2014-2015 NASA Student Launch Project Proposal

Florida International University
American Society of Mechanical Engineers (FIU-ASME)

Florida International University Engineering Center
College of Engineering and Computing
10555 West Flagler Street
Miami, Florida 33174

Maxi-MAV *October 6th, 2014*

Contents

1.0 TEAM OVERVIEW

The student section of the American Society of American Engineers (ASME) at Florida International University (FIU) would like to participate in the 2014-2015 NASA Student Launch competition. The FIU-ASME team wishes enter the Maxi-MAV portion of the competition. As this is the first year in which FIU is seeking to participate, the goal is to establish a rocketry group and increase interest in the field of rocketry among FIU students.

1.1 FACULTY ADVISOR

Dr. Benjamin Boesl
Assistant Professor, Mechanical Eng., PhD
bboesl@fiu.edu
(305) 348-3028

Florida International University
MME Department
10555 West Flagler Street
Miami, Florida 33174

1.2 TEAM PARTICIPANTS

Team Leader
Giancarlo Lombardi
BS Mechanical Engineering – Senior
NAR Member – Level 1 Certified
glomb002@fiu.edu
(305)632-8584

Project Manager
Maryel Gonzalez
BS Mechanical Engineering – Senior
NAR Member – Level 1 Certified
mgonz219@gmail.com
(786)712-3155

Safety Officer
Carmela Vallalta
BS Mechanical Engineering - Junior
cvall045@fiu.edu
(954)496-0838

Lead Designer
Christopher Hayes
BS Mechanical Engineering - Senior
chaye001@fiu.edu
(305)905-4301

Chief Engineer
Joseph Coverston
BS Mechanical Engineering – Junior
TRA Member – Level 2 Certified
jcove010@fiu.edu
(407)754-6572

Members

Name	Major	Standing
Mateo R.	Mechanical Eng.	Sophomore
Jorge D.	Mechanical Eng.	Sophomore
Alexander D.	Mechanical Eng.	Sophomore
Yussimil L.	Mechanical Eng.	Sophomore
Daniella B.	Mechanical Eng.	Sophomore
Alexsandra O.	Mechanical Eng.	Sophomore
Jonathan P.	Mechanical Eng.	Sophomore
Jorge L.	Mechanical Eng.	Freshman

1.3 TEAM ORGANIZATION

The project will follow a typical project hierarchy and delegate responsibilities to key members of the FIU-ASME team. These members, due to their increased knowledge and expertise in High-Powered Rocketry, will be in charge of leading the team in design and construction of the rocket and AGSE.

Role	Responsibilities
Team Leader	- Main representative for team - Organize and schedule team meetings - Obtain periodic reports from other leading members
Safety Officer	- Safety briefings before critical manufacturing/test flights - Evaluate overall safety of vehicle/AGSE design, construction, and assembly - Produce MSDS for all constructions materials, motor grains, igniters, and chemicals used - Implement procedures established for construction, assembly, launch, and recovery activities
Project Manager	- Draft and edit reports and presentations - Lead fundraising efforts - Oversee the allocation of funds
Lead Designer	- Organize and evaluate the proposal of ideas - Generate CAD and run simulations on relevant software - Responsible for validating system designs
Chief Engineer	- Evaluate feasibility of proposed designs - Determine and acquire materials for construction - Oversee the manufacturing of parts and components
Member	- Aid in generating CAD models and running simulations - Assist with Vehicle and AGSE construction - Aid in fundraising efforts

1.4 TRA MENTOR

For this competition Joseph, our Chief Engineer, will be the team's TRA mentor. He is a level 2 certified TRA member (number: 12413) with over 5 years of experience in High Power Rocketry and 4 years of experience with experimental motors and composite rocket structures. Joe received his Level 2 Certification in January of 2010, and has mentored two previous USLI teams. He comes from a wide background of interests, including experimental rocket propellants, fluid dynamics in scaled hybrid motors, advanced composites design, and metallurgy. He has completed and tested over 15 experimental rocket motors, and is a published researcher on numerous papers dealing with hybrid injectors and composite structures.

1.5 NAR SECTION

The FIU-ASME team plans on working in conjunction with the Spaceport Rocketry Association (NAR Section: 342), located in Palm Bay, FL. Their facilities and location will be utilized for launching both full and subscale rocket vehicles.

