Using Summer Programs to Excite Interest in Engineering

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Abstract

Decreased enrollment in engineering majors has been a general trend around the country and at the United States Military Academy (USMA) at West Point, New York. This paper discusses summer programs USMA has implemented to create interest and increase student knowledge of engineering. The students who participate gain a much broader understanding of engineering, and are much more likely to stay in the engineer major. They are also more likely to select the Corps of Engineers as their Army branch, and serve as engineers after graduation. The student summer program and its variety of appealing international and continental US locations is also being used as a promotional tool to attract more underclassmen to the engineering majors. Students travel locations for the summer of 2002 included: Japan, South Korea, Germany, Kosovo, Panama, Honolulu, Seattle, New Orleans, etc. The presented assessment data shows this program to be highly successful.

Introduction

The Civil Engineering Division at West Point has two summer programs for students that will be entering their junior or senior year. Both of these programs are under West Point's Academic Individual Advanced Development (AIAD) program, which covers all summer academic programs at West Point, regardless of department or academic discipline. The first program, the Cadet District Engineer Program (CDEP), is designed to introduce Civil Engineering majors to the function of a typical US Army Corps of Engineers District within the continental US and overseas. CDEP is an internship type program that does not provide academic credit, and participation is voluntary. The program usually last between 3-5 weeks and students participate in various activities to include duties typically assigned to new engineers within the district. Some of these duties include:

- Assistant Project Engineer
- Quality Assurance Inspector
- Project Manager
- Assistant Project Manager
- Construction Representative
- Field Engineer
- Project Officer

In the second program, USMA civil and mechanical engineering majors who will be entering their junior or senior year are invited to participate in the US Air Force Academy's (USAFA) Field Engineering and Readiness Laboratory (FERL). FERL is a hands-on classroom type program that receives three-semester hour academic credit. The lab introduces the students to the basics of civil engineering practice and it consists of three blocks: Surveying, Construction Methods, and Construction Materials. The three-week program occurs each June.

Students gain practical experience on the capabilities of construction equipment and an appreciation of operator skills through hands-on training in building temporary/permanent facilities, roads, and airfield aprons.

Objectives

The objectives of the two summer programs are to:

- **a.** Allow USMA CE students to gain practical engineering experience away from the West Point environment.
- **b.** Introduce students to the US Army Corps of Engineers.
- **c.** Allow USMA students the opportunity to participate in the USAFA FERL program, gaining valuable practical construction experience as part of their engineering education.
- **d.** Have students participate on multidisciplinary teams.
- **e.** Learn the roles and responsibilities of civil engineers and the issues they face in professional practice.
- **f.** Increase knowledge of contemporary issues.
- **g.** Understand the impact of engineering solutions in a global and societal context.
- **h.** Prepare and motivate students to pursue continued intellectual and professional growth – both as Army officers and as engineers.

Participation

Students at USMA train each summer. During their first summer, prior to freshman year, the students spend six weeks participating in military training (basic training). In the second summer, the students spend eight weeks participating in military training (similar to ROTC Advance Camp). The students must also spend six weeks training the freshman or sophomores during one of their last two summers (cadet summer detail). Additionally during the last two summers, the students must spend three weeks at either Airborne or Air Assault School (Military Individual Advanced Development – MIAD), and three to five weeks in the Army taking the place of a sergeant or lieutenant (Drill Cadet Training Program - DCTP or Cadet Troop Leader Training - CTLT) in preparation for their future job as a platoon leader. Some cadets must pull a six-week cadet summer detail both summers. So as you can see, the summer is already full, and we are trying to add something engineer related into whatever time is available.

During the summer of 2002, 16 students had the time available to participate in the Cadet District Engineer Program. The students went to 12 districts and 13 different locations. Six students went outside the continental United States; two to Germany, two to Japan, one to South Korea, and one to Hawaii. The other students went to engineer districts located at Baltimore, Boston, Chicago, Eglin Air Force Base, Jacksonville, New Orleans, Patrick Air Force Base, and Seattle. The typical jobs the students performed were Quality Assurance Inspector and Assistant Project Manager. All the students had a positive experience and reported an increased interest in civil engineering. There were 38 CDEP slots offered during the summer of 2002 in 27 different locations (Table 1). Unfortunately, 21 slots went unfilled because of the extremely busy schedule many of the students already have.

