NORTHERN ARIZONA UNIVERSITY

Department of Mechanical Engineering
HCC2026
Karsten Jones
Anthony Nuzzo
Nathaniel Holguin
Dawson Stevens

To: David Willy

From: HCC26

Re: Project Management for 486C

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Introduction

This document establishes the project management plan for Capstone II and defines how the team will execute design finalization, purchasing, manufacturing, testing, and demonstration activities through competition in late April. Building on lessons learned during Capstone I, this plan emphasizes schedule control, readiness tracking, and risk mitigation to support progressive hardware maturity at each Hardware Status Update and full system readiness by the HCC 2026 competition (April 27–29).

This report is intended to function as a living control document, guiding decision-making and resource allocation throughout the semester rather than serving solely as a retrospective summary.

Project Management Reflection

Project Management – Practices to Continue

Several project management practices from Capstone I will be continued due to their effectiveness:

- Weekly team meetings with documented action items improved accountability and maintained steady progress.
- Division of labor across mechanical, electrical, and multidisciplinary roles enabled parallel task execution and reduced schedule coupling.
- Regular incorporation of advisor and competition feedback improved alignment with both academic and competition requirements.
- Centralized digital file management reduced version conflicts and improved documentation accessibility.

Project Management – Gaps Identified

Capstone I also revealed several gaps that directly inform Capstone II planning:

- Late convergence on key design decisions compressed manufacturing and integration schedules.
- Workload distribution became uneven as subsystem scope evolved.
- Project risks were discussed informally but not tracked or revisited systematically.
- Design rationale was not consistently documented, increasing the likelihood of rework.

These issues primarily affected schedule robustness and documentation continuity and are explicitly addressed in the action items below.

Project Management – Action Items

To address the areas identified above, the following action items will be implemented during Capstone II:

1. **Establish and maintain a centralized decision log.**
   Major design decisions will be documented along with alternatives considered and justification. This will improve continuity and reduce confusion as the project progresses.
2. **Define a clearer work breakdown structure by subteam.**
   Tasks will be explicitly assigned to mechanical, electrical, and project management roles to improve accountability and balance workload.
3. **Create and maintain a formal risk register.**
   Key technical, schedule, and resource risks will be documented with mitigation strategies to reduce the likelihood of late-stage disruptions.
4. **Front-load manufacturing planning and internal resource scheduling.**
   Because the project relies primarily on in-house fabrication, early planning will be emphasized to avoid delays related to shop access, equipment availability, and printer time.

Remaining Design Efforts

The following design efforts remain and must be completed before the project deadline, as well as sustained fabrication and system integration:

- Finalization of mechanical geometry and mounting configurations
- Completion of subsystem interface definition
- Final CAD updates and preparation of fabrication files
- Confirmation of materials and manufacturing methods for fabricated parts
- High level costs
- Cultural effects(landmarks/passages)
- Social success metrics
- Operation and maintenance requirements
- Triple-Bottom-line assessment of options(Economic, Environmental, Social outcomes)
- Opportunities to reduce cost of added power
- Define equipment selection
- Operational models
- Feasibility assessment
- Community Connections
- Prony break build and test

Tentative Schedule / Gantt Chart

Introduction

Figure 1 shows the tentative project schedule for ME 486C from Week 1 through the first Hardware Status Update (33% build). The schedule was developed by working backward from required course milestones and includes project management, mechanical, and electrical tasks necessary to reach the initial hardware readiness level. The Work Breakdown Structure is shown on the left, and the schedule reflects the current understanding of task sequencing and workload distribution for Capstone II.