2.0 FACILITIES/EQUIPMENT

The FIU-ASME team has an 800 square foot warehouse which will be used for storage and construction, located at 12043 SW 131 Ave Miami FL, 33156. It is available for use 24/7 with basic construction tools including a drill, jig saw, circular saw, belt sander, and soldering iron. Also available for use is the Florida International University machine shop from 9 am until 5 pm on weekdays and after-hours upon request. It is equipped with a CNC milling machine, lathe, grinder, belt sander, and welder.

In addition, university computer labs are available to the team on weekdays from 8 am to 10 pm. These computer labs are equipped with engineering CAD software that will be utilized for designing and modeling vehicle and AGSE systems.

3.0 SAFETY

3.1 SAFETY PLAN

Below is the stated plan of action that the team will follow in order to comply with all safety requirements specified by the competition handbook, FAA regulations, and NRA/TAR rules.

3.1.1 MATERIALS

Prior to any handling or use, the MSDS of all adhesives and parts will be analyzed. Gloves, Glasses, and chemical or particulate respirators will be available for all team members who are fabricating the Airframe and AGSE, and their use will be required dependent upon the MSDS recommendations. The Team Safety Officer will be responsible for both checking out the required safety equipment to all team members, and ensuring that all team members are in compliance with the MSDS of the materials they are working on.

3.1.2 FACILITIES

The warehouse facility will have a ventilated workspace, as well as enough room to separate exothermically curing materials from heat sensitive items. The Safety Officer or Lead Designer will be present at all meetings that involve substantial construction, and will supervise all team members to ensure compliance with both good workshop etiquette and procedures, and any applicable local safety codes.

3.1.3 RISK ASSESMENT

Qualification for use of a power tool is defined as having over 20 hours of use with a similar model of power tool. All team members who are not qualified to use a power tool will only use that tool after they become familiar with the tool while it is unpowered, and only under supervision of a team member who is qualified to use that tool. After 20 hours of supervised use a member is considered qualified.

Category	Risks	Preventative Measures	Danger Level (1-10)
Construction	Power Tools	Only team members who are qualified for use of a power tool will be permitted to use that tool on the project. Constructing parts of the rocket outside of pre-determined team hours is not encouraged, but will allowed if there is a great need.	10
	AGSE	A plan for the path of action of the AGSE will be created and a safety plan will be created based off of the maximum area of travel for the moving parts of the AGSE, with a safety distance added to the known range of movement. Simulations of the AGSE programming will be run prior to any physical test, and measurements of the AGSE movement will be taken using retractable measuring devices, instead of through direct hands on contact. The AGSE will have a Fail-Safe shut off/retract switch that will be within reach of the safety officer for the duration of any mechanical or programming test of the AGSE that has the potential to move any physical parts.	7

	Rocket Separation and Ejection Testing	All tests of rocket separation and ejection will have a minimum safe distance of 15 feet, and will be supervised by the Chief Engineer who is a Certified Level 2 NAR/TRA member, and has years of experienced dealing with E-matches and gas ejection systems. Tests will be conducted in a large outdoor paved parking lot, with no easily flammable objects within 50 feet, and fire suppression systems will be on hand to deal with any unexpected ejection events. Damp towels and fire extinguishers will be on standby in the event that a parachute or other protected flammable object that is critical to the operation of the recovery system begins to deflagrate.	10
	Hazardous chemicals	All team members will be aware of the specifics of handling both composite materials, and the MSDS of any materials that they will come in contact with over the course of each day. The Safety Officer will be responsible for checking that all team members stay in compliance with the guidelines of the MSDS for their particular section of the project, and that team members do not remove masks, glasses, gloves, aprons, or shoes during the course of each build meeting.	6
	Rocket Flight tests	All rocket flight tests will conform to TRA or NAR guidelines, and the prefect of the launch site will confirm the launches' compliance to the applicable safety distances and the handoff of rocket control to the launch site director.	4
	Transport / Shipping of materials	All transporting of explosive materials will abide by federal and state laws. DOT approved flammable canisters will be used to transport ignition components of the rocket to the launch site, and the motors will be either purchased locally at each launch site, or will be shipped with Fed-Ex hazardous ground shipping. All hazardous materials will be inspected prior to unpacking or use to ensure that no harmful contamination has or will occur.	4

