Seattle Goodwill Capstone

Team Goodwill Charms: Apoorv Bansal, Nathan Klaff, Joleen Lawson, Carisa Lin, Tiffany Yam
University of Washington Department of Industrial & Systems Engineering

Acknowledgements: This project was possible through the support of Brent Frerichs and his team, as well as our professor, Dr. Patty Buchanan. Thank you all so much!

Introduction

Seattle Goodwill's e-commerce has been expanding rapidly and they are expecting an annual growth of around 20-30% in this sector. With this, our project question is:

How do we create a facility design that optimizes the effectiveness of their e-commerce sector?

Customer Requirements

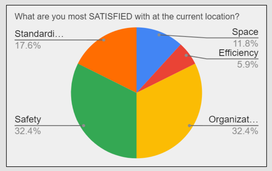
The primary requirements for this project include creating a streamlined facility for Seattle Goodwill's e-commerce operations, improving their existing processes and creating a flexible design that allows room for expansion and future improvements.

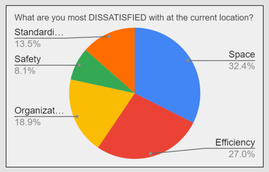
Ethics & Considerations

Environmental: what makes a facility desirable and worth working in, tailoring it to employee desires?
Social: how do we build a facility that models after Goodwill's mission and values?
Economic: how do we minimize cost while maximizing operations?

Employee Survey

To best tailor our customer and facility requirements to those working, we sent out survey that received 38 responses.





Ideas about better space and efficiency allocation while keeping the current state of organization and safety will be the main goal.

Projections

With the trend of 20% growth annually, the new facility is going to model this growth. Yet, this does not come without any risks. Below is a chart indicating that if a building is built for 20% annually, the capacity of the building will be over or under-utilized depending on the true growth.

Actual Percent growth annually	5%	15%	18%	20%	22%	25%	30%
Percent Capacity in FY 2030	26%	65%	85%	100%	118%	150%	223%

Cost Benefit Analysis

In order to determine the economically optimal number of stations for each process, the team utilized a series of excel sheets, like the one below, to document numerous simulations at varying numbers of stations.

The excel then uses a variety of costs to determine which number of stations generates the most amount of profit relative to the other trials.

Number of Stations	StartupCost/month	Salary/month	ConstantCost/month	ThroughputAuctions	ThroughputBooks	ThroughputJewelry	Sales	Total Monthly Gain
1	$ 30.23	$ 18,000.00	$ 4,320.00	700	5000	500	$ 59,000.00	$ 36,649.77
2	$ 60.45	$ 36,000.00	$ 8,640.00	700	5000	1000	$ 84,000.00	$ 39,299.55
3	$ 90.68	$ 54,000.00	$ 12,960.00	700	5000	1500	$ 109,000.00	$ 41,949.32
4	$ 120.91	$ 72,000.00	$ 17,280.00	700	5000	2000	$ 134,000.00	$ 44,599.09
5	$ 151.13	$ 90,000.00	$ 21,600.00	700	5000	2200	$ 144,000.00	$ 32,248.87

Per Unit Price Books	Per Unit Price Auctions	Per Unit Price Jewelry
$ 4.00	$ 20.00	$ 50.00

Salary of Employee avg	Hours/month
$ 20.00	720

Per Unit Cost/Mo	Station Cost
$ 30.23	$ 800.00

Warehouse upkeep
$ 4.00

Sqft per Unit
70

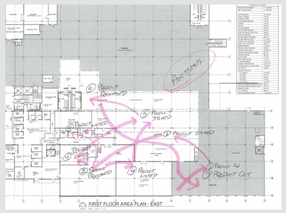
Other staff salary	Staff:manager ratio
$ 30.00	15

Per Sqft Cost	Payback Period via SDE
$ 14.48	60

Current Layout and Proposed Alternatives

Current Layout

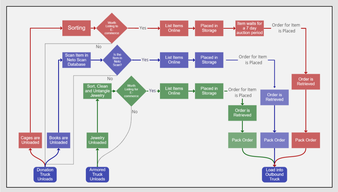
The Spaghetti map below showcases the process flow for the auctions sectors of Seattle Goodwill. Current pathways taken by the goods are longer than necessary and non intuitive.



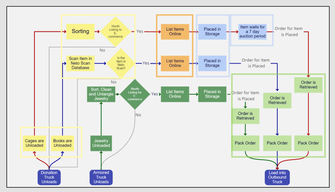
Proposed Layout

To improve upon this our team developed two alternatives, accounting for all the customer requirements and the growth and expansion considerations.

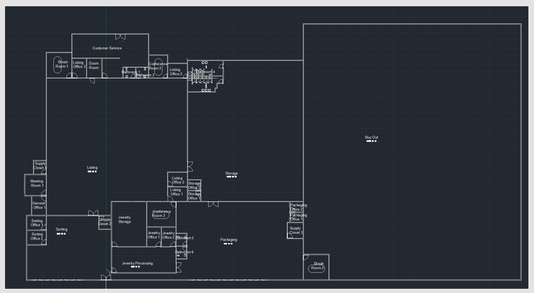
Product-based Layout



Process-based Layout



CAD: A Combination of Product and Process



Throughput Study

In order to validate which layout will be most optimal for Goodwill, a throughput study was conducted. The index of performance chosen was the increase of items listed in each product line by 1%.

