Orbital Test Stand

Problem Definition and Project Plan

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Presentation Overview

- ❏ Introduction
- ❏ Customer Needs
- ❏ Goals
- ❏ Objectives
- ❏ Constraints
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- ❏ Schedule

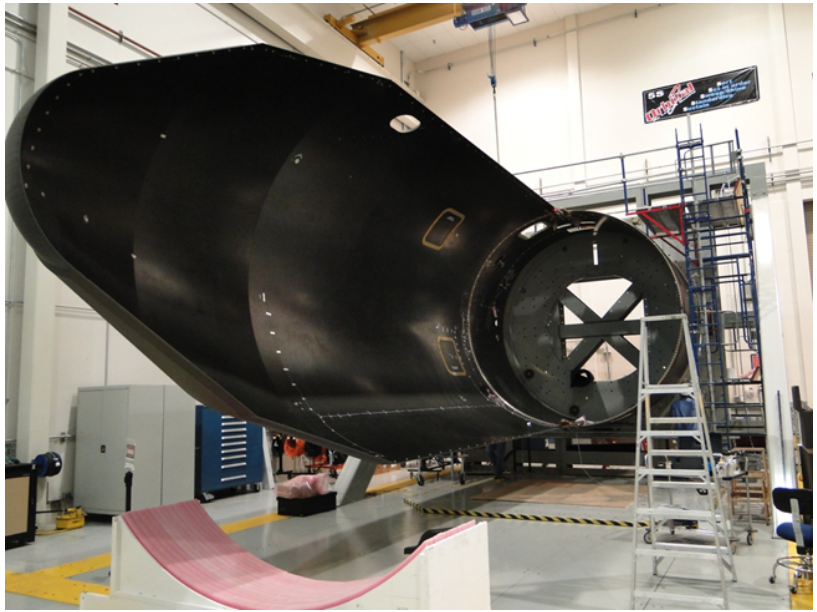
Introduction to Orbital

- Specializes in small- and medium-size space and rocket systems
- An important player in the $100 billion annual global space market
- Manufactures and tests a number of notable launch systems including the Antares (right), Pegasus, and Minotaur
- Provides launch services for U.S. government, commercial, and international customers
- Emphasizes a strategy based on clear market focus, product line breadth, technical excellence, and cost efficiency

Antares launch vehicle
Source: Orbital

Customer Needs

- The procedure for rotating launch vehicles on the test stand is inefficient and unsafe.
- Rotating launch vehicles on the test stand places Orbital engineers in a dangerous position.
- The setup time for testing is exhausted by the need to manually rotate the launch vehicles.



Horizontal test stand with one fairing loaded

Source: Orbital

Project Goals

- ❑ Meet customer requirements
- ❑ Easy to transport and integrate
- ❑ Easy to operate
- ❑ Easy to manufacture/maintain

Project Objectives

Objective	Measurement Basis	Units
Minimize time it takes to load launch vehicle onto test stand	Time to load launch vehicle with new mechanism in place compared to current procedure	minutes
Minimize costs associated with new design concept	New design cost compared to maintaining current procedure	dollars
Limit new modifications made to test stand	Cost of material for modifications	dollars
Handle the loads of full catalog of Orbital launch vehicles	Strength	psi
Minimize space requirements	Square footage required by new mechanism	ft^2
Improve manuerability of launch vehicle movement	Vertical/horizontal movements of test vehicle	ft

Project Constraints

- Mechanism should allow for launch vehicles to rotate +/- 360 degrees
- Rotational speed of mechanism should not exceed 1 RPM
- Mechanism should be able to counteract an off-center load of 570 lb at 153 inches
- Mechanism should interface with current design using minimal modifications

Testing Environment

Environment A

- ❏ Material testing
- ❏ Max moment
- ❏ Strength
- ❏ Small scale model

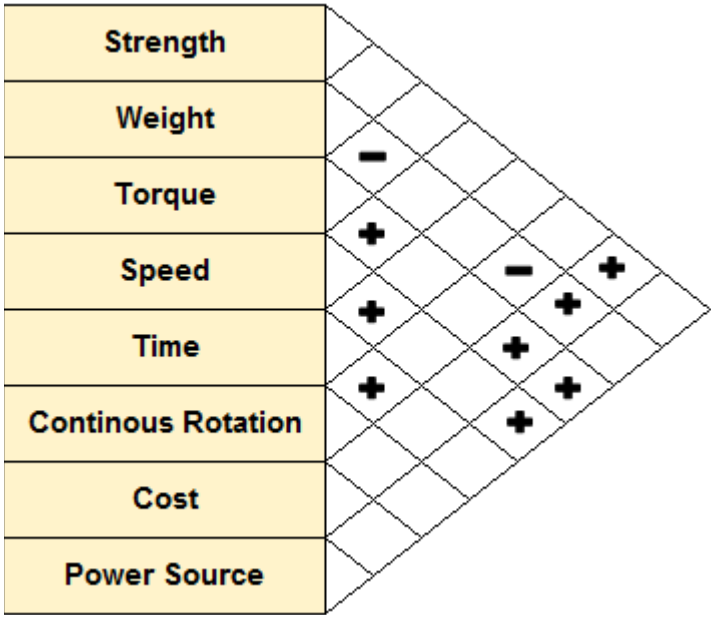
Environment B

- ❏ Computer testing
- ❏ Simulation
- ❏ Finite Element Analysis

Quality Function Deployment (QFD)

