THE ROLE OF STUDENT CHAPTERS IN IMPROVING CE PROGRAMS

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Introduction

ASCE Student Chapters and Clubs add tremendous value to civil engineering (CE) programs [1, 2, 3, 4, 5]. The value added can and should be tied back to program objectives and outcomes as part of a regular, formal program assessment process. This paper will describe the activities of the student chapter at the United States Military Academy (USMA), describe the USMA civil engineering program outcomes, and show how many of the chapter activities support these program outcomes and add value to the Civil Engineering program.

The USMA Student Chapter

Student chapter leaders and members are faced with many unique challenges that affect chapter activities. USMA students have an unusually high level of mandatory requirements outside the classroom that restrict the time available for extracurricular activities. These requirements, which include physical training classes, mandatory meal attendance, military drill and ceremony, and compulsory intramural sports participation, limit the student chapter's ability to plan long-duration events. Therefore, student leaders focus their efforts on short duration activities, trying to get the biggest benefit for the most valuable student resource: time. With limited and tightly controlled increments of available time, we attempt to tailor our activities to accommodate this constraint. Those USMA chapter activities that add the greatest value to our CE program, are listed below, and described in the sections that follow:

- Community service and outreach through adopt-a-highway clean up, Habitat for Humanity participation, and support of those community service independent study projects in the CE program [6].
- Exposure to professional societies such as ASCE, ASEE, The Society of American Military Engineers (SAME), and the Army Engineer Association (AEA).
- Knowledge of the profession and exposure to engineering practitioners through lunchtime seminars featuring prominent engineers both in and out of the Army.
- Field trips to project sites such as Big Dig in Boston, NYC Port Authority and Woodrow Wilson Bridge/I-495 interchange in D.C.
- Lunch and dinner seminars that support the CE curriculum by welcoming CE new majors to the program, present avail opportunities for Advanced Individual Academic Development (AIAD), and advertise the available independent study projects for the year. AIADs are the USMA equivalent of a co-op program where students spend three weeks in an Army lab or Army Corps of Engineers District in the summer.
- Competition projects for stimulating underclass interest in civil engineering through: concrete canoe, steel bridge, timber bridge, and big beam competitions.

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- Paper and web-based publication of a social calendar that improves student cohesiveness, provides emphasis for important events such as the FE exam and program completion, and provides leadership and planning opportunities for the students.
- Participation at ASCE regional student conference, ASCE faculty advisor training, ASCE student leader training, ASCE national convention and the ASCE 150th anniversary national student conference.
- An awards program that recognizes the contributions of club leaders.

CE Program Outcomes

The USMA Civil Engineering (CE) Program Outcomes shown in Table 1 define what students should be able to accomplish upon graduation. Traditionally, the CE program relies on the formal curriculum to reach these outcomes through classroom instruction, laboratory experiences, field trips, homework, projects, and presentations. The many constituencies that contribute to the CE program objectives are shown in Figure 1. USMA cadets are clearly one of the major program constituents and cadet input is used to help articulate our program objectives. At the same time, the student chapter activities contribute to the accomplishment of many program outcomes – especially some of the more nebulous outcomes that are difficult to quantify. Table 2 provides the chapter faculty advisor's assessment of the student chapter contribution to each of the program outcomes on a scale of 1 to 5. A rating of 1 indicates little or no contribution, while a value of 5 indicates that a significant contribution to the outcomes is derived from that activity. Clearly there are some outcomes such as "proficiency in calculus-based physics" or "designing and conducting experiments" where ASCE chapter activities provide little benefit. For those outcomes where there is a student chapter contribution, the faculty advisor lists the relevant supporting activities. Table 2 is presented in the same format that course directors provide for their annual course assessments. The student chapter contributions are part of the annual CE Program Assessment process where both chapter activities and the curriculum are integrated and improved as a result of the assessment. Many of the initiatives described in this paper are a result of that assessment.

