 2.08 \times 10^5 \text{years} \times \text{plants} \\
\text{X} = 778 \times 10^4 \text{plants} \\
\text{X} = 2985 \text{plants/year} \\
\]

**Biodiesel**

\[
\frac{4.41 \times 10^{12} \text{gal}}{1} \times \frac{6228571 \text{gal}}{\text{year}} \times \frac{53937 \text{years} \times \text{plants}}{27 \text{years}} = 53937 \text{years} \times \text{plants} \\
\text{X} = 1.96 \times 10^4 \text{plants} = 735 \text{plants/year} \\
\]
Alternative Fuel Station
Value

• Value of project, benefits drawn from project
  – A more efficient intermodal freight terminal allows for less materials, less time required for drivers, and less room for error
  – With oil running out and greenhouse gas emissions rising, we *need* alternatives to keep our economy running and also keep the earth as an inhabitable environment
• Major impacts, risks and challenges
  – Faster more efficient yards may eliminate jobs
  – Capital development and installation
• Ethical Issues
  – Land use and neighboring area
  – Alternative fuel restrictions (EPA fines $30,000 for engine/tank alterations without a permit)
• Next Step for continuing IPRO = in-city = Harvey, Illinois
In Conclusion

- Increased reliance on basic freight traffic
- The importance of implementing alternative fuel for practical, economical and ecological purposes