Two students participated in the USAFA FERL program. Both students had very positive experiences and reported that they are more likely to branch Corps of Engineers because of their experience. They both recommend sending more students in the future. There where five FERL slots available, three went unfilled.

Table 1: Engineer District Positions Available Summer 2002

District	# Slots	District	# Slots
Baltimore	1	--Patrick AFB, Cape Canaveral, FL	1
Charleston	1	--Mobile, AL	2
Chicago	1	--Maxwell AFB, Montgomery, AL	1
Detroit	1	--Fort Rucker, AL	1
Europe	2	--Redstone Arsenal, Huntsville, AL	1
Far East (S. Korea)	2	Nashville	1
Honolulu	1	New England	2
Jacksonville	2	New Orleans	1
Japan	2	Norfolk	1
Kansas City	1	Omaha	2
Louisville	1	Pittsburgh	1
Memphis	2	Portland	2
Mobile (in locations shown with --)	(8)	St. Paul	1
--Eglin AFB, Ft Walton Beach, FL	1	Seattle	2
--MacDill AFB, Tampa Bay, FL	1	**Total=**	**38**

Student Comments

The following are representative examples of Free-Form comments made by the students who participated in the Cadet District Engineer Program (CDEP) during the summer of 2002.

- First and foremost, I gained a greater desire to learn all I can from my classes in the fall semester. I saw a lot of work with concrete and became interested in learning more in the concrete design class I will be taking so that I can understand the mechanics and terminology... The opportunity that I had to see the construction process greatly increased my academic and professional development.
- The most important aspect of the AIAD for me was to actually get out there and see the things that I am learning in the classroom. Getting out to a site and observing a compaction test being done and the importance of it helped me better understand why I did those calculations in Soils class. In addition, observing other things such as the retaining wall provided me with a good visual of what I was studying and its importance… I wasn't sure beforehand, but after my AIAD experience, I am sure that I want to join the Corps of Engineers.
- Everything we discussed in class the previous semester we saw first hand on our AIAD. Amazing, the stuff actually exists!!… I was surprised how similar construction is to the military, and how the same traits that will make a successful officer can be very helpful to construction project managers… it was amazing to go on this AIAD and see the exact structures and concepts that we had been talking about in class all last semester. This includes concepts from hydrology and soils especially, but also structures and fluids. Here is a perfect example of a real life problem that could have easily been a class design problem.
- I thought that this AIAD was extremely useful. I have a much better idea of the options that I have if I spend a career in the Army. I got some experience in seeing

what actual engineers do on a daily basis. This was extremely helpful, because I really didn't know what the occupation was really like. This summer caused me to think a little bit harder about how I look at my academic classes.

- This AIAD was without a doubt a very enriching experience. I was able to see first hand some of the theory I had learned in class in real life. Things such as footings and testing the soil for moisture content and density were among some of the concepts I was exposed to. Also, the whole process involved in building a structure is much more clear to me now. I had no idea of how many things had to take place before laying down the first brick. Additionally, working with contractors and subcontractors was also part of the experience. Dealing and solving problems with them was an important part of what we were doing there. It is because of this AIAD that I have now a much better understanding of Civil Engineering, in particular structures and construction management.
- This program helped me decide that I had made the right choice in taking civil as a major. It also educated me in the role of the Army Corps of Engineers. I was able to learn and see many things I may never get to experience again. The civilians I worked with were extremely courteous and never failed to answer my questions or help me with a problem. This has been the best summer activity I have done away from West Point…I had already decided I wanted to branch Engineers, but this has reinforced my decision, because I look forward to someday be able to do similar work for the Army.
- The Taft AFRC was undergoing a lot of structural steel work during my stay, so this provided a direct application to my recently completed civil engineering courses… The biggest benefit I gained out of this experience was to see how the various civil engineering disciplines work together to design and build a structure... I continue to be excited about my career as a civil engineer.
- The AIAD was useful because I was given the opportunity to talk to engineers and their various partners like finance, public relations, and environmentalists. The other important part of the AIAD was the fact that I was working with the Corps. I think this was a great opportunity for me since the Corps is something I could pursue in my military career. I also got to witness the unique and complicated situation of dealing with other nation's rituals, language, and regulations. During the AIAD, I saw how important funding and prior planning are to a project, both of with cannot be as appreciated in the classroom as in real life. The AIAD was an experience that I could apply in both a military and civilian environment.