Chapter activities may not contribute equally towards ABET accreditation for all students since not all students join the ASCE chapter nor do all students participate in all activities. For the USMA CE program, chapter activities are a supplement for attaining outcomes, much as an elective course contributes to accreditation. Thus, chapter activities are relied upon for enrichment rather than as a sole contributor to any outcome. The CE program relies on the core CE curriculum to meet minimum accreditation requirements, but the ASCE chapter greatly enhances the engineering education of any student who chooses to participate. Because ASCE charges no dues for student members, chapter membership is close to 100% of CE students. Those chapter activities that offer the greatest contribution to program outcomes are described below in the context of the outcome they support.

Graduates demonstrate creativity, in the context of engineering problem solving.

Demonstrating creativity in an undergraduate civil engineering program can be challenging. There is a substantial body of basic knowledge that must be mastered before a CE student can be creative without being dangerous. For the USMA CE student, opportunities for creativity do not

appear until the final semester during independent study projects, the capstone design experience, or in the professional practices course. Until then, problems may be open-ended, but not necessarily creative.

Competitions associated with the ASCE Regional Student Conference provide a venue for students to be highly creative in their entries and their presentations. The AISC Steel Bridge competition offers a set of functional requirements. Students design and fabricate a steel bridge that carries the required load while minimizing weight and deflection and maximizing aesthetic quality. There is no approved solution and the students only have to do it better than other students who presumably have the same skills and knowledge background. The ACI Concrete Canoe Competition and the Timber Bridge Competition provide the same opportunity for other students. These competitions have a set of general rules and the student teams have considerable le latitude in their solutions. The chapter provides the teams with both financial and physical support in the development and execution of these designs.

The K'nexercise is a project management exercise where students learn the design-bid-build procurement process and appreciate the dynamic interactions of the key players involved in a construction project. Students role-play the architect-engineer, owner, contractor, and project manager for a project that uses K'nex toys to build a structure that meets functional requirements. The exercise, which has traditionally been part of the CE Professional Practices course, provides some unique and highly creative solutions. The Student Chapter revised the rules to accommodate a single day competition and offered the event as part of the 2001 ASCE Regional Student Conference held at West Point. The student teams are divided into two groups, the architect/engineers (A-E) and the contractors. The A-E must produce a set of plans and pass them to the contractor who must then bid the work. The K'nexercise finishes as all teams construct their design in the shortest possible time. The lowest cost functional structure wins. The K'nexercise was so successful that USMA was invited to run the competition at the 150th Anniversary Student Conference in Madison, Wisconsin.

Given the time constraints on the typical USMA CE major and the rigidity of the Academy's schedule, the student chapter leaders must be creative to make the chapter successful. They need to plan events that accommodate the schedule, are relevant to the CE profession, offer variety, and are sufficiently interesting to attract students who have many other demands on their time. This often requires clever flyers, enticing incentives, creative scheduling, multiple means of communication, and the ability to integrate chapter activities with the CE curriculum.

Graduates can function effectively on multidisciplinary teams.

The senior capstone design course offers students a significant opportunity to participate on a multidisciplinary team. The ASCE student chapter provides additional opportunities through community service and chapter leadership. The projects are truly multidisciplinary, since team members must take responsibility for different aspects of a project and come together at the end to produce a finished product. Thus, students perform diverse roles on the project or team and are challenged to work with others representing different views.

Twice a year, the chapter travels to Newburgh, New York to work with Habitat for Humanity, a non-profit group that builds or renovates old buildings for low-income people. Students form into groups and work on different aspects of the project. One to two students lead the work groups and must coordinate resources and requirements between the groups to ensure they accomplish the goals for the day. The competition for resources and the resolution of different ideas can cause anxiety in students. The event is always a success once all members realize that they are working toward a similar goal.

Not every student serves in a leadership position in the student chapter. However, the student leaders who do step forward tend to divide the duties into clear and separate categories, much like a design project. If one area fails, then the whole project would fail. The officer positions (president, vice-president, secretary, treasurer) lend themselves to division of labor. For individual chapter events, the chapter president will divide the responsibilities along functional areas such as transportation, food, and program coordination, so that the events are likely to succeed. Once again, individuals working on different tasks toward a common goal can demonstrate multidisciplinary teaming.

