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ATMAE to ABET Accreditation: An Assessment Transition in an Electronics and Computer Engineering Technology Program

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ATMAE to ABET Accreditation: An Assessment Transition in an Electronics and Computer Engineering Technology Program

Abstract

Bowling Green State University currently offers an ETAC-ABET accredited undergraduate Bachelor of Science degree in Electronics and Computer Engineering Technology. The program was previously accredited by ATMAE with the name Electronics and Computer Technology in the Bachelor of Science in Technology degree. The program faculty has decided to seek ABET accreditation due to the professional engineer registration our students can seek and other reasons. This paper presents the process adopted by the ECET program faculty to use the past ATMAE accreditation practices to present ABET accreditation. A hallmark of our program has been the mandatory two-semester long co-op experiences and an optional third-semester co-op experience, which has served as an important tool along with our in-class course instruction and laboratory experience for the success of our students. Our program educational objectives review and student outcomes assessment of ABET's Engineering Technology Accreditation Commission general 'a to k' criteria and Electrical/Electronic(s) Engineering Technology, and Computer Engineering Technology program specific criteria use four direct and indirect quantitative methods and additional qualitative methods. The direct quantitative methods include: course-embedded assessment, course final grades, co-op employer student performance appraisal; and the indirect quantitative method is an end of semester student course evaluation. The qualitative methods include student co-op report feedback, industrial advisory board input, and alumni input in addition to regular input from faculty. This paper describes how the data from these methods are used for assessment and continuous improvement that resulted in a successful maximum ABET accreditation period for our ECET program.

I. Introduction

Bowling Green State University (BGSU) currently offers an ETAC-ABET accredited undergraduate Bachelor of Science degree in Electronics and Computer Engineering Technology (ECET). The program was previously accredited by Association of Technology, Management, and Applied Engineering (ATMAE)[1,2] with the name Electronics and Computer Technology (ECT) in the Bachelor of Science in Technology degree. The program faculty has decided to seek Accreditation Board for Engineering and Technology (ABET)[3,4] accreditation due to the professional engineer registration our students can seek and other reasons. This paper presents the process adopted by the ECET program faculty to use the past ATMAE accreditation practices to present ABET accreditation. A hallmark of our ECET program has been the mandatory two-semester long co-op experiences and an optional third-semester co-op experience, which has served as an important tool along with our in-class course instruction and laboratory experience for the success of our students.

In a recent paper, various synergies of converging ABET, ATMAE, and other accreditation processes were discussed[5]. Our intent is not to seek reaccreditation for our ECET program with ATMAE but to explain how we used some of those practices and methods for ABET accreditation. The use of internship workplace competencies for ETAC-ABET program outcomes assessment was discussed in a recent paper[6]. We have been using our students' co-op experience as a tool for program assessment and continuous improvement in the past, and we will discuss how that is incorporated into ABET assessment in this paper. The use of course-embedded methods for ETAC-ABET assessment was discussed in a recent paper[7]. Our course-embedded assessment uses similar methodology but considers ABET 'a to k' student outcomes separately rather than combining into eight outcomes.

Our Program Educational Objectives (PEO) review and Student Outcomes (SO) assessment of ABET's Engineering Technology Accreditation Commission (ETAC) general 'a to k' criteria and Electrical/Electronic(s) Engineering Technology (EET) and Computer Engineering Technology (CET) program specific criteria use four direct and indirect[8] quantitative methods and additional qualitative methods. The direct quantitative methods include: course-embedded assessment, course final grades, co-op employer student performance appraisal; and the indirect quantitative method is an end of semester student course evaluation. The qualitative methods include student co-op report feedback, industrial advisory board input, and alumni input in addition to regular input from faculty. This paper describes how the data from these methods are used for assessment and continuous improvement that resulted in a successful maximum ABET accreditation period for our ECET program. Our past ATMAE accreditation details for the ECT program are described in the next section. The current ABET accreditation details for the ECET program are given in the third section, which includes PEO, SO, assessment methods, and continuous improvement. Concluding remarks are offered in the final section.

