

## Team 520 Concept Selection

### House Of Quality

		Engineering Characteristics						
Units:		N/A	N/A	dB	N/A	items/s	N/A	ft/s
Customer Requirements	Importance Weight Factor	Simple Construction	Accurate Sensors	Sound	Durable	Sort Speed	PLC Integration	Assembly Line Conveyor
Portable	2	9			3			1
Sorts correctly	4		9			6	3	3
Quiet	2			6				
Safe	4		3			1		3
Sorts at a reasonable speed	4		3			9		6
Uses a PLC Controller	2						9	
Considers possible glitches or miswiring	3	1			3		9	
Transport	4	3						9
Raw Score (327)		33	60	12	15	64	57	86
Relative Weight %		10.1	18.3	3.7	4.58	19.6	17.4	26.3
Rank Order		5	3	7	6	2	4	1

The house of quality method produced the above chart with results for the most important design parameters based on what the customer requirements are. The customer requirements were linked to engineering characteristics and their relevance to each other was weighted accordingly. The results of the House of Quality(HOQ) show that the most important component is the assembly line conveyor system because it has the most pivotal role in the finished product's functionality. Therefore, the concept the group selects to go forward with should optimize this feature. The least important system according to HOQ was the sound

production of the device, which is reasonable as it will be used in an industrial manufacturing setting which may require hearing protection.

**Pugh Chart**

		<b>Concepts</b>							
<b>Selection Criteria</b>	<b>Assembly Line Trainer</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>
<b>Portable</b>	<b>D A T U M</b>	S	+	S	S	-	S	S	-
<b>Ease of Use</b>		+	+	-	S	+	S	S	S
<b>Stability</b>		+	S	S	+	+	S	S	+
<b>Cost</b>		S	-	+	S	-	+	-	S
<b>Speed</b>		+	-	-	+	S	-	+	S
<b>Sorting ability</b>		+	+	+	+	+	+	+	+
<b>Design is Complex</b>		S	-	S	S	-	S	S	S
<b>Use of PLC</b>		+	+	+	S	S	+	+	+
<b>Weight</b>		-	S	+	-	-	S	S	-
<b>Number of items to sort</b>		+	+	S	-	S	+	+	-
<b># of pluses</b>		6	5	4	3	3	4	4	3
<b># of negatives</b>		1	3	2	2	4	1	1	3