Personnel	Amount	Members will be subject to qualification on equipment and will always work under the direction of a team member or qualified machinist.	1
	Transportation	Transportation of the rocket body and electronics do not pose any risk greater than those normally associated with driving. The Chief Engineer will be responsible for loading and securing all rocket parts into the transport vehicles so that the parts will not pose any additional risk to the passengers of the vehicle.	0
Launch	Faulty / Damaged Equipment	All equipment will be tested before it is flown, and all electronic equipment will be visually inspected and then checked for internal continuity prior to the 'OK' for flight check.	3
	Missing / Forgotten Equipment	All equipment will be laid in sections and will be accounted for prior to transport. Each section of the rocket will be accounted for by a team member, and then each team member will report to the Project Manager to ensure that all members are present before loading of the parts into the vehicles begins. In the event that a part is broken, forgotten or missed, various customizable parts will be brought in duplicate so that a non-critical part can be either created or replaced prior to flight of the rocket. Critical parts, such as the Rocket Motor, Altimeter, and Electronics package will be checked by both the team member responsible and double checked by the Team Leader before the team is allowed to travel from the loading site at FIU to the Launch site.	2

3.2 PROCEDURES FOR NAR/TRA PERSONNEL

The NAR/TRA mentor will check that the flight computers are set to "OFF" before loading the ejection charges. All of the parachute loads will be inspected prior to being loaded into the rocket, and all flame proof materials will be checked for wear and holes prior to loading. The knots on all shock cords will be checked, as well as the firmness of their fit onto the airframe and associated components of the airframe. Metal to shock cord interfaces will be checked for rust and smoothness to ensure that the cord cannot be torn by the force of ejection. The TRA mentor will then build and load the rocket motor into the fully assembled rocket, and will ensure that the igniter cannot have voltage across its terminals by twisting the ends of the igniter together. The TRA mentor and the team will then fill out a flight card for the rocket, stating its expected altitude and the certified impulse of the motor. The rocket will then be loaded onto the AGSE, and upon completion of payload insertion, and once the rocket has been lifted to a proper launch angle, the Igniter will be inserted by the AGSE into the rocket engine, and the TRA mentor will then check the igniter for proper insertion. If the Igniter is properly inserted, the TRA mentor will complete wiring the igniter to the launch control system present at the launch site, and a team member will arm the flight computers. Once the continuity beeps from the flight computers are confirmed, the team will move back to the minimum safe distance for the launch.

3.3 BRIEFING

All team members will be briefed on the high power rocketry code for Level 2 flights prior to the launch day. A short quiz about safe distances and the procedure for launching a rocket safely will be given prior to travelling out to the launch site. Team members will be given a basic instruction on the “heads up” nature of launch sites, and will be actively discouraged from engaging cell phone texting and conversations while at the launch site, unless they are in a designated “safe” area, far from the minimum safe distance required by NAR/TRA for the site. All team members will be able to identify the potential hazards of assembling the rocket for launch and will remain focused and alert so that proper protocol is followed.

Caution statements will be issued with every plan of action for the construction of the Rocket and AGSE. The safety officer will create a general Personal Protection Equipment guideline for team members working on the rocket to consult before starting work each meeting. The safety procedure will be inserted into every working document after the section that details the powered equipment, chemicals, or materials to be used.

