

Evolution of a Senior Capstone Course Through the Assessment Process

Abstract

The civil engineering senior capstone design course at the United States Coast Guard Academy has evolved over the past fifteen years. Historically teams of cadets worked in parallel on one design problem with a single faculty advisor. The senior design projects now actively involve students in a variety of real world consulting projects to help the Coast Guard and local communities meet technical challenges. Each student team works on a unique project with a faculty advisor. The departmental assessment process confirmed the educational benefits of student exposure to real world projects with clients, budgets, and deliverables. The assessment process also revealed that there are challenges in ensuring consistent course standards and opportunities for demonstration of educational outcome achievement with multiple projects and advisors. Other areas identified for course improvement included closer student/faculty communication during the semester, assessment of both individual and group performance, pacing student work evenly through the semester, leveraging class time to better support both project work and educational outcomes achievement, and better development and assessment of technical communication skills.

The capstone course was subjected to thoughtful review in June 2006 with development of course adjustments to address identified issues. This paper discusses changes in the course based on assessment data analysis. Notable changes include implementation of new class material supporting projects and professional practice issues, requirement of a formal written final report with significant guidance provided, standardization of grading policy across groups, required weekly progress reports, and a problem statement explaining how each project addresses the elements of design. With one year of data since implementing course changes, faculty members are optimistic about long term improvements in educational outcome achievement and an enhanced ability to administer diverse capstone projects while applying consistent standards for student performance and assessment.

Introduction

The United States Coast Guard Academy (CGA) is one of the nation's four federal service academies. CGA focuses on the academic, military and physical development of young men and women as leaders in service to our nation. CGA provides the U. S. Coast Guard (USCG) with approximately 190 new Coast Guard officers each year. Upon graduation, each graduate receives a commission as an Ensign in the Coast Guard and a Bachelors of Science degree in one of eight fields. The Civil Engineering program, one of four engineering majors at CGA, averages 30 graduates per year. The CGA Civil program has taken advantage of the small class size in its development of the capstone design course. Students work in teams on several projects each year with clients in the Coast Guard or the local community.

In the late 1990s the engineering department at CGA initiated a comprehensive assessment program to address the new accreditation criteria established for ABET 2000. This assessment process has led to a number of curricular improvements, enhanced student learning and an educational program that better meets the needs of the Coast Guard. As a part of the assessment process, each course is subjected to an end of course review process where assessment data focused on achievement of the various educational outcomes (ABET Criteria 3 and 8) are reviewed and discussed with recommendations for course improvements. In 2000, as a result of the End of Course Review (EOCR) process, the Civil Engineering faculty created the framework for today's capstone course based on student end of course surveys, constituent focus groups, senior exit surveys, and faculty observations.

The current capstone design course, Civil Engineering Design (CED), was developed to mimic the civil engineering experiences students will face when they enter the engineering workforce after graduation. While this capstone course model continues to develop with each successive semester, the Civil Engineering Faculty at CGA feel the new course is better able to achieve the course objectives of graduating students who can "plan, design, execute, and manage a complex open-ended civil engineering project".¹ In accomplishing this goal, students produce engineering design documents, construction drawings, cost estimates, construction schedules, and any other necessary project specific documents. In addition, students communicate the results of their project via a formal presentation to their client."¹

Course Improvements: 2000-2005

Prior to 2000, the capstone civil engineering course at CGA was called "Planning and Design of Construction Projects". This course was a graduation requirement for all civil engineers and was offered in the Spring Semester of the student's senior year. The course covered:

"the planning, design and execution of civil engineering construction projects. The classroom portion of the course covers miscellaneous topics such as cost and schedule estimating, construction management and engineering economics. The lab portion is organized in two phases; the first phase covers the planning process and the second the design process. In the planning phase cadets will evaluate alternatives and prepare planning documents. During the design phase, cadets will prepare a design for a project which will culminate in a set of construction drawings, cost estimate and construction schedule and possibly an outline specification."²

The course consisted of two 50 minute classroom sessions each week and two three hour laboratory periods per week. The classroom portion of the course focused on cost estimating, scheduling, construction management, and engineering economics. The laboratory periods provided the students with a designated six hour time block each week to move forward on their capstone design.