The greatest example of developing and executing a project with a multi-disciplinary team was the 2001 Student Regional Conference held at West Point. The student chairman assigned staff responsibilities in the areas of administration, operations, and logistics. The various competitions (steel bridge, concrete canoe, K'nexercise, paper competition) each had a student responsible for that event. The division of labor kept any individual from being overwhelmed and forced the students to work as a multidisciplinary team to be successful.

Graduates demonstrate an appreciation of the roles and responsibilities of civil engineers and the issues they face in professional practice.

Student chapter activities probably have the greatest impact in reinforcing student understanding of what society expects from civil engineers. Aside from the three-week AIAD experiences, students at USMA do not have the opportunity to do summer internships with civilian engineering or construction firms. However, the chapter leaders organize and host at least five seminars per semester on civil engineering topics and projects. These seminars typically occur in conjunction with lunch or dinner meals. The subsidized pizza or subs help provide an additional incentive to attend. Meeting topics vary greatly but typically focus in two areas:

1) Professional Development in Civil Engineering
2) Civil Engineering and the U.S. Army

Professional Development in Civil Engineering -- Without a graduate-level program, students at USMA are not exposed to the many facets of civil engineering. The student chapter helps the department mitigate this shortfall through the seminars. The CE Professional Practices Course also relies on guest speakers from industry, but the student chapter events are the only means of including sophomores, juniors, and seniors at the same event. Some examples that illustrate the variety of speakers include Ralph Locurcio speaking about the new cadet library currently being designed. Dr. Paul Mlaker presented his findings on the 9-11 Tragedy at the Pentagon, even before they were released to the public. As the lead structural engineer on the team, Dr. Mlaker

demonstrated how structural redundancy prevented collapse despite the loss of many columns. Mr. Chris Raferty's (Skilling Corporation) presentation on the construction of the Experience Music Project in Seattle Washington fascinated the students. His presentation covered the Design Build Project Delivery system and described how changes impact the contractor and the architect-engineer. Mr. Dave Edwards, a seasoned contractor, offered a candid assessment of how a junior engineer is viewed on the project site. These presentations provide a perspective from engineering professionals that could never be obtained in the classroom. Students gain an awareness of the challenges faced by real engineers in professional practice.

Civil Engineering and the U.S. Army – The Academy's mission is to produce leaders of character to serve on active duty in the military. Between two-thirds and three-quarters of the CE majors each year choose to serve in the U.S. Army Corps of Engineers (USACE). With many prominent USACE leaders visiting West Point every year, there are numerous opportunities to invite them to address the ASCE student chapter. Undersecretary of the Army, the Honorable Dominic Izzo, gave the students an overview of how large construction projects, from locks and dams to barracks, are developed, funded, planned and completed USACE. Mr. Izzo showed students how the political, social and economic aspects can support or defeat a project being built. Similarly, Colonels Ken Kasprisin and Rick Pollo, the commanders of the St Paul and Detroit Districts respectively, visited to review the civil and military construction projects in their districts. Cadets were very interested in the local and national politics involved in many of these projects. Colonel John O'Dowd briefed the cadets on the New York District's role in the post 9/11 clean up and General Steve Rhodes told cadets about the North Atlantic Division and offered advice for new lieutenants joining the Army. Students are treated to an insider's view of the issues facing Army engineers at the highest level.

Another important role of the civil engineer is as a servant to society. The Student Chapter emphasizes this responsibility through its community service projects. In addition to Habitat for Humanity, the student chapter participates in Highway Clean up. Students and faculty plan and execute the two-mile clean up of a busy highway outside of the academy several times per year. Many of the independent study projects that are part of the CE curriculum focus on service to the community and the Student Chapter is occasionally called upon to support these projects. For example, the student chapter incorporated the USMA entry in the National Timber Bridge competition into part of a local nature trail. The students excavated the abutments, constructed the footings and emplaced the bridge across a creek.

