From Conception to Accreditation: The Path of an Engineering Technology Program

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Abstract

The Information Engineering Technology (IET) program at Northern New Mexico College (Northern or NNMC) was created in 2009. From its conception, a main goal of the institution was to be ABET accredited. To that end, the Department of Engineering built a program based on the input of an external advisory board that tailored the IEEE/ACM guidelines for IT programs to the local needs, following a continuous quality improvement (CQI) plan that addressed the eight General Criteria and the Program Criteria established by the Engineering Technology Accreditation Commission (ETAC) of ABET. In October of 2014, the IET was accredited by the ETAC Commission of ABET, with the next comprehensive review being scheduled by 2019. This paper describes the accreditation process for the IET program at Northern New Mexico College from its conception to accreditation.

Index Terms

ABET, Accreditation, Information Engineering Technology, Student Outcomes.

1. Introduction

Founded in 1909 as the “Spanish American Normal School at New Mexico,” Northern has always been a Hispanic Serving Institution (HIS). The college evolved from a secondary boarding school to a vocational training school to New Mexico’s first designated community college in 1977, and finally to a baccalaureate degree granting institution in 2004. Northern is located in the small city of Española, which has a population of approximately 10,000.

From its conception in 2009, ABET\textsuperscript{1} accreditation was a main goal of the then new bachelor program in Information Engineering Technology (IET) at Northern New Mexico College. As the latest institution in offering bachelor degrees in the state of New Mexico, offering an ABET-accredit program was for Northern New Mexico College a proof to the state higher education community that the IET has met the standards necessary to produce graduates who are ready to enter the IET profession and to provide students with enhanced opportunities in high-demand employment, graduate education, and global mobility.

This paper presents the path from conception to accreditation of the IET program hosted by a small, rural institution with limited resources. With 3.5 FTE faculty members dedicated to the program, the paper describes lessons learned on how to build an ABET-quality program under constrained faculty and resource conditions.
2. Accreditation Process

The ABET accreditation process takes approximately 18 months, from submitting the Request for Evaluation (RFE) by January 31, to the ABET’s commissions meeting in July to decide accreditation actions. A program seeking accreditation or re-accreditation from ABET must demonstrate that it fulfills the eight general criteria and the additional program criteria. The general criteria are:

1. Students
2. Program Educational Objectives
3. Student Outcomes
4. Continuous Improvement
5. Curriculum
6. Faculty
7. Facilities
8. Institutional Support

The additional program criteria are set by the leading professional societies. In the case of Information Engineering Technology, the professional society is the IEEE, which defined five additional outcomes to the eleven outcomes given by General Criterion 3, Student Outcomes.

Each criterion can be complied at different levels:

- Concern: A Concern indicates that a program currently satisfies a criterion, policy, or procedure. However, the potential exists for the situation to change;
- Weakness: A Weakness indicates that a program lacks the strength of compliance to ensure that the quality of the program will not be compromised. Therefore, remedial action is required;
- Deficiency: A Deficiency indicates a criterion, policy, or procedure is not satisfied. Therefore, the program is not in compliance with the criterion, policy, or procedure.
- Strength: A Strength is an exceptionally strong, effective practice or condition that stands above the norm, and has a positive effect on the program.

For programs that are seeking initial accreditation, if the evidence supports a program Deficiency for a given criterion, the program is recommend Not-to-Accredit action. Thus, in the case of the IET program, it was challenging to fulfill the eight criteria and program criteria with 3.5 FTE faculty members. The following section describes the approach the Department of Engineering followed to achieve the accreditation goal.
3. IET Criteria Compliance

3.1 Students

Criterion 1, Student, requires the program to evaluate students’ performance, monitor their progress in attaining student outcomes, thereby enabling graduates to attain program educational objectives. The key elements implemented at Northern New Mexico College to achieve the above were:

- Specific admission policy to the engineering technology program
- College student transfer policy
- College course transfer policy
- Departmental transfer policy
- Work in lieu of courses policy
- Course testing out policy
- Advisement policy
- Graduation policy

Since the program under evaluation was new and the processes and policies were under constant evolution, it was critical to explain changes, motivations for changes (supported by data when possible), and dates when the changes were implemented. This was very important to have in the self-study report (SSR) to explain potential mixed messages that may arise from the faculty or students interviews. Some examples here are: a) the SSR included the program admission policy for 2010-2011 and the one for 2012-2014; b) both the college course transfer policy and the departmental were included.