II. ATMAE Accreditation

Bowling Green State University had its initial accreditation in 1982 by the National Association of Industrial Technology (NAIT). All academic programs seeking NAIT accreditation were in the College of Technology (now the College of Technology, Architecture and Applied Engineering, or TAAE). Later accreditation applications would include the Electronic Technology program and finally, its successor program, the Electronics and Computer Technology program. The most recent accreditation was in 2010 by the Association of Technology, Management, and Applied Engineering, the new name of NAIT[1].

Bowling Green State University prepared teachers for a baccalaureate degree in the "practical arts" through courses offered by the Industrial Arts and Engineering Drawing department. This department would eventually become today's' TAAE college. During the period of NAIT's creation, academics in Industrial Technology advocated Industrial Technology practices present in the post World War II Industrial Arts programs. These included practices that directly and indirectly affected student development (student success) as listed below.

- Direct Effect Practices
    - Inclusion of Management Courses
    - Field Experience (on the job)

- Indirect Effects Practices
    - Participation of Industrial Advisory Boards
    - Alumni Feedback

The TAAE College at BGSU has a long history of using all of these practices in its ATMAE accredited programs[2]. The following list shows where the practices were reported in our ATMAE 2010 Self Study.

- Management Courses
    - Mission subsection
    - Foundation Requirements subsection
- Field Experience (generally known as Co-op in TAAE)
    - Compliance with Standards section and these subsections
        - Mission subsection
        - Foundation Requirements subsection
        - Industrial Experiences subsection
- Participation of Advisory Boards
    - Mission subsection, Program Goals subparagraph
    - Mission subsection, Competency Validation subparagraph
- Alumni Feedback
    - Mission subsection, Program Development subparagraph

All these ATMAE practices have shaped responses and programmatic details provided in ECET's ABET Self Study report. The past practices used for assembling and organizing display materials for ATMAE accreditation visits have also helped us prepare display materials[9] for ABET accreditation visit.

III. ABET Accreditation

The ECT program faculty of Bowling Green State University started its attempts to seek ABET accreditation in 2006 by proposing a set of curriculum changes to meet TAC-ABET criteria. While the attempt was not successful at that time, evidence of the real support for ABET accreditation came from the administration in 2010 with a one-time budget allocation. The curriculum modifications with a change of program and degree name to ECET were approved in 2013. These modifications brought capstone course as an integral part of the program curriculum in addition to increasing the technical content by reducing the management courses requirement, which was mandated by ATMAE accreditation. The program faculty has prepared the preliminary Self Study report, and the BGSU has requested for readiness review from ABET in October 2013. The ECET program received a positive response after the review and BGSU submitted request for evaluations for 2014-2015 accreditation cycle. The program faculty updated the preliminary Self Study report and BGSU submitted the final Self Study report to ABET in June 2014. The accreditation team visited in October 2014, and the final program accreditation came in August 2015. In this section, the assessment part of the Self Study report for ABET is explained in detail along with an indication of previous ATMAE accreditation practices adaptation.

III.1. Program Educational Objectives

One of the first steps in the preparation of the ABET Self Study report is to identify a set of program educational objectives[9]. The ECET program developed the following three PEO.

Program Educational Objective 1

The Electronics and Computer Engineering Technology program prepares exemplary electronic and computer engineering technology professionals who are problem solvers in the areas of instrumentation and process control, communications and computer networking, computer technology, electric machinery and power systems, and renewable energy.

Program Educational Objective 2

The program will prepare graduates to work as effective employees and team members and to possess appropriate oral and written communication skill.

Program Educational Objective 3

The program will prepare graduates to value their profession and to recognize the global impacts of their profession on society. They will recognize their professional need to advance in their careers and continue their professional development.

III.2. Student Outcomes

The faculty next developed student outcomes for the program[9]. Eleven learned capabilities of students in the ECET program were set in the list of student outcomes. The student outcomes, 'a to k', for the ECET program are identical to the student outcomes of criterion 3 of ABET[4].

In addition to student outcomes 'a to k', there are six student outcomes, 'l to q' identified. The student outcomes, l to n listed below, for the ECET program are identical to the outcomes c, d and e of program criteria for Electrical/Electronic(s) Engineering Technology and similarly named programs[4]. The outcomes a and b of the EET program criteria of ETAC-ABET are supported by student outcomes 'a to k' of our ECET program.

