

Northrop Grumman Supersonic Rocket

Project Management

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Spring 2025-Fall 2025



Project Sponsor: Northrop Grumman

Faculty Advisor: Dr. Aminul Islam Khan

Instructor: Professor Carson Pete

Level III Advisor: Rick Maschek

Reflection:

Project Management – Successes

Our team experienced several key successes last semester related to project management and communication. The most effective aspects of our collaboration included:

- **External Networking:** We successfully established valuable connections, including a Level 3 rocket expert, contacts at Embry-Riddle, Discord communities focused on OpenRocket, and Nova Kinetics. These relationships significantly enriched our technical knowledge and design approach.
- **Professional Presentation:** Our recent presentation to Northrop Grumman was well received. Their positive feedback validated both our technical progress and our ability to clearly communicate our project goals and progress.
- **Fundraising and Resource Management:** We raised \$700 through GoFundMe and around \$100 through our Panda Express fundraiser, with another event planned for May 23rd. Additionally, we received parts and manufacturing help from Nova Kinetics, which significantly reduced our overall costs and allowed us to reallocate funds to other critical areas of the project. These efforts not only supported our budget but also demonstrated strong community and industry engagement.

Project Management – Room for Improvements

Despite our successes, several areas still require development to improve overall project execution and communication efficiency:

- **Communication Consistency:** Team communication was inconsistent, leading to confusion about task responsibilities and progress.
- **Time Management:** Personal deadlines were sometimes unmet due to lack of schedule enforcement.
- **Constructive Feedback:** We missed opportunities to give each other direct, actionable feedback, which slowed down issue resolution.
- **Team Availability:** We often lacked structure when it came to our availability with the whole team or other things came up.

Project Management – Action Items

To address the areas above, we've identified specific corrective actions. Each item below corresponds to an area of improvement:

1. Update Timesheet Daily

- a. Improves: Time Management, Accountability

- b. While we already have a timesheet, we will now ensure it is updated daily by all team members. This will provide a clear log of individual contributions and help us catch delays early.
- 2. Establish (another) Weekly Meeting Schedule**
 - a. Improves: Communication Consistency, Team Availability
 - b. A fixed weekly meeting will help maintain alignment. Agendas can be shared in advance, and meeting notes could be recorded for transparency.
- 3. Initiate Peer Feedback Sessions Every Two Weeks**
 - a. Improves: Constructive Feedback
 - b. We will add structured feedback time to every other team meeting to give direct, respectful input on what's working and what needs improvement.
- 4. Create a Group Chat Summary System**
 - a. Improves: Communication Consistency
 - b. A rotating responsibility will be set for summarizing key decisions and updates from the group chat into a shared document or channel.

Remaining Design Efforts for Rocket Capstone Project

Rocket Design and Assembly

- 1. Booster Mount**
 - a. Design, engineer, and manufacture the booster mount to ensure structural integrity and compatibility with the rocket system.
- 2. Safety Protocols**
 - a. Develop comprehensive safety protocols for the following:
 - i. Rocket assembly.
 - ii. Launch preparation.
 - iii. Integration of critical components, including avionics and GPS systems.
- 3. Component Integration**
 - a. Assemble and integrate all necessary components for rocket functionality, including avionics, GPS, and other critical systems.

Magnetic Separation System (Capstone Focus)

- 1. Electrical Schematics**
 - a. Create detailed electrical schematics for the electromagnetic system used in magnetic separation.
- 2. Electromagnet Polarity Research**

- a. Conduct in-depth research into reversing the polarity of electromagnets to optimize the separation mechanism.
- 3. **H-Bridge Development**
 - a. Design and develop a functional H-Bridge circuit capable of reversing the polarity of the electromagnets.
- 4. **Arduino Testing**
 - a. Test the electronic components and H-Bridge functionality using an Arduino microcontroller.
- 5. **Experimental Design with 3D Printing**
 - a. Develop an experimental setup using 3D-printed parts to simulate the magnetic separation system, controlled via Arduino.
- 6. **Permanent Circuit Board**
 - a. Design and manufacture a permanent circuit board incorporating the finalized electrical schematics for the magnetic separation system.
- 7. **Collaboration with Northrop Grumman**
 - a. Schedule regular meetings with a Northrop Grumman electrical engineer to review and validate the electrical designs.
- 8. **Metal Coupler Manufacturing**
 - a. Design and manufacture a metal coupler to serve as the electromagnetic holder for the magnetic separation system.
- 9. **Thermal Insulation Analysis**
 - a. Conduct analysis and simulations to develop an insulation system for the magnets, ensuring they maintain strength under the heat generated during supersonic travel.

Gantt Chart:

Our team's Gantt chart includes all our summer work which includes client meetings and meetings with our professor as a team. We will have Emanuel, Lee, and Adriana staying over the summer in Flagstaff to work on the motor retainer, ignitor, black powder testing, and any other testing. Once Fall starts the team will reconvene to see what else needs to be done before our first launch. September 6th is our first launch and November 23rd is the second. In between launches we'll be working on finalizing the magnet separation system. Post final launch is finalizing any other rocket issues we ran into during November and wrapping up capstone.