The subsections related to Student Performance Evaluation, Transfer Students and Transfer Courses were thoroughly explained including even redundant details. The reason is that lack of detail may cause unnecessary questions when the evaluation team is reviewing the transcripts. This section allows explaining the potential reasons for courses that were taken without the appropriate pre-requisites (which many times are easily explained because of a change in catalog and course descriptions).

One of the most relevant elements of the review is the student transcript evaluation. Using the exact language provided in each of the above policies, a one-page document was developed to explain every detail in each of the student transcripts that were provided to the evaluation team before their arrival. The document addressed all issues that may raise concerns: courses taken without pre-requisites or co-requisites, transfer courses, course substitutions, changes in course names, etc. These documents were sent to the ABET evaluation team along with the transcripts requested.

Keys for Criterion 1: Have a faculty advisor for each student. Enforce students to regularly meet with their advisor (e.g., advisement hold preventing them to enroll to classes before meeting with advisor); having a clear policy and procedures for transfer students, transfer credits, credit in lieu, admission, and graduation requirement. Good student services such as academic advisement help students to advance through the program according to the appropriate sequence of courses and thus to attain the student outcomes.
3.2 Program Educational Objectives

Criterion 2 refers to the Program Educational Objectives (PEOs). They are broad statements that describe what graduates are expected to attain within a few years of graduation and are based on the needs of the program’s constituencies. The IET PEOs were:

- Aligned and consistent with the mission and vision of both the Institution and the Department the program belongs
- Assessed through an established process by the Department

The adopted process for review and assessment of the PEOs at Northern New Mexico College is shown in Figure 1. When visiting, evaluators sought evidence to support the process that the Department of Engineering at Northern New Mexico College followed to establish and evaluate the PEOs.

The evidence to support the process included:

- Meeting minutes where PEOs were established and evaluated
- Results from surveys where program constituencies (external advisory board, students and faculty) were asked to provide feedback about the PEOs.

![Figure 1. Process for review of the Program Educational Objectives.](image)

**Keys for Criterion 2:** Have a strong (representative of the region) External Advisory Committee to identify the needs of the region. Maintaining a documented process that is systematically used for periodic review of the PEOs so that they remain consistent with the institution’s mission, the constituents’ needs, and the criteria is crucial for Criterion 2.
3.3 Student Outcomes

Criterion 3 is Student Outcomes (SOs). They describe what students are expected to know and be able to do by the time of graduation. These relate to the skills, knowledge, and behaviors that students attain as they progress through the program.

The IET program, by agreement of the faculty and External Advisory Committee (EAC), adopted the 16 student outcomes composed of 11 standard outcomes of the general criterion 3 for Engineering Technology Programs for bachelor degrees (outcomes 1-11) published by the ABET ETAC commission for the 2009/2010 Accreditation Cycle; and five additional outcomes adopted from the published ABET ETAC commission Program Criteria for Information Engineering Technology for the 2009/2010 Accreditation Cycle (outcomes 12-16). SOs adopted by the IET are given in Appendix I.

While SOs remained consistent during the existence of the IET (2009-present), the associated skills, knowledge, and behaviors slightly changed over time according to the input from the EAC (which meets at least once per year) and the continuous improvement plans resulting from the input. The process by which SOs are reviewed are documented through minutes of faculty and EAC meetings.

Thus, it is of main importance to match each SO with the appropriate skills, knowledge, and behaviors. These are subsequently mapped to courses where they are assessed and evaluated. The following is an example of mapping a student outcome (SO6) to skills, knowledge, and behaviors.

IET SO6: An ability to identify, analyze and solve technical problems.

Specific knowledge, techniques, and skills associated to student outcome 6:

- Analyze and solve problems of designing and operating computer networks composed of Wide Area Networks and Local Area Networks.
- Analyze and identify syntax and semantic errors in Java code.
- Identify inter-VLAN routing problems, analyze, and solve them.
- Analyze CSV files, modify according to certain needs, and export them to a different database.
- Identify the need for logical operations and use them appropriately.
- Identify, analyze, and solve penetration threats using Access Control Lists.

Finally, SOs are assessed and evaluated, as described in the following subsection.