In this class, the students were presented with a few capstone project options. From these options, the students were allowed to choose which project they wanted to work on and

which students they wanted to work with. Capstone group size was limited to no more than four students and each group had to develop their own unique solution for the given situation. As an example, the Class of 1998, which was composed of thirty-three students, was presented with 2 project options:

(1) *Rails to Trails* – where the student group was responsible for the rehabilitation of an existing, but abandoned, rail bridge as part of the nationwide effort to convert old railroad paths to bike/hike paths.

(2) *Air Station Cape Cod Pool Design* – where the student group was responsible for the design of an in ground pool and associated bath house for a Coast Guard base.

Three groups of students worked on each capstone project. At the end of the semester, all six groups presented their final design to an engineering audience that included the stakeholders for their project. This course format created a realistic scenario where teams were competing against each other in terms of cost and final design. The downside of this competitive capstone process was that no group saw their final product fully implemented because the stakeholders were able to pick and choose which elements of the student designs they wanted to implement. Students felt they had spent a semester working on a project that was quickly disassembled for its parts. Instructors wrestled with student frustration and the reality that good projects were tough to come by and an engineer's "final design" could always be modified by a client.

In 2000, the classroom and the capstone design components of this course began to change. Planning and Design of Construction Projects continued to consist of two 50 minute classroom sessions each week and two three hour laboratory periods per week. To enhance student achievement of various educational outcomes and better meet the needs of the Coast Guard, the classroom portion of the course expanded its focus to cover lecture topics that can be assigned to six broad categories:

1. Planning
2. Cost Estimating
3. Scheduling
4. Engineering Economics
5. Engineering Ethics
6. AutoCAD exposure

The laboratory portion of the course continued to provide time each week for students to work on their specific capstone design, but this designated lab time became slightly more structured. The first month of the semester, the course instructor guided the students to focus on the planning aspects associated with their project. This phase of the course concluded with Planning Presentations and a chance for the students to share their research and project goals with their peers and instructors. The rest of the semester, the students spent in the design/build (depending on the project) phase of their capstone experience. The semester still concluded with a final presentation where the students reported their results and summarized their work.

In response to student end of course feedback, the capstone project options increased from two to three. The competition still existed and students continued to mention in their comments that they would prefer that projects were unique to each group.

During the EOCR at the conclusion of the Spring 2000 semester, a recommendation was made to change the courses name from “Planning and Design of Construction Projects” to “Civil Engineering Design”. The new course name more accurately reflected the evolving nature of the projects chosen which spanned an increasingly diverse set of sub-fields within civil engineering. Based on student feedback and instructor observation, more guest speakers and more field trips were added to the course.

As CED began to take shape, the CGA Civil Engineering Faculty found more and more topics were needed to provide civil engineering graduates with level of the education necessary to effectively serve in the field and to foster achievement of educational objectives. As Coast Guard Civil Engineering began moving from a historical engineering design and construction model to a broader engineering management model⁶, the CGA Civil Engineering program was asked to respond. The faculty recognized that it was not possible to adequately cover construction management and project planning topics within a senior capstone design class. Assessment data reflected that these topics were not well covered and that there was insufficient time and focus on the actual senior capstone projects as a result of all the lecture topics.

In the Fall of 2003, a new course called “Construction Project Management” (CPM) became a prerequisite to CED. CPM lectures included all of the topics that had been identified as necessary for a Civil Engineer to succeed after graduation:

- Construction Industry Overview
- Design Package Components
- Scheduling
- Engineering Economics
- Cost Estimating
- Contracting/Project Management
- Engineering Ethics
- Sustainable Design
- Capital Asset Management
- Planning
- Facilities Management

CPM also fostered educational outcome achievement in areas relating to engineering ethics, professional practice issues, and engineering economics and deepened student knowledge of construction management practices prior to embarking on their senior design projects. Survey results for program graduates before CPM was implemented were compared with survey results of graduates who have had the CPM class. The data indicates that graduates are benefiting tremendously from this course both for Coast Guard practice and in support of graduate studies.