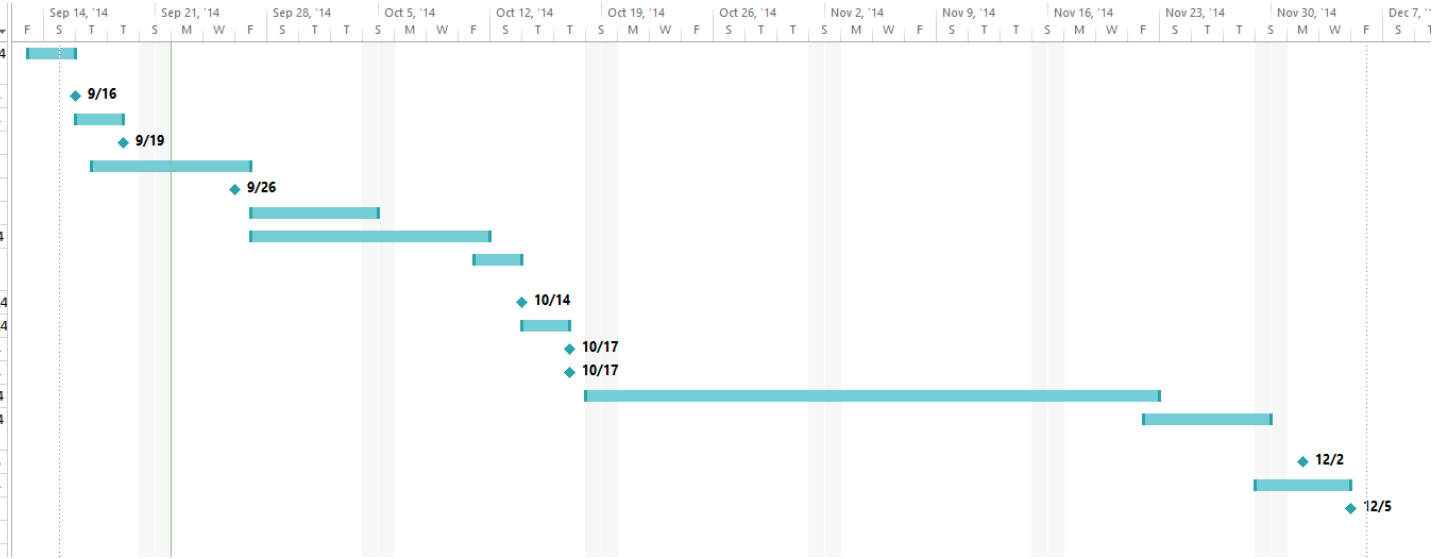
		ENGINEERING REQUIREMENTS							
		Strength	Weight	Torque	Speed	Time	Continous Rotation	Cost	Power Source
CUSTOMER REQUIREMENTS	Provide 360° Rotation				X	X	X		
	Rotate less than 1 rpm				X	X			X
	Counteract off-center load	X	X	X					
	Attach to Test Stand	X	X					X	
	Interface with Adapter Ring	X	X					X	
	Minimal Modifications							X	

House of Quality



Project Schedule

Task Mode	Task Name	Duration	Start	Finish
	Prepare presentation 1	2 days	Sat 9/13/14	Mon 9/15/14
	Presentation 1	0 days	Tue 9/16/14	Tue 9/16/14
	Prepare report 1	3 days	Tue 9/16/14	Thu 9/18/14
	Report 1	0 days	Fri 9/19/14	Fri 9/19/14
	SOTA	8 days	Wed 9/17/14	Fri 9/26/14
	Orbital trip	0 days	Fri 9/26/14	Fri 9/26/14
	Concept generation	7 days	Sat 9/27/14	Sat 10/4/14
	Preliminary analysis	12 days	Sat 9/27/14	Sat 10/11/14
	Prepare presentation 2	2 days	Sat 10/11/14	Mon 10/13/14
	Presentation 2	0 days	Tue 10/14/14	Tue 10/14/14
	Prepare report 2	3 days	Tue 10/14/14	Thu 10/16/14
	Report 2	0 days	Fri 10/17/14	Fri 10/17/14
	Concept selection	0 days	Fri 10/17/14	Fri 10/17/14
	Analysis/Modeling/C	27 days	Sat 10/18/14	Sat 11/22/14
	Prepare presentation 3	7 days	Sat 11/22/14	Sat 11/29/14
	Presentation 3	0 days	Tue 12/2/14	Tue 12/2/14
	Prepare report 3	5 days	Sat 11/29/14	Thu 12/4/14
	Report 3	0 days	Fri 12/5/14	Fri 12/5/14



Conclusion

- **Customer Need**: Safe, efficient, and reliable mechanism for rotating launch vehicles on test stand
- **Project Goal**: Develop an easily integratable mechanism to satisfy customer need
- **Project Objective**: Minimize costs and modifications associated with new design
- **Project Constraints**: Continuous rotation of +/- 360 degrees with a speed not exceeding 1 RPM
- **Testing Environment**: Small physical model and computer simulations
- **Project Schedule**: Three phases for Fall 2014 semester

References

[1] S. Hengl, “Request for Proposal for NAU Capstone Project,” Aug., 2014.

[2] R. Gentle, “Horizontal Test Stand Structure Rotation Mechanism,” Sept. 2014.

[3] Orbital Sciences. *About Orbital* [Online]. Available: https://www.orbital.com/CompanyOverview/About/

[4] Orbital Sciences. *Chairman’s Welcome* [Online]. Available: https://www.orbital.com/CompanyOverview/