- **l.** The ability to analyze, design, and implement control systems, instrumentation systems, communications systems, computer systems, or power systems.
- **m.** The ability to apply project management techniques to electrical/electronic(s) systems.
- **n.** The ability to utilize statistics/probability, transform methods, discrete mathematics, or applied differential equations in support of electrical/electronic(s) systems.

The Student Outcomes, o to q listed below, for the ECET program are identical to the outcomes c, d and e of program criteria for Computer Engineering Technology and similarly named programs[4]. The outcomes a and b of the CET program criteria of ETAC-ABET are supported by student outcomes 'a to k' of our ECET program.

o. The ability to analyze, design, and implement hardware and software computer systems**.**
p. The ability to apply project management techniques to computer systems.
q. The ability to utilize statistics/probability, transform methods, discrete mathematics, or applied differential equations in support of computer systems and networks.

III.3. Assessment Methods

Electronics and Computer Engineering Technology program faculty identified the following constituencies, which have their needs met as the program delivers on its program educational objectives and student outcomes:

1. Students
2. Employers/Advisory board
3. Faculty
4. Alumni
5. ABET/IEEE professional accreditation body/lead professional society

The periodic review of PEO and SO assessment is performed by using assessment tools that collect data from categories congruent to the professional interest of the program constituencies. The program has identified the following assessment tools by which data are accumulated:

1. Student course evaluation
2. Cooperative education (co-op) reports generated by students
3. Employer interview tool
4. Alumni input
5. Faculty annual self-assessment
6. Advisory board comments and review
7. Facilities and resource review (record of equipment shortages, breakdowns, and student review of lab experience)

The data are analyzed with respect to its ability to validate or invalidate the usefulness of the existing PEO and SO, the institution's mission, the constituents' needs, and the established target criteria. This assessment process is shown in Figure 1. In our preliminary Self Study report, alumni input was sought as a survey. However, ABET indicated alumni data collection assessment is not required, and the program has not done the alumni surveys as part of final Self Study report but included their input in other qualitative methods. Some of these assessment tools for ABET by which data are collected are similar to our past ATMAE accreditation practices as identified in the previous section. A detailed account of these is given in the following.

