Post Launch Assessment Review

By:

Georgia Tech A.R.E.S.

NASA Student Launch 2017

Project Name: KRIOS

April 24th, 2017

Georgia Institute of Technology
School of Aerospace Engineering
270 Ferst Drive, Atlanta GA 30332 - 0150

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1. Team Summary

Table 1.1: Team Summary

Team Summary	
School Name	Georgia Institute of Technology
Mailing Address	270 Ferst Drive, Atlanta GA 30332 - 0150
Team Name	Team A.R.E.S. (Autonomous Rocket Equipment System)
Project Title	Mile High Club
Rocket Name	KRIOS
Project Lead	Sam Rapoport
Project Lead E-mail	samrapoport3@gmail.com
Team Email	gtares@gmail.com
Safety Officer	Vikas Molleti
Team Advisor	Dr. Eric Feron
Team Advisor e-mail	eric.feron@aerospace.gatech.edu
NAR Section	Primary: Southern Area Launch Vehicle (SoAR) #571
NAR Contact, Number & Certification Level	Gerardo Mora gmora3@gatech.edu NAR Number: 98543 Certification Level: Level 2 Certified for HPR by NAR

2. Launch Vehicle

2.1. Vehicle Summary

The launch vehicle, KRIOS, is designed with the goal of maximizing safety and performance. As is standard in most model rockets, there are two separations points (shown in Figure 2.1): One just below the avionics bay where the drogue parachute deploys from, and one just below the nose cone, where the main parachute resides. Unlike in most other designs presented at the competition, the roll-inducing mechanism for this vehicle actuates at the bottom, below the CP, such that stability does not decrease during flight. A view of this system mounted to the bottom of the motor tube can be seen in Figure 2.3.

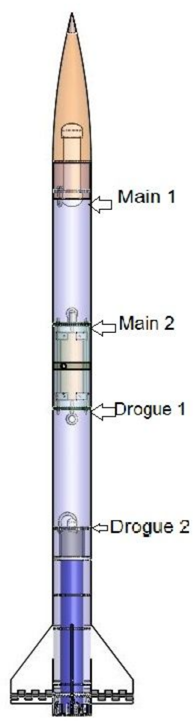

Figure 2.1 Ejection Charges

Figure 2.2 Completed Vehicle

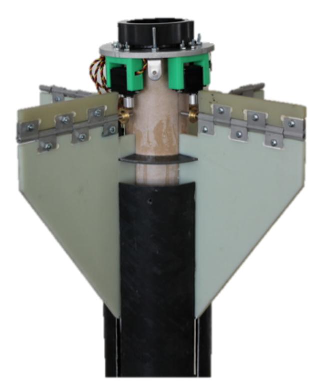

Figure 2.3 Roll Mechanism

2.1.1 Vehicle Dimensions

Dimension Description	Value
Length (nosecone tip to motor retainer)	102.5 in
Tube Diameter	5.5 in
Coupler Length	11 in
Center of Pressure	80.98 in
Center of Gravity	67 in
Motor Selection	Aerotech L1150R
Total Impulse	3488.95 Ns
Gross Lift Off Weight	541 oz
Thrust to Weight Ratio	7.3

2.2 Payload Summary

2.2.1 Brief Payload Description

The vehicle's payload was designed to accomplish active roll control. The payload consisted of a roll mechanism and electronics suite. The mechanism actuated ailerons on the trailing edge of the fins.The electronics suite which collected data on the vehicle's state and sent commands to the roll control mechanism. The system implemented a number of physical and electrical constraints in order to be robust to failure.

3. Lessons Learned

3.1. Summary of Overall Experience

Overall, competing this year has given the team a very valuable learning experience. All of the members on the team were completely new to the competition, and most were underclassmen without a large amount of technical experience. In addition, we had no faculty, funding, or engineers/grad students with large technical knowledge to rely on. In order to succeed, we reached out rapidly to many different faculty, departments, organizations, and companies to secure funding and ensure we'd have the resources to participate.

One of the main flaws this year was lack of rigid structure and sticking to hard deadlines. We were largely successful in the design and building of our rocket, however most launches we tried to put everything together last minute, causing any small solvable issue to be too large a time delay for us to successfully launch. We have learned that it's critical to leave a large buffer of time before deadlines to allow time to fix unseen problems before a critical window. We learned the value of GANTT Charts and will flesh our's out more and adhere much more rigidly to it next year.