**Keys for Criterion 3:** Student outcomes adopted by the program must encompass those of ABET Criterion 3. If the program does not adopt the ABET Criterion 3 SOs, then it must demonstrate, through a mapping, how the SOs of the program and those of ABET Criterion 3 match. All knowledge, techniques, and skills (contained in ABET SOs) must be covered. The student outcomes and the process for their periodic review and revision of them must be documented.
3.4 Continuous Improvement

Each program seeking accreditation or re-accreditation must regularly use appropriate, documented processes for assessing and evaluating the extent to which the student outcomes are being attained. The results of these evaluations must be systematically utilized as input for the continuous improvement of the program. The evaluation of student work to verify that students attain the target level for each student outcome takes place at least once per year. For those student outcomes where students did not attain the target level, action plans for improvement are designed. Figure 2 shows the process for assessing and evaluating student outcomes, and implementation of action plans for continuous improvement at Northern New Mexico College.

Figure 2. The process for defining, evaluating, and assessing student outcomes.

The curriculum map (CM) is a critical tool to devise the assessment and evaluation process, as it identifies courses where student work is collected. Table 1 shows the CM for the IET program. Note that to assess and evaluate a certain student outcome, say SO14 (samples from four courses are collected), several measurement points were taken. This is not required (i.e., a single measurement point could be enough); however, multiple measurement points may help identify weaknesses, especially if the program is new. If multiple measurement points are taken for a student outcome, an approach to aggregate results could be needed. The Department of Engineering decided to implement the following process. Consider again the assessment of SO14 (see Table 1), where samples from four courses are used. For each activity in those courses used to measure the level of attainment of a student outcome, there must exist a target performance which is used to discriminate whether a student attain or not the student outcome. The level of attainment of outcomes per student was defined as follows:

- **Target met**: a student achieves 70% of the instrument scale (note that target refers now to an individual student performance).
- **Target not met**: a student does not achieve 70% of the instrument scale.
Table 1. Curriculum map illustrating the correspondence between courses and outcomes.

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>Student Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>EECE 105L</td>
<td>Micro-computer Systems</td>
<td>X</td>
</tr>
<tr>
<td>ENGR 110</td>
<td>Introduction to Engineering</td>
<td>X</td>
</tr>
<tr>
<td>EECE 132</td>
<td>Computer Networks I</td>
<td>X X X X</td>
</tr>
<tr>
<td>EECE 152L</td>
<td>Computer Programming I</td>
<td>X X</td>
</tr>
<tr>
<td>CS 201</td>
<td>Math Foundation of CS</td>
<td>X</td>
</tr>
<tr>
<td>EECE 203L</td>
<td>Circuit Analysis</td>
<td>X X X X</td>
</tr>
<tr>
<td>EECE 231</td>
<td>Intermediate Programming</td>
<td>X X X X X</td>
</tr>
<tr>
<td>EECE 238L</td>
<td>Computer Logic Design</td>
<td>X X X X</td>
</tr>
<tr>
<td>IT 250</td>
<td>Introduction to Databases</td>
<td>X X X X</td>
</tr>
<tr>
<td>EECE 329</td>
<td>Human Computer Interaction</td>
<td>X X X X</td>
</tr>
<tr>
<td>EECE 330</td>
<td>Computer Networks II</td>
<td>X X X X</td>
</tr>
<tr>
<td>EECE 342</td>
<td>Wireless and Mobile Computing</td>
<td>X X X X</td>
</tr>
<tr>
<td>IT 350</td>
<td>Database Management</td>
<td>X X X X</td>
</tr>
<tr>
<td>EECE 355</td>
<td>Web Engineering</td>
<td></td>
</tr>
<tr>
<td>IT 410</td>
<td>Info. Assurance &amp; Security</td>
<td>X X X X X</td>
</tr>
<tr>
<td>EECE 435</td>
<td>Software Engineering</td>
<td>X</td>
</tr>
<tr>
<td>EECE 440</td>
<td>Advanced Computer Networks</td>
<td>X X X X X</td>
</tr>
<tr>
<td>ENGR 474</td>
<td>Engineering Project Management</td>
<td>X X X X</td>
</tr>
<tr>
<td>IT 490</td>
<td>Capstone I</td>
<td>X X X X X X X X</td>
</tr>
<tr>
<td>IT 491</td>
<td>Capstone II</td>
<td>X X X X</td>
</tr>
<tr>
<td></td>
<td>Follow up survey</td>
<td></td>
</tr>
</tbody>
</table>
For the aggregate result of a student outcome measured in a class (including all students), the Department defines the level of attainment of outcomes per class as follows:

- Target met: 75% of all students or more achieve target.
- Target in progress: less than 75% of all students achieve target.