The following comments are from the two USMA students that participated in the US Air Force Academy's Field Engineering and Readiness Laboratory (FERL) program at the USAFA during the summer of 2002.

- The FERL program was definitely beneficial to my major. It shows students how much fun civil engineering is when it is put to use. It was mostly a hands-on course with a little classroom instruction. It confirmed that I had chosen the right major for me and it let me see how another academy worked. It's a broad survey course that helped me get a head start on a lot of the courses I have to take now.

- I learned a lot. When I started this summer, I was unsure if I wanted to stay a civil major. After all of the hands on experience, talking with professional engineers, and seeing some of the classes being applied to the real world, I became positive that this is what I want to study. Also, I am a very visual person, and the hands on experiences will give me a lot of scenarios to draw upon when I begin studying those areas

Assessment

All of the students who participated in the Civil Engineering summer programs were asked to answer a number of questions to assess whether the program objectives were being met. Table 2 below has the average of the student assessment and then the faculty program manager's assessment for each of the questions. This table was part of the annual course assessment conducted in preparation for the annual program assessment. Course objectives 4-7 are pulled directly from our program objectives (Table 3).

Table 2: Assessment of Summer Program Objectives

The assessment questions below were answered using the following scale: 1=UNSAT 2=MARGINAL 3=SAT 4=GOOD 5=EXELLENT

Course Objectives		Student Assess	Faculty Assess	Remarks
1	Specific missions at your AIAD location	4.00	3.5	Touring/ site visits vs doing work on a project.
2	Likelihood of Branching Engineers (5 Much More, 4 More, 3 Neutral, 2 Less, 1 Much Less)	4.00	4.5	Six 3s from students who had already made up their minds, one 2, and eleven 4 or 5s.
3	Function on multidisciplinary teams	4.09	4	Most projects are multidisciplinary teams.
4	Roles and responsibilities of civil engineers and the issues / professional practice	4.82	4.5	Greatest contribution to the CE program. Provided the practical experience to supplement the academic program.
5	Knowledge of contemporary issues	3.91	4	Each project was tied to some current military or civil engineering requirement.
6	Broad education /understand the impact of engineering solutions (global/societal context)	3.91	3	Experiences varied.
7	The preparation for and willingness to pursue continued intellectual and professional growth	4.36	4	Based on student comments and feedback.
8	Overall impression of AIAD experience	4.41	4.5	Based on comments from both the students and the engineering districts.

The Table 3 below shows how the students and the AIAD program director rate the contribution of this summer program to the Civil Engineer Division Program Outcomes. This table is completed for each Civil Engineering program and used as part of the program assessment.

Table 3: Assessment of Summer Program Contribution to Program Outcomes

1 – No Contribution 2 – Small Contribution 3 – Moderate Contribution 4 – Large Contribution 5 – Very Large Contribution

