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Outcome Assessment at the U. S. Military Academy

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Abstract - The United States Military Academy (USMA) recently had seven of its programs favorably reviewed by the Engineering Accreditation Commission (EAC) and the Computing Accreditation Commission (CAC) of the Accreditation Board for Engineering and Technology (ABET). The favorable comments of the review board members validated the USMA's model for continuous assessment. USMA has developed unique practices for assessing student performance, including course diaries and extensive graduate surveys; practices that were in place before the previous ABET/CAC visit and which continue to be useful. USMA also has unique institutional structures such as a special faculty council and inter-departmental faculty goal teams that tightly integrate the development and assessment of the engineering and computer science programs across the academic program.

1. Background

The United States Military Academy (USMA) at West Point, New York, is a medium-size academic institution with 4000 undergraduate students, called cadets. There are no graduate students. All cadets take a core curriculum of 31 courses, called core courses, ranging from English and Philosophy to Military History to Calculus. Beyond the core curriculum, twenty-two different majors are offered, including seven accredited engineering programs: Computer Science, Electrical Engineering, Civil Engineering, Mechanical Engineering, Systems Engineering and Environmental Engineering. All seven programs request accreditation visits by ABET on the same cycle, which helps consolidate the institutional effort. Six of the programs undergo a review by the Engineering Accreditation Commission (EAC) and the Computing Accreditation Commission (CAC) reviews the CS Program. There is some synergy to be gained from combining the visits into a joint review, but this necessitates coordination at the institutional level and cooperation between programs, including the non-engineering programs that are not seeking ABET accreditation. Recently, the seven programs at USMA received highly favorable reviews by the EAC and CAC and our program planning and assessment system was cited as a model of best practices. We present USMA's planning and assessment system, both at the institutional level and at the program level, using the Electrical Engineering program as an example.

2. Institutional Level

The institutional-level practices used to prepare for the visit were a refinement of USMA's existing assessment program. The Academy as a whole already had an assessment model, illustrated in Figure 1, which differs from, yet is complementary to, the ABET Assessment

Model. The mission of USMA is "To educate, train, and inspire the Corps of Cadets so that each graduate is a commissioned leader of character committed to the values of Duty, Honor, Country; professional growth throughout a career as an officer in the United States Army; and a lifetime of selfless service to the nation.[1]" Therefore, our primary constituency is the United States Army and our academic program goals reflect this. The overarching academic goal is that "graduates anticipate and respond effectively to the uncertainties of a changing technological, social, political, and economic world." In addition, USMA has 10 goals for 10 separate academic programs (shown in Figure 2), each with a learning model, articulated a pamphlet published by the Dean of the Academic Board entitled *Educating Future Army Officers for a Changing World* [2]. The assessment model is oriented on the total academic program goals.

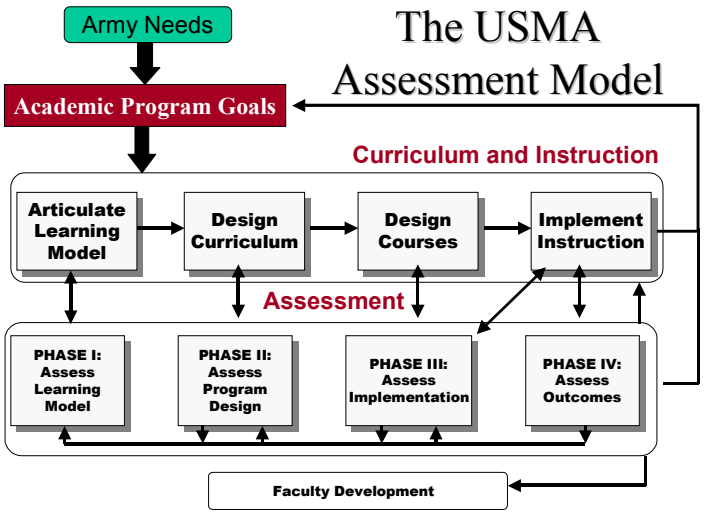

Figure 1: USMA Assessment Model

The academic program goals are assessed in a cyclic manner. Learning models form the core of the process. Once established, those models drive the assessment process. Programs are designed to support the learning models. The learning models reflect both military needs and current academic trends and practice. Assessment of the learning models is based on review against other institutions as well as assessment against academic goals. Reviews take place in such things as instruction strategy and lesson plans, development of evaluation instruments, and then results of such instruments. At the intuitional level, assessment is performed by the Assessment Steering Committee. The Assessment Steering Committee is a sub-committee of the Academic Board and is composed of goal teams which assess each of the ten academic program goals, shown in Figure 2. Each goal team is composed of six to fifteen faculty members from several departments.