3.4 COMPLIANCE WITH FEDERAL LAW

Our launches will take place at an FAA sanctioned NAR Launch. Our test launches will be at NAR Section 342 located in Palm Bay FL. Our final full-scale test launches will take place at NAR section 563, located in Bunnell, FL. Both launch sites contact FAA ATC prior to opening a rocket launch window, and we will be launching at both sites under the guidelines set forth by NAR, which include more stringent rules than the FAA 14 CFR, Subchapter F, Part 101, Subpart C, and NFPA 1127. All of our flights will take place under an FAA waiver that is obtained by the launch director of the NAR locations we will be flying at. Our rocket will be launched on a suborbital trajectory, and the launch will be simulated in Rocksim with a high impulse 5-section Cesaroni motor prior to transport to the launch site to ensure that the rocket will be over 5 calibers in stability so that it does not create a hazard to persons, property or aircraft. The Rocket motors that we will be using for both our test launches and final launch will not have enough impulse to create a suborbital trajectory for the rocket, so that we will fully comply with section 101.23 General Operating Limitations of FAA 14 CFR, Subchapter F, Part 101, Subpart C. In accordance with launch site protocol and to ensure compliance with NFPA we will not launch when the drought index is equal to or greater than 600, and we will provide additional fire suppression materials for the AGSE equipment. As stated in 1.14.3 of the 2014-2015 NASA SL handbook, we will not use the “Skidmark” type of reload for our chosen rocket motor. To comply with the Code of Federal Regulation 27 Part 55: Commerce in Explosives; and for fire prevention, we will either be creating our own pyrotechnic igniters using Magnelite pyrogen from Rocketflight Corporation, which have been cleared for transport without a LEUP, or we will be making them out of a specialized APCP compound that does not require a LEUP to transport and is classified as a rocket propellant. All pyrotechnic devices such as igniters and rocket fuel related items will be transported in a DOT approved flame proof canister.

3.5 ROCKET MOTOR HANDLING

The Chief Engineer will purchase the motor reloads from an online vendor or locally at a launch site, and will store the reloads in a separate flame proof canister. The Chief Engineer will load the rocket motor in accordance with TRA guidelines, and will be responsible for the rocket motor in its entirety. Igniters for the rocket motors will come packaged with the reloads, and the ejection charges will be filled by the Chief Engineer with small amounts of black power, according to the engineer’s discretion on the amount of force required to ensure separation. The amount will not exceed 5 grains of black powder. The black powder will be stored in a separate flame proof canister from all of the other energetic ingredients, and will have a desiccant loaded into the canister to aid in the removal and prevention of moisture contamination.

3.6 WRITTEN STATEMENTS

All the members of the FIU-ASME team understand and will abide by the safety regulations established by the competition handbook as well as those of the NAR and TRA.

3.6.1 SAFETY INSPECTIONS

We understand that range safety must inspect our rocket every time before it is flown. We will comply with the determination of safety inspection.

3.6.2 RANGE SAFETY OFFICER

We understand that the RSO has the final say on all matters relating to safety. We understand that the RSO reserves the right to deny the launch of our rocket due to safety reasons.

3.6.3 FAILURE TO COMPLY

We understand that if our team does not satisfy the safety requirements specified in the competition handbook, we are subject to disqualification and will not be able to launch our rocket.

4.0 TECHNICAL DESIGN

4.1 VEHICLE DESIGN

4.1.1 VEHICLE DIMENSIONS

- 7 feet tall from motor retainer to tip of nose cone
- Inner diameter of 6 inches
- 4 fins, at 90 degrees offset from each other
- Independent sections (starting from bottom):
  - *Lower Airframe* - contains motor mount tube and main parachute
  - *Electronics/Payload Bay* - contains payload, 2 onboard computers
  - *Upper Airframe* - contains rocket drogue/payload parachute
  - *Nosecone*

4.1.2 MATERIAL SELECTION

Torayca T700S Standard Modulus fiber wrapped over phenolic airframe tubing and plastic nosecone, and Blue Texalium electrical fiberglass wrapped over phenolic electronics bay tubing.

3.1.1 JUSTIFICATION

- High strength to weight ratio
- Generally accepted use in High-Powered Rocketry
- High-pressure lamination of carbon composite over phenolic tube
- Phenolic Tube is easily accessible, and has precision fitting sectional couplers that are easily reinforced
- Phenolic tubing is crafted to dimensional standards that allows for interchangeability between vendors for all internal and some external parts
- Custom layups of composite fibers allow for selective reinforcement of critical sections, such as the fin section, and the payload bay
- Composites have an exceptionally strong impact tolerance without sacrificing lightness or cost limitations