	Program Objective			
	Produce Civil Engineering graduates who demonstrate:	**Student Assess-ment**	**Program Director Assess-ment**	**Explain CD's Assessment**
1	Apply the engineering thought process to design CE & ME components and systems	3.09	2	Did little design work
2	Demonstrate creativity	3.64	3	Some students worked on projects which permitted some planning and design opportunities
3a	Proficiency in structural eng.	3.45	2	Only by way of observation
3b	Proficiency in environmental eng.	3.64	2	Only by way of observation
3c	Proficiency in hydrology & hydraulic engineering	3.55	2	Several students observed hydrology-related projects
3d	Proficiency in geotechnical eng.	3.18	2	
4a	Proficiency in mathematics	2.45	1	
4b	Proficiency in calculus-based physics	2.09	1	
4c	Proficiency general chemistry	2		
5	Design and conduct experiments, and analyze and interpret results.	2	1	
6	Function on multidisciplinary teams	4.09	4	Most projects are multidisciplinary teams
7	Roles and responsibilities of civil engineers and the issues / professional practice	4.82	4.5	Greatest contribution to the program. Provided the practical experience to supplement the academic program
8	Use the modern engineering tools necessary for engineering practice	3.64	3	Exposed to lots of new equipment
9	Write effectively	3	3	Several did reports during the AIAD
10	Speak effectively	3.55	4	Active participation in project meetings, etc. Several gave briefs.
11	Knowledge of contemporary issues	3.91	4	Each project tied to some current civil or military engineering requirement
12	Broad education /understand the impact of engineering solutions (global/societal context)	3.91	3	Experiences varied.
13	The preparation for and willingness to pursue continued intellectual and professional growth	4.36	4	Based on student comments and feedback.

Overall, the student assessment shows they are benefiting from participating in the summer programs. Eleven students reported they are more likely to branch engineers (verses infantry or artillery for example) and therefore work as engineers in the future. Only one student reported becoming less likely to branch engineers. His reason was he didn't like the amount of office time and paperwork he experienced. He plans to branch infantry so he can spend more time in the field leading soldiers.

As both student comments and the assessment in Table 2 and Table 3 show, the summer program experience outside the classroom reinforces what the students have learned in their courses, and demonstrates the use and application of what they have learned. They were able to gain practical experience about the roles and responsibilities of civil engineers. Most of the students were exposed to professional practice issues, and gained first hand knowledge of contracting, dealing with multiple contractors and subcontractors, and exposure to labor unions. Also, many of the construction projects the students worked on were high visibility political projects that were being done in response to public concern about the environment.

Future Improvements

- **Student Signup Process for USAFA FERL Program**
  - Publicize the AIAD program in January to the Sophomores, possibly through Statics & Dynamics, &/or the CE Club.
  - Emphasize the neat, hands on things they will get to do, as well as the nice location to do them in – i.e., Colorado Springs, CO.

- **Corps of Engineers District Solicitation: Request for participation**
  - Emphasize getting a firm project scope earlier in the process. This may be the key to getting students to participate at less desirable locations.
  - Coordinate with United States Army Corps of Engineers (USACE) Headquarters to get a good contact list for the districts, and request their assistance in determining district support for the program for the upcoming summer.
  - CC district commanders on all email from the USMA coordinator about the CDEP. This is to ensure responsiveness from district POCs.

- **Support from United States Corps of Cadets (USCC)(manages student military training, and thus is overall in charge of managing student summer assignments)**
  - Encourage better coordination between the Office of the Dean and the Cadet Advance Training (CAT) Cell. In coordinating the summer training requirements for each student, the priorities higher than our engineering AIAD were:

    - Cadet Summer Details (training freshmen and sophomores)
    - CTLT or DCTP (acting as a lieutenant or a sergeant in the Army)
    - MIADs (Airborne School, Air Assault School, etc.)
    - Emerging Leader Program

  - The CAT cell works for the Department of Military Instruction (DMI), in conjunction with USCC, and marginally with the Office of the Dean. This appeared to be personality driven. Without close interaction between the Dean and DMI/USCC, our AIAD program is constantly adjusting to shifting priorities. An example of this is Cadet A was scheduled to go to airborne school, but for what ever reason, now will

not be able to go, freeing up an airborne slot for another student. Cadet B has signed up for the CDEP AIAD, has orders and is all ready to go. Cadet B's TAC tells him an airborne slot has opened up and he is going, forcing cancellation of the AIAD.

Conclusions

The Civil Engineering summer student programs at West Point are achieving their objectives. The students who participate gain a much broader understanding of engineering, and are much more likely to stay in the engineer major. They are also more likely to select the Corps of Engineers as their army branch, and serve as engineers after graduation. The summer student programs and the variety of state side and oversea locations are also being used as a promotional tool to attract more underclassmen to the engineering programs. We are sure similar internships with local engineer firms or the Department of Transportation (DOT) would be as successful in assisting the students in gaining a broader understanding of engineering.

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Bibliography

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