In case that the target is in progress, faculty members devise action plans to be implemented to obtain the target.

Given that the level of attainment of a student outcome is measured in multiple classes, the Department defines the overall level of attainment of a student outcome for the Information Engineering Technology (IET) program as follows:

- For 100-level and 200-level classes, the Department assigns 1 point if the level of attainment is marked as Target in progress.
- For 100-level and 200-level classes, the Department assigns 2 points if the level of attainment is marked as Target met.
- For 300-level and 400-level classes, the Department assigns 2 points if the level of attainment is marked as Target in progress.
- For 300-level and 400-level classes, the Department assigns 4 points if the level of attainment is marked as Target met.

The level of attainment of a student outcome considering all courses where the student outcome is measured, is defined as:

\[
\text{Level of attainment of outcome} = \frac{\text{Points achieved}}{\text{Maximum points in outcome}}
\]

It is important to carefully design the curriculum map so that each student outcome is assessed and evaluated in at least one upper-division course. Most IET student outcomes are assessed and evaluated in multiple upper-division and lower-division courses.

Table 2 summarizes the level of attainment of SO14. Each entry in each table is documented and attached to student work samples.

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>Assessment Tool/Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Exam</td>
</tr>
<tr>
<td>EECE 132</td>
<td>Computer Networks I</td>
<td>In progress (1)</td>
</tr>
<tr>
<td>EECE 342</td>
<td>Wireless and Mobile Computing</td>
<td></td>
</tr>
<tr>
<td>IT 410</td>
<td>Info. Assurance &amp; Security</td>
<td></td>
</tr>
<tr>
<td>EECE 440</td>
<td>Adv. Computer Networks</td>
<td></td>
</tr>
</tbody>
</table>
It is important to document the above process of assessment and evaluation, and to repeat the process regularly. In the case of the IET program, each student outcome was assessed and evaluated at least twice during the years 2009-2013, prior to the ABET visit in Fall 2013. This permits to quantify whether the action plans (resulted from the first assessment and evaluation) are successful or not to improve student performance. Similarly, the impact of action plans must also be documented.

Keys for Criterion 4: A documented and appropriate student outcome assessment and evaluation process in place and functioning on a regular basis. The documentation should include information such as assessment tool (e.g., rubrics, lab reports, exams, etc.); a timetable of implementation; who is responsible in the assessment process; who is responsible for the evaluation of assessment data; and who is involved in making decisions on how to respond to the evaluation. Assessment measures must determine the extent that student outcomes are being attained. The evaluation results must be used as input for continuous improvement of the program, which results in the attainment of student outcomes.

3.5 Curriculum

Criterion 5, curriculum, requires the program to effectively develop the following subject areas in support of student outcomes and program educational objectives:

Mathematics: the IET includes integral (Calculus II) and differential (Calculus I) calculus, which is above the level of algebra and trigonometry (required by ABET). The IET also includes Discrete Mathematics.

Technical content: the IET focuses on applied aspect of information engineering technology. Technical content represents 60% of total credits, which is within the limits by ABET (between 33-66%).

Physical and Natural Science: the IET curriculum requires students eight credit hours of science (Physics I and Physics II) with lab experiences.

Capstone I and II: The integration of content of the program is achieved in two consecutive project-based courses, Capstone I and Capstone II. They provide an integrating experience that develops student competencies in applying both technical and non-technical skills (e.g., effective communications, team work). Student work collected in these courses is also useful for assessment and evaluation. By the time students are enrolled in Capstone I and Capstone II, they should already have developed the knowledge, techniques and skills identified in each student outcome. Otherwise, corrective action is needed.

