ENHANCING ENGINEERING EDUCATION THROUGH GLOBAL CO-OPS

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Abstract – *Each summer, most academic departments at the United States Military Academy in West Point, New York develop intern-like opportunities for their students, or cadets as they are referred to at the Academy. These opportunities are reserved for emerging junior and senior cadets who are otherwise not conducting military training during the summer. In the Department of Systems Engineering, we coordinate various opportunities with government and non-government affiliated organizations for cadets to work on engineering problems related to their disciplines. This program, known as "Academic Individual Advanced Development" or AIAD, is vital to the educational development of cadets and provides them with an opportunity to participate in activities beyond baseline requirements. The AIAD opportunity is designed to facilitate interaction among cadets and military and/or civilian organizations for a three-to-four week period and discover the "real world" applicability of their academic endeavors here at West Point.*

These experiences broaden student perspectives and provide them with practical advanced education related to their professional responsibilities as student leaders and future commissioned officers. Participating organizations gain by having additional personnel to work on engineering projects, and by having the opportunity to expose future Army leaders to the vital functions performed by their organization.

This paper explores the uniqueness and nature of our work-based education program, its purpose, our process for matching cadets with a participating agency and follow-up feedback from students. The feedback is used to assess the viability of the program for future students and participating organizations. Additionally, this paper provides practical guidelines for implementing such a program in any engineering curriculum to enhance a student's engineering education and learning.

Introduction

In the early 1980s, reformers became increasingly preoccupied with the effects of inadequate education of U.S. workers on the nation's economy. This development coincided with increasingly competitive economic challenges from Japan, Germany, and other European countries. The indicators were that high schools and colleges were failing to prepare the nation's workforce. What was discovered was that schools were not doing their job because they 1) provided no incentive for students to work hard; 2) did little to help students find good jobs; 3) did not teach the attitudes and maturity needed on the job; 4) isolated young people from adults who could act as models and mentors; 5) did a poor job of teaching the so-called advanced

generic skills or workplace basics such as problem solving and teamwork, and the job-specific skills that are taught atrophy as young people spend years churning through unskilled youth jobs; and 6) provided a form of schooling that was ineffective in its pedagogic strategy. [1] Work-based education evolved as a solution to these immediate problems.

The objective of the work-based education program emphasizes problem solving, teamwork, learning in context, and more active participation of students in their own learning. The teaching occurs in the classroom and students are later provided an opportunity to learn and use skills learned in the classroom in a well-designed work experience. Since traditional schooling alone hinders the full development of each student's cognitive abilities, incorporating education into real-world situations in which what is being learned will be used, work-based education has become the bridge to the intellectual or cognitive gap between school and work. [1]

Work-based education and a variety of additional models and approaches have been attempted to address the perceived deficiencies of traditional schooling. Lessons from these experiences were incorporated into the School-to-Work Opportunities Act of 1994. According to the act, a comprehensive reform plan must include three broad components: 1) school-based learning, 2) work-based learning, and 3) connecting activities.

This paper explores the uniqueness and nature of the Academy's work-based education program, its' purpose, the process for matching cadets with a participating agency, and follow-up feedback from students. The feedback is used to assess the viability of the program for future students and increase the value gained from the program for participating organizations. This paper provides practical guidelines for implementing such a program in any engineering curriculum to enhance a student's engineering education and learning.

An Integrating Experience

The academic program at West Point has evolved in response to the needs of the Army and trends in higher education. The balanced offering of courses in the arts and sciences leads to a Bachelor of Science degree and builds a solid foundation for future graduate study. Most academic courses are taught much the same as they are at a civilian institution, with some exceptions - there is usually between 14 to 18 cadets per class and attendance is mandatory. The core curriculum incorporates 26 courses equally balanced between the arts and sciences; provides the foundation for the academic program and the broad knowledge necessary for achieving success as a commissioned military officer. The core curriculum also provides an opportunity for academic specialization. There are currently 22 optional majors and 25 fields of study. The majors and fields of study cover virtually all the liberal arts, science and engineering disciplines one would expect to find in highly selective colleges. Cadets enrolled in the field of study program take three to four less courses than academic majors.