As a result of the addition of CPM, the CED class schedule consisted mostly of field trips and guest speakers. It was noted by the course coordinator of CED in the Spring 2004 EOOCR that the removal of the formal classroom lectures was helpful in enhancing the quality of the projects completed that year. In addition, the CED coordinator was able to focus on the improvement of the capstone project process. The most significant improvement made was the number and type of capstone projects. Coast Guard Civil

Engineering entities (the local Civil Engineering Unit in Providence, RI; the Coast Guard Research and Development Center in Groton, CT; Coast Guard Headquarters; and the Facilities Engineering Branch of CGA) were asked to provide project proposals for the cadets. This request required some explanation of what a “good” student capstone project would entail. Units were asked to provide a project with a design component that could be accomplished by a group of no more than five students in a four month window with students working eight hours a week. The response was phenomenal. For the first time, each student group was assigned a project unique to their group. Seven projects were assigned to twenty-five students. A complete list of recent project titles appears in Appendix A. The projects were real civil engineering problems with student teams working for clients at Coast Guard units. The students saw their value and took pride in knowing that their efforts were going to be implemented. The improvement in student attitude toward their projects was reflected in assessment data.

While the new projects were well received by the students, faculty, and Coast Guard units, the new model presented a new set of challenges. As the number of projects increased, the number of faculty advisors also had to increase adding work load stress to an already overloaded faculty. Each project was unique and, in some cases, no one on the faculty had the expertise in the required field. For example, in 2005, one of the capstone projects looked at the damage being done to the piers at a local Coast Guard Station by the waves created from the river traffic. The first step in this project was to collect and analyze wave data; a task that required a learning curve for both the students and the faculty advisor.

Over the next three years, not much was changed with respect to the format of the CED course. The CED course coordinator continued to reach out to Coast Guard units for civil engineering project ideas and the program continued to receive excellent project opportunities. The original goal of no more than five students to a group was revamped to no more than seven due to increasing enrollment, the number of projects required for larger classes and the amount of time allotted by the institution for the final presentations. The added workload of the advisors was monitored. The grading process was discussed and seemed to be the one element of the new CED course that still needed improvement. The CED course coordinator was responsible for collecting project options from outside units, arranging guest speakers and field trips, setting up any additional training (like AutoCAD), creating the course syllabus and schedule, planning deadlines for the capstone project teams, and making the arrangements for the final presentations. The individual project advisors were responsible for the grading of the mandatory project notebook, poster and presentation. This left inconsistencies in the grading criteria for the only written assessment tools for the course.

Course Improvements: 2006-2008

Based on assessment data and discussions with other engineering faculty at the biannual departmental review meeting, the Civil Engineering Faculty met in June 2006 to discuss improvements to the CED lecture and laboratory. The three main issues were (1) to develop a common grading scheme; (2) to discuss the format of the course: should we

return to a more formal lecture portion of the course?; and (3) should a final report be required in addition to the final notebook submission? This meeting led the CED course coordinator to make additional changes to the CED course.

For reasons of consistency between groups, enhancing student/faculty communication, and encouraging consistent work within each capstone team, a formal grading rubric was developed. Prior to this 2006 meeting, a student's final grade was based on the following submittal breakdown:

Project Notebook	30%
Project Poster	20%
Formal Presentation	50%

Each advisor was responsible for how these three deliverables were graded. The advisor would have worked closely with the group over the course of the semester and would have a clear picture of which students contributed most to the final product. The students who contributed most to the final outcome of the project would find that their final grade reflected effort. There was a lot of room for advisor inconsistency between different groups.

In the June 2006 meeting, the following grading scheme was suggested:

Problem Statement	10%
Weekly Time/Performance Reports	20%
Project Results	20%
Poster	10%
Project Notebook and Final Report	20%
Final Presentation	20%

This revised grading scale was designed to help the advisor and the student stay on track (with the weekly performance reports). This scale still incorporated the poster, the final report and the final presentation and emphasized the importance of these elements to the project through their weighted value. The additional criteria also accounted for whether or not the group was able to achieve the desired goals and helped them to focus on the goal of the project early on through the required written problem statement.