Figure 2: USMA Goal Teams and Their Relationship to the Overall Faculty Structure

Assessment includes feedback to cadets on performance as well as feedback from cadets on their perceptions of course outcomes. Finally, assessment of overall goal achievement takes place. This must, by its nature, take place over the cadet 47-month experience. Measures such as surveys, discussion, course products, etc. are used as part of such assessments. To avoid a large impact on faculty and cadets, multiple measures, taken at multiple points, and frequently already imbedded in existing instruments form the basis for assessment. For such measures to be as non-intrusive as possible, yet provide true assessment value, the academic program must be well articulated with stated objectives and outcomes.

The USMA Assessment Model serves the Academy well as a mechanism for continuous improvement. It differs from the ABET model, yet is complementary to it. The ABET model of assessment is a double loop, shown in Figure 3. The left loop represents the program in its dealings with external agencies. This loop identifies constituents and assists the program in incorporating the needs of those constituents into program development. Taking those needs into account allows programs to break from a preset mold so they may best support environmental factors such as labor markets, regional needs, as well as traditional program strengths. Educational objectives should be developed which meet the needs of the institution and the needs of the students in pure academic measures, plus be founded in the practical realm of real-world needs of any such non-academia partners.

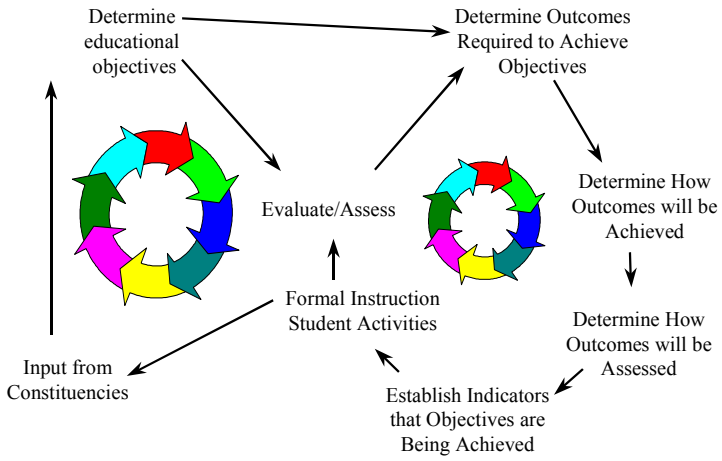

Figure 3: ABET Assessment Model

The right loop is more internal to a program. Programs develop objectives, which are what the program intends its graduates to "become." Objectives look beyond graduation. Based on reasons discussed in the next section, the target time frame for our objectives is at the fifth to seventh year after graduation. Outcomes, on the other hand, are what we expect our graduates to be able to "do" as they leave the program. Hence outcomes tend to be measured within the 47-month USMA experience. Once outcomes are determined, it is necessary to determine how to achieve those outcomes. Some measures or means of assessment are necessary to ensure the outcomes are achieved. Once it is determined what is desired, and how to measure that you meet those objectives, then design and conduct of instruction begins. During and after instruction an evaluation is made to determine if the outcomes have been achieved. The cycle repeats as more and more information is acquired. As constituents and needs change, objectives (and the outcomes that support them) change.

While the interaction of the two loops is implied, the assessment cycles progress at different rates. Academic programs cannot be changed as rapidly as constituent's can change needs. On the other hand, the program loop cannot move at such a slow speed that programs for incoming students lag significantly behind the needs of constituents. Another impact of time is that in many instances there is a long gap between an outcome and an important assessment of that outcome. For example, a program goal might be enhance the students' ability to enter graduate programs. There is often a time lag between completion of an undergraduate program and entry into graduate schools, especially in the case of USMA where students typically attend graduate school later than their civilian counterparts. Every USMA graduate is immediately commissioned in the U.S. Army or one of our sister services and serves a minimum of five years on active duty. As a result of the nature of the duties of young officers, our graduates usually do not have the opportunity to employ advanced engineering knowledge until five to seven years after graduation. Therefore graduates do not achieve the objectives for USMA ABET programs until five to seven years after graduation, which is somewhat later than most ABET-accredited programs.