The Academic Individual Advanced Development (AIAD) program, a work-based education program, is an integral component of West Point's academic program. Each summer, most academic departments at West Point develop intern-like opportunities for students or cadets. These opportunities are reserved for emerging junior and senior cadets who are otherwise not conducting military training during the summer. The Department of Systems Engineering

establishes many opportunities with various government and non-government affiliated organizations for cadets to work on practical engineering problems related to their discipline and commensurate to their skill level. The AIAD program is vital to the educational development of cadets and provides them with an opportunity to participate in activities beyond baseline requirements. The core objective of the program emphasizes the "real world" applicability of a cadet's academic endeavor and an opportunity to gain experience in problem solving and teamwork in an organizational setting.

Unlike the focus of internships at civilian universities, the AIAD program offers no immediate employment potential for cadets since cadets must serve a minimum of five years in military service to their country. Instead the objective is that these experiences broaden student perspectives and provide them with practical advanced education related to their professional responsibilities as future commissioned officers. Participating organizations gain by having additional personnel to work on engineering projects, and by having the opportunity to expose future Army leaders to the important functions performed by their organization.

The AIAD program, strictly voluntary, grants cadets at least one opportunity to participate in the AIAD program as they emerge into their junior and senior year of study. There is much value to be gained from a work-based education program, which calls for a planned and structured work experience having productive educational value and is carefully coordinated with the learning that occurs in the classroom. These criteria are used when recruiting organizations to participate in the AIAD program.

A Model To Import

The success of the AIAD program is due in large part to the manner in which the program is structured and coordinated. The fundamental basis of the success of the program is based on the efforts of an individual designated as the AIAD coordinator. This individual, in many respects, serves as a Program or Project Manager and is responsible for linking all aspects of managing and planning the implementation and execution of the program within the department. The AIAD coordinator should be provided a team of individuals from within the department to represent a group of cadets participating in the program. The planning for the AIAD program begins in the fall term and culminates with feedback from cadets at the conclusion of the summer prior to the start of the fall term. The program is described below with direct reference to the program in the summer of 2003. This model, with some minor changes, may be successfully imported into any academic department to enhance a student's engineering education and learning.