In the group discussions about the need/desire of formal lectures, it was decided that formal lectures were a necessary part of this course and should be used to introduce the students to guest speakers and to help guide the students in their required course documentation. The assessment process also indicated that there were some topics that were better incorporated into CED lecture that helped the program meet educational objectives. The weekly schedule included two class lectures. The first lecture block each week would be used to provide the students with tools to help them be successful in their project, such as developing a team charter, technical writing abilities, civil specific FE review sessions, presentation skills, or to bring in a practicing engineer to present some contemporary element of the civil engineering industry. The second lecture each week would be set aside as a required meeting time for the group and their advisor. After this meeting, the group would be responsible for producing meeting minutes (Appendix B) to document topics discussed at the meeting and to help the group monitor progress.

The third change made as a result of this summer meeting was the addition of a final report. “It was agreed that a final report should be incorporated to ensure that cadets have developed written technical communication skills. The report should be submitted in stages and reviewed/revised so that it is not all left to the end of the semester. Since many projects have clients and/or are ongoing for several years, both a report and a notebook containing notes and calculations should be submitted and graded for each project.”³

In addition to the changes decided upon in the June 2006 meeting, the project notebook, the team charter, and the problem statement criteria were all updated. Historically, the project notebook was required to “be tabbed”⁴ and had to “contain all notes taken in class, handouts and graded materials.”⁴ If the binder was not turned in, a 5% reduction of the overall course grade was taken. Beginning in 2007, the notebook was required to contain the project problem statement, 14 progress reports, problem statement related sections, any calculations, research papers from CPM, and a final technical report. Student work must articulate how their project relates to the elements of design included in ABET criterion 3 and their project planning must be formulated in terms of CGA’s own iterative design process. To ensure that students were on track, the project notebook was collected five times during the course of the semester, including the final submission, and assigned a grade by the CED instructor. The Problem Statement became planning assignment one (Appendix C) and is the first academic grade the capstone groups receive during the second week of class. The team charter became planning assignment 3 (Appendix D) and forced the students to discuss team related issues during the first few weeks of class before team stresses could develop.

In every situation possible (project notebook, final report, etc.), a grading rubric was developed and distributed among advisors. Example rubrics can be seen in Appendix E.

Challenges and Benefits

Throughout the course improvement process, challenges have arisen. The current assessment processes (EOCR, focused discussion groups, etc.) used in the Civil Engineering Program at CGA have helped to mitigate or even eliminate some of the challenges encountered during the development of CED. Great strides have been made in fostering educational outcomes, in ensuring that grading is consistent, in keeping groups on track the entire semester, and in leveraging class and lab time for important topics, guest speakers, AutoCAD training, and field trips.

Despite continuous communication and yearly assessment, the Civil Engineering Design course still faces a number of challenges that the Civil Engineering faculty members at CGA will continue to work on. The first and longest standing challenge is developing a system for finding quality student capstone projects that can be successfully completed during the course of one semester (30 class meetings). Additionally, it has become increasingly challenging to find funding for the number of projects that will be required as Civil Engineering enrollment continues to rise. Related to the time crunch of one academic semester is determining the “correct” number of deliverables for a student group. Because CPM is a prerequisite for CED, the current standard is to assign capstone

projects to the students by the first of November while the students are still in CPM. The student's final assignment in CPM is an individual research paper associated with some element of their capstone project. By requiring these papers, students return from winter break with a head start on their capstone project and the first requirement of their project notebooks.

