

The Undergraduate Cubesat Experience at the University of Minnesota

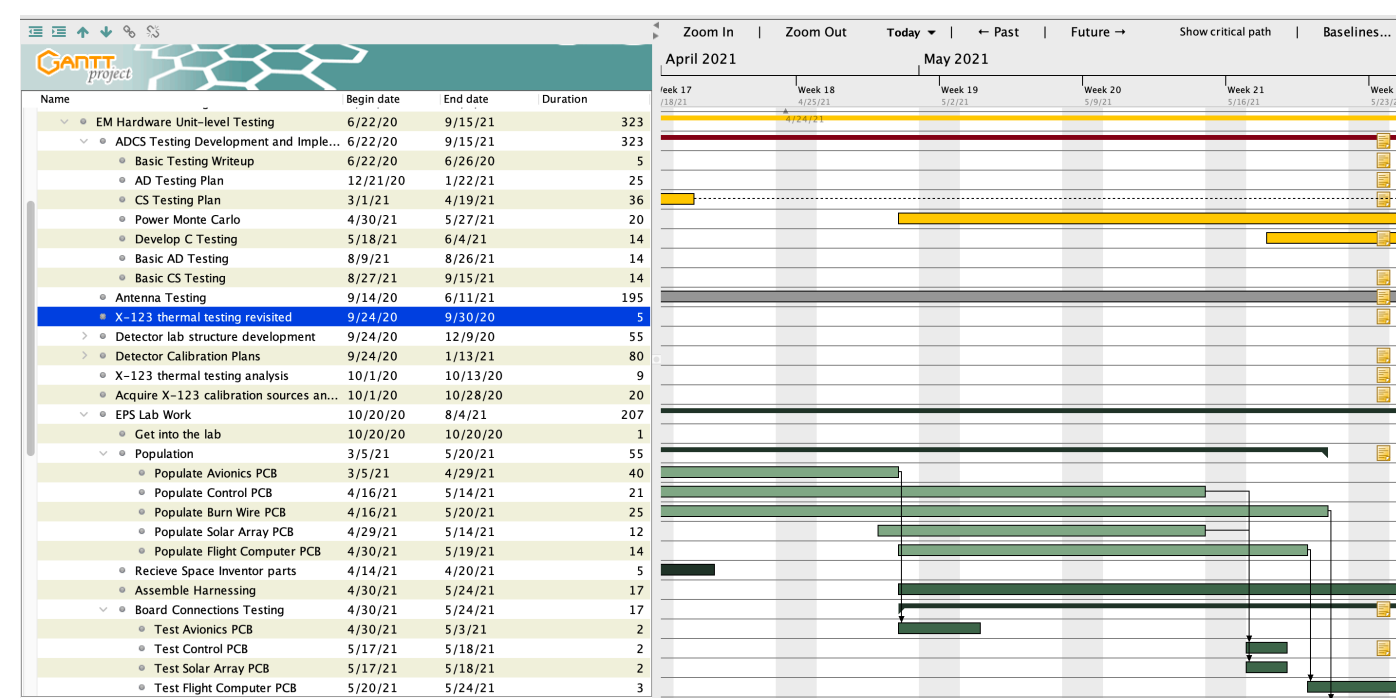
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Introduction

Building a satellite is a large undertaking with a lot of moving parts. Undergraduate students have complicated schedules with even more moving parts. Running a team of 60+ undergraduates toward the goal of launching a satellite is therefore quite the managerial challenge. Detailed on this poster are some specific challenges, along with strategies for mitigating them, that the UMN Small Satellite Research Lab faces in their work toward launching two small satellites.

Scheduling

At the UMN SSRL, we use GanttProject to enumerate tasks and distill the critical path of development at any given time. The project manager asks each team lead to enter tasks for all the active projects within each team, along with the estimated dates between which that project will be started and completed. The PM also asks for detail in the notes of each of those tasks so that they and the CE have a better glimpse into what is going on with each team, but also to ensure that the tasks necessary have been thought through ahead of time. The dynamic Gantt chart for the entire satellite project is brought up at each weekly meeting with all the team leads, in an effort to catch any issues that might delay the critical path.



Hierarchical Structure

Our team has up to 80 undergraduate students working on various aspects of satellite development at any given time, making it important to divide responsibilities. The major roles and responsibilities are described in the chart and figure below.