The USMA model and the ABET model are not competing interests. That is, following one model is not done at the expense of the other. In fact, the models themselves are similar. If

one model is followed it will cover all aspects of the other model. For example, following the right-hand side of the ABET model covers all the phases of the USMA assessment model. The left-hand side of the ABET model, which deals with constituents, can be likened to a Phase 0 of the USMA model; e.g. input from the Army into developing the Academy Goals.

At USMA, our primary constituency is the US Army. One of the ways in which the engineering programs assess the needs of the Army and how well our programs prepare our graduates is through extensive surveys of cadets and graduates. It is important to note that USMA assesses all the academic program goals, not just the objectives or outcomes of ABET or CAC-accredited programs. All cadets complete surveys during their senior year that ask questions such as "I am confident in my ability to apply mathematical principles to solve real-world problems," "I am confident in my ability to solve basic real-world engineering problems," and "I am confident in my ability to employ the Army's new technology." One of USMA's unique institutional structures that support academic assessment is the Office of Policy, Planning, and Analysis (OPA). Four years after graduation, OPA sends graduates follow-up surveys. On average, more than 50% of the graduates respond. In addition, the graduates are asked to present similar surveys to their supervisors (usually mid-level military officers), who evaluate the graduates on the same questions. More than 75% of the graduates who completed surveys also provided surveys to their supervisors and more than 75% of the supervisors complete and return the surveys. The graduates and their supervisors are asked questions about how the USMA education has prepared them to be leaders in their branch of service (usually the Army). All graduates have a five-year commitment to serve as officers in some branch of the military. Table 1 presents sample data for majors in Electrical Engineering program in the class of 1999, which was surveyed in 1999 during that class' senior year and again in 2003 at the four-year point in their careers. The responses show that the tremendous confidence the students have as seniors, at the end of their academic program but before they actually put their knowledge and skills to the test is borne out in their responses after they have had at least one military assignment. Their supervisors responses confirm that the academic program has prepared these graduates well for the challenges they faced.

Question	Senior Response (1999)	Graduate Response (2003)	Supervisor Response (2003)
What is your level of confidence in your ability to solve basic real-world engineering problems?	4.8	5.0	4.7
What is your level of confidence in your ability to use the Army's advanced technology?	4.8	4.5	4.3

Scale:

5 – Very Confident 4 – Confident 3 – Somewhat Confident 2 – Not Very Confident
1 – Not at all Confident

Table 1: Sample Survey Questions and Responses for the Class of 1999

Although the fundamental process of assessment was already in place, preparation for the visits of the ABET evaluation teams required additional logistical and administrative measures. The Dean of the Academic Board (USMA does not have a Dean of Engineering) appointed a committee of representatives of the various programs undergoing ABET review, departments

offering courses in support of ABET programs, the Dean's staff and library, and institutional research. This ABET Committee is a standing committee and during the years leading up to an ABET accreditation visit, the ABET Committee chairperson serves as the point of contact between ABET and USMA. The ABET Committee also served as the focal point for support from programs not undergoing ABET review. More information about the composition and charter of the ABET Committee may be found in[3].

In the years preceding the ABET accreditation visit, the institution conducted cross-program reviews where a member of the ABET committee from one program would review another program at the Academy. Internal review had several advantages to both the program doing the evaluation and the program being evaluated: the evaluator obtains perspective on what an external evaluator will experience in preparation for the visit based on the self-study, public materials, institutional profile and transcripts. Second, the evaluator learns how another program does assessment and documentation. Thirdly, the program being evaluated will receive early feedback on problems or potential problems and can take action to address them. These cross-program reviews enabled the programs to share good ideas and improve in a relaxed atmosphere.