Figure 3 provides an overview of the IET program. The number of credits required for graduation is 124. While the program is a technology program, students are required to take core math and science courses (Calculus and Physics) as required by any engineering program. Specifically, students have to complete the math sequence up to Calculus II and Engineering Physics I and II (calculus-based). The IET program includes other engineering-based courses.
such as Discrete Mathematics and Algorithms, Circuit Analysis, and Computer Logic Design, thus providing students with engineering foundations. Senior students are required to take two Capstone courses (senior design). As an Information Engineering Technology program, there are five student outcomes specified in the Program Criteria (see Appendix I, student outcomes 12-16) that are attained through the learning material in the courses labeled as engineering foundations in Figure 3 and reinforced in 400-level courses. To acquire the background required for courses such as Circuit Analysis and Computer Logic Design, the IET program includes the course ENGR 120 Introductory Math for Engineering (see Figure 3). This course is organized as suggested by the Wright State Model. These courses (Engineering Foundations) are typical in Computer Engineering and Electrical Engineering programs.

![Figure 3. Overview of the IET program at Northern New Mexico College. The five pillars of IT (Programming, Web Systems, HCI, Databases, and Computer Networks) are covered as suggested by ACM/IEEE. Freshman courses are shown in yellow.](image)

The IET curriculum has a requirement of nine optional technical credits. Figure 3 shows some courses students may take to fulfill this requirement. Optional courses emphasize areas in
computer science (Data Structures and Algorithms, Data Mining), computer networks (Advanced Routing and Switching, Network Management), math (Differential Equations, Linear Algebra), and engineering (Computer Architecture and Organization).

The optional courses are intended to allow for further breadth or depth according to the career path and area of interest. Those students who are interested in graduate school may be advised to take courses such as Differential Equations and Linear Algebra. Students interested in computer science may prefer to strengthen their knowledge with data structures, algorithms and math. Others who choose the industry path or IET field may prefer courses in networks, databases, or to prepare for industrial-type of certificates through advanced courses in security and networks.

3.6 Faculty

Criterion 6 requires faculty with expertise and educational background consistent with the program. The competence of faculty members must be demonstrated by factors such as education, professional credentials and certifications, professional experience, ongoing professional development, contributions to the discipline, teaching effectiveness, and communication skills. Collectively, the faculty must have the breadth and depth to cover all curricular areas of the program.

Perhaps one of the most challenging tasks for smaller institutions such as Northern New Mexico College is to have the faculty with the breadth and depth to cover all areas. The IET faculty consists of 3.5 FTE tenured/tenure track faculty, who are able to teach three or four courses per semester each (courses only have one section). It is essential, then, to exploit the strength of each faculty and provide professional development opportunities to cover the curricular areas. From its conception, the approach of the Department of Engineering was to train the faculty with the goal of covering the breadth of the information engineering technology discipline, and to permit each faculty develop at least one course in its area of expertise to contribute with the depth of the program. The five pillars of the IT discipline (see Figure 4), described by the ACM/IEEE\(^3\), plus information assurance and security, were covered by ensuring, with professional development, that each member covers at least two pillars or one pillar and information assurance and security.

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**Keys for Criterion 5:** The curriculum should develop subject areas in support of **student outcomes and program educational objectives**, including math (integral and differential calculus or other appropriate math), technical content focused on applied science and engineering, physical and natural science and integrative experience. The External Advisory Committee should periodically review the curriculum and provide advisement on current and future aspects of technical fields the future graduates are being prepared on.
Each faculty member has a workload that allows both teaching and administration tasks. They are also totally involved in the needs of the students in their formation period through their advising roles; this indicates a high level of commitment and dedication in their activities. The Department of Engineering also administers a tutoring program to help students to be successful in their program of studies.

3.7 Equipment

Classrooms, offices, laboratories, and associated equipment must be adequate to support attainment of the student outcomes and to provide an atmosphere conducive to learning.

To this extend, ABET sought that the institution had adequate:

- Office space, classrooms and labs
- Computing resources
- Guidance/supervision to use the labs and that the labs are used in a safely manner
- Process to maintain and upgrade facilities
• Library services

Even though all items in the list are important, item 1, 2 and 3 are especially of concern for ABET program evaluators for an Engineering Technology program as the students are directly impacted by the state of these facilities. According to ABET, engineering technology programs are more practical than theoretical in nature. Engineering technology programs, in contrast to engineering programs, focus on application and implementation while the latter often focus on theory and conceptual design.