4.1.3 CONSTRUCTION METHODS

The airframe will be constructed by pulling a carbon fiber sleeve over the entire phenolic airframe tube. Moisture and UV proof Epoxy lamination resin will then be applied to wet out the entirety of the carbon fabric. Specially-treated heat shrink tubing will be pulled over the carbon and phenolic and will be subjected to 500-700 degrees Fahrenheit from the center of the tube outwards, shrinking the tube in a circumferential manner slowly expanding from the center. The payload bay section will be constructed in the same manner, with the substitution of Blue Texalium Electrical glass instead of carbon fiber. The plastic nosecone will be laminated with carbon fiber by a hand layup. After the airframe has cured, 3 centering rings will be attached to a 54mm/ 2.14inch phenolic motor mount tube, and will then be filleted with JB weld and then hand laid up with fiberglass, such that a right angle no longer exists from the axial face of the tube to the centering rings. The motor mount tube will protrude 0.5 inches from the face of the lowest centering ring, and a space of 20 inches will exist between the middle centering ring and the lowest ring. The motor mount will then be inserted into the bottom of the airframe such that the centering ring is 0.125 inches up from the lowest edge of the airframe.

A G10 fiberglass centering ring will then be laminated onto the bottom of the centering ring, and carbon fiber will be hand laid up over the centering ring. A motor mount tube will then be installed on the end of the 2.14 inch tube using JB weld. Fin channels will then be marked on the side of the airframe using a rotary table at 178 degree angles. The bottom cut will be .75 inches from the bottom of the airframe, and will be 20 inches long. A commercial foam product will be inserted into the newly generated slits in the airframe, and then the fins will be inserted into the slits. A jig will be constructed around the lower section of the rocket in order to ensure that the fins maintain a 180 degree angle from each other, and so that the fins maintain contact with the inner 2.14 inch motor mount tube of the rocket. After the fins are installed, JB weld will be used to create a fillet in between the fins and the airframe, and then carbon fiber will be laid up over the entirety of the fins, fillet and airframe in 3 separate sections, so that each 180 degree section of the rocket has a separate piece of carbon fiber.

A solid bulkhead will be pushed from the top of the lower airframe to provide closure to the top of the 2.14 inch motor mount tube. The electronics bay will be fitted in a coupler tube that sits in between the lower airframe and the upper airframe section. The main parachute will be located in between the lower airframe and the electronics payload bay, and will be attached by steel 0.25 inch eye bolts to the lower airframe and electronics bay. The upper airframe will consist of a length of carbon laminated phenolic tubing that simply connects the electronics bay to the nosecone. The upper airframe will contain a parachute that will act as the rocket drogue and payload parachute. Kevlar shock cord will be used to connect the nosecone to the payload bay, electronics, and parachute. A separate Kevlar shock cord will be used to connect the lower airframe to the main parachute.

4.2 PROJECTED ALTITUDE

3000 feet above ground level.

4.2.1 JUSTIFICATION

Section 1.2 of the vehicle requirements state that the maximum number of points for the competition can be obtained by reaching an altitude of exactly 3000 feet above ground level.

4.3 RECOVERY SYSTEM

4.3.1 PARACHUTE DIMENSIONS

Dual-Deployment

- Drogue diameter: 36 in
- Main diameter: 54 in

4.3.2 EJECTION ALTITUDES

- Deploy drogue at 3000 ft. AGL (apogee)
- Deploy main at 1000 ft. AGL
    - Payload, Upper Airframe, and nosecone are also deployed using the drogue parachute to control descent

4.4 MOTOR SELECTION

4.4.1 BRAND AND DESIGNATION

Test Flights: Cesaroni Pro 54-4G

- K630 Blue Streak 1679 N*s
- K740 C-Star 1874 N*s

Final Flight Cesaroni Pro 54-5G

- K650 Smoky Sam 1750 N*s
- K780 Blue Streak 2180N*s

4.4.2 JUSTIFICATION

- Ease of use
- Cesaroni Technologies Motor Reloads are known for their reliability, and each reload comes with an igniter, which, when combined with the igniters our team will produce, will give us redundancy on one of the most critical launch components.
- The use of two different impulse reloads for the same motor allows for the rocket to more accurately reach 3000 ft in varying wind and launch conditions.

4.5 AGSE SYSTEM

As stated in the competition handbook, the launch rail will commence in the horizontal position. It will then autonomously retrieve a payload that will be a given distance away from the vehicle. The system will also then autonomously lift the rail to the vertical position and insert the igniter into the motor. All processes will be commanded by an Arduino programmable microcontroller.