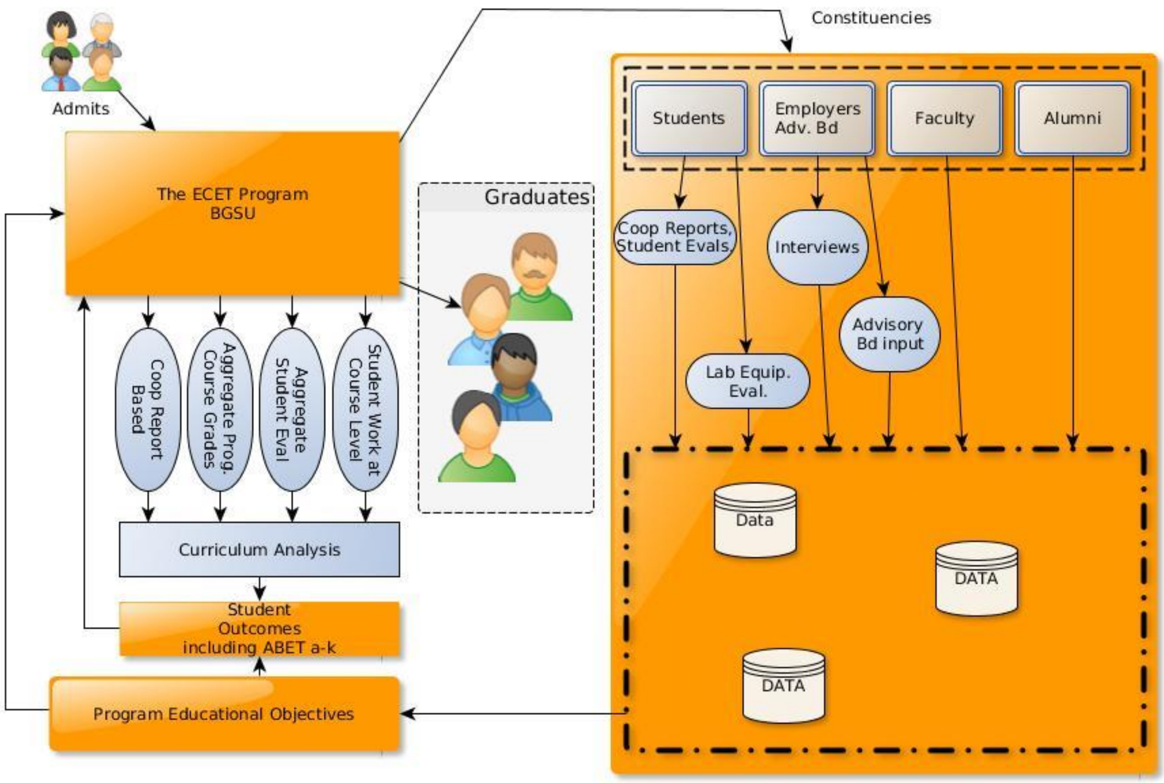

Figure 1. Assessment process.

Internal Assessment Mechanisms

Data collection within the assessment process is implied by four mechanisms internal to the university: 1) student work at the course level (referred to as course-embedded assessment, which is used as a faculty based course assessment method), 2) aggregate program course grades, 3) aggregate student evaluation and 4) student co-op report. Relationships and details of these assessment tools are shown in Table 1. The course grades are only an aggregate indicator of students' performance, and they are not a sole assessment tool. Rubrics are used in the course-embedded assessment. Further details of each of these four mechanisms are explained below.

Course-Embedded Assessment:

- The student work at the course level is assessed using this faculty based course assessment method according to the objectives stated in the course syllabus.
- This is a direct quantitative method.
- Rubrics are used in this assessment.
- Data are collected every semester by the course faculty.
- An analysis is done annually by the ECET program faculty.
- The assessment goal is 70%.
- An example of this assessment method is given in Table 2.

Table 1. Assessment data collection – internal resources.

Co-op Reports	Aggregated Prog. Course Grades	Aggregated Student Evaluations	Student Coursework
<u>Tech 2890 Co-op Report</u> Report assignment: Research job after Graduation. Mapped to Outcome "h"	For all ECET courses, the course letter grades are gathered and computed into an aggregated course grade on a 4 point scale	Q 27. Gained Factual Knowledge Mapped to Outcome "a"	Exams Student Outcome Mappings will vary depending on exam content
<u>Tech 3890 Co-op Report</u> Report assignment: Research Professional Associations & Networking. Mapped to Outcome "h"		Q 28. Learned Fundamental Principles Mapped to Outcome "a"	Laboratory work (if present) Student Outcome Mappings will vary depending on lab objective
<u>Tech 3890 Co-op Report</u> Report assignment: Evaluate Academic Program with respect to Co-op experience. Mapped to Outcome "a, c, d, e"		Q 29. Learned Application of Material Mapped to Outcome "d, f"	Homework Student Outcome Mappings will vary depending on homework objective
<u>Tech 3890 Co-op Report</u> Report assignment: Provide a plan for near term co-op or regular employment. Mapped to Outcome "h" x		Q 30. Developed Needed Skills and Competencies Mapped to Outcome "a"	Report or Presentation (if present) Student Outcome will vary depending on report or presentation objective
<u>Tech 3890 Co-op Report</u> Report assignment: Research degree major specific objectives. Mapped to Outcome "h"		Q 38. Equipment and Supplies are Available. Mapped to Outcome "c"	
<u>Tech 4890 Co-op Report</u> Report assignment: Research expected career path over next five years. Mapped to Outcome "h"			
<u>Tech 4890 Co-op Report</u> Report assignment: Concerning co-op preparation, evaluate BGSU Academic experience. Mapped to Outcome "a, c, d, e"			

Table 2. Data for course-embedded assessment.