The final challenge associated with CED is a double edge sword. The CED course coordinator and many of the project advisors are typically members of CGA's rotating military faculty. Because CGA is a military institution, active duty members of the Coast Guard with at least a M.S. in the required field can apply to be assigned to CGA for a "tour", generally three to four years. These active duty members bring with them experiences "from the field". For Civil Engineers, rotating military instructors usually come from a Coast Guard Civil Engineering command. The benefit of this is that the faculty member has just left a tour where they have been active in the "how to" daily life of a Coast Guard Civil Engineer and they can bring these real time experiences back into the classroom. The challenge is that this active duty member brings to the table very little, if any, formal classroom teaching experience. While only senior members of the rotating staff (members with at least a year of teaching experience) teach CED, the turnover rate for CED instructors is historically every two to three years. This trend makes record keeping and communication among the Civil Engineering faculty essential. In recent years, there has been a greater emphasis on senior faculty mentorship and involvement in the course and many permanent faculty members regularly advise project teams along with rotating faculty members.

Members of the Civil Engineering faculty, feedback from members of Coast Guard Civil Engineering units, and student surveys overwhelming indicate that the Civil Engineering Design course has made notable improvement over the last decade. Graduates of CGA's Civil Engineering Program are better prepared for a career in civil engineering and more broadly as project managers for the Coast Guard based on the culmination of their student experiences in CED.

Conclusion

The CGA Civil Engineering faculty has worked hard to develop the present capstone course. CED provides a platform for real life learning. Students often experience some amount of realistic frustration that comes from working in a project team on a real project with deliverables. One student commented, "I feel like our project in general gave us a lot of experience with the civil engineering side of the Coast Guard. We looked at a lot of contemporary issues and are looking at many new ways of constructing buildings better and faster. The hardest part of our project was the huge communication barrier that took place. If I could do it over again I would have asked someone from outside of our group to help with the problem."⁵ This experience is tough to create. Using real world problems that do not have clear objectives provide CGA civil engineering graduates with the opportunity to experience some of the challenges of a real engineering problem while still in the classroom setting. Maintaining this reality while academically assessing the capstone group has proven to be difficult, but well worth the effort.

The creation of CGA's senior design course has been ten years in the making and has improved through the collective efforts of over twenty permanent faculty, rotating military faculty, and willing capstone project stakeholders. Through end of course reviews, student feedback, field unit input, and other assessment tools, the faculty at CGA knows the capstone process improvements are adding benefit to our graduates and our service. We believe the improvements and successes we have made at our Academy are applicable and worth implementation beyond our gates. As one student reflected, "pretty much everything I learned over the past four years was combined together in this class. The class led our project along and taught us how to prepare a timely technical report. Without the guidance of this course, I doubt many projects would have been correctly completed."⁵ The capstone course in Civil Engineering at CGA will continue to evolve to reflect best practices in education, accreditation criteria, and the needs of the Coast Guard.

References

1. *United States Coast Guard Academy Catalog of Courses: 2007-2008*. USCGA, New London, CT.
2. *Syllabus for Planning and Design of Construction Projects*. Spring 1998. USCGA, New London, CT.
3. Meeting to Discuss CED Issues: June 13th, 2006. USCGA Civil Engineering Faculty, New London, CT.
4. 2001 Civil Engineering Design Syllabus
5. 2007 CED End of Course Surveys
6. Chief, Civil Engineering, USCG address. University of Illinois, Champaign/Urbana, IL. September 1999.

