Concept Selection

Team 304: Nick Grant, Nicholas Haynes, Jacob Ray,
Christian Perez, Andrew Lois, SirDarius Lomack

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Concept Selection

After generating a mix of 8 high-fidelity and medium-fidelity concepts, the team needed to select a final design that was most suitable to the project's scope and met the majority of the customer needs. Firstly, the list of selected concepts were renamed and included with their descriptions in Table 6.0.1. The team conducted several concept selection analyses including: binary pairwise comparison, house of quality, pugh charts, and the analytical hierarchy process. After completing the concept selection process, the team agreed with the results and chose Display, as the final concept.

Table 6.0.1: *Selected Concepts for Concept Selection*

Concept Name	Original Concept #	Description
Revolver	51	Design an apparatus of revolving fuses (think revolver cylinder). When one blows, it will slide down in its chamber. Once it is deemed safe to reconnect, the springs inside the cylinder will re-engage the fuse. If the fuse is bad, the cylinder will rotate to a new fuse
Upgraded Auburn	64	Utilize the Auburn concept with one spherical joint, stakes in the foot pedals, and a hand held remote control to adjust the legs.
Tripod	11	A three legged device with a motor powered wheel that can extend the pole and support it. It will have a way to manipulate the legs of tripod to adjust for terrain
Cable Pull	50	Design an apparatus that utilizes a cable to pull the fuse back into position. The fuse will be on guides to accomplish this. The cable will be fixed to the pole as would a flag mast rope.
Upgraded Hookstick	35	Redesign the hookstick to have a tripod at the button and a second stick attached to a hinge at the top so one direction of movement is fixed
Smart Fuse	27	The fuse switch is redesigned to be a smart device that break the circuit in the event of shorting, but can also be connected by bluetooth to a device that the linesman carry to troubleshoot

Magfuse	49	Design an apparatus that will use magnets that act as a gravitational maglock. When the fuse needs to be broken to prevent line overload, the magnets will disengage. We can then re-power the magnets to attract the fuse back into position. The fuse must be on guides.
Pneumatic Pole	48	Design a robotic extendo pole with a tripod. When the tripod opens, it will anchor itself into the ground by pneumatic hooks. The pole can then be extended and controlled by remote joystick.

6.1 House of Quality

Prior to the creation of the house of quality, a binary pairwise comparison of the customer needs was completed. Each of the needs were compared against the others and the need which was deemed of higher importance was given a 1, while the other was given a 0. Summing the rows of this matrix resulted in the importance weight factor matrix of our customer needs. This binary pairwise comparison can be seen below in Appendix A, Table A-1. Our most important need was determined to be “Interacts with the fuse switch and was given a weight factor of 7, while our least important need was “the device is lightweight” and was given a 0 for importance.

The house of quality was created next. On the leftmost axis, the customer requirements were listed, while the engineering characteristics were listed on the top axis. Going through the chart, each engineering characteristic was ranked depending on its level of contribution to fulfilling the customer requirement. The engineering characteristic relationship was measured as weakly, moderately, or strongly related to the customer requirement. Using the importance weight factor matrix along with the values now assigned to the chart, each engineering characteristic was given a ranking of importance. The most important characteristic for our product was determined to be reducing the strain on the user, while the least important was reaching the fuse switch.

The purpose of ranking our project's engineering characteristics is to eliminate the less important ones, helping to simplify our concept selection process. We decided to eliminate some of these based on their relative weight percentages. If any of the characteristics had a lower relative weight percentage than the total average of the relative weights, it was eliminated from our process. This left 5 remaining engineering characteristics to be used in the creation of the pugh charts. The house of quality is shown below in Table 6.1.1.

Table 6.1.1: *House of Quality*

House of Quality						
		Engineering Characteristics				
Improvement Direction		↑				
Units		ft	lbs	n/a	n/a	
Customer Requirements	Importance Weight Factor	Reaches the fuse switches	Reduces strain on the user	Gets to the job site	Interacts with the switches	
Reaches 40 feet	5	9	3		9	
Endures weather conditions	3		1	9	3	
The product must be collapsible	2	3	9	9		
Interacts' with the fuse switch	7	9	9		9	
Reduces the force needed to reach the switch with the stick.	2	3	9		9	
The device can resist voltage	5		1		9	
It does not interfere with other power lines	3	3			9	
The device is lightweight	1	9	9	9	3	
Raw score	533	138	131	54	210	
Relative Weight %		25.9	24.6	10.1	39.4	
Rank Order		3	8	6	6	