	Data for Course-Embedded Assessment for Spring 2013					
	ECET 4530 Digital Computer for Process Control					
Faculty Member: xxxx	Semester: Spring 2013			Number of Students = 11		
	Course-Embedded Assessment - Bench Mark 70%					
Course Objective	Criteria	Tool 1	Class Mean %	Tool 2	Class Mean %	Average Class Mean %
Develop an understanding of both the theoretical and applied techniques used to interface to computers and control real world processes.	a, c, e	Final Exam	66.8	Homework	75.8	71.3
Develop control system modeling and simulation concepts using MATLAB/ SIMULINK.	a, b	Test 1	80.7	Lab	94.1	87.1
Design controllers using PID and other methods.	d, f	Test 2	65.9	Homework	75.8	70.8
Develop and use the necessary programming techniques with LabVIEW to implement laboratory assignments.	b, f	Test 1	80.7	Lab	94.1	87.4
Develop rudimentary skills in networked control systems and work with a fieldbus network (CAN) in laboratory environment.	b, c, e, f	Final Exam	66.8	Lab	94.1	80.4
Critically read and evaluate technical literature and communicate that information to the instructor via technical reports, laboratory exercises.	g, h, i, k	Lab	94.1	Report/ Presentation	99	96.5

Aggregate Program Course Grades:

- The aggregate course grades are computed based on an A-F letter grade system used at BGSU for all ECET courses.
- This is one of the direct quantitative methods, and only used as an indicator for aggregate performance.
- Data are collected every semester by the course faculty.
- An analysis is done annually by ECET program faculty.
- The assessment goal is 2.5 out of 4.0.
- An example of this assessment method is given in Table 3.

Table 3. Data for course CGPA index.

Courses	A	B	C	D	F	CGPA Index	Faculty
ECET 1960 Electrical-Electronic Systems	4	10	11	0	0	2.72	xxxx
ECET 2050 Renewable Energy and Energy Sustainability	7	6	2	0	0	3.33	xxxx
ECET 2400 Electric Circuits	7	5	0	0	0	3.58	xxxx
ECET 2410 Electronic Circuits	2	4	2	0	0	3	xxxx
ECET 2490 Digital Electronic Components and Systems	5	4	2	0	0	3.27	xxxx
ECET 3000 Electric Machinery and Controls	5	6	1	0	0	3.33	xxxx
ECET 3100 Programmable Logic Controllers	2	4	4	1	1	2.42	xxxx
ECET 3410 Electronic Devices	2	3	2	0	0	3	xxxx
ECET 3440 Electronic Communication Circuits	9	2	0	0	0	3.81	xxxx
ECET 3490 Digital Computer Analysis	1	0	3	0	0	2.5	xxxx
ECET 3860 Digital Communication Networks I	4	5	1	0	0	3.3	xxxx
ECET 4410 Instrumentation	2	3	2	0	0	3	xxxx
ECET 4450 Wireless Communication Systems	10	6	0	0	0	3.6	xxxx
ECET 4530 Digital Computer for Process Control	2	3	6	0	0	2.64	xxxx
ECET 4860 Digital Communication Networks II	7	6	0	0	0	3.53	xxxx

Aggregate Student Evaluations:

- The aggregate student evaluations are done at the end of the semester. Students are asked to evaluate the instructor and the course.
- This is an indirect quantitative method.
- Five course related questions from the evaluations are used in the assessment.

- Data are collected every semester by the department.
- An analysis is done annually by the ECET program faculty.
- The assessment goal is 3.0 out of 4.0.

The five questions chosen are:

1. Gained factual knowledge (Q27)
2. Learned fundamental principles (Q28)
3. Learned application of material (Q29)
4. Developed needed skills and competencies (Q30)
5. Availability of equipment and supplies (Q38)

The collected data are illustrated for one course, ECET 3860, spanning a three semester time-period. Data are shown as a histogram in Figure 2.