Figure 1 graphically depicts the model used to successfully manage the AIAD program. The model has six phases: 1) Identify Participating Organizations, 2) Contact Organizations, 3) Cadet Notification, 4) Cadet-Agency Coordination, 5) Cadet Attendance, and 6) Assessment.
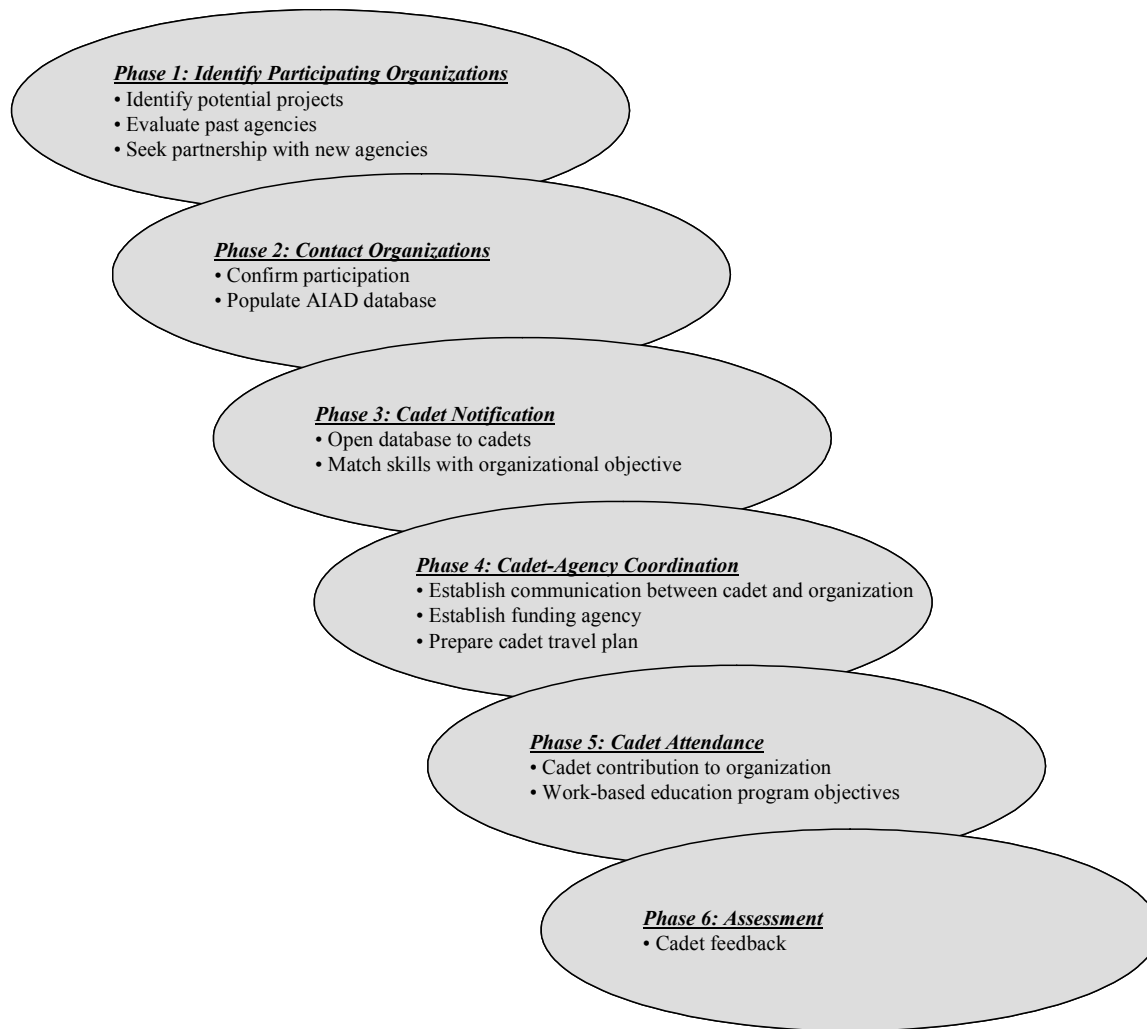
Phase 1: Identify Participating Organizations
- Identify potential projects
- Evaluate past agencies
- Seek partnership with new agencies

Phase 2: Contact Organizations
- Confirm participation
- Populate AIAD database

Phase 3: Cadet Notification
- Open database to cadets
- Match skills with organizational objective

Phase 4: Cadet-Agency Coordination
- Establish communication between cadet and organization
- Establish funding agency
- Prepare cadet travel plan

Phase 5: Cadet Attendance
- Cadet contribution to organization
- Work-based education program objectives

Phase 6: Assessment
- Cadet feedback

FIGURE 1. AIAD MANAGEMENT MODEL

Phase 1: Identify Participating Organizations

Identification of potential organizations (past and new) marks the first phase. Potential organizations are described as organizations able to provide cadets with intellectual, professional, and personal development experience in one or more of the four disciplines within the Department of Systems Engineering – Systems Engineering, Engineering Management, Operations Research and Information Systems Engineering.

The Department of Systems Engineering arranges AIAD opportunities with a variety of government and Department of Defense organizations, such as government research centers, the Congressional Science and Technology Office, the Army Research Lab, the Communications and Electronics Command, Joint Task Force-Bravo and the National Aeronautics and Space Administration (NASA). The department has also worked with civilian organizations such as Boeing, Raytheon, Enron, Sikorsky, AIG, USAA and others. Past organizations determined to

have been of minimal benefit in meeting the purpose and objective of the AIAD program are not considered the following year.

Phase one occurs in the fall term preceding the summer in which the AIAD occurs. The AIAD coordinator and senior faculty (department representatives) are involved in the identification of participating organizations; however in some cases cadets may refer organizations.