Time Study

To validate the data given to us, we decided to go into the facility and execute time studies on each process across all three operations:

Sorting · Listing · Shipping

Additionally, due to Jewelry's unique process, we also performed time studies on the following:

Pricing · Lotting · Gold Check

Each time study was taken with an hour or more of event data. We then compared these data points to the averages we were provided, which was accurate. However, to create a more accurate model, we used our data set to create the following distributions using StatFit for our processes:

Process	Distribution	units	n =
Books Sorting	Lognormal (0,1.25,1.24)	sec	50
Books Listing	Lognormal (0,2.25,5.56)	sec	18
Books Shipping	Uniform (5,22)	sec	18
Jewelry Pricing	Uniform (3,41)	sec	28
Jewelry Lotting	Triangular (12,13.5,15)	min	2
Jewelry Sorting	Triangular (676,907,1231)	sec	3
Jewelry Gold Check	Triangular (18,32,44)	sec	6
Jewelry Pricing	Triangular (85,106,113)	sec	7
AI Packaging	Lognormal (0,1.24,0.607)	min	11
AI Labeling	Lognormal (0,3.43,0.556)	sec	29
AI Listing	Lognormal (0,2.39,0.588)	min	12

This provided us the opportunity to begin to accurately model our simulation, rendering proper throughput and utilization.

Simulation

Using the data from our time studies, as well as the data provided by the Seattle Goodwill Team, we proceeded with our discrete event simulation for each individual process (ran over a month):

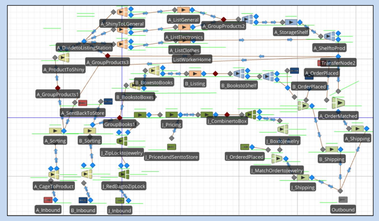
Auctions
Initial Throughput: 21,443
Number of Workers: 24

Jewelry
Initial Throughput: 5,500
Number of Workers: 12

Books
Initial Throughput: 64,335
Number of Workers: 16

The total throughput for all products was 91,278. After validating and verifying these processes were accurate to the existing physical facility, we then created Product and Process layouts, combining all three processes into one:

Product Layout
Initial Throughput: 90,488
Number of Workers: 52
Main distinction:
Straightforward processes, does not share resources



Process Layout
Initial Throughput: 91,096
Number of Workers: 52
Main distinction: Shares resources/workers for sorting, listing, and shipping individually

After creating these combined processes and ensuring accuracy, the next step was to line balance and determine which of the two were ideal for Seattle Goodwill's e-commerce operations.

Line Balancing with Takt Time

Using the cost benefit analysis sheets, the optimal amount of stations was calculated in 2 ways. First, the number of items ordered was kept constant, and the number of stations was changed to see what was the minimum number of stations that were needed to move at the current pace of items being ordered.

Method 1	Throughput/mo	takt time (hr)	takt time (min)		Sorting mean	Pricing mean	Listing mean	Packaging mean
Auctions	21000	0.04	2.13		4.71		8.68	
Books	65000	0.01	0.69	0.10	8.71		2.55	
Jewelry	5500	0.14	8.12		0.08	1.67	0.33	
Total	91500	0.01	0.49					5

Second, the process was done again, but this time, the number of items ordered were scaled to meet the number of items that are sorted and listed. After this, a buffer was added in order to allow for a <100% station utilization and an amount of buffer to add flexibility to the design. Finally, the stations were scaled to account for 5 years of growth within the facility throughput.

Method 2								
Auctions	28000	0.03	1.59		4.71		8.68	
Books	151000	0.00	0.30		0.10		2.55	
Jewelry	11600	0.06	3.85		0.08	1.67	0.33	
Total	190600	0.00	0.23					5

This same process was used to the current process, but this current number is for a 24-hour facility.

Results

The results of the chosen process-based layout with the CAD drawn floorplan are shown in the indices of performance. With the process-focus layout and line balancing, the is a significant increase in items that are processed per month. The adjacency score is now increased, so the flow of items will be more intuitive. Plus, the ability to expand is present with the new building have a buy-out space until needed.

	Index of Performance		
	Increase Throughput	**Adjacency Score**	**Expandable Ability**
Current	Items/Month Auctions: 20645 Books: 64325 Jewelry: 5518	Current adjacency score 12	N/A
Proposed Layout	2.5% increase for auctions .1% increase for books 1.4% increase for jewelry Line Balance: 7.5% increase for auctions .1% increase for books 11.2% increase for jewelry	New adjacency score 20	Process layout friendly to expansion Buyout space for 60,000 sq ft Space available for 20% annual growth

Impacts

We believe that our findings and our proposed layout will significantly impact Seattle Goodwill's E-Commerce operations. As a result of our findings, they will be able to -

Cost effective · Meet Growth Projections · Uphold ethical standards and employee satisfaction · Streamline Processes

Team Goodwill Charms recommends the **24-hour, process-based layout** with a building floor plan resulting in an **74,000 square foot building.** The number of stations needed in 5 years is shown below because that is when the new building is planned to be built.

5 Year Projections for Number of Stations Needed	Sorting	Pricing	Listing	Packaging
Auctions	6		12	
Books	2		16	
Jewelry	1	4	2	
Combined				28
Total	9	4	30	28
Grand total	71			

Recommendations

Some employee recommendations: better tables and equipment, cross training, kaizen events, more 120V outlets, better relations with stores for looking out for ecommerce items, and better process for employees to buy items.