To demonstrate that resources (especially labs) were adequate for the program, the following documentation was created:

• Age of equipment and state of equipment (i.e., when the equipment was bought and current state).
• Mapping of computing resources to Information Engineering Technology courses (Table 3).
• Core equipment maintained by the Department was adequate in terms of students to equipment ratio (Table 4).

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>Room</th>
</tr>
</thead>
<tbody>
<tr>
<td>EECE 105L</td>
<td>Micro-computer Systems</td>
<td>HT: High Tech Building</td>
</tr>
<tr>
<td></td>
<td></td>
<td>HT 118</td>
</tr>
<tr>
<td>ENGR 110</td>
<td>Intro. to Engineering</td>
<td>HT 123</td>
</tr>
<tr>
<td>EECE 132</td>
<td>Computer Networks I</td>
<td>HT 126</td>
</tr>
<tr>
<td>EECE 152L</td>
<td>Computer Programming I</td>
<td>SERPA Building</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SERPA 115</td>
</tr>
<tr>
<td>CS 201</td>
<td>Math Foundation of CS</td>
<td>X</td>
</tr>
<tr>
<td>EECE 203L</td>
<td>Circuit Analysis</td>
<td>X</td>
</tr>
<tr>
<td>EECE 231</td>
<td>Intermediate Programming</td>
<td>X</td>
</tr>
<tr>
<td>EECE 238L</td>
<td>Computer Logic Design</td>
<td>X</td>
</tr>
<tr>
<td>IT 250</td>
<td>Introduction to Databases</td>
<td></td>
</tr>
<tr>
<td>EECE 329</td>
<td>Human Computer Interaction</td>
<td></td>
</tr>
<tr>
<td>EECE 330</td>
<td>Computer Networks II</td>
<td></td>
</tr>
<tr>
<td>EECE 342</td>
<td>Wireless and Mobile Computing</td>
<td></td>
</tr>
<tr>
<td>IT 350</td>
<td>Database Management</td>
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<td>EECE 355</td>
<td>Web Engineering</td>
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<td>IT 410</td>
<td>Info. Assurance and Security</td>
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<td>EECE 435</td>
<td>Software Engineering</td>
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<td>EECE 440</td>
<td>Advanced Computer Networks</td>
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</tr>
<tr>
<td>IT 490</td>
<td>Capstone I</td>
<td></td>
</tr>
<tr>
<td>IT 491</td>
<td>Capstone II</td>
<td></td>
</tr>
</tbody>
</table>

*Courses also have access to laptops (22 units) that are in the portable "Computers On Wheels (COW)" cart.
Table 4. Core computer equipment maintained by the Department of Engineering.

<table>
<thead>
<tr>
<th>Laboratory</th>
<th>Location</th>
<th>Quantity</th>
<th>Students/Equipment Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Networking</td>
<td>HT 118</td>
<td>22</td>
<td>0.68 : 1</td>
</tr>
<tr>
<td>Computer Programming, Databases</td>
<td>HT 123</td>
<td>22</td>
<td>0.68 : 1</td>
</tr>
<tr>
<td>and Systems</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Software Engineering</td>
<td>HT 126</td>
<td>18</td>
<td>0.83 : 1</td>
</tr>
<tr>
<td>Instrumentation Lab</td>
<td>SERPA 115</td>
<td>12</td>
<td>1 : 1</td>
</tr>
<tr>
<td>General Purpose Lab</td>
<td>SERPA 117</td>
<td>7</td>
<td>6.8 : 1</td>
</tr>
<tr>
<td>Computer On Wheels cart</td>
<td>Portable</td>
<td>22</td>
<td>0.68 : 1</td>
</tr>
</tbody>
</table>

* For the classes in the Instrumentation lab, no more than 12 students are admitted.

Keys for Criterion 7: this criterion plays a very important role (even more for engineering technology programs that are more practical than theoretical) because they directly support the attainment of the student outcomes; for the IET program, most student outcomes are assessed and evaluated through lab activities. Having up-to-date and maintained equipment ensures continuing adequacy through the period of accreditation. An experience that helped tremendously the maintenance and update of the equipment and curriculum is the partnership with the industry. For the networking pillar, the equipment and curriculum is periodically updated at lower costs (~30% lower than market prices) by participating in the Cisco Academy. Similar approaches were taken for the other curricular areas.