4.5.1 PAYLOAD RETRIEVAL

- Payload bay equipped with a hinged door (quarter circumference opening) that will be opened/closed with a stepper motor
- The launch rail will be made out of 4-sided 1.5 inch T-slotted aluminum
- The launch pad will be equipped with a sliding mechanism that includes:
  - Three wheels that allow the mechanism to slide within one of the rail slots
  - A plate that provides structure to the mechanism
  - Two retractable arms that have a maximum reach of 4 ft.
  - Two stepper motors per arm that will be utilized to extend the arms and to clamp the payload
  - A servomotor that will be used to rotate the arms into the open payload bay door

4.5.2 LIFTING RAIL TO VERTICAL POSITION

A servomotor will be utilized to rotate the rail from the horizontal position to the vertical position.

4.5.3 INSERTING IGNITER

A linear actuator will be placed below the AGSE so as to insert the igniter into the rocket when it is in the vertical position.

4.6 SYSTEM REQUIREMENTS

4.6.1 VEHICLE

- 3 Flight Computers (2 redundancy, 1 payload)
- Single Stage rocket motor with 2180N*s of impulse, capable of propelling the rocket to an altitude goal of 3000 ft
- GPS unit in payload bay and airframe
- Resealable payload bay with Aerodynamic outer sealed surface
- Durable rocket airframe with the ability to launch multiple times in a single day without repair or modifications
- Only 4 independent sections, which satisfies the maximum of 4 independent sections as defined in requirement 1.1.4 of the competition handbook

- Each flight computer will have a second battery to provide additional current and standby time to allow for a 1 hour launch window, to satisfy requirement 1.1.7 of the competition handbook
- A Cesaroni rocket motor will be used, and a commercially available 12-volt Cesaroni igniter will be used to ensure compatibility with a standard 12-volt launch system as defined in 1.1.8

4.6.2 RECOVERY

- 36 inch Drogue deployed at apogee
- Payload ejection at 1000 ft.
- Main chute ejected at same as payload

4.6.3 AGSE

- Grabbing arm must not be in vehicle's path in start position and during launch
- Payload must start outside of vehicle mold line

4.7 TECHNICAL CHALLENGES AND SOLUTIONS

- Balance of center of mass due to payload placement within vehicle
    - Solved by using a more powerful rocket engine and by adding ballast mass to appropriate section of rocket
- Defining flight profile (max altitude, drift, events, descent rate, etc.)
    - Solved by using simulation software and by doing testing of a scale model of the rocket in similar conditions to the final launch day
- Autonomous acquiring and insertion of payload into vehicle
    - Solved by using a programmable microcontroller and by using precision stepper motors to maintain accurate placement and precision of robotic AGSE arm
- Autonomously securing payload bay (closing doors)
    - Solved by using an auxiliary power supply that powers a motorized payload bay door
- Synchronization of AGSE and vehicle event timelines
    - Solved by using clocks that are synchronized on both systems on launch day
- Automatically-disconnecting auxiliary vehicle power source (from Launchpad)
    - Solved by using a magnetic quick disconnect plug
- Program to command grabbing arm and autonomous events
    - Solved by using commercially available CAM software to model the process that the arm must go through in order to retrieve the payload from different locations.

5.0 EDUCATIONAL ENGAGEMENT

For the educational engagement portion of our project, the FIU-ASME Team plans to collaborate with FIU's new community outreach program called 'Engineers On Wheels' (EOW). Mainly, our project will entail teaching middle school students the general principles of aerodynamics, procedures in building their own bottle rockets, and ultimately, introduce them to the fundamentals of rocketry.

In order to achieve this, the FIU-ASME Team will develop a Rocketry Workshop to engage the young students in a fun and interactive manner. By presenting our personal model rockets as well as short power-point presentations with basic theory and fun facts, our goal is to teach them the rudimentary principles regarding the mechanics and flight procedures of a rocket. After assuring their basic understanding, our FIU-ASME Team will host a mini-rocket-building seminar during which participating students will design their own fins and decide the placement onto their airframe in addition to designing the shape of their nosecone. Next, they will assemble their water bottle rockets using supplies we provide and prepare for a small rocket launch competition. The supplies we will be providing are as follows: 100 2-L bottles, a Porter-Cable 6-Gallon electric air compressor, zip ties, aluminum tubes or rods, power extension cords, poster boards, duct tape, scissors, a 25ft airline, a shut off valve, PVC for the launch pad, and miscellaneous materials such as clamps, and rubber O-rings to seal the bottles. Funding will be provided by the Engineers on Wheels program.