ME486C - HCC26 - 33% Build Schedule

Task name	Stard date	End date	Assigned	Status
Project Management	1/12/2026	1/18/2026	ME Team	Closed
Introduction	1/12/2026	1/14/2026	Dawson	Done
Project Management Reflection	1/13/2026	1/15/2026	Anthony	Done
Remaining Design Efforts	1/14/2026	1/15/2026	Nathaniel	Done
Tentative Schedule/ Gantt Chart	1/15/2026	1/18/2026	Nathaniel	Done
Purchasing Plan	1/15/2026	1/17/2026	Anthony	Done
Manufacturing Plan	1/15/2026	1/17/2026	Dawson	Done
Analytical Assessment Plan	1/15/2026	1/18/2026	Karsten	Done
Competition Alignment	1/15/2026	1/18/2026	Karsten	Done
Engineering Calculations	1/12/2026	1/23/2026	ME Team	Open
Added Power Investigation	1/17/2026	1/23/2026	Anthony	In process
Full Cost Calculations	1/17/2026	1/23/2026	Karsten	In process
Full Feasibility Assessment	1/18/2026	1/23/2026	Dawson	In process
Equipment and Material Selection	1/18/2026	1/23/2026	Nathaniel	In process
Individual Analysis	1/18/2026	1/30/2026	ME Team	Open
Cultural and Social Analysis	1/20/2026	1/30/2026	Karsten	In process
Site Operation Analysis	1/20/2026	1/30/2026	Dawson	In process
Environment Impact/Protection Plan	1/20/2026	1/30/2026	Nathaniel	In process
Pony Brake Build and Test	1/20/2026	1/30/2026	Anthony	In process
33% Build	1/12/2026	2/5/2026	ME Team	Open
Engineering Model Summary	1/12/2026	1/18/2026	Corbin	In process
Final CAD and Fabrication Files	1/12/2026	1/20/2026	Corbin	In process
Manufacturing Confirmation	1/12/2026	1/20/2026	ME Team	In process
EE Architecture Development	1/12/2026	1/22/2026	EE Team	In process
Testing Plan	1/12/2026	1/24/2026	Karsten	In process
Manufacture and Fabrication	1/12/2026	1/24/2026	ME Team	In process
EE Build and Integration	1/12/2026	1/25/2026	EE Team	In process
Prototype Dry Assembly	1/12/2026	1/26/2026	ME Team	In process
Community Connections	1/12/2026	2/5/2026	Nathaniel	In process

