Northrop Grumman

Articulating Handling Arm: Background Presentation

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Northrop Grumman Logo [1]

Project Description

Northrop Grumman Corporation (NGC)

- Requested team design of a functional handling arm
- Able to hold avionics
- Articulating/maneuverable
- Soldering/other necessary activities
    - During system integration and testing

Background

- This is a new concept
  - NGC currently has no identical products
- Researched similar designs
- Used similar ideas/concepts for benchmarking

Benchmarking

- Tabletop tablet mount
- Moves in all 6 directions
- Supports up to 2 lbs
- Uses post for height adjustment
- $94.95

Figure 1: Tablet Stand [2]

Benchmarking (Continued)

- Tabletop monitor stand
- Hand movements in all 6 directions
- Supports up to 33 lbs
- Swivels at clamp
- $129.99

Figure 2: Monitor Stand [3]

Benchmarking (Continued)

- Motorized robotic arm kit
- Moves in all 6 directions
- Has proper pivot points
- $299.99

Figure 3: Robotic Arm [4]

Benchmarking (Continued)

- Tabletop LED desk lamp
- Spring operated to keep position
- Moveable in all needed directions
- $173.10

Figure 4: Desk Lamp [5]

Customer Requirements

- Reliability
- Durability
- Supports Size Requirements
- Supports Load Requirements
- Budget
- Benchtop Mountable
- Electrostatic discharge (ESD) Compliant
- Easy Manipulation
- Safety
- Portability

Engineering Requirements

Table 1: Engineering Requirements

Customer Requirement	Engineering Requirement	Target
Reliability	Longevity of Components	Life Cycles
Durability	Structural Integrity	Load tested to 125% (lbs.)
Size Requirement	Size of Components	Minimum: 6.0 x 2.5 x 1.125 (in.) Maximum: 6.0 x 2.5 x 12.375 (in.)
Load Requirement	Load Capacity	Minimum:1/2 (lbs.) Maximum: 15 (lbs.)
Benchtop Mountable	Compatible with Table	Pressure (psi)
ESD Compliant	ESD Compliant	0V between arm and user (V)
Ease of Manipulation	Torque Requirements	20lbs additional force @ locked (lb-ft)
	Degrees of Freedom	Six (df)
Safety	Factor of Safety	Safety Factor: ≥3.0
Portability	Device Weight	≤50 (lbs.)
Budget	Cost	1,450 ($)

House of Quality

Table 2a: House of Quality

			Technical Requirements									
	Customer Needs	**Customer Weights (1-10)**	Longevity of Components	Structural Integrity	Size of Components	Load Capacity	Compatible with Table	ESD Compliant Material	Degrees of Freedom	Factor of Safety	Device Weight	Cost
1	1. Reliability	8	9	9		1						
2	2. Durability	7	9	9		1						
3	3. Size Requirement	10			9				1			3
4	4. Load Requirement	10		3		9				1		3
5	5. Benchtop Mountable	8					9		1		3	
6	6. ESD Compliant	6						9				3
7	7. Easy Manipulation	7	3		3				9	1	3	
8	8. Safety	10	3	9						9		
9	9. Portability	7			9		3		1		9	3
10	10. Budget	6	3	1	3	1	1	1	1	1	3	9

House of Quality (Continued)

Table 2b: House of Quality

Technical Requirement Units	Life Cydes	lb	in	lb	psi	V	df	FoS	lb	$
Technical Requirement Targets	10^6	125%	*	*	0.4	0	6	≥3	≤50	1450
Absolute Technical Importance	204	261	192	111	99	60	94	113	126	153
Relative Technical Importance	2	1	3	7	8	10	9	6	5	4

* - minimum and maximum requirements given by client

House of Quality (Continued)