Phase 2: Contact Organizations

The identification of organizations that qualify to participate in the AIAD program marks phase two. Of special interest are organizations with projects that have the potential to be carried into the academic year as Capstone Projects or senior projects. Projects having no capstone potential are evaluated solely on whether the project supports one or more of the four academic disciplines mentioned above. During this phase, organizations are contacted on whether they are willing to participate in the AIAD program. Consenting organizations are entered into an interactive database management system, which will eventually be accessed by cadets and participating organizations.

The cadets will use this interface system to survey AIAD opportunities after participating organizations have had a chance to update their information in the database. This specific event occurs in phase three. Information contained in the database includes: 1) Cadet sponsor's contact information, 2) Project title, 3) Project location, 4) Project description, 5) Security clearance requirement, 6) Available slots, 7) Potential capstone eligibility, 8) Duration, and 9) Organization point of contact information. The information gathered is used by cadets to assists them in the selection of a project that meets their individual academic goals. Of course, some are more interested in location than organization. As in phase one, the AIAD coordinator and department representatives coordinate the activities and events that occur in this phase. This phase occurs during October and November.

Phase 3: Cadet Notification

After organizations have been granted the opportunity to update their information in the interactive database, cadets are given access to the database and required to submit their AIAD choice in order of preference. This phase occurs between January and middle to late February. Once the database closes, the AIAD coordinator and department representatives screen cadet choices and match cadets with a participating agency based on the cadet's major, interests, and talents.

Cadets are then notified and informed of the results of the matching process. In the event a cadet is not satisfied with the match, they may reapply for one or all of their initial choices. Phase four begins after cadets are matched with projects commensurate to the academic skill level required for each project. There is a high success rate in cadets receiving their first choice. Eighty-nine percent (89%) of cadets surveyed received their first choice. In contrast, not all organizations are requested. Those organizations not requested by a cadet are sent correspondence indicating their agency was not chosen and are highly encouraged to reapply the following year.

Phase 4: Cadet-Agency Coordination

In phase four, which occurs between February and May, department representatives coordinate AIAD dates, and link-up between their group of cadets and their respective organization. A cadet's summer consists of many events, primarily military in nature. As a result, it is sometimes difficult to find a date that best serves both the organization and cadet. In the end, the assignment of dates is based on cadet availability and when the organization can accommodate them. The AIAD dates, once confirmed, are then passed to the department's administrative secretary who coordinates travel arrangements and financial reimbursement to cadets for AIAD related expenses.

While performing an AIAD, cadets receive per diem rates based on the cost of living index for the area in which the organization is located. Cadets receive reimbursements for expenses incurred for lodging, airfare, and rental car expenses. Because cadets are employees of the federal government, they are prohibited from receiving income directly from an organization. Consequently, funding to cover per diem and expenses is sourced in one of several ways. The academic department presenting the AIAD to a cadet, the United States Military Academy, or the participating organization funds the AIAD projects. In lieu of providing direct funds to cadets, the organization funds a general gift fund internal to the United States Military Academy to cover all expenses for their AIAD project.

Both telephone and email are widely used to create the link-up between a cadet and their respective organization; however a primary vehicle used to facilitate the connection is a four-page document provided to both the cadet and the organization. This document contains 1) West Point personnel information, 2) Cadet information, 3) Organization personnel information, 4) Recommended work agenda, and 5) Logistical (meals, uniform, travel, intercity transportation and lodging) information. In addition to this document, cadets are asked to draft a resume indicating academic intent and that resume is sent via email with the four-page document to the participating organization prior to cadet arrival.

Phase 5: Cadet Attendance

Phase five is the most critical phase in addition to phase one. It is in this phase that the core objectives of the work-based education program objectives are sought. Three or four weeks is a short time to spend within an organization; however it is hoped that cadets realize 1) the attitudes and maturity needed on the job, 2) the basics of organizational teamwork, and 3) the "real world" applicability of their academic endeavors. A discussion of benefits follows.