Title	University position	Responsibilities
PIs	Faculty	Budget
		Communicating with university
		General guidance/mentorship
PM (project manager)	Undergrad	Oversees the master schedule
		Organizes recruitment
CE (chief engineer)	Undergrad	Facilitates communication throughout the team
		Oversees technical development of satellite
Team Leads	Undergrad	Tends to the RVM (requirements verification matrix)
		Coordinates communication between team members
		Assigns tasks to team members
		Point of contact with respective sub-system
		Contributes to sub-system development

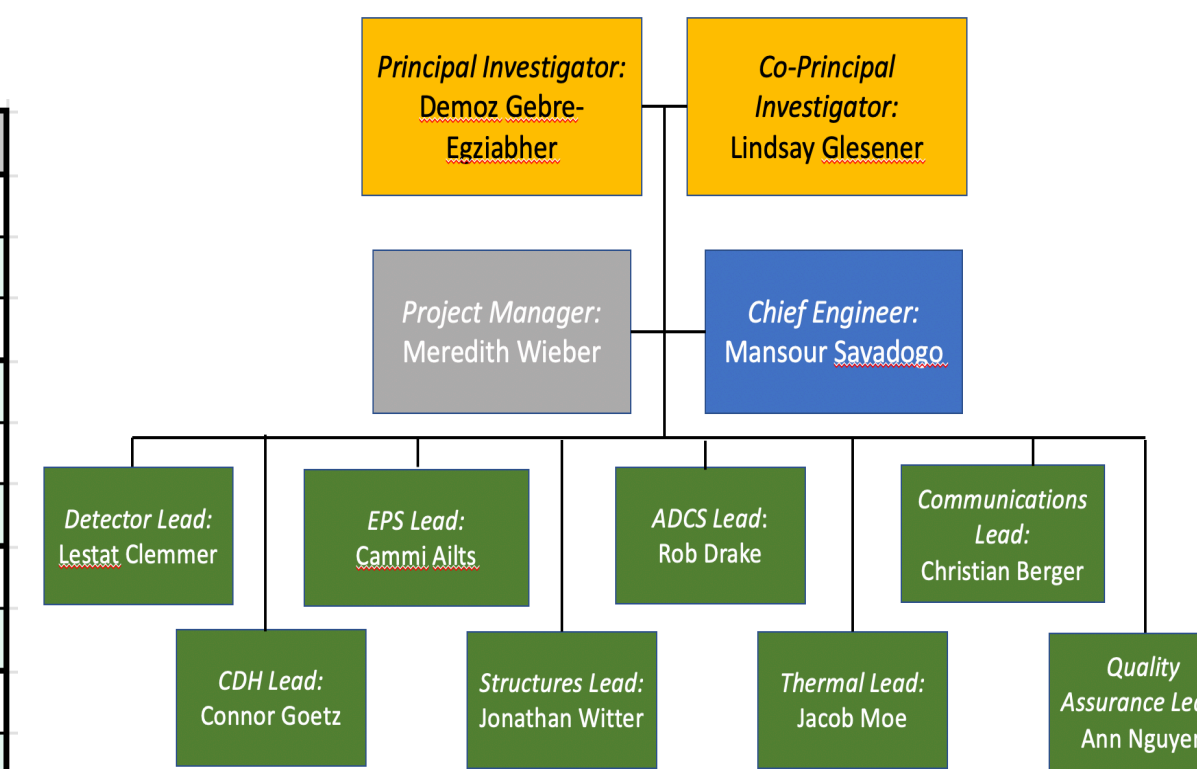
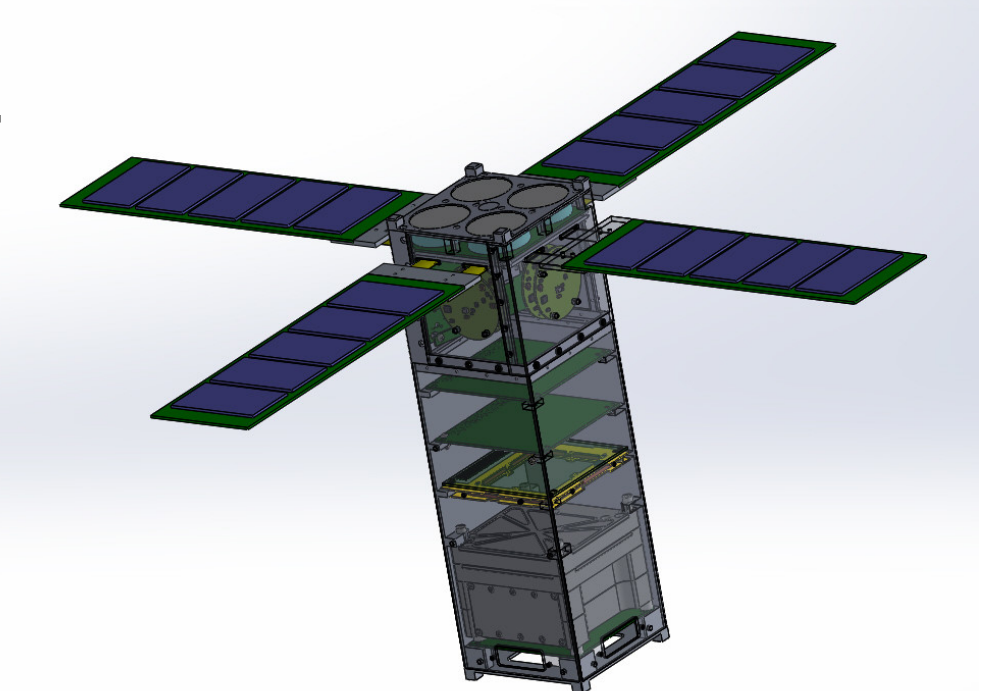


