Box Truck and Route Optimization
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Introduction
Amazon is an international technology company based in Seattle that focuses on e-commerce, cloud computing, digital streaming, and artificial intelligence.

Problem Definition: Amazon is using third party box trucks to deliver small parcel and large shipments with little visibility and moderate utilization of truck capacity resulting to low cost efficiency.

Goal Statement: Optimize transportation methods and box truck capacity from vendors to Inbound Cross Dock (IXD) facilities in order to reduce costs and save time.

Gaylord Study
As said in the previous section, to best utilize a box truck’s capacity, small parcels must be consolidated. This can be done by using gaylords. There are three main types:

<table>
<thead>
<tr>
<th>Type</th>
<th>Cardboard</th>
<th>Wire</th>
<th>Plastic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual</td>
<td>48” x 40”</td>
<td>50”</td>
<td>54”</td>
</tr>
<tr>
<td>Price</td>
<td>$21.25</td>
<td>$40</td>
<td>$115</td>
</tr>
<tr>
<td>Lifespan</td>
<td>Weeks</td>
<td>* not suitable for shipping *</td>
<td>Years</td>
</tr>
</tbody>
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Why Gaylords?
- Gaylords improve process flow with regards to time and utilization
- Consolidation into gaylords helps decrease damage by about 53%
- Optimal standard operating procedure (SOP) is to stack packages by wall-building according to our Excel trial studies

Routing Model
A key part of the capstone project was to create a realistic model for Amazon’s entire distribution system, using routing data supplied by Amazon. This involved the writing of over 2000 lines of code to optimize and accurately simulate Amazon’s distribution system.

Testing with a Sample Route
In order to further test and compare gaylord sizes, we needed to visualize how they fit into the truck to find the best truck capacity utilization. Using a Container Loading Problem open-source spreadsheet [1], we tested how 21 shipments fit into gaylords and the box truck. As shown in the graph below to the left, the larger the gaylord, the better the overall truck capacity utilization. Below to the right is pictures of the optimally packed gaylord and box truck, both using cardboard gaylords of 48” x 40” x 36” size.

Cost & Feasibility
Amazon has three shipping methods: using their own box truck, hiring a box truck company, and using third parties such as UPS & USPS. According to our research, the cost of daily usage for buying or hiring a box truck is $201.09 or $350, respectively. It is cheaper for Amazon to purchase their own box truck than hiring a box truck and driver. Additionally, we found the break-even point for the use of Amazon owned box trucks compared to using USPS or UPS.

Web Tool
As the world transitions to a remote setting, our team thought that it would be important to have a platform to display our results to our project sponsors.

UW Capstone Team Amazon
Note: the web application is in development to help visualize the results for our experiment. To view the application, enter the website. The figure shows some of the features we added to the website:
- Gaylord Volume: Gaylords can be made in different sizes, although we found the optimal gaylord capacity to be 40 cubic feet.
- Human Capacity: How much a person can carry in cubic feet varies, we assumed 4.5 cubic ft.
- Distance: The distance from vendors to where the box truck can park varies with different vendors. We assumed 30 ft. in our calculations.

Results
- It is cheaper for Amazon to purchase their own box truck.
- Truck capacity goes from 72.4% without gaylords to 90.6% with gaylords.
- The loading/unloading process is 22.59% faster when using a gaylord.
- Stacking gaylords will double truck capacity.
- Gaylord usage was found to offer a 1.78% net saving.
- Shipments sent both third party and internally saves 2.1% of costs.

Future Recommendations
- Implement gaylords in box trucks slowly and record data to validate the use of the tool.
- Create simulations based on the data generated from the optimization model and compare it with implementation data to see how accurate it is.
- Combine the optimal gaylord model with the route model to create routes based on pickup sequence.

Acknowledgments
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