6.2 Pugh Chart

Team 304 used the Pugh charts to whittle down the number of concepts. These decisions were made based on the important engineering characteristics determined in the House of Quality. The Pugh charts are used to compare the selected concepts to a datum. The chart uses (+), (-), or (S) to dictate if a concept is better, worse, or satisfactory when it is compared to the datum. The chart uses a (+) symbol to dictate if an engineering characteristic has a more positive effect on the product when compared to the datum. The (-) symbol determines if the concept characteristic is worse than the respective datum. The (S) symbol, satisfactory, is used to represent that the concept is equivalent in function of the engineering characteristic when compared to the datum.

The datum selected for the first iteration Pugh chart is the current method of closing the fuse switch, which uses a device called an extendo pole which reaches to the fuse switch on a utility pole. The three concepts that proved to have the lowest total, shown in red in Table 6.2.1, were then excluded from the concept selection process. The remaining three concepts moved onto the second iteration of the Pugh chart. Most of the three concepts had similar results, so the engineering characteristic which had the greatest effect on the results was the product being collapsable. The concepts which received a better rating were deemed to possess a more productive method of making closing a fuse switch easier. Those concepts used one or more methods of closing the fuse switch, having the variability of concepts allows for different ways of attacking the problem. Fuse switch extendo concept made for a good datum for iteration two because it received a score of 8 in the first iteration of the Pugh chart. This was the median of the results, so it offered room for improvement when compared to the other concepts.

Table 6.2.1: *Pugh Chart: Iteration 1*

Pugh Chart: Iteration 1									
Engineering Characteristic	Fuse Switch Extendo Pole	Concepts							
		Pneumatic Pole	Magfuse	Smart Fuse	Upgraded Hookstick	Cable Pull	Revolver	Upgraded Auburn	Tripod
Reaches 40 feet	Datum	+	+	-	+	+	+	+	+
Endures weather conditions		+	+	S	S	+	+	+	+
The product must be collapsible		+	-	+	-	+	+	+	-
Interacts' with the fuse switch		+	+	+	S	+	+	+	S
Reduces the force needed to reach the switch with the stick.		+	+	+	S	+	+	+	S
The device can resist voltage		+	S	+	S	-	+	S	S
It does not interfere with other power lines		-	S	-	S	-	-	S	S
The device is lightweight		+	-	+	-	+	+	S	S
Plus (+)		7	4	5	1	6	7	5	2
Satisfactory (S)		0	2	1	5	0	0	3	5
Minus (-)		1	2	2	2	2	1	0	1
		12	6	7	3	8	12	13	7

In the second iteration of the Pugh chart, the Pneumatic pole is only satisfactory and no longer provides benefit through its ability to be collapsed, which leaves one sole design idea with the highest score. The Upgraded Auburn design's score remained the same, but because it provides benefits over the Cable pull design as well, it had the best score in the second iteration. Although it loses a benefit in the collapsibility in this iteration, it makes up for that by not interfering with power lines as much as the Cable pull.

Table 6.2.2: *Pugh Chart: Iteration 2*

Pugh Chart: Iteration 2				
Engineering Characteristic	Cable Pull	Concepts		
		Pneumatic Pole	Revolver	Upgraded Auburn
Reaches 40 feet	Datum	+	+	+
Endures weather conditions		+	+	+
The product must be collapsible		S	+	S
Interacts' with the fuse switch		+	+	+
Reduces the force needed to reach the switch with the stick.		+	+	+
The device can resist voltage		+	+	S
It does not interfere with other power lines		+	-	+
The device is lightweight		-	+	S
Plus (+)		6	7	5
Satisfactory (S)		1	0	3
Minus (-)		1	1	0
		11	12	13

6.3 Analytical Hierarchy Process (AHP)

The analytical Hierarchy Process quantifies the importance of a variety of criteria, and justifies decisions that the group makes. Characteristics that are deemed highly relevant in the house of quality were compared against each other to assign numerical values to signify the importance of each characteristic. Using the Comparison Criteria Matrix, the group assigned ascending values to quantify how important specific features are to the overall design. 1 represents equal importance between the two, 3 indicates slightly more important, 5 being moderately more important, 7 demonstrates significantly more important, and 9 can be shown through evidence as being extremely more important. If the value in the matrix is the inverse, it shows that the opposite of one of these designations is true. When each row of the matrix is averaged, we can create a normalized version of the previously mentioned matrix, which is shown in Table 6.3.1. This matrix provides the weighted importance of each criteria, which will then be used to determine the final design in the last stage of the Analytical Hierarchy Process.