3.8 Institutional Support

Criterion 8 refers to Institutional Support. The leadership and support from the institution must be adequate to ensure quality and continuity of the program. In the case of the IET, while the accreditation process started because of the interest of the faculty and chair of the program in 2009/2010, the institution supported the initiative of the department. Strategies followed included:

- Faculty recruitment and retention: while faculty salaries are not at the level of larger institutions, Northern New Mexico College tried to compensate this by providing funds for continuous professional development;
- Student resources: financial support to maintain adequate tutoring staff and lab equipment, including student lounge and student association.

At Northern New Mexico College, the Department of Engineering is supported partially with soft money. While this is ephemeral and subject to continuing grant applications, it is important to be clear and transparent with ABET. For the IET accreditation, the overall budget was included in the self-study report, funds from both hard money and soft money. Criterion 8 does not provide a minimum budget, but rather evaluate if “sufficient resources” exist, which may be unique at each institution. To demonstrate “sufficient resources,” it is valuable to list:

- Support for Teaching
- Infrastructure Support
- Adequacy of Resources
- Student Support Center
3.9 Program Criteria

The Program Criteria are established by the member societies. In the case of Information Engineering Technology (IET) and most Engineering Technology programs, the leading society is IEEE. Each program seeking accreditation from the ETAC Commission of ABET must demonstrate that it satisfies all Program Criteria implied by the program title. For the IET, the IEEE defines five additional student outcomes to be attained by graduates of the program. The Department of Engineering at Northern New Mexico College decided to include the five student outcomes of the ETAC ABET Program Criteria for Information Engineering Technology programs as regular student outcomes. Thus, they were added to the eleven student outcomes of Criterion 3, to create a set of sixteen student outcomes. Based on this approach, if the program complies with Criterion 3, then it also complies with the Program Criteria.

4. ABET Visit and Accreditation Impact

4.1 ABET Visit

Prior to the on site visit, the Self-Study report (SSR) is submitted before July 1st. Visits are usually scheduled during the Fall semester (September – December). The SSR is the primary document that each program uses to demonstrate its compliance with all applicable ABET criteria and policies. Based on it, the visiting team forms an initial judgment of whether the program meets ABET requirements or not. It addresses all eight criteria and the program criteria, and thus should be as comprehensive as possible. Because of the limited time the visiting team has for the actual visit (usually three days), it is imperative to narrate all evidence in a clear and unambiguous manner so that the visiting team can easily corroborate the evidence on site.

During the visit, a faculty member should be available at all time to the ABET team. Particular consideration should be taken for the Sunday (visits usually are scheduled for Sunday-Tuesday), since that day the ABET team will look at the assessment and evaluation material and corroborate that the program is in compliance with several criteria, with attention to Criteria 3.

Keys for Criterion 8: demonstrate that there is adequate institutional support and leadership to assure the quality and continuity of the program. Institutional support refers to sufficient resources for creating a conducive environment for students (institutional services, labs, computers, tools, tutors) and for faculty (to attract, retain, and provide for professional development; support staff). At the end, these resources facilitate the attainment of student outcomes and program educational objectives.
and 4. Thus, the faculty member who is available on Sunday should be familiar with all the documentation provided to the team.

**Figure 5.** Arrangement of material in the ABET working room.

To facilitate the work of the ABET team, the material should be labeled and easy to understand. Figure 5 illustrates the ABET working room prepared at Northern New Mexico College. First, the curriculum map is next to the assessment and evaluation reports and student work used for assessment, arranged in a per-course binder manner. By reading the curriculum map, which maps student outcomes and courses where student outcomes are assessed, the reviewer can easily access the binder with a course of interest. Substantial additional student work provide an assurance that the assessed material was not hand-picked. Minutes, graduate files (including transcripts) surveys and statistics are also provided, as well as textbooks (see Figure 6).

**Figure 6.** Per-course assessment binders (left) and textbooks (right).
The assessment binder contained the following material separated by tabs: syllabus, assessment report (which included the description of the tool used for assessment and evaluation, data analysis, percentage of students attained the target for each student outcome assessed, and action plans), student samples or data collection (one tab per tool – exam, quiz, etc. – used for assessment), and additional student samples (see Figure 7).

Figure 7. Organization of an assessment binder.