Appendices

Appendix A: History of Capstone Projects: 2004-2008

Appendix B: Meeting Minutes

Appendix C: Planning Assignment 1

Appendix D: Planning Assignment 3

Appendix E: Grading Rubrics

APPENDIX A: Capstone Projects: 2004-2008

Year	Project Title	# of cadet groups	total # of cadets
2004	Group Long Island Sound Facility Asset Survey Board	1	4
2004	Nantucket East Breakwater Light Solarization & Redesign	1	4
2004	Evaluation of a Shipboard Wastewater Treatment System	1	3
2004	Treatment of Shipboard Gray Water in a Laboratory Scale Membrane Bioreactor	1	3
2004	Concrete Beam Tester	1	4
2004	Toby May Scoreboards - Structural Design	1	4
2004	LORSTA Port Clarence Eyebolt Study	1	3
2005	CGA New Fitness Facility	1	5
2005	Shipboard Wastewater Treatment	1	4
2005	Wave Analysis of Station New London Harbor	1	4
2005	McAllister Hall: Design for Student Centered Learning	1	3
2005	McAllister Hall: Power Lab Mezzanine Extension Design	1	4
2005	McAllister Hall: Atrium Enclosure Design	1	4
2006	McAllister Hall Indoor Air Quality	1	3
2006	Stonington Soccer Field Remediation	1	4
2006	LORSTA Port Clarence Eyebolt Study	1	5
2006	CGA Quarters 1 Rain Garden and Handicap Access Ramp	1	5
2006	Wave Analysis of Station New London Harbor	1	4
2007	CGA Cadet Obstacle Course Design	1	4
2007	CGA Storm Water System Analysis and Design	1	6
2007	LORAN Transmitter Building Modernization	1	5
2007	Students Arts Center Design	1	4
2008	CGA Boat Wash Effluent	1	6
2008	McAllister Hall Renovation and Design	1	6
2008	Station New London Planning and Expansion	1	6
2008	Station New York Retaining Wall	1	6
2008	New Orleans Flood Gate Design	1	7

APPENDIX B: Meeting Minutes

MEETING MINUTES

PROGRESS REPORT # 1

Jan 17th, 2008

Project Title: Mac Hall Roof Project

ATTENDEES

Advisor	Dr. A.D. Visor
Lead Engineer	1/c A. Cadet (rotating position)
Team Member	1/c B. Cadet
Team Member	1/c C. Cadet
Team Member	1/c D. Cadet

PROJECT STATUS

% complete to Date:	0%
Estimated budget	\$0
Days until presentation dress rehearsal (date TBD by Advisor):	98
Days until final presentation (May 1, 2008):	111
Days behind/ahead of schedule:	0
Hours spent working on the project since the last meeting	48
Meeting Duration	30 minutes

MEETING AGENDA_[c2]

1. Introductions.
2. Discuss/ add constraints and evaluation criteria to the Define section of the DRIDS-V.
3. Restructure Research methods.
4. Work to identify all possible solutions and move toward Decide phase.
5. Etc.

DISCUSSED ISSUES

1. **Everything in this section, will be items discussed that were not on agenda examples from a real project meeting are shown below.**
2. Boom representative will be on site today to assist in anchoring the boom.
3. Contractor requests that the Coast Guard find out when lockers will be cleaned out.
4. LTJG Smith requested roofing material submittals as soon as possible to avoid delays in roof installation.
5. All screw/nail holes, drywall anchors and other damaged areas to be repaired by contractor where pictures, plaques, flags and half hulls were previously located.
6. Follow up with pavement contractor about sidewalk forms.

One Week Look Ahead

1. Meet in Mac 224 Thursday 24 Jan 08 at 1330.
2. Progress schedule due to Advisor on 24 Jan 07.

Clarification Issues:

1. **These are “to do” items. Things discussed in the meeting that were not resolved b/c someone needed to do some more research or gather further information. Could also be waiting on information from client.**
2. **Issue:** 1/c A. Cadet to talk to project POC about budget and direction to head.
Resolution: Followed up via email 18 Jan after meeting.
3. **Issue:** 1/c B. Cadet to talk to CGA Facilities about historical constraints/requirements to consider in the addition of a new roof.

Resolution: pending

4. *Real World Example:* **Issue:** The new ventilation fan that is to be installed may impact ceiling height in the new handicap bathroom area. Finish schedule calls for 8ft finished ceiling height, existing is only 8’5”. Cut sheet on the fan is needed to determine final ceiling height. Also appears on the detailed drawing to be a suspended ceiling, but the finish schedule calls for GWB.

Resolution: AE to answer.

Assignments:

1. A schedule of what will be accomplished this semester. DUE: 22 Jan 08.

Upcoming events:

1. *Example:* CAD training Jan 22nd during lab
2. Field trips
3. Site visits
4. Poster competition

****If any items discussed at the above meeting are not listed here, please inform 1/c C. Cadet (name of this weeks Lead Engineer) so that proper documentation is maintained.**

APPENDIX C: Planning Assignment 1

Planning Assignment 1

Due 22 Jan 2008

Project Design Process:

Engineering Design is a Process. Engineering is the application of science to solve problems in order to improve our lives. To improve the efficiency of your problem solving as you complete your senior design project, you use the Unified Problem Solving Process listed below.