**Concept 1:** Uses rotational actuation and linear actuation to sort objects.

**Concept 2:** Two conveyors placed perpendicular.

**Concept 3:** Uses a robotic arm.

**Concept 4:** One conveyor sorts material while other sorts size.

**Concept 5:** Conveyor dumps into boxes on a rotating structure.

**Concept 6:** Piston controlled arm.

**Concept 7:** One conveyor with several pistons.

**Concept 8:** Fix two conveyors together permanently.

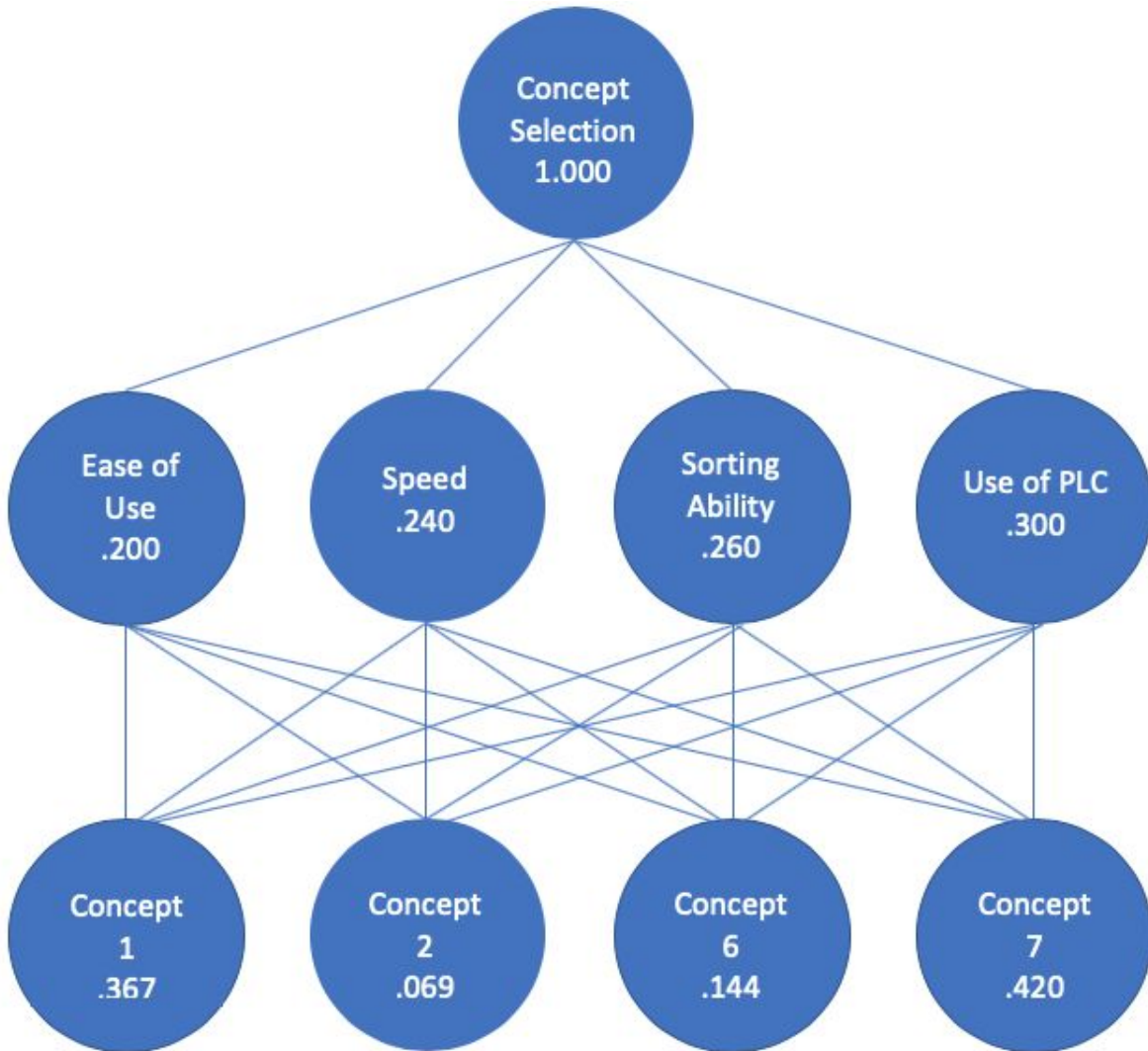
The pugh chart is used above to narrow down our top eight concepts and choose a winner. Each design is assessed by the capabilities of actions the device can perform or characteristics of the design. Three scores are used which are a negative if design doesn't meet the criteria, satisfactory if the design meets the need, and a positive sign which means the design performs the action very well. Each design is ranked for the action and the sums are given at the bottom. Since concept 3 has an average rating, it will be used as the datum in the next pugh chart.

**Pugh Chart**

		<b>Concepts</b>			
<b>Selection Criteria</b>	<b>Concept 3</b>	<b>1</b>	<b>2</b>	<b>6</b>	<b>7</b>
<b>Portable</b>	<b>D A T U M</b>	S	S	S	S
<b>Ease of Use</b>		+	+	-	+
<b>Stability</b>		+	+	S	S
<b>Cost</b>		+	-	+	-
<b>Speed</b>		+	-	S	+
<b>Sorting ability</b>		S	S	S	+
<b>Design is Complex</b>		+	S	-	S
<b>Use of PLC</b>		-	S	+	S
<b>Weight</b>		S	-	+	S
<b>Number of items to sort</b>		S	S	S	+
<b># of pluses</b>			5	2	3
<b># of negatives</b>		1	3	2	1

This pugh chart uses concept three for the datum since it has the average rating. concept three uses a robotic arm to sort the materials. The two highest ranked designs are concept 1 and concept 7. Concept one uses rotational actuation and linear actuation to sort objects concept seven uses several pistons to sort the objects into bins. Once all values were compared to concept three, concept one was shown to be the winner with concept seven in second place.

**Analytical Hierarchy Process (AHP)**



Using the top four criteria and concepts identified in the House of Quality and Pugh Charts, the Analytical Hierarchy Process chart was constructed above. Weighting the criteria respectively, the AHP chart awarded concept 7 with the highest score. Concept 7 was followed by concepts 1, 6, then 2.

## Final Selection

Through the use of a House of Quality chart, two Pugh charts, and an Analytical Hierarchy Process model, we have chosen concept 1 to be the final design. This concept uses rotational and linear actuation to sort the objects based on size and material. From Pugh chart 1 we were able to eliminate half of the concepts and use Pugh chart 2 to decide the best concept out of the 4 that remained; 1, 2, 6, and 7. Pugh chart 2 yielded that concept 1 is the clear winner. Concept 1 utilizes each of the top four requirements of this design, determined by the House of Quality chart. This concept will use each of the conveyors, it will be able to sort objects quickly and decisively using the inductive sensor and 2 proximity sensors, and everything will be controlled by an Allen-Bradley Micrologix 1000 PLC. Please see the conceptual design below to see how the design will operate. We believe that this concept will meet all of the customers needs and allow us to deliver a final product that the customer and our group will be proud of.