Other useful strategies were the use of News boards and capstone project posters (see Figure 8). Information in the News board includes recent grants, students’ publications, advisee/advisor lists, and others. This permits to highlight the level of activities faculty and students are engaged in, efficiently using the limited time of ABET team (the News board and Capstone posters were located in the main hallway).

Figure 8. News board and Capstone posters in the main hallway of the Engineering building.
4.2 Accreditation Impact

As the IET program only recently received the accredited letter (August 2014), data is still being collected to quantify the impact of the accreditation on the program. However, since the current 2014/2015 academic year, the IET program has attracted a clear interest in community colleges and high schools of the region to articulate career paths from high-school and community colleges to the ABET accredited IET program. Multiple MOUs and transfer agreements have been developed in the last year.

The enrollment of the IET program (number of students who are enrolled in at least one credit hour and declared IET as the major) is shown in Figure 9. While the college-wide enrollment has remained flat or slightly declined during the years 2009 and 2015, the enrollment of the IET program has only increased since its inception. The accreditation process that started in 2009 has positively impacted on the program’s enrollment. By following the ABET continuous quality improvement (CQI) principle, the faculty applied it to all the activities from Criterion 1 to Criterion 8 (advisement, curriculum improvements emphasizing career readiness, hands-on activities, lab developments, open door policy, private and public grants obtained by the department, etc.). The faculty perceived that students across the different departments and the community noted the CQI effort in the IET program and thus this contributed to attract more students to the program. As mentioned previously, keeping up with career trends and adjusting the curriculum to what the job market demands was essential to maintain the upward enrollment trend.

5. Conclusion

This paper illustrates the ABET accreditation process of the IET program at Northern New Mexico College, from its conception. The paper describes how each ETAC ABET criterion was successfully addressed with a 3.5 FTE faculty size. Characteristics of the IET program that permitted an efficient use of resources include the adaptation of the IEEE/ACM guidelines for IT programs to the local needs; the systematic application of a continuous quality improvement plan applied to the eight general criteria and to the program criteria for information engineering technology and similar named programs, and the development of a curriculum that incorporates extensive hands-on activities that are relevant and in high demand for the job market. The paper also describes the approach used by Northern’s faculty to measure student outcomes using a metric that aggregates results from different activities in different courses and how its application
allows the faculty to identify strengths and weaknesses of the program and subsequent corrective actions.

References

1. http://www.abet.org
3. Curriculum Guidelines for Undergraduate Degree Programs in Information Technology, Association for Computing Machinery (ACM) and IEEE Computer Society, 2008.
Appendix I. IET Student Outcomes

The student outcomes of the IET program are composed of 11 standard outcomes of the general criterion 3 for Engineering Technology Programs for bachelor degrees (outcomes 1-11) published by the ABET ETAC commission for the 2009/2010 Accreditation Cycle; and five additional outcomes adopted from the published ABET ETAC commission Program Criteria for Information Engineering Technology for the 2009/2010 Accreditation Cycle (outcomes 12-16).

1. An appropriate mastery of the knowledge, techniques, skills, and modern tools of their disciplines.
2. An ability to apply current knowledge and adapt to emerging applications of mathematics, science, engineering, and technology.
3. An ability to conduct, analyze and interpret experiments, and apply experimental results to improve processes.
4. An ability to apply creativity in the design of systems, components, or processes appropriate to program educational objectives.
5. An ability to function effectively on teams.
6. An ability to identify, analyze and solve technical problems.
7. An ability to communicate effectively.
8. A recognition of the need for, and an ability to engage in lifelong learning.
9. An ability to understand professional, ethical and social responsibilities.
10. A respect for diversity and a knowledge of contemporary professional, societal and global issues.
11. A commitment to quality, timeliness, and continuous improvement.
12. The application of Computer and network hardware, operating systems, system and network administration, programming languages, applications software, and databases in the building, testing, operation, and maintenance of hardware and software systems.
13. The application of electrical, electronic, telecommunications, and digital signal propagation fundamentals in the building, testing, operation and maintenance of hardware and software systems.
14. The ability to design, implement, maintain and provide for the security of facilities involved with the processing and transfer of information.
15. The ability to apply project management techniques to facilities that process and transfer information.
16. The ability to apply discrete mathematics, and probability and statistics in the support of facilities that process and transfer information.