Table 2c: House of Quality

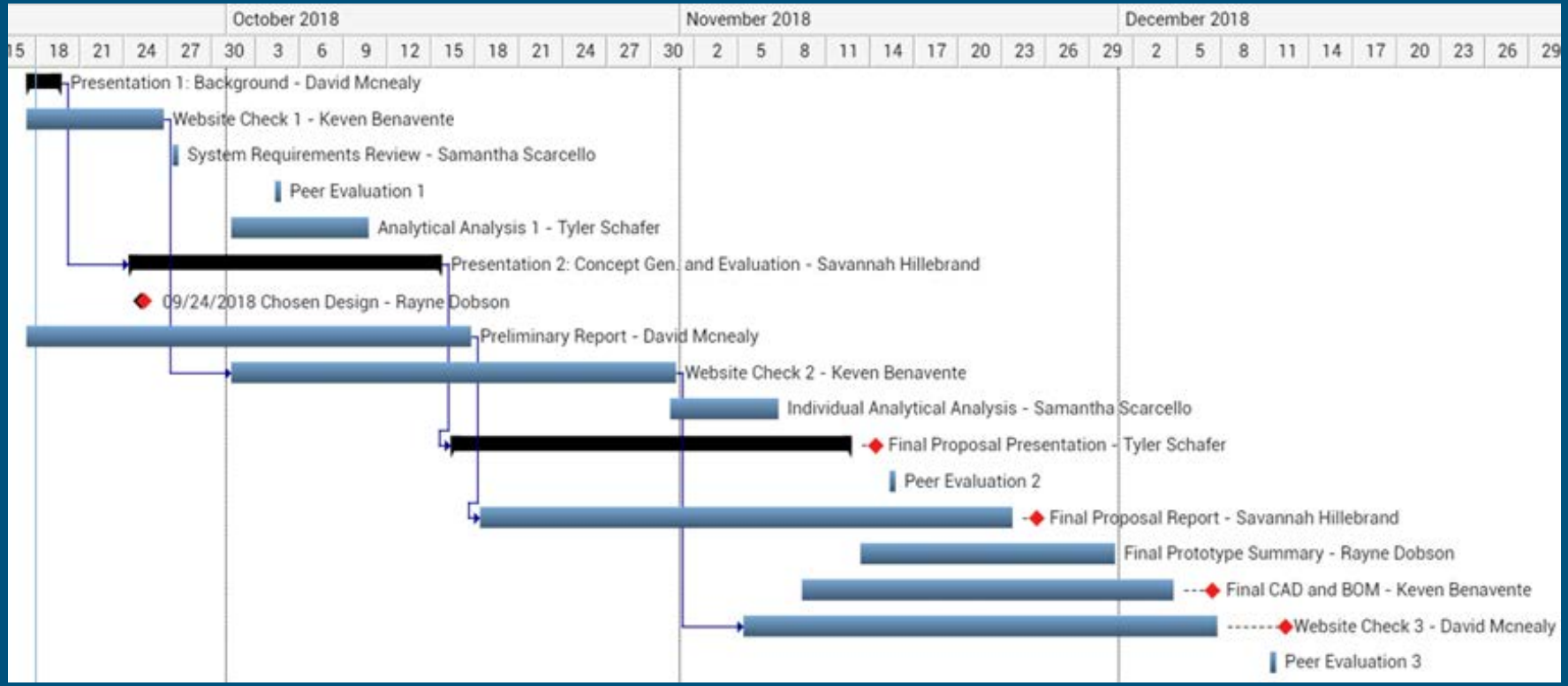
1	Longevity of Components										
2	Structural Integrity	++									
3	Size of Components										
4	Load Capacity	+	++								
5	Compatible with Table			-							
6	ESD Compliant Material										
7	Degrees of Freedom			--		+					
8	Factor of Safety		++		++						
9	Device Weight		-	--							
10	Cost	-	-	--			-		-	--	
							Technical Requirements				
	Customer Needs	**Customer Weights (1-10)**	Longevity of Components	Structural Integrity	Size of Components	Load Capacity	Compatible with Table	ESD Compliant Material	Degrees of Freedom	Factor of Safety	Device Weight	Cost

Schedule

- Finish Assignments 36 hours before Deadline
- Milestones
  - Design Selection
  - Website Check
  - Preliminary Design Review
  - Critical Design Review
  - Final Proposal report
  - Final CAD and BOM

Gantt Chart

Table 3: Gantt Chart



Budget

Table 4: Budget

Item	Details	Miles	Quantity	$/day	Total
Gas [6]	2014 Chevy Suburban 4WD	332 (round trip)	5 trips	$50	$250
Vehicle Rental			5 trips	$60	$300
Prototyping	3D printing, nuts, bolts, etc				$300
Final Product	Finished and Final Product				$600
			Grand Total		**$1,450**

* Gas Prices Estimated using GasBuddy

References

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Questions