NRG Hypersonic Rocket

Start Date: 05/05/2025

				Week 1 (05/05 - 05/11)							Week 2 (05/12 - 05/18)							Week 3 (05/19 - 05/25)						
				M	T	W	TH	F	SA	SU	M	T	W	TH	F	SA	SU	M	T	W	TH	F	SA	SU
Summer																								
Meet with Carson after semester ends	Team	0	1d																					
Start ignitor design	Team	0																						
RockSim Verification with OpenRocket & Rasaero	Team	0																						
Avionics wiring	Team	0																						
NG meeting 1	Team	0																						
Build Motor Retainer	Emanuel, Lee, Adriana	0																						
NG meeting 2	Team	0	1d																					
NG meeting 3	Team	0	1d																					
Black Powder Testing	Emanuel, Lee, Adriana	0																						
NG meeting 4	Team	0	1d																					
Carson meeting (every 2 weeks)	Team	0	1d																					

				Week 1 (08/25 - 08/31)							Week 2 (09/01 - 09/07)							Week 3 (09/08 - 09/14)						
				M	T	W	TH	F	SA	SU	M	T	W	TH	F	SA	SU	M	T	W	TH	F	SA	SU
Fall 1																								
First meeting after summer	Team	0																						
Any last minute rocket needs	Team	0																						
September Launch	Team	0	1d																					
Mag Sep Design (prototype)	Team	0																						
Mag Sep testing	Team	0																						
Any launch fixes	Team	0																						
Website Check	Adriana	0																						
Mag Sep manufacturing	Team	0																						

Fall 2			Completion (%)		Week 9 (10/20-10/26)							Week 10 (10/27 - 11/02)							Week 11 (11/03-11/9)							
					M	T	W	TH	F	SA	SU	M	T	W	TH	F	SA	SU	M	T	W	TH	F	SA	SU	M
Undergraduate Symposium Registration	Team	0																								
Poster Design Draft	Team	0																								
Mag Sep. Completion/Testing	Team	0																								
November launch	Team	0	1d																							
Power Point Presentation	Team	0																								
Poster Design (Completion)	Team	0																								
CAD Packet	Team	0																								
Finalized Website	Adriana	0																								
Practice Presentation	Team	0	1d																							
Undergraduate Symposium	Team	0	1d																							
Client Handoff	Team	0																								

NRG Hypersonic Rocket			Week 1 (09/09 - 09/11)							Week 2 (09/12 - 09/18)							Week 3 (09/19 - 09/25)							Week 4 (09/26 - 09/01)							Week 5 (09/02 - 09/08)							Week 6 (09/09 - 09/15)							Week 7 (09/16 - 09/22)							Week 8 (09/23 - 09/29)						
Start Date: 06/05/2025			T	M	Tu	F	SA	SU	T	M	Tu	F	SA	SU	T	M	Tu	F	SA	SU	T	M	Tu	F	SA	SU	T	M	Tu	F	SA	SU	T	M	Tu	F	SA	SU	T	M	Tu	F	SA	SU	T	M	Tu	F	SA	SU								
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			Week 1 (09/25 - 09/31)							Week 2 (09/31 - 09/07)							Week 3 (09/08 - 09/14)							Week 4 (09/15 - 09/21)							Week 5 (09/22 - 09/28)							Week 6 (09/29 - 10/05)							Week 7 (10/06 - 10/12)							Week 8 (10/13 - 10/19)						
Fall 1			T	M	Tu	F	SA	SU	T	M	Tu	F	SA	SU	T	M	Tu	F	SA	SU	T	M	Tu	F	SA	SU	T	M	Tu	F	SA	SU	T	M	Tu	F	SA	SU	T	M	Tu	F	SA	SU	T	M	Tu	F	SA	SU								
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			Week 9 (10/20-10/26)							Week 10 (10/27 - 11/02)							Week 11 (11/03-11/9)							Week 12 (11/10-11/16)							Week 13 (11/17-11/23)							Week 14 (11/24-11/30)							Week 15 (12/01 - 12/07)							Week 16 (12/08 - 12/14)						
Fall 2			T	M	Tu	F	SA	SU	T	M	Tu	F	SA	SU	T	M	Tu	F	SA	SU	T	M	Tu	F	SA	SU	T	M	Tu	F	SA	SU	T	M	Tu	F	SA	SU	T	M	Tu	F	SA	SU	T	M	Tu	F	SA	SU								
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Purchasing Plan:

- Costs for most of the team's parts have already been established. We have had a Bill of Materials (BOM) going since the beginning of the semester and have actively updated it. As of currently, the team has a theoretical balance of \$1,017.10. This includes suspected purchases in ME486C.

