Quick Change Electrical Connection

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Team 09

Need Identification

Document

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1.0 Introduction

This project works with the defense company Raytheon to design a self-aligning, simply installed quick-change nose assembly for a weapon. Since their start 90 years ago, Raytheon has been known for their admirable defense and aerospace systems that has been used in government applications throughout the world. Today, their projects remain at the top of their industry with Integrated Defense Systems, Intelligence and Information Systems, Raytheon Missile Systems, and Space and Airborne Systems.

Our team is given the opportunity to be a part of the Raytheon Company by designing a quick-change nose assembly for a weapon. This includes electronic connections that self-align and provides a secure contact of that connection for all environmental factors the weapon will experience in normal conditions.

2.0 Need Statement

The current nose assembly is unable to provide the ability to quickly install the nose without compromising the electrical connection.

3.0 Problem Statement

Goal:
Design an improved electrical connection alignment.

Objectives:

To design an alignment for the electrical connection, the following objectives in Table 1 must be met. Our design must be cost effective because this will be reproduced on a large scale and must last the life of the nose assembly, which is 15 years. Our design must also be easily replaced and repaired in the field if any damages were to occur.

Table 1: Objectives

Objective	Basis of Measurement	Units
Inexpensive	Cost of producing 200 units per year	$
Long life	Time before failure	Years
Field Replaceable	Time taken to replace	Minutes
Easily Repaired	Distance part is deformed	Inches

Constraints:

- Must fit in a 1.5'' x 4'' x 2'' zone
- Connection must be maintained for a mating tolerance of ±0.020''
- Resistance to captive carriage vibration standards

- **Transportation Loads**: Must resist 30 Gs of shock in all directions
- **Temperature Range**: -54^{o} to 80^{o} C
- **Sand**: The connector shall be able to operate after exposure to blowing sand with protective covers at particle concentration of 1.06 gram (gm)/m3 with a wind velocity of 40 mph (59 ft/sec, 17.9 m/s) and a corresponding particle size from 74 to 1000 micrometers.
- **Dust**: The connector should be able to be exposed to dust at a particle concentration of 10.6 ± 7 grams (gm)/m^3 with a wind velocity of 20 mph (29 ft/sec, 8.95 m/s) and a corresponding particle size less than 150 micrometers.
- **Water and Ice**: The nose assembly should be able to be operated under exposure to 1 inch/hr (25.4 mm/hr) with an average droplet size of 0.07-inch diameter for duration of 5 min at a velocity of 862 ft/sec.
- **Bomb Rack Ejection Shock**: Must be able to resist loads from a 50G acceleration from ejection of an aircraft.
- **Corrosion Resistance**: Must be able to resist exposure to 5% salt solution
- Must be compatible with JP-10 Jet Fuel.

Test Environment:

The environment that our design will be tested at must be capable to meet all the constraints listed above. This would have to be in a test facility at Raytheon, and various places at NAU. For instance the temperature test could be done in the mechanics of material lab, room 117, as well as testing for fatigue and endurance strength.

Recapitulation of Problem Statement

Need: The current nose assembly is unable to provide the ability to quickly install the nose without compromising the electrical connection.

Problem Definition

Goal: Design an improved electrical connection alignment.
Objectives:

Objective	Basis of Measurement	Units
Inexpensive	Cost of producing 200 units per year	$
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- Transportation Loads
- Temperature Range
- Sand
- Dust
- Water and Ice
- Bomb Rack Ejection Shock
- Corrosion Resistance
- Must be compatible with JP-10 Jet Fuel.