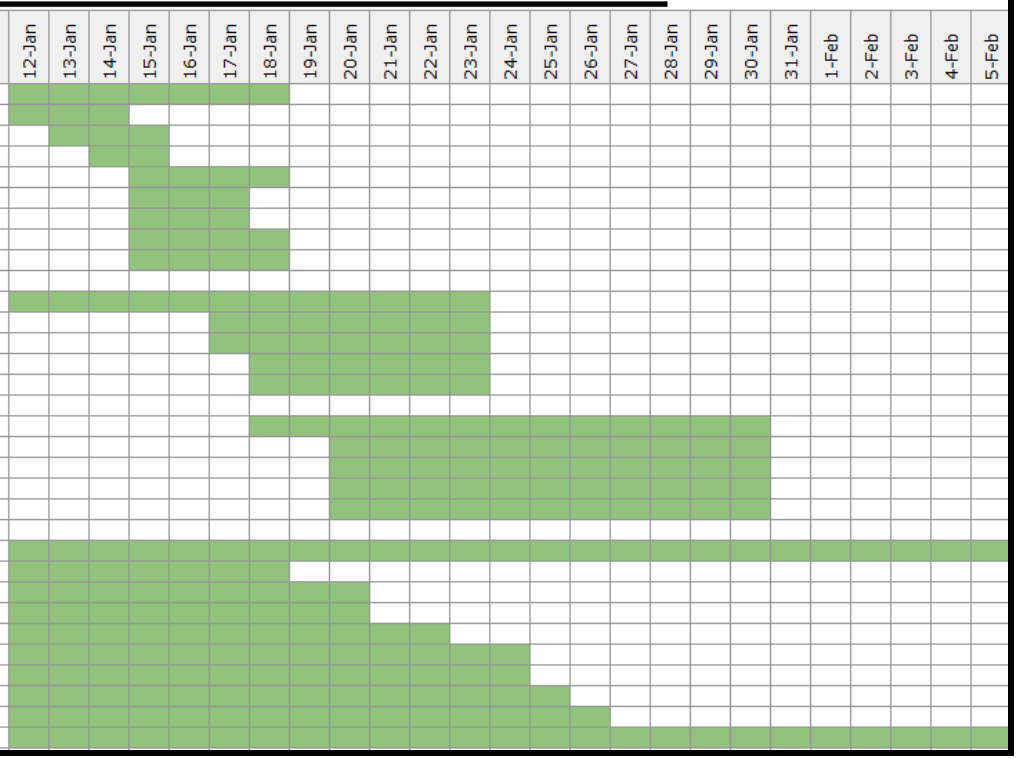

***Figure 1**: Week 1 through 33% Hardware Status Update*

Discussion of Major Work and Milestones

- Prior to the 33% Hardware Status Update, system architecture and subsystem interfaces must be clearly defined.
- Mechanical tasks include CAD refinement, structural updates, and preparation of files for early fabrication.
- Electrical tasks focus on defining basic architecture and integration requirements.
- Manufacturing planning occurs early to support the project's emphasis on in-house fabrication.
- Project management efforts focus on coordinating schedules, identifying risks, and preparing for sustained fabrication after the first Hardware Status Update.

Purchasing Plan

The project purchasing strategy is intentionally minimal and focuses on enabling internal fabrication rather than sourcing multiple external components. At this stage, the primary purchased item for the project is a 3D printer used to support prototyping and fabrication throughout the semester, then the travel fees for the final competition are factored. Most other components will be fabricated in-house or sourced through existing laboratory resources.

Part Name	Subsystem	Make/Buy	Qty	Material	Who Makes It	Where Made	Vendor	Lead Time	Cost	Part Status
3D Printer	Fabrication	BUY	1	N/A	Manufacturer	Lab	Snapmaker	In-house	$2,883	Purchased

***Figure 2**: BUY items*

What are our expenses to date?		
Description		Expense amount
3d Printer	Artizan snapmaker 3D 3in1 printer	$2,882.94
Machined metal shaft	7 inch metal shaft	$10.00
Team Shirts	Team shirts x8	$125.00
Total Expenses		$3,017.94
True remaining balance		$14,982.06

***Figure 3:** Expenses to date*

What are our Future Expenses?			
Description			Expense amount
Conferences and Meetings	Greenbay, Wisconsin	Travel	$9,500.00
			$3,017.94
Fundraising	No positive Results		$0.00
Total Expenses			$12,517.94
True remaining balance			$2,464.12

Figure 4: *Future Expenses*

The purchasing-only BOM view highlights the following project management considerations:

- External vendor lead-time risk is low due to the limited number of purchased components.
- Internal equipment availability becomes a critical scheduling constraint.
- Future purchasing needs may emerge as the design matures, requiring ongoing BOM updates.

Action Items:

1. Track 3D printer availability and usage throughout the semester.
   This ensures internal fabrication activities do not create schedule conflicts or bottlenecks.
2. Review the purchasing plan at each Hardware Status Update.
   This allows newly identified purchasing needs to be incorporated without disrupting the overall schedule.

Manufacturing Plan

Because the project relies heavily on internal fabrication, the manufacturing plan is a critical component of project management. The BOM was extended to include information on who will fabricate each part, where fabrication will occur, required materials, and estimated fabrication time.

Part Name	Subsystem	Make/Buy	Qty	Material	Who Makes It	Where Made	Vendor	Lead Time	Cost	Part Status
Dam Model	Structure	MAKE	1	PLA	ME Team	3D Printer	—	—	$—	Planned
Turbine Housing	Mechanical	MAKE	1	PLA	ME Team	3D Printer	—	—	$—	Planned
Mounting Bracket	Mechanical	MAKE	2	PLA	ME Team	3D Printer	—	—	$—	Planned
Test Fixture	Testing	MAKE	1	PLA	ME Team	3D Printer	—	—	$—	Planned

Figure 5*: MAKE items*

Review of the manufactured-items BOM view reveals several areas requiring continued planning:

- Fabrication time estimates are approximate and must be refined through iterative builds.
- Responsibility for fabrication must be clearly assigned to avoid delays.
- Assembly sequencing must be coordinated with print completion times.