Unified Problem Solving Process (DRIDS-V)

1. DEFINE

Define the problem, question or goal. Identify constraints and evaluation criteria.

2. RESEARCH

Learn about the problem. Gather information. List assumed information, keep track of sources. List known elements that still need to be researched.

3. IDENTIFY

Brainstorm and identify all solutions or how you will determine what the best solution will be.

4. DECIDE

Select the best solution. Identify criteria that will be used for the final decision.

5. SOLVE

Complete and document the solution. Cite sources. How will you know you have found the solution?

6. VERIFY

Ensure that the solution adequately solves the problem/answers the question; if not, iterate. Exercise judgment; ensure answer is reasonable.

Conceptually, steps 2-6 provide feedback to the previous steps. In other words, if you learn something that modifies or invalidates the result of a previous step, iterate, go back and repeat the process.

Project Notebook Assignment #1:

Provide a conceptual outline of your project in terms of the DRIDS-V problem solving process. Thus, you should articulate your project definition, list necessary areas of research, and determine tests or other outcomes that will verify whether your final product actually **SOLVES THE PROBLEM YOU DEFINED**.

APPENDIX D: Planning Assignment 3

Team Charter:

A team charter is the first step in defining your team.

Team charters should, at a minimum, include the following:

- Establish ground rules (at least 5).
- Define why the team exists / agree on a purpose
- Identify stakeholders and prioritize them
- Define individual roles and define your team's definition of participation
- Determine a decision making method (consensus, majority rule, etc.)
- Define specific tasks (one per person) for your team and list constraints of your project (at least 3)
- Identify limits (time, budget, informational) and group and stakeholder expectations
- Arrange logistics (meeting place, meeting times, travel?, etc.)
- How will feedback be provided? (hidden ballot, open forum, etc.)

Project Metrics:

A metric is a simple, current standard of measurement used on a project to drive important activities.

Metrics should tie back to goals/important activities on each project.

Metrics MUST be **SMART**:

S	Specific
M	Measurable
A	Achievable
R	Relevant
T	Timely

By taking a pulse each week on your key metrics, you will be able to accurately assess your project:

Are you on track?

What element of the project needs more attention?

Are you running out of time? Money?

Project Notebook Assignment #3:

Create a team charter for your CED team.

Define at least 3 metrics for your project by answering the following questions:

1. What are the important activities for your project? (list at least 3)
2. List one way you can measure each of these activities. (i.e. define the metric for your activity)
3. What is the assumed outcome of each metric?
4. Will all of your goals be met with your metrics?

APPENDIX E: Project Notebook Grading Rubric

Civil Engineering Design Project Notebook Grade Sheet – 2008

Project Title: _____

Cadet(s): _____

Criteria	Points
Final Report (50 points) 1 Final Report from each group. Each team member receives the same grade.	
Background/Reference Material (15 points) - References - Research Results (CPM Research Papers) - Previous year's documentation - Sponsor documentation/executive summaries. - Correspondence (emails, letters) w/ sponsors, vendors, technical advisors, etc.	
Project Documentation (10 points) - Project Poster (a copy of both posters sized to fit in the binder) - Project Plan - Requirement Documentation - Problem Statement - Support Plan - Points of contact	
Supporting Documentation (5 points) - Software documentation (code, user manuals, etc.) - Hardware documentation (user manuals, schematics, etc) - Purchase requests including vendor information	
Weekly Status Reports (10 points)	
Electronic Copy (5 points) - All documentation (from above) - Your paper & outline - Data files (raw data, processed data, spreadsheets, etc.)	
Organization (5 points) - Cover sheet/title - Table of contents - Well organized	
Total (100 Points)	

NOTE – These are just examples of the types of documents that might be included in these categories. Due to the varying nature of each project, your project may not have all of these items. You should also not limit yourself to those items that appear on the list – if you feel it is important to the project; include it in your binder.