4.0 Criteria Tree

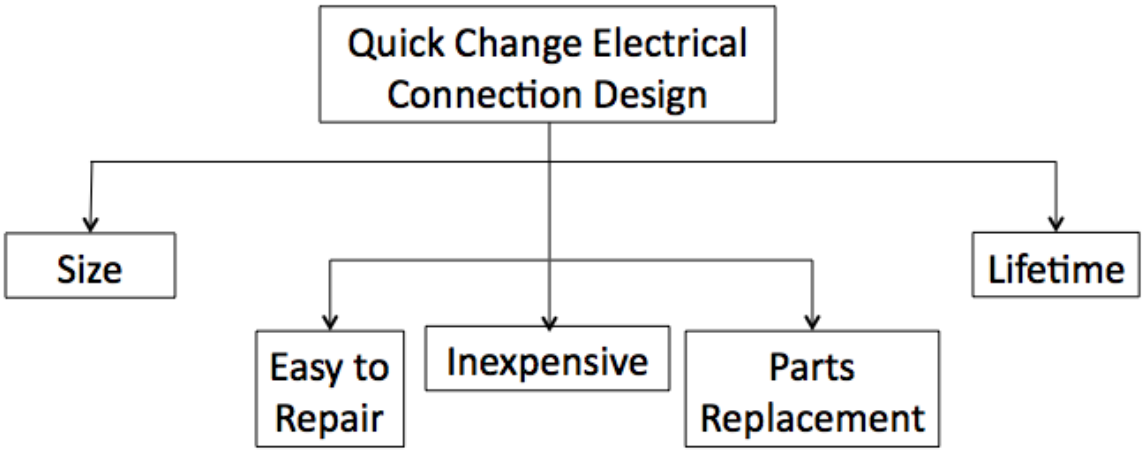


Figure 1 - Criteria Tree

This Criteria Tree represents the criteria of the project and what the design team needs to accomplish. All of these items are important for the Quick Change Electrical Connection Design.

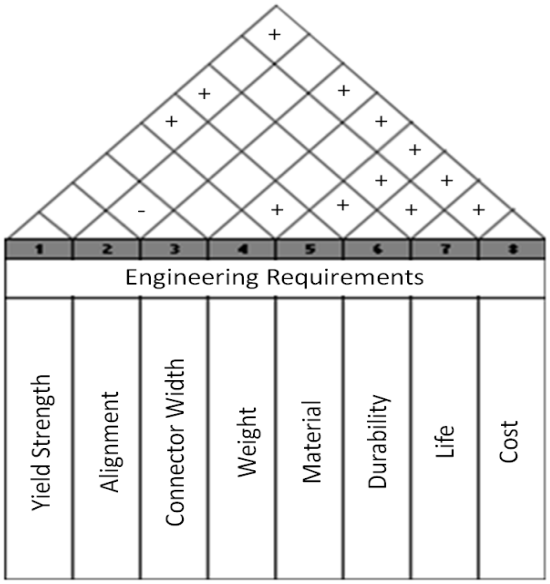
5.0 Quality Function Deployment with House of Quality

Table 2: Quality Function Deployment

	Yield Strength	Alignment	Connector Width	Weight	Material	Durability	Life	Cost
Withstands Corrosion					X	X		
Operates under Various Conditions					X	X		
Resistant to damage	X							
Fits Properly		X	X					
Lasts a long time							X	
Withstands Forces	X					X		
Inexpensive				X				X
Units	Pa	cm	cm	N	C	cm	Years	$

This table assesses how the customer requirements correlate to the engineering requirements. For example the table shows that by what material we choose and the durability of that material, we can insure that our design will meet the requirement that it withstands corrosion. This allows our team to discern which requirements will give the best analysis.