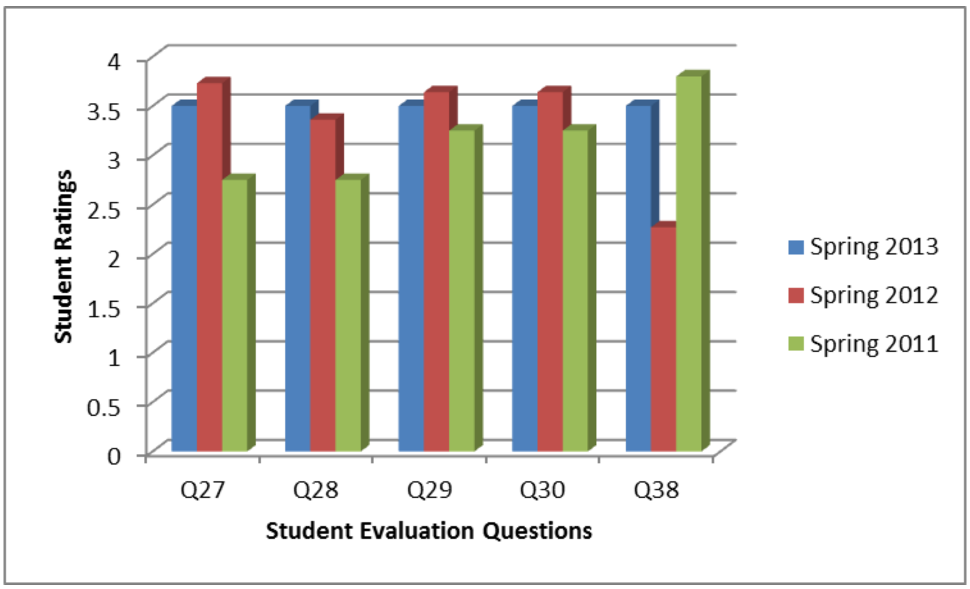

Figure 2. Student evaluation data for ECET 3860 course.

Co-op Report Data Assessment:

- The selected objectives from the student co-op reports used in this process are listed in Table 1.
- This is a qualitative method.
- Co-op report data are collected every semester.
- Analysis is done annually by the ECET program faculty.
- There are no numeric goals for this tool; however, the information is useful for qualitative analysis of the curriculum.

External Assessment Mechanisms

Data collection, apart from that generated exclusively within the university, is also performed. Three external constituencies are used: 1) employers, 2) alumni and 3) the program's advisory board.

Employer Data Assessment:

The questions in Table 4 are chosen from a larger set of questions asked of cooperative education employers. The questions are responded to during a student's cooperative education experience. This is a direct quantitative method of co-op employer student performance appraisal. Data are collected every semester by the college. Analysis is done annually by ECET program faculty.

Table 4. Assessment data collection – employer.

Employer Interview Questions and Performance Appraisal, and Mappings to Student Outcomes
Usefulness of the ECET major to the industry:
1. How well connected is the major for co-op position (SO: a, f, l, o)
2. How well are students financially compensated during the co-op (SO: a, f, j, l, o)
Do our students comprehend principles and methods related to the industry (SO: a, c, f, k)
Do our students have appropriate communication skills (SO: g)
Do our students have team membership skills (SO: e, h, i, k)

The co-op employer data for two terms are analyzed for the two sets of questions. The first set corresponds to answers given by the employer to the faculty representatives. Table 5 shows the data on a Likert scale of 1 to 3 with 3 being “best” and 1 “poor”.

Table 5. Co-op employer interview questions.

Question #	Description	Score (out of 3)
1	How well connected is the major for co-op position	2.55
2	How well are students financially compensated during the co-op	2.50

The second set corresponds to performance feedback given by the employer for student employees. Table 6 shows the data on a Likert scale of 1 to 5 with 5 being “Exceeds”.

Table 6. Employee performance rating by co-op employer.

Question #	Description	Score (out of 5)
1	Do our students comprehend principles and methods related to the industry	4.33
2	Do our students have appropriate communication skills	4.44
3	Do our students have team membership skills	4.56

The data show a satisfaction with our ECET students by their employers. This indicates our curriculum is properly aligned with the expected student outcomes.

Alumni Feedback Assessment:

ECET program faculty members have several opportunities to interact with alumni such as co-op employer site visits, professional society’s participation, campus-based alumni events hosted by the university, email communications and advisory board membership of alumni. Feedback is collected periodically. An analysis is done annually by the program faculty. The analysis information is used during the review of PEO and SO assessment.