Figure 1: Graphical representation of the distribution of responsibility

Our Missions

UMN SSRL is building two 3U cube-satellites: IMPRESS and EXACT. Both satellites use the same hardware and share the same physical model, shown below. IMPRESS is a solar-science mission, fully-funded by the NSF. It will observe X-Rays produced by solar flares on very short timescales to investigate the mechanisms which accelerate the particles. EXACT is a mission funded for development through the Air Force's University Nanosatellite Program that will observe X-Rays

from the Crab Pulsar which could be used as a clock for GPS-denied navigation in the future.



Weekly Meetings

Weekly meetings between team leads and admin (PI, PM, CE, graduate mentors) are important for bringing the day-to-day of each sub-team into the bigger picture of the whole satellite. It is important for the PIs, PM, CE, to question the updates given by each sub-system in order to identify inconsistencies or neglected details.

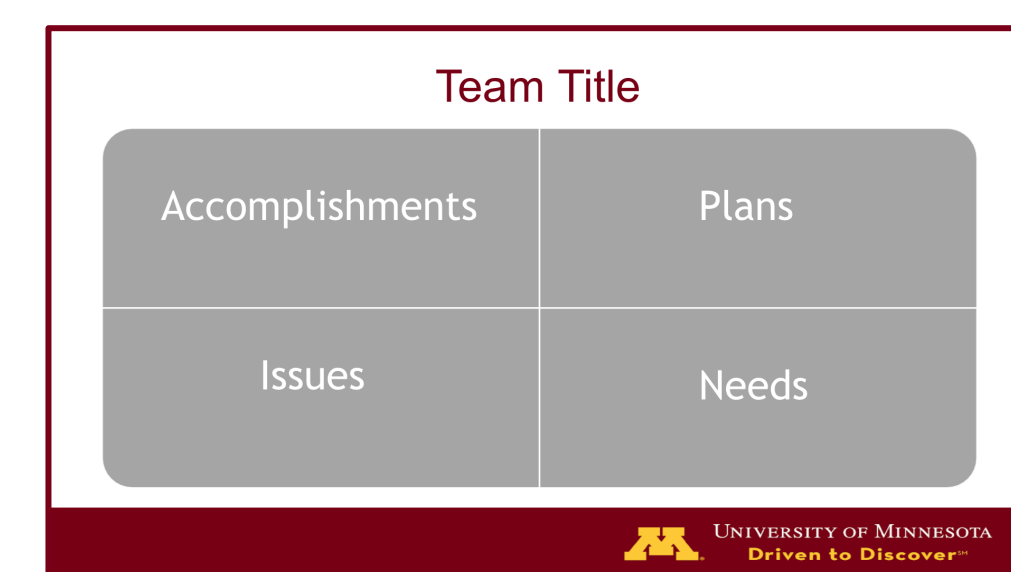


Figure 2: Template Quad Chart

Quad Charts (shown above) structure the conversation surrounding each sub-system at the weekly exec meeting. They stimulate an efficient path to discovering issues that may become larger hurdles to satellite development further down the road.

Other Student Considerations

Turnover:

- UMN SSRL does not require interviews, or applications to join the lab; anyone may join, even if they can only spend ~3-5hrs/wk on lab work
 - Hosting interviews might allow the lab to find students who are more committed to the long-term, but it is a tradeoff with providing a flexible research opportunity for many students
- It is easy to get buried in sub-system work and forget that it is contributing to the eventual launch and operation of a satellite
 - Periodic "full-team meetings" which usually include some background info on SSRL, as well as an overview of the mission objectives, to remind team members of the big picture

Transfer of Knowledge:

- With such frequent turnover, it is easy for historical knowledge on each system to get lost as students move on
 - We have a "Quality Assurance" team to be responsible for organizing, reviewing, and assisting with writing documentation

Compensation:

- It is difficult to find students who can spend all their time outside of classwork on satellite work without being provided some minor compensation
 - Funding for SSRL satellites typically comes from student-centered competitions or programs, which provide finite budgets
 - Carefully planning out hardware costs and using the "extra" funds to support students part-time, especially during the summer directly