We gained a lot of technical experience, but more than that learned a huge deal (sometimes the hard way) about project management, the engineering cycle and fixing things that go wrong, management of people, group management and organization, and communication.

3.2 Improvements for Next Year

Improvements Needed	What Worked?
Keep an updated timeline for each team	Secured adequate funding early on
Meeting set up for sub teams	High quality presentations
Modular design to split up systems and distribution of avionics eqpt in vehicle	Streamlined new members and gave them tasks to bring them up to speed quickly
Better packaging and preparation for transportation to prevent vehicle damage	Attending several launches to get familiar with procedures and safety expectations
Generate documentation throughout year, note every design change	Took advantage of several outreach opportunities
More active Gantt Chart, use to enforce deadlines, updated by subteams	
More social events to encourage team bonding	

Team Apparel	
Recruitment of more technically diverse/experienced members	
More effort needs to be spent of presentation of work at Rocket Fair during competition. Includes Aesthetics of rocket, live system demos, interactive displays, team spirit.	

3.2.1 Organization of Next Year

Most of the positions from this year will carry over to next year. However, to aid in documentation and the design process we have added three new roles to the team: A Chief Engineer to oversee the progress of each sub-team and provide coordination between mechanical and electrical systems, a Review Board composed of graduate students who will serve as a panel that will advise and accept designs/revisions, and a Systems team to keep track of revisions over time, require necessary documentation to be created for each revision, and alter relevant members of design changes to the vehicle. All leadership positions have been filled with newly elected members, and there are plans in place to ensure transfer of knowledge from old leadership to new ones throughout the summer. See Figures 3.1 and 3.2 to see the organizational charts for team structure next year.

A new purchase order has been created, and will be filled using remaining funds to re-stock the club's inventory of raw material, as well as introduce new tooling and furniture to build infrastructure and ensure smoother operation next year.