Table 6.3.1: *Normalized Comparison Criteria Matrix*

Normalized Criteria Comparison Matrix									
Customer Needs	1. Reaches 40 feet	2. Endures weather conditions	3. The product must be collapsible	4. 'Interacts' with the fuse switch	5. Reduces the force needed to reach the switch with the stick.	6. The device can resist voltage	7. It does not interfere with other power lines	8. The device is lightweight	**Criteria Weight**
1. Reaches 40 feet	0.104275287	0.160771704	0.192307692	0.064516129	0.173110214	0.379075057	0.225225225	0.178571429	0.184731592
2. Endures weather conditions	0.034410845	0.053590568	0.115384615	0.064516129	0.057703405	0.025018954	0.024774775	0.107142857	0.060317768
3. The product must be collapsible	0.020855057	0.017684887	0.038461538	0.064516129	0.057703405	0.025018954	0.024774775	0.035714286	0.035591129
4. 'Interacts' with the fuse switch	0.729927007	0.375133976	0.346153846	0.460829493	0.403923832	0.227445034	0.525525526	0.25	0.414867339
5. Reduces the force needed to reach the switch with the stick.	0.034410845	0.053590568	0.038461538	0.064516129	0.057703405	0.025018954	0.075075075	0.107142857	0.056989921
6. The device can resist voltage	0.020855057	0.160771704	0.115384615	0.152073733	0.173110214	0.075815011	0.024774775	0.178571429	0.112669567
7. It does not interfere with other power lines	0.034410845	0.160771704	0.115384615	0.064516129	0.057703405	0.227445034	0.075075075	0.107142857	0.105306208
8. The device is lightweight	0.020855057	0.017684887	0.038461538	0.064516129	0.019042123	0.015163002	0.024774775	0.035714286	0.029526475
Sum	1	1	1	1	1	1	1	1	1

To ensure the validity of the rated importance of the engineering characteristics, a consistency check was conducted and proved to support the calculated results. The initial Criteria Comparison matrix and the consistency check are shown in Appendix B, Tables B-1 and B-2.

From the normalized chart we determined that “Interact with the fuse switch” and “Reaches 40 feet” are of the highest importance and should be reflected in the final design choice moving forward. These characteristics are critical to our customers' needs and our key goal of being able to easily close the fuse switch.

In our Pugh Chart iterations, we narrowed the design concepts down to three: the Pneumatic pole, the Revolver, and the Upgraded Auburn design. All three designs were compared between each other in relation to each of the individual engineering characteristics. The same rating scale from the Criteria Comparison matrix was used for each of these individual comparisons. Each of these were normalized in the same fashion and given consistency checks, all of which can be found in Appendix B. Similar to the Criteria Weights found in the Criteria Comparison, a Design Alternative Priority was found from the averages of each characteristic matrix. These values were compiled into the Final Rating Matrix shown in Table 6.3.2. These rows show how well the design idea fulfills the engineering characteristic, the higher the value the better it performs and vice versa.

Table 6.3.2: *Final Rating Matrix*

Final Rating Matrix				
	Pneumatic pole	Upgraded Auburn	Revolver	Criteria Weights {W}
Reaches 40 feet	0.125	0.125	0.125	0.136
Endures Weather conditions	0.125	0.125	0.063	0.054
Collapsibility	0.125	0.016	0.344	0.029
Interacts with fuse switch	0.125	0.125	0.125	0.346
Reduces force on user	0.125	0.234	0.125	0.071
Voltage resistance	0.125	0.125	0.125	0.059
Doesn't interfere with power lines	0.125	0.234	0.125	0.536
Lightweight	0.125	0.234	0.016	0.008

Following the assignment of the Design Alternative Priorities into the Final Rating Matrix, the said matrix was multiplied by the Criteria Weights Matrix, the table to the right of the Final Rating Matrix, and placed within Table 6.3.3 below. The Alternative Value chart shows the overall rating for each concept with the higher value representing the best design concept.

Table 6.3.3: *Alternative Value*

Concept	Alternative Value
Pneumatic Pole	0.080
Upgraded Auburn	0.084
Revolver	0.083

Following the values in the table above, the ideal concept to move forward with is the Upgraded Auburn design to complete the assigned functions of the device and best serve the end user.