Action Items:

1. Assign fabrication responsibility for all manufactured components.
   Clear ownership improves accountability and prevents duplicated effort.
2. Refine fabrication duration estimates as prototype builds begin.
   Updating estimates will improve schedule accuracy and workload balance.
3. Coordinate manufacturing and assembly schedules.
   This reduces idle time and supports efficient integration during later project phases.

Analytical Assessment Plan

Due to the nature of this project, an analytical assessment plan has been developed to ensure that all required analyses are completed in a structured manner and aligned with the Hardware Status Updates and associated course deliverables. Rather than treating analysis as a one-time activity, analytical work is phased to support progressive hardware readiness, manufacturing decisions, testing preparation, and final competition performance.

Analytical Scope and Self-Learning Focus

Initial self-learning and analytical efforts focus on establishing feasibility, context, and foundational understanding of the project. These efforts include:

- A detailed, high-level cost analysis to understand cost flow within the projected system and verify feasibility within the expected budget.
- Assessment of cultural and social impacts associated with the project site and how these factors contribute to overall project benefit.
- A site operation analysis examining mechanical uptime, operational constraints, and maintenance requirements at the current dam location.
- A Triple Bottom Line (economic, environmental, and social) evaluation of potential implementation options.
- Investigation of methods to reduce the levelized cost of added power at the site.
- Development of an environmental protection and impact assessment to evaluate potential effects on local species and ecosystems.
- Study of Prony brake fundamentals to support the design and eventual testing of prototype-scale power and torque measurement systems.

Alignment with Hardware Status Updates

33% Hardware Status Update (Analytical Readiness Gate)
By the 33% Hardware Status Update, the team aims to solidify all analyses that influence system architecture, feasibility, and early manufacturing decisions. This includes finalized cost feasibility studies, site operation constraints, environmental considerations, and foundational mechanical analysis. At this

stage, analysis will no longer drive major design changes, allowing manufacturing and fabrication efforts to proceed with reduced technical risk.

67% Hardware Status Update (Integration and Validation Support)
By the 67% Hardware Status Update, analytical efforts shift toward validating manufactured components and subsystem integration. Cost models will be refined using as-built data, environmental and operational assumptions will be confirmed against physical progress, and Prony brake concepts will be applied to prototype testing. Analysis at this stage supports integration decisions and informs testing plans rather than defining new requirements.

100% Hardware Status Update (Final Verification and Testing Support)
By the 100% Hardware Status Update, analytical work will focus on final verification of system performance and alignment with customer and engineering requirements. All analytical results will support testing outcomes, demonstration readiness, and final competition preparation, with no remaining open-ended analytical dependencies.

Competition Alignment (Special Project Section)

As a competition-based project, Capstone II deliverables are aligned where possible with competition requirements while maintaining compliance with ME 486C expectations. Design documentation, schedule planning, and fabrication activities are structured to support both academic deliverables and competition milestones without over-committing resources early in the semester.

Due to the compressed timeline and sequencing of competition deliverables, select capstone deliverables may require minor re-alignment to better match the natural progression of the project. By the 33% Hardware Status Update, the team plans to fully complete and submit the Site Selection and Justification deliverable and achieve approximately 50% completion of the Facility Conceptual Design submission. This scope encompasses the majority of the remaining design efforts required to support early manufacturing and integration activities. Completing these items at this stage allows sufficient time for unforeseen design modifications prior to final submission deadlines.

As the project approaches the 67% build milestone, the team proposes to submit material corresponding to a near-complete system build for the February competition submission, excluding select late-stage testing and validation results that are dependent on final hardware assembly. This approach reflects the physical readiness of the system at that stage while preserving adequate time for testing, iteration, and refinement.

Following this milestone, the project will rejoin the standard capstone schedule for completion of all remaining testing, prototyping, and validation activities in advance of the final Hardware Status Update and competition dates. This proposal does not require changes to the overall project schedule, but instead advances select internal deadlines to better align analytical, design, and manufacturing efforts with competition needs.