Advisory Board Feedback Assessment:

The composition of the ECET program advisory board is broad and includes well-placed individuals from manufacturing, telecommunications, utilities, petroleum, engineering project consulting, and community college level academics. The board meets at least once per year. An agenda is generated to facilitate the participation of the board in the assessment process. The data gathered are reported in the minutes of the meeting. The data are used in the continuous improvement of the program.

III.4. Continuous Improvement

An important example of the continuous improvement of the ECET program is as follows: the advisory board of the program and many program alumni have consistently recognized the importance of ABET accreditation and have encouraged the ECET faculty and administration to seek ABET accreditation. Their support has been cited numerous times by ECET faculty during its effort to help convince university administrators to commit to the ETAC-ABET process.

Table 7 illustrates the evaluation and change process for curriculum improvement done in few courses. It cites the impetus for a course change, the assessment tool used, the action taken and the impacted student outcomes. Some cases cited in the “action” column concern laboratory improvement efforts by the program. The continuous improvement cycle for one course is also shown as a “snapshot” for ECET 2050 course in Figure 3.

Table 7. Continuous improvement for ECET courses.

Course Number	Impetus for Change	Assessment Tool used	Action	Impacted Student Outcome	By Whom
ECET 2050	Expanded technical content	Faculty input and Advisory committee input	Added math-based analysis to the wind and hydropower course modules.	a, b	xxxx
ECET 2490	Integration of programmable logic devices into lab	Student evaluations, Course-embedded assessment, Advisory board input and Faculty input	Introduced Altera FPGA material in lectures and labs.	a, c	xxxx
ECET 3100	Improved laboratory hardware and software	Advisory board input, Employer input and Alumni input	Replaced Modicon PLC with Allen-Bradley PLC and implemented HMI software.	c, d, l, o	xxxx