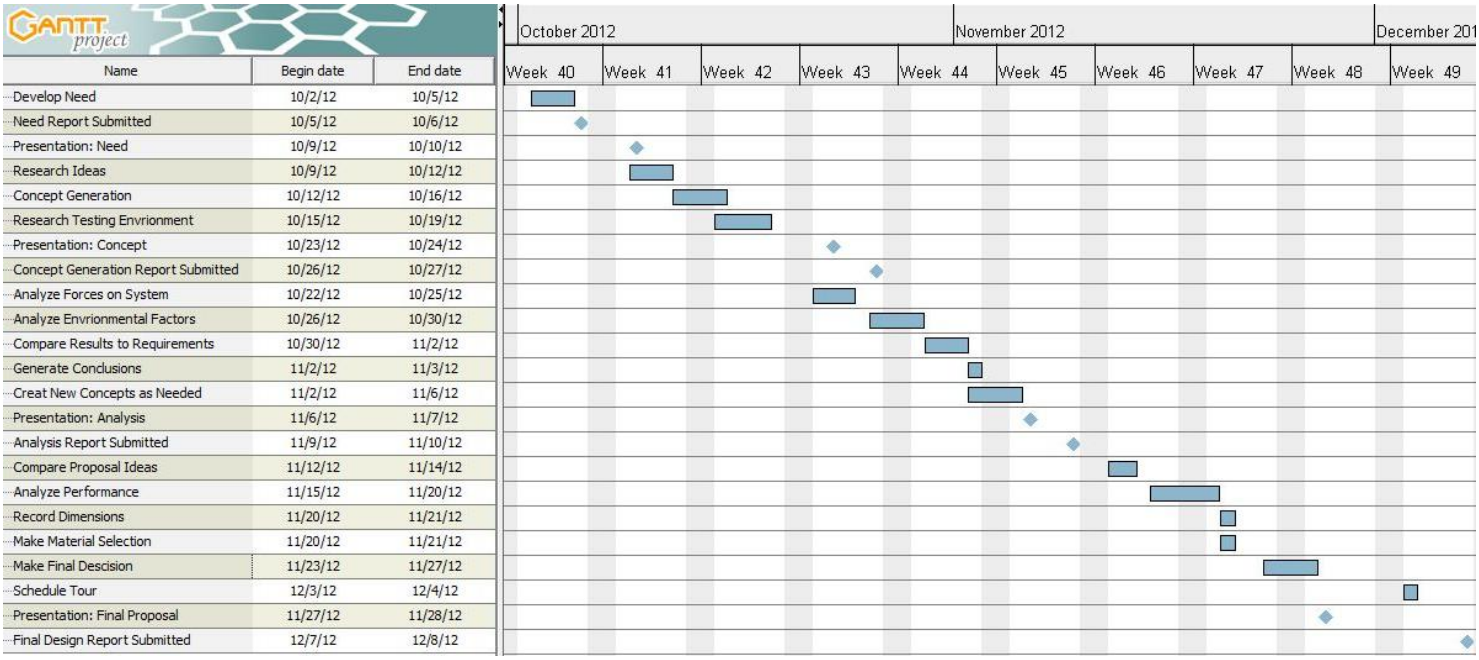
Table 3: House of Quality



This table shows whether the different requirements are positively correlated or negatively correlated. This allows our team to accurately connect the similarities of each of the requirements. For instance, this table shows that the material and durability of our design are positively correlated which means when the strength of the material increases, so will the durability.

6.0 Gantt Chart

Below is our project plan for the upcoming months:



Name	Begin date	End date
Develop Need	10/2/12	10/5/12
Need Report Submitted	10/5/12	10/6/12
Presentation: Need	10/9/12	10/10/12
Research Ideas	10/9/12	10/12/12
Concept Generation	10/12/12	10/16/12
Research Testing Envrionment	10/15/12	10/19/12
Presentation: Concept	10/23/12	10/24/12
Concept Generation Report Submitted	10/26/12	10/27/12
Analyze Forces on System	10/22/12	10/25/12
Analyze Envrionmental Factors	10/26/12	10/30/12
Compare Results to Requirements	10/30/12	11/2/12
Generate Conclusions	11/2/12	11/3/12
Creat New Concepts as Needed	11/2/12	11/6/12
Presentation: Analysis	11/6/12	11/7/12
Analysis Report Submitted	11/9/12	11/10/12
Compare Proposal Ideas	11/12/12	11/14/12
Analyze Performance	11/15/12	11/20/12
Record Dimensions	11/20/12	11/21/12
Make Material Selection	11/20/12	11/21/12
Make Final Descision	11/23/12	11/27/12
Schedule Tour	12/3/12	12/4/12
Presentation: Final Proposal	11/27/12	11/28/12
Final Design Report Submitted	12/7/12	12/8/12

Figure 2 - Gantt Chart

7.0 References

[1] Steve, Larimore. United States. Raytheon Missile Systems. *Univeristy Design Project 2012-2013*. 2012. Print.

8.0 Appendices

Appendix A Page