3. Program Level

Each ABET program has objectives which a graduate is expected to achieve a few years after graduation. Along with objectives, each ABET program has outcomes which graduates are expected to achieve by the time of graduation. At the program level, the primary assessment mechanism is outcome assessment. The Electrical Engineering program at USMA has six outcomes, which relate to ABET EAC Criterion 3a-k for Engineering programs, but are tailored to the needs of our constituents. Each outcome has a faculty member tasked to monitor our graduates' achievement of that outcome. The faculty member analyzes the courses in the curriculum and with the assistance of course proposals and summaries produced by each course director, determines which courses in the program (or service courses from other programs) support the program outcome. The faculty member then gathers, collates, and analyzes data from the relevant courses. The faculty member keeps updated a series of notebooks documenting performance measures obtained from course-end feedback, student performance on assignments in relevant courses, graduate surveys, and surveys of supervisors of our graduates. These outcome notebooks are continuously maintained, rather than being compiled in the year or two preceding the ABET accreditation visit.

In a parallel process that is directly tied to the USMA Assessment model, each course is assessed at the end of the semester that it is taught. This serves not only the ABET process of assessment but also provides essential continuity to the EE program, where a course may be taught by a different faculty member each semester. A significant fraction of USMA faculty members are active-duty military officers who teach at USMA for three years then return to troop leading assignments in military units. The loss of institutional knowledge from the high rate of turnover is mitigated by a rigorous process of course summaries and proposals executed every semester. The course assessment process is done with a living document called the course diary, which consists of a course summary and a course proposal (see Figure 4).

The outgoing course director prepares the course summary which includes administrative information about the course including the enrollment, the textbook, and the average earned by students in that course, along with the students' overall QPA. There is also a section summarizing resources used, including expendable supplies, software licenses, and major equipment purchases. The focus of the summary is an assessment of the conduct of the course and student performance, including the strengths and weaknesses of incoming students (which could indicate opportunities to revise coverage of certain topics in prerequisite courses), results of implementing previously recommended changes and suggestions for improvement to the next iteration of the course. The course summary also describes the how the course objectives support the program outcomes and objectives. To add oversight and continuity to the process, the course director reviews the course summary with and gains the concurrence of the EE program director (a tenured faculty member).

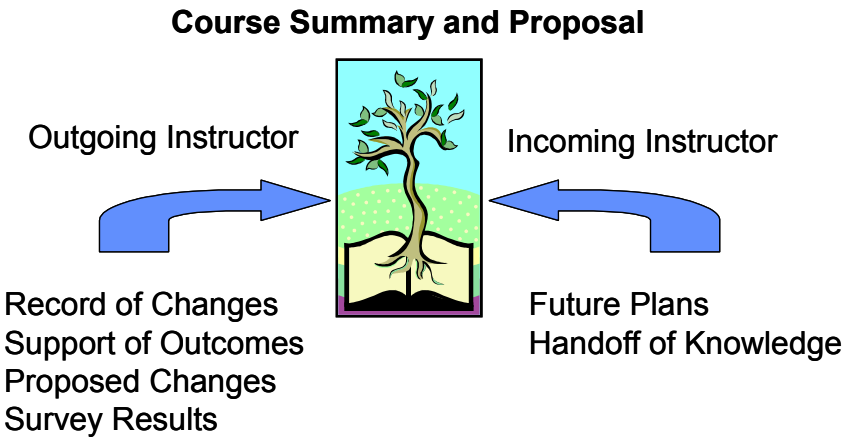

Figure 4: Course Summary and Proposal Process

Before the start of the next semester, the incoming course director (who may or may not be the same person as the outgoing course director) prepares a course proposal for the semester ahead. The course proposal reviews the recommendations made in the previous semesters' summary, determines and justifies which if any changes will be implemented and lists and justifies new changes for the upcoming semester. In a similar manner to course summaries, the incoming course director and the EE program director review the course proposal.

4. Conclusions

Institutions desiring ABET accreditation of one or more of their academic programs must demonstrate a process of continuous assessment at both the institutional and program level. The institution must identify the needs of its constituencies in order to properly formulate institutional and program objectives that graduates will attain a few years after graduation. From these objectives, the program determines outcomes that graduates should meet by the time they graduate. USMA's Assessment Model, though it predates the most recent ABET accreditation visit and differs slightly from the ABET model, served it well as a framework for the preparation of that visit. At the program level, the primary assessment mechanism is outcome monitoring, supplemented by a rigorous assessment of each course every time the course is taught. The process of formulating, assessing, and revising program objectives and outcomes was cited as

model of best practices and was a significant contributor to the EE program's overall favorable review.

5. References

[1] "The United States Military Academy at West Point," http://www.usma.edu/mission.asp., accessed on 5 January 2004.

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