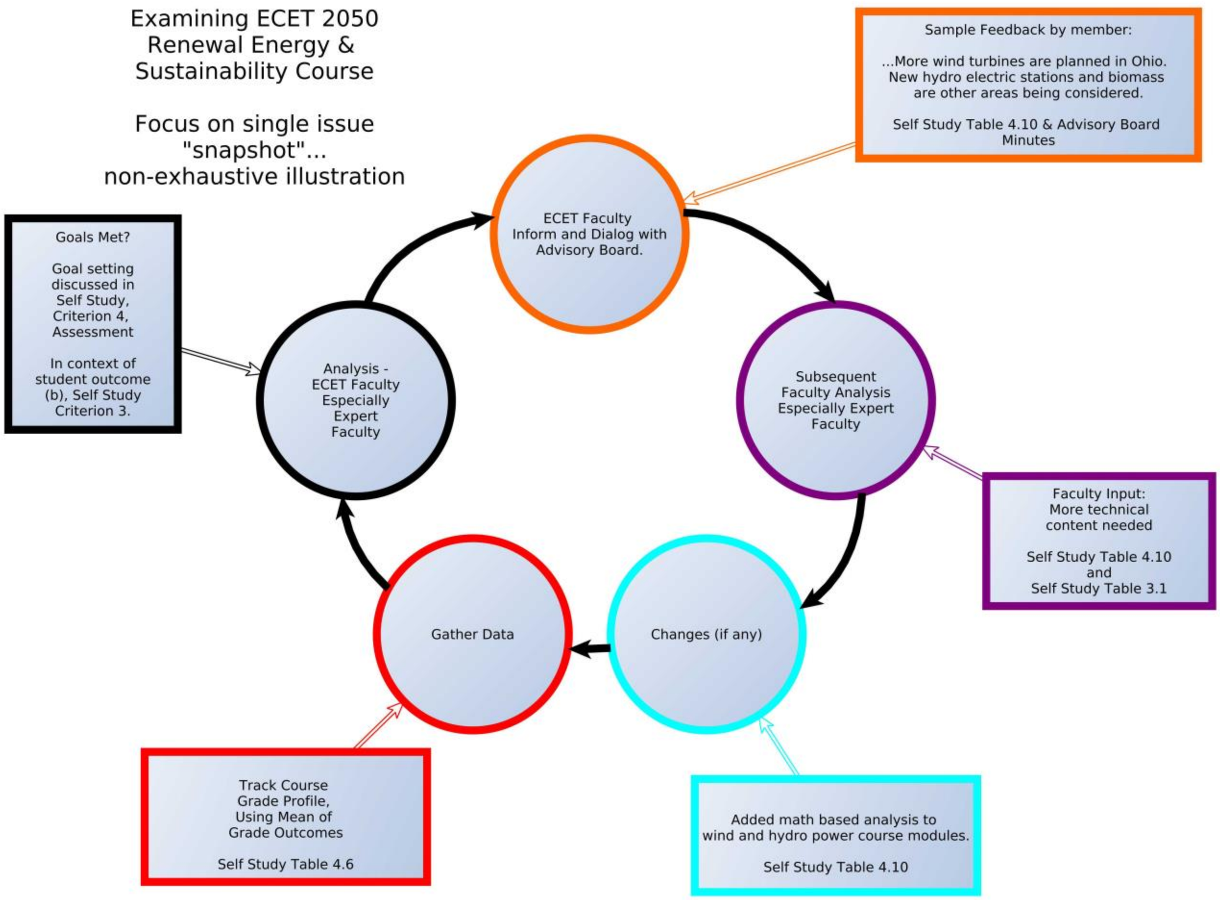

Figure 3. Continuous improvement cycle for ECET 2050 course.

IV. Conclusions

This paper presented the process adopted by the ECET program faculty to use the past ATMAE accreditation practices to present ABET accreditation. A hallmark of our ECET program at BGSU has been the mandatory co-op experiences, which has served as an important tool along with our in-class course instruction and laboratory experience for the success of our students. Our program educational objectives review and student outcomes assessment of ABET's ETAC general 'a to k' criteria and EET and CET program specific criteria used four direct and indirect quantitative methods and additional qualitative methods. The direct quantitative methods include: course-embedded assessment, course final grades, co-op employer student performance appraisal; and the indirect quantitative method is an end of semester student course evaluations. The qualitative methods include student co-op report feedback, industrial advisory board input, and alumni input in addition to regular input from faculty. This paper described how the data from these methods are used for assessment and continuous improvement that resulted in a successful maximum ABET accreditation period for our ECET program. Following the accreditation, several alumni that received the prior ATMAE accredited BS in Technology degree showed interest to return to the university to get ETAC-ABET accredited BS ECET degree. We are hoping that this ABET accredited degree will increase our student enrollment.

References

1. ATMAE (2015), Accreditation Program Policies and Procedures. http://c.ymcdn.com/sites/www.atmae.org/resource/resmgr/Docs/ATMAE_Accreditation_Policies.pdf
2. ATMAE (2014), Outcomes Assessment Accreditation Handbook. http://c.ymcdn.com/sites/www.atmae.org/resource/resmgr/docs/handbook_2011_outcomes_asses.pdf
3. ABET (2015), Accreditation Policy and Procedure Manual. http://www.abet.org/wp-content/uploads/2015/10/A001-16-17-Accreditation-Policy-and-Procedure-Manual-11-1-15.pdf
4. ABET (2015), Criteria for Accrediting Engineering Technology Programs, http://www.abet.org/wp-content/uploads/2015/10/T001-16-17-ETAC-Criteria-10-16-15.pdf
5. Dyrenfurth, M. J., & Newton, K. (2012), *Synergies of Converging ABET, ATMAE, and Institutional Accreditation Processes* Paper presented at 2012 ASEE Annual Conference, San Antonio, Texas. https://peer.asee.org/21982.
6. Balascio, C. C. (2014), *Engineering Technology Workplace Competencies Provide Framework for Evaluation of Student Internships and Assessment of ETAC of ABET Program Outcomes* Paper presented at 2014 ASEE Annual Conference, Indianapolis, Indiana. https://peer.asee.org/20401.
7. Abdallah, M. (2015), *Student Outcomes Assessment and Evaluation for ETAC/ABET* Paper presented at 2015 ASEE