West Point Bridge Designer (WPBD) contest is a highly successful nationwide outreach effort to interest K-12 students in civil engineering. The student chapter assists this project in several ways, such as providing student members at the Building Big exhibition in Washington D.C. Chapter volunteers showed school-age children how to design a bridge using the WPBD software. The WPBD program is designed to influence and inspire the next generation of engineers.

Graduates can write effectively and Graduates can speak effectively.

Although writing and speaking are listed as two separate outcomes, effective communication is highly important for all engineers. Many chapter events require students to speak in front of

their peers and faculty. For example, a student chapter seminar is scheduled for senior students to formally describe their AIAD experience to the younger civil engineering majors. The goal is to encourage sophomores and juniors to participate in the AIAD program.

Through the ASCE Student Chapter, senior students write an essay on an ethical issue for the annual Daniel Mead Essay Competition. Faculty select the best three papers for the ASCE Upstate New York Regional Conference. The three winners travel to the conference and present their papers to a group of judges and peers. The student chapter supports other essay contests as well. USMA submitted entries for the ASCE Urban Public Transportation Systems contest last year and the Engineering Water Resource Institute contest this year. The Concrete Canoe Competition also requires both a technical paper and an oral presentation as part of the graded criteria. The team must fully understand the technical portion of their work and communicate it in a clear, concise method as they are subject to questioning by the judges. The students responsible for writing and submitting the chapter's annual report need to write in a lucid, organized and logical manner to document the chapter's accomplishments. Military officers must communicate clearly and concisely, so this becomes one of the CE program's most important outcomes.

Graduates demonstrate knowledge of contemporary issues.

The student chapter seminars discussed earlier support the knowledge of contemporary issues outcome as well. Chapter leaders also participate in the activities at ASCE national conferences, which exposes them to the most pressing contemporary issues facing engineers today. At the 150th Anniversary ASCE National Conference in Washington D.C., student leaders participated in events dealing with two of the most important topics in engineering: recruitment and ethics. The participants acted out an ethical dilemma in front of an audience to stimulate discussion and analysis of the dilemma. The case study generates an intense discussion with many varied opinions regarding how to handle a complex ethical issue. As a result, student leaders return and provide feedback to the rest of the chapter on where the profession is going.

The annual ASCE national conferences also provide exposure to the civil engineering profession and its contemporary issues. The various session topics range from wastewater to international construction to forensic engineering. Attending sessions on current issues such as the masters degree being the first degree of civil engineering, separate licensing for structural engineers, and the status of various professional codes offers the latest information on policies and issues facing engineers. There is not a better opportunity available for students to meet and learn from practicing engineers. Students also get to see where their professional organization, ASCE, is trying to steer the profession for the years to come. All of these activities stress to students the importance of civil engineers for the betterment of society.

Graduates have the broad education necessary to understand the impact of engineering solutions in a global and societal context.

The student chapter sponsors field trips to major construction projects. For example, Bob Magnifico spoke to the students about the construction at the Metropolitan Transit Authority at a lunchtime seminar and provided the chapter with a tour of the underground construction two

months later. Using gift money from the Academy's Association of Graduates, students can visit projects farther away. Last year, students visited the Big Dig project in Boston and both the Woodrow Wilson Bridge renovation and the I-495/95 interchange rerouting in Washington D.C. The publicity surrounding the Big Dig and the controversy concerning budget overruns is a perfect illustration of the political impact of a project. The Washington D.C. projects illustrate how difficult construction can become if society demands that infrastructure remain operational during the construction process. These field trips provide students with the opportunity to see engineering in action. Students see how creativity and the engineering problem solving process can overcome extremely complex problems, whether they be redirection of traffic flow on I-495 or handling the alignment of submerged tunnels at the Big Dig.

There is considerable overlap in the student chapter contributions to the various outcomes. Certainly the guest speaker seminars, the conference attendance, and the community service projects described earlier also help students understand the impact of engineering solutions in a global and societal context.

Graduates are prepared for and motivated to pursue continued intellectual and professional growth—as Army officers and engineers.