6.4 Final Selection

Team 304's final selection is the Upgraded Auburn design, which was concept number 64 on the Concept Generation assignment. This decision was made after having the highest alternative value (Table 6.3.3) using the values obtained from AHP and scoring above the datum in both iterations of the Pugh chart on Table 6.2.2. This concept demonstrates the best fit for the needs of the customer and fulfilling the expectations of the project scope, and will be the idea that our group will build upon.

Appendix A - House of Quality

Table A-1: *Binary Pairwise Comparison*

Binary Pairwise Comparison									
Customer Needs	1	2	3	4	5	6	7	8	Total
1. Reaches 40 feet	-	1	1	0	1	0	1	1	5
2. Endures weather conditions	0	-	1	0	0	0	1	1	3
3. The product must be collapsible	0	0	-	0	1	0	0	1	2
4. 'Interacts' with the fuse switch	1	1	1	-	1	1	1	1	7
5. Reduces the force needed to reach the switch with the stick.	0	1	0	0	-	0	0	1	2
6. The device can resist voltage	1	1	1	0	1	-	0	1	5
7. It does not interfere with other power lines	0	0	1	0	1	1	-	0	3
8. The device is lightweight	0	0	0	0	0	0	1	-	1
	2	4	5	0	5	2	4	6	n-1 = 7

Appendix B - AHP

Table B-1: *Criteria Comparison Matrix*

Criteria Comparison Matrix									
Customer Needs	1. Reaches 40 feet	2. Endures weather conditions	3. The product must be collapsible	4. 'Interacts' with the fuse switch	5. Reduces the force needed to reach the switch with the stick	6. The device can resist voltage	7. It does not interfere with other power lines	8. The device is lightweight	**Criteria Weight**
1. Reaches 40 feet	1	3	5	0.14	3	5	3	5	5
2. Endures weather conditions	0.33	1	3	0.14	1	0.33	0.33	3	3
3. The product must be collapsible	0.2	0.33	1	0.14	1	0.33	0.33	1	2
4. 'Interacts' with the fuse switch	7	7	9	1	7	3	7	7	7
5. Reduces the force needed to reach the switch with the stick.	0.33	1	1	0.14	1	0.33	1	3	2
6. The device can resist voltage	0.2	3	3	0.33	3	1	0.33	5	5
7. It does not interfere with other power lines	0.33	3	3	0.14	1	3	1	3	3
8. The device is lightweight	0.2	0.33	1	0.14	0.33	0.2	0.33	1	1
Sum	9.59	18.66	26	2.17	17.33	13.19	13.32	28	n-1 = 7

Table B-2: *Consistency Check 1*

Weighted Sum Vector {Ws}=[C]{W}	Criteria Weights {W}	Consistency Vector {Cons}={Ws}./{W}
2.651	0.136	19.46
0.529	0.054	9.72
0.398	0.029	13.52
6.424	0.346	18.58
0.828	0.071	11.73
0.881638451	0.059	14.95
1.15302089	0.536	2.15
0.343108616	0.008	41.67

Average Consistency	Consistency Index	Consistency Ratio
16.47	2.868	2.584

Table B-3: *Normalized Reaches 40 feet Criteria Comparison*

Normalized Reaches 40 feet Comparison [C]									
	1	2	3	4	5	6	7	8	Design Alternative Priorities {Pi}
1. Pneumatic Pole	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
2. Magfuse	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
3. Smart Fuse	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
4. Upgraded Hookstick	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
5.Cable Pull	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
6. Revolver	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
7. Upgraded Auburn	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
8. Tripod	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
Sum	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Table B-4: *Reaches 40 feet Consistency Check*

Average Consistency	Consistency Index	Consistency Ratio
8.00	2.500	4.808

Table B-5: *Normalized Endures Weather Conditions Criteria Comparison*

Normalized Endures weather conditions Comparison [C]									
	1	2	3	4	5	6	7	8	Design Alternative Priorities {Pi}
1. Pneumatic Pole	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
2. Magfuse	0.125	0.125	0.125	0.125	0.000	0.000	0.000	0.000	0.063
3. Smart Fuse	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
4. Upgraded Hookstick	0.125	0.125	0.125	0.125	0.250	0.250	0.250	0.250	0.188
5.Cable Pull	0.125	0.125	0.125	0.125	0.000	0.000	0.000	0.000	0.063
6. Revolver	0.125	0.125	0.125	0.125	0.000	0.000	0.000	0.000	0.063
7. Upgraded Auburn	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
8. Tripod	0.125	0.125	0.125	0.125	0.375	0.375	0.375	0.375	0.250
Sum	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Table B-6: *Endures Weather Conditions Consistency Check*

