### Operations Research and Statistics

**Simulation Model, Machine Learning and OptQuest**

**Purpose**
Determine the distribution of Production Assistants (PAs) and workstations which produces the highest textile production throughput

**Methodology**

**Simulation Models**
The team created seven different simulation models to represent future states in the Goodwill facility. The following are most relevant:

- Centralize Stores Into One Production System - No Conveyor
- Production System Separated by Store
- Production Areas of Stores Determined by Conveyor Belt

**Facility Layout (Current, Centralized, Conveyor)**

**Analysis For Machine Learning**

**Linear Regression**
- Eliminates low-impact factors and analyzes the % change
- High % change confirms high-impact factors

**Random Forest**
- Non-linear model analyzes important factor patterns
- Small MSE values confirm high-impact patterns affecting output

**Cost Analysis for OptQuest Outputs**

**Results**

<table>
<thead>
<tr>
<th>Models</th>
<th>Important Factors from Machine Learning</th>
<th>Models with Greatest Throughput</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 2</td>
<td>Non-Conveyor Models Cage Flow Time</td>
<td>Model 3 5.91%</td>
</tr>
<tr>
<td>Model 4</td>
<td>Conveyor Models Waiting Time &amp; Textile Number on conveyor before first workstation</td>
<td>Model 4 32.61%</td>
</tr>
</tbody>
</table>

*The best model depends on desired results. Optimal Production Assistant utilization is dependent on number of produced textiles. The following decision tree helps Goodwill decide which option to pursue when there are less than 24 Production Assistants.*

### Human Factors

**Station Layout**

**Purpose**
Improve space utilization while creating an ergonomic station

**Method**
The most utilized containers are placed in front of the Production Assistants with the less utilized containers placed on their sides

**Results**

Old Station Layout

New Station Layout

<table>
<thead>
<tr>
<th>Footprint + Asiles</th>
<th>Footprint</th>
</tr>
</thead>
<tbody>
<tr>
<td>$436^\circ$</td>
<td>$185^\circ$</td>
</tr>
<tr>
<td>Estimated Annual Cost Savings:</td>
<td>$1557</td>
</tr>
</tbody>
</table>

*Goodwill values space at $9 per sq. ft.*

### Acknowledgements

The team would like to thank our Capstone mentor, Dr. Patty Buchanan as she guided us through this project. The team is thankful for the project sponsor, Brent Freichs, for his guidance, support, and welcoming persona. The team would also like to thank Goodwill and all of its employees who interacted with the team and welcomed us to their facilities.