Part of the professional growth of any engineer is participation in the professional societies that support the discipline. Membership in the ASCE student chapter illustrates the benefits of a professional society. Student officers attend the ASCE student leader conference and see the societies role in education. Presumably, the students also see the benefits when their faculty advisor attends the ASCE faculty advisor workshop. Since student membership is free, there is no reason not to join. Hopefully the seed is planted for lifelong participation.

One of the best methods to influence students is informal interaction between faculty, professionals and students. The student chapter develops an active social calendar to support this. The Fall semester begins with a three-hour boat cruise on the Hudson River, welcoming the seniors back for their final year. The chapter invites practicing engineers from the local ASCE section, faculty, and senior students to this cruise. The intent is to motivate students for the challenges that lie ahead and allow for interaction with professionals outside of the classroom. The chapter also sends members to the Engineer Week dinner in Fishkill where they meet members from engineering societies throughout the mid-Hudson valley.

The most popular social event is the post-FEE Party. The student chapter underclassmen host a celebration for all the seniors taking the Fundamentals of Engineering Exam. Chapter members get to eat a free meal, socialize, and blow off some steam after the eight-hour exam. The fact that the event is important enough to have a party emphasizes that professional registration is tremendously important to civil engineers and passing the FEE is the crucial first step. The final social event is the Senior Farewell Cruise. The students celebrate the end of a rigorous four-year program and the graduating CE majors are presented with their official CE coin. This event provides closure for many of the students, for both the CE program and for their life at the academy. It also marks the beginning of a new phase of their educational and professional growth. The student chapter also sponsors a senior group photo of the CE majors and each student receives a copy during the graduation week open house.

As most professional societies present awards, part of the USMA chapter's success is an aggressive awards program -- designed to motivate the students for future growth in civil engineering as well as to recognize excellence. The student chapters from West Point, Union College, and RPI host a combined student chapter dinner every year. A prominent guest speaker is featured and awards are presented to students from all three colleges. The MOLES (a group of professionals engaged in heavy construction) Student Award goes to the Chapter President in recognition of his or her leadership and dedication to the success of the chapter. The annual Samuel W. Pinnell award is designated for the student who actively contributes to the ASCE chapter while maintaining a high grade point average in the CE major.

Conclusions

Through a variety of activities, the ASCE student chapter can add real value to any civil engineering program. This paper has shown how these activities at West Point directly support the civil engineering program outcomes. The benefits seem to be greatest in the areas of bringing real world engineering into the CE program. Students gain a better understanding of the challenges facing engineers in professional practice, knowledge of contemporary issues, awareness of the impact of engineering in a broader societal context, and motivation to continue intellectual and professional growth. Students will benefit when an engineering department has an active student chapter. Students are more likely to join and participate in a professional society after graduation when they are introduced to the benefits as a student. The interaction between students and practicing professionals who are attacking the challenges of the day inspires the students to learn. The USMA CE program will continue to integrate the student chapter activities into the curriculum to the point that the two become inseparable.

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TABLE 1. Civil Engineering Program Outcomes

CE Program Outcomes

1. Graduates can apply the engineering thought process to design civil engineering components and systems.
2. Graduates demonstrate creativity, in the context of engineering problem-solving.
3. Graduates are proficient in the structural, environmental, hydro, and geotechnical discipline areas of civil engineering.
4. Graduates are proficient in mathematics, calculus-based physics, and general chemistry.
5. Graduates can design and conduct experiments, and analyze and interpret data.
6. Graduates can function effectively on multidisciplinary teams.
7. Graduates demonstrate an appreciation of the roles and responsibilities of civil engineers and the issues they face in professional practice.
8. Graduates can use modern engineering tools to solve problems.
9. Graduates can write effectively.
10. Graduates can speak effectively.
11. Graduates demonstrate knowledge of contemporary issues.
12. Graduates have the broad education necessary to understand the impact of engineering solutions in a global and societal context.
13. Graduates are prepared for and motivated to pursue continued intellectual and professional growth—as Army officers and engineers.