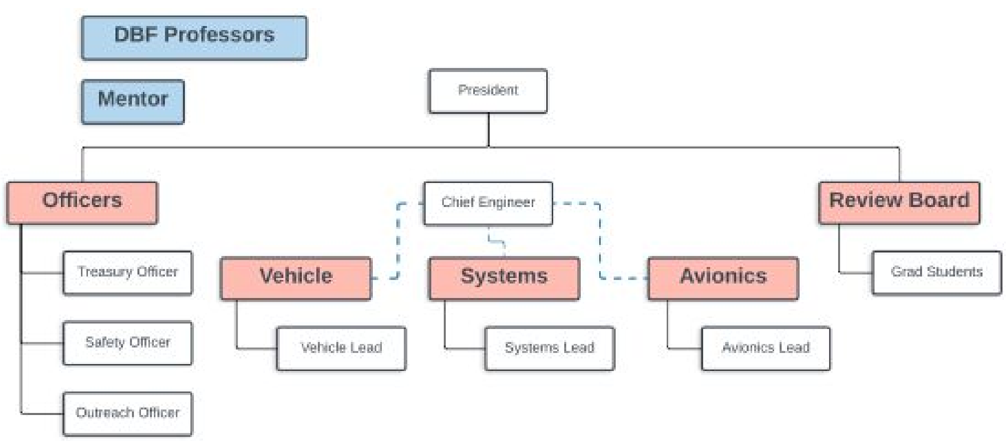

Figure 3.1 Team Hierarchy

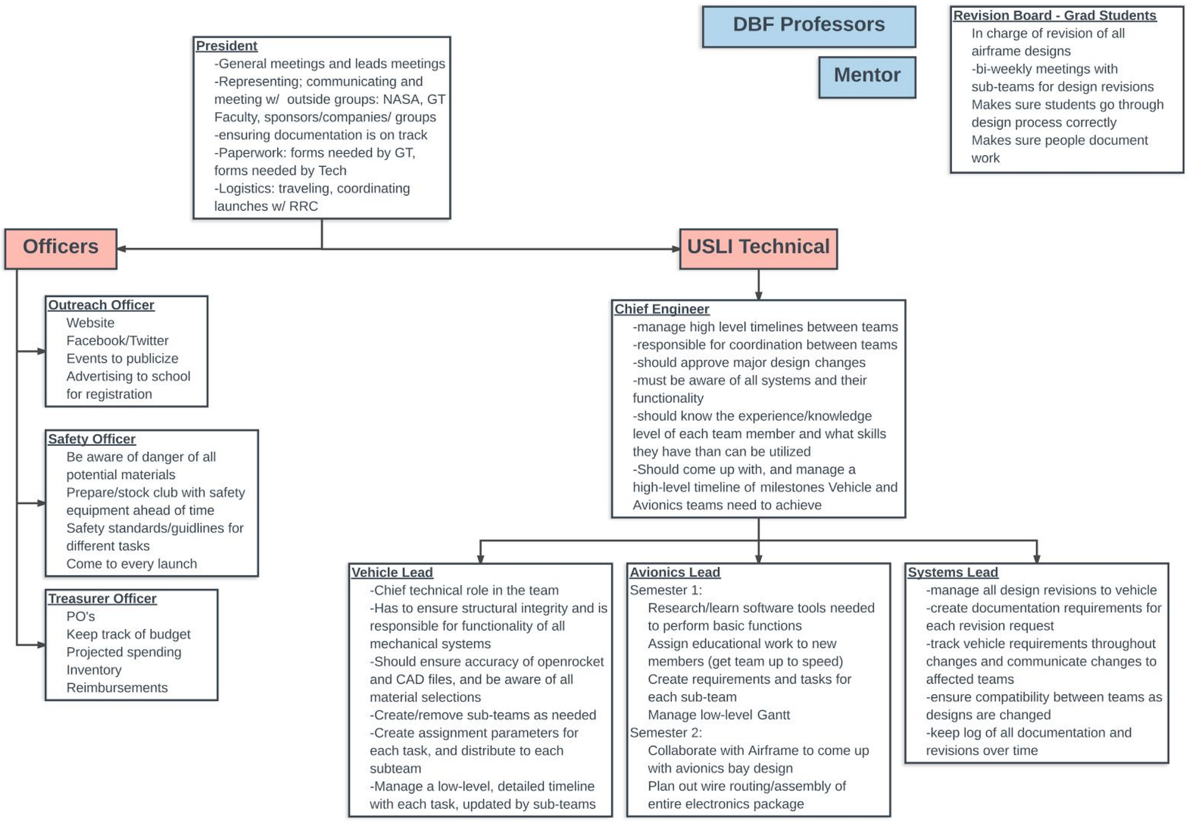

Figure 3.2 Leadership Roles & Descriptions

4. Educational Engagement Summary

4.1 Peachtree Charter Middle School

With Peachtree Charter Middle School, we worked with the 7th grade technology teacher to develop a 3 week curriculum about rocketry, discussing the history of rocketry and spaceflight, the physics of trajectories, CAD, and the engineering process. While the curriculum was being taught, we visited the school and taught two classes a lesson about the physics of trajectories, and then talked about our rocket, USLI, and the design process with them and showed them our rocket.

4.2 Boy Scout Engineering Merit Badge

In February, we arranged with a local Boy Scout troop to come to Georgia Tech to teach them the Engineering merit badge, show them around a college campus (more specifically a STEM college), and show them some of the labs and projects us in the team are involved with.

In the Engineering merit badge, we taught basics of materials science, discussed our rocket and project in respect to the engineering design cycle, and had them design, sketch, and pitch their own unique product.

4.3 Future Plans

Next year, we plan on continuing our Peachtree Charter program and Boy Scout merit badges. We also hope to reestablish an after school rocketry program we previously ran at Frederick Douglass High School. In addition, we hope to run a booth and establish a presence at the Atlanta Science Festival in spring and Inventor's Faire in fall. We also plan to work with CEISMC (Georgia Tech's education outreach branch) and assist them in events.

5. Budget Summary

5.1 Funding Sources

Sponsor	*Contribution*	*Date*
2015-2016 Unused Funds	$388	--
Georgia Space Grant Consortium	$4000	Oct 2016
Georgia Tech Aerospace Department	$2500	Jan 2017
Orbital ATK Motor and Travel Stipend	400	Apr 2017
Total	$7300	

5.2 Spent Budget

Item	*Cost*
Rocket Materials	$3600
Travel	$1100
Total	$4700

The remaining funding will go towards resources for next year and expanding of tooling/inventory.

5.3 Future Funding

Next year we plan to continue established funding from the Georgia Space Grant Consortium. We are working closely now with Georgia Tech's Aerospace Systems Design Lab for next year and will have funding through sponsors that department, and most likely can re-acquire funding through Georgia Tech's Aerospace Department again if necessary.