6.0 TEAM WEBSITE

The ASME-FIU student section recently acquired a new website (asme.fiu.edu). At the time of this writing, the webpage is still under development. This makes the website lend itself to adding a new page for the team to publish its milestones. The ASME website will host the team's page (URL pending) for posting competition updates. The USLI team will utilize the webmaster from ASME to keep the education web presence up to date with their latest activities and progress.

7.0 PROJECT PLAN

7.1 TIMELINE

September	
11	Request for Proposal (RFP) goes out to all teams.
October	
6	Proposal due to NASA
17	Awarded proposals announced
31	Team web presence established
November	
5	Preliminary Design Review (PDR) report due
7-21	PDR video teleconferences
December	
January	
16	Critical Design Review (CDR) report due
21-31	CDR video teleconferences
February	
1-4	CDR video teleconferences
March	
16	Flight Readiness Review (FRR) report due
18	FRR video teleconferences
April	
7	Team travels to Huntsville, AL
7	Launch Readiness Reviews (LRR)
8	LRR's and safety briefing
9	Rocket Fair and Tours of MSFC
10	Mini/Maxi MAV Launch day, Banquet
12	Backup launch day
29	Post-Launch Assessment Review (PLAR) posted
May	
11	11 Winning team announced

7.2 BUDGET

Part	Units	Unit Price ($)	Price ($)
Phenolic Tubing and Couplers	X	X	200
Electronics	1	300	300
Composites	20	30/ft	600
Adhesives and Binders	5	15	75
Resin	1	140	140
Shrink-wrap	14	6.59/ft	92.26
1.5” 80/20 rail	5 ft. x2	10	100
Stepper Motor	3	130	390
Aluminum parts	5	20	100
Machine Work	20	35/hr	700
Pro54 4 Grain Casing P54-4G	1	83.11	Donated
Pro54 5 Grain Casing P54-5G	1	95.81	95.81
Pro54 C-STAR 4 Grain Reload Kit	2	115.04	230.08
Pro54 Blue Streak 4 Grain Reload Kit	1	115.04	115.04
Pro54 Blue Streak 5 Grain Reload Kit	2	135.41	270.82
Pro54 Smoky Sam 5 Grain Reload Kit	1	140.50	140.50
Team Travel + Lodging	X	3000	3000
Total			**6459.51**

7.3 FUNDING PLAN

In order to achieve the planned budget of $10000 for the Maxi-Mav launch, the following procedures will be followed to fund the project. The student section of the American Society of Mechanical Engineers at Florida International University has already contributed $1000 towards the purchase and manufacturing of vehicle components. The FIU-ASME team will also be seeking funding from private corporate sponsors, as well as grants, more specifically from the Florida Space Grant Consortium. Alternate funding options will include a campus-wide Rocket-Shaped bake sale and carwash. Private donations will be accepted as well. For such cases, the FIU-ASME team will provide recognition and/or merchandise discounts in order to encourage contributions. A final funding consideration will include crowd-funding via websites, such as Kickstarter, Indiegogo, and GoFundMe. All options will be considered and executed throughout the funding process to achieve maximum funds.

Type of Funding Source	Expected Amount ($)
ASME - FIU Student Section	1000
Crowdfunding	1000
Grants	2000
Corporate Sponsorships	4000
Private Donations	1500
Misc. Fundraising	500
TOTAL	**10000**

7.4 COMMUNITY SUPPORT

The FIU-ASME team plans to reach out to local companies with the goal of acquiring financial, material and/or manufacturing contributions. The team will put together a short presentation about the Student Launch to aid in the soliciting process. FIU-ASME will also display our rocket design in common areas of the university with the goal of getting support from fellow students and staff.

7.5 PROJECT SUSTAINABILITY

To continue the rocket project from year to year, FIU-ASME will continue to encourage members to participate in future events. Experienced members will help to train new members. Recruitment will be done by the members of ASME's Executive board each year to create renewed interest in the projects. Corporate sponsors will be contacted throughout the year by our members to keep them updated and interested in the projects in which we are involved. Alternate funding will come from fundraising efforts done at FIU by ASME members.