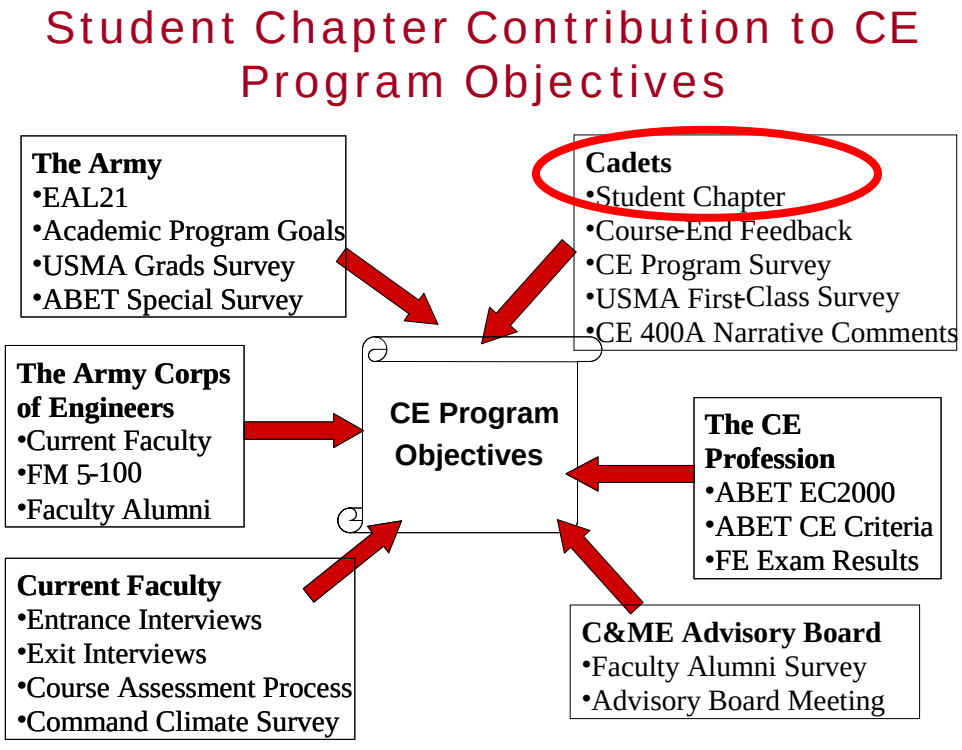

Figure 1. Constituencies contributing to the CE program Objectives

TABLE 2. Student Chapter Contributions to Program Outcomes			
	Program Outcome		
	Produce Civil Engineering graduates who demonstrate:	**Faculty Advisor Assess**	**Events That Support The Program Outcome**
1	Apply the engineering thought process to design CE components and systems	1	
2	Creativity	4	Seminars, Conferences, Field Trips
3a	Proficiency in structural engineering	2	Seminars, Regional Conference Competitions
3b	Proficiency in environmental engineering	1	
3c	Proficiency in hydrology & hydraulic engineering	2	Seminars, Field Trips
3d	Proficiency in geotechnical engineering.	2	Seminars, Field Trips
4a	Proficiency in mathematics	1	
4b	Proficiency in calculus-based physics	1	
4c	Proficiency in general chemistry	1	
5	Design and conduct experiments, and analyze and interpret data	1	
6	Function on multidisciplinary teams	3	Community Service, Student Chapter Leadership
7	Roles and responsibilities of civil engineers and the issues / professional practice	5	Seminars, Conferences, Field Trips
8	Use the modern engineering tools necessary for engineering practice	1	
9	Write effectively	5	Mead Papers, Conferences
10	Speak effectively	5	Seminars, Conferences, Mead Papers
11	Knowledge of contemporary issues	4	Seminars, Field Trips
12	Broad education to understand the impact of engineering solutions in a global/societal context	4	Seminar, Field Trips, Conferences, Community Services
13	The preparation for and willingness to pursue continued intellectual and professional growth	5	Social Events, Seminars, Field Trips