- All remaining parts will be ordered except for one. Depending on how our current magnetic separation design performs during testing, we will manufacture new aluminum rings with teeth. If this happens, the aluminum will be donated by Professor Pete and the manufacturing CNC's will be courtesy of Nova Kinetics.
- There are no “primary” vendors for our specific capstone project due to the fact that we have such a wide variety of different parts needed. One vendor we will buy from is RocketMan Parachutes because they will have custom sized parachute bags for us, as well as shock cords with proper length. For the remaining part that needs to be manufactured, the primary manufacturer will be Nova Kinetics because they will be assisting in the process, as well as providing the necessary machinery. No “backup” vendors will be needed in our case.
- The manufacturer that will be helping us manufacture the aluminum rings with teeth for the separation system if we decide to do a redesign will be Nova Kinetics. There are no official lead times that Nova Kinetics provides us with. The “lead time” in our case is dependent on how busy Nova Kinetics is and how available our team is. The time that we will receive our part will depend on both Nova's availability and our availability.
- The team will decide if we need a redesign during the testing phase of the magnetic separation device, early on in the Fall 2025 semester. The official date that the team will need all parts by is November 1st to ensure everything is ready for the 2nd launch with the magnetic separation device. If the team decides to remanufacture the separation device, the status will simply rely on the team's availability as well as Nova Kinetics' availability.

Purchased:	Future Purchases:
Fiberglass materials	Electromagnets
Fiberglass coupler manufacturing	12V Battery
Arduino	Magnetic Insulation
Load Cell / Strain Gauge	Shock Cords
Booster Upgrade	Custom Parachute Bags
2 Drogue Chutes	Propellant Reload Kits
Booster Main Chute	Key Switches
Sustainer Main Chute	PCB Boards
2 Tender Descenders	Quick Links
GPS Systems	
Altimeters	
Wires	

Manufacturing Plan:

- Nova Kinetics will assist in manufacturing all future parts. Any material will be donated from material such as fiberglass, carbon fiber, and the resin system.
- The process for the bulkheads and water jetting should take about 2 weeks to complete. While the couplers used to sandwich the bulkheads will be used from a scrape coupler saving time to work on other things.
- The raw material used will be aluminum in regards the separation device. The team has already remade multiple couplers. Fiberglass will be used to produce more if necessary. Bulkhead will be used for the motor retainer system which will be made from carbon fiber about 1/8 inch in thickness which will then be stacked on top to have a 1/4" thickness. The orientation will be 45 and 90 degrees alternating to have strength in both directions.
- The parts will be made at 2 possible locations. Both locations are owned and operated by Nova Kinetics. A water jet machine will be used by another company that Carson will help us get in contact with once the carbon fiber plate is laid up.

Manufactured	Future Manufactured
Fiberglass couplers	Possible magnetic separation devices' aluminum rings with teeth
Carbon Fiber Bulkheads x4	Possible Carbon Fiber Release mechanism

Testing Plan:

The following tests are essential to validate our rocket's safety, functionality, and overall flight performance:

- Black Powder Charge Testing
 - Purpose: This ensures that we have the proper amount of black powder that we need for our rocket
 - Design Relevance: Confirms charge sizing and placement are effective for safe parachute deployment and recovery.
- GPS Functionality Testing
 - Purpose: Validates the tracking system's ability to communicate real-time location throughout the entire flight envelope.
 - Design Relevance: Ensures successful rocket recovery and supports compliance with FAA and safety protocols.
- Full Inconsistency Check

- Purpose: Identifies any integration issues across systems (electronics, mechanical, structural) before launch and also ensures that our rocket is in good shape.
- Design Relevance: Allows correction of flaws that may not be apparent, reducing risk of in-flight failure.
- Hot Separation Testing (September Launch)
 - Purpose: It helps ensure that our rocket works how it should and also helps us understand what other things we may have to improve on for the next launch.
 - Design Relevance: Verifies that the updated separation system functions under stress and confirms flight readiness.
- Magnetic Separation (MagSep) Testing (November Launch)
 - Purpose: Tests the updated magnet-based separation system on an actual launch.
 - Design Relevance: Confirms reliability 12-magnet design and that our separation system actually works.

Why These Tests Are Important

Each of these tests directly informs the final rocket design by:

- Validating system reliability
- Identifying weak points before flight, enabling proactive redesigns
- Confirming that mission-critical systems (separation, recovery, GPS) will function as intended
- Increasing safety and confidence for actual launch days

Manufacturing Required Before Testing

Before testing can begin, we must complete the following manufacturing tasks:

- Updated Separation System Construction
 - Fabricate the new 12-magnet separation system (top and bottom) using the donated aluminum. This includes precision placement and secure attachment of magnets.
- Rocket Adjustments (if needed)
 - Make any final structural or mechanical adjustments to the rocket body based on test feedback or recent design changes. This may involve reinforcement, bracket additions, or adjustments for integration of electronics.
- Finishing Touches on All Subsystems
 - Ensure all components avionics bay, recovery systems, payload section, etc. are assembled to flight-test-ready standards, including wiring, fasteners, and load-bearing joints.