Average Consistency	Consistency Index	Consistency Ratio
8.00	2.500	4.808

Table B-7: *Normalized Collapsibillity Criteria Comparison*

Normalized Collapsibility Comparison [C]									
	1	2	3	4	5	6	7	8	Design Alternative Priorities {Pi}
1. Pneumatic Pole	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
2. Magfuse	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.125	0.016
3. Smart Fuse	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.125	0.016
4. Upgraded Hookstick	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.125	0.234
5.Cable Pull	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
6. Revolver	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.125	0.016
7. Upgraded Auburn	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.125	0.344
8. Tripod	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
Sum	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Table B-8: *Collapsibility Consistency Check*

Average Consistency	Consistency Index	Consistency Ratio
8.00	2.500	4.808

Table B-9: *Normalized Interacts with fuse switch Criteria Comparison*

Normalized Interacts with Fuse switch Comparison [C]									
	1	2	3	4	5	6	7	8	Design Alternative Priorities {Pi}
1. Pneumatic Pole	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
2. Magfuse	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
3. Smart Fuse	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
4. Upgraded Hookstick	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
5.Cable Pull	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
6. Revolver	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
7. Upgraded Auburn	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
8. Tripod	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
Sum	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Table B-10: *Interacts with fuse switch Consistency Check*

Average Consistency	Consistency Index	Consistency Ratio
8.00	2.500	4.808

Table B-11: *Normalized Reduces force needed for traditional fuse switching Criteria Comparison*

Normalized Reduces force needed for traditional fuse switching Comparison [C]									
	1	2	3	4	5	6	7	8	Design Alternative Priorities {Pi}
1. Pneumatic Pole	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
2. Magfuse	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
3. Smart Fuse	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.125	0.234
4. Upgraded Hookstick	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.125	0.016
5.Cable Pull	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.125	0.016
6. Revolver	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.125	0.234
7. Upgraded Auburn	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
8. Tripod	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
Sum	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Table B-12: *Reduces force needed for traditional fuse switching Consistency Check*

Average Consistency	Consistency Index	Consistency Ratio
8.00	2.500	4.808

Table B-13: *Normalized Voltage resistance Criteria Comparison*

Normalized Voltage resistance Comparison [C]									
	1	2	3	4	5	6	7	8	Design Alternative Priorities {Pi}
1. Pneumatic Pole	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
2. Magfuse	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
3. Smart Fuse	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
4. Upgraded Hookstick	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
5.Cable Pull	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
6. Revolver	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
7. Upgraded Auburn	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
8. Tripod	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
Sum	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Table B-14: *Voltage resistance Consistency Check*

Average Consistency	Consistency Index	Consistency Ratio
8.00	2.500	4.808

Table B-15: *Normalized Does not interfere with other power lines Criteria Comparison*

Normalized Does not interfere with other power lines Comparison [C]									
	1	2	3	4	5	6	7	8	Design Alternative Priorities {Pi}
1. Pneumatic Pole	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
2. Magfuse	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
3. Smart Fuse	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.125	0.234
4. Upgraded Hookstick	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.125	0.016
5.Cable Pull	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.125	0.016
6. Revolver	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.125	0.234
7. Upgraded Auburn	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
8. Tripod	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
Sum	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Table B-16: *Does not interfere with other power lines Consistency Check*

Average Consistency	Consistency Index	Consistency Ratio
8.00	2.500	4.808

Table B-17: *Normalized Device is lightweight Criteria Comparison*

Normalized Device is lightweight Comparison [C]									
	1	2	3	4	5	6	7	8	Design Alternative Priorities {Pi}
1. Pneumatic Pole	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
2. Magfuse	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.125	0.234
3. Smart Fuse	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.125	0.234
4. Upgraded Hookstick	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.125	0.016
5.Cable Pull	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.125	0.016
6. Revolver	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.125	0.234
7. Upgraded Auburn	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.125	0.016
8. Tripod	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
Sum	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Table B-18: *Device is lightweight Consistency Check*

Average Consistency	Consistency Index	Consistency Ratio
8.00	2.500	4.808