In this phase, a department representative tracks his or her designated cadet from arrival to the AIAD location and return to West Point. A team of representatives from the Department of Systems Engineering remain at West Point while cadets perform their AIAD in the event a cadet or participating organization needs to contact someone for any reason. Cadets are asked to maintain a journal while performing their AIAD as a follow-up measure and an aid in ensuring they are getting value from their AIAD experience. These journals are reviewed and used when assessing cadet feedback. Historically, cadets attending AIADs have worked on a specific project while at an organization. These projects are normally very well advanced, but are also

scoped to match a three-to-four week timeframe. Upon completion, the cadets are required to complete an after action report (AAR) that summarizes their experience during the AIAD.

Phase 6: Assessment

Feedback on the AIAD program is solicited through an AAR that is developed by the United States Military Academy. As stated, cadets are also asked to maintain a journal while performing their AIAD on day-to-day events and activities. The culmination of this phase typically occurs within the first two-weeks of school in the fall term.

To improve client feedback potential, we have developed a web-based system that makes it easy for the client to input as well as the department to consolidate results. Unfortunately, we still do not receive a great deal of feedback from participating organizations. The feedback we do receive from organizations, and the feedback received from cadets, is very positive about the experience. The AARs are reviewed with specific attention given to benefits gained by cadets that align with work-based program goals, and lessons to be learned. One of the uses of these AARs is to determine if the department should continue relationships with participating organizations.

Benefits

The AARs are our primary source for enhancing the AIAD program for both cadets and participating organizations. Cadets were surveyed on the value of the AIAD program in realizing the applicability of their academic endeavors and associated work-based program objectives. The results follow in Table 1.

Table 1. AIAD Program Assessment Summary

85%	Work performed had a direct relationship to skills learned in academic discipline
85%	Work fulfilled expectation of a military experience
24%	Received education on pending role as a military professional
24%	Gained a sense of how the Army works at different levels
18%	Gained an appreciation for other cultures
12%	Learned value in teamwork
9%	Insight gained on direction of future military programs
9%	Realized the role civilians (commercial companies and academic institutions) play in military readiness
9%	The AIAD experience assisted in determining military career field
6%	Need better two-way communication

The feedback reveals the AIAD program is a very rewarding experience for cadets; and a reflection of the direct correlation between the objectives desired in a work-based education program. There were additional unforeseen benefits not articulated in a work-based education program such as insight into career field designation and the valuable role of a diverse workforce; however these are benefits that can be directly attributed to the nature of the program as modeled by a military institution.

The program 1) teaches the attitudes and maturity needed on the job, and an understanding of the nature of the organization cadets will soon enter, 2) connects cadets with adults who can act as models and mentors, 3) teaches workplace basics such as problem solving and teamwork, and most importantly 4) bridges the intellectual gap between classroom learning and the opportunity to apply learned classroom skills in a well-designed work experience.

The only negative experience mentioned was the need for better two-way communication between department representatives and cadets; and the need for more spending money.

Conclusion

The work-based education program, entitled AIAD, described herein provides several clear enhancements to an institutions' work-based education program. Aside from becoming experienced in problem solving, learning how to work in teams and learning in context, cadets were given the opportunity to actively participate in their own learning; however the greatest benefit for the cadets was the opportunity to encounter a real-world work environment that encouraged 1) usage of academic skills, 2) a knowledge of workplace attitudes and maturity expected as future military officers, and 3) provided insight into type organizations cadets can expect to interact with during their military career . The concepts discussed in this paper may be readily imported into any academic department. However, the specific details may need to be adjusted to accommodate each program, as West Point is not your average academic institution.

To launch a similar program, there is a clear need first for a program coordinator the identification of department representatives to help institute and maintain the program. The program coordinator must be 1) knowledgeable enough to coordinate the events and activities in each of the six phases of the AIAD management process, 2) have the time, in addition to routine academic duties, to handle the enormous amount of planning and coordination, and 3) possess excellent interpersonal skills. It is readily apparent through experience that without such a structure, the objectives and goals of a work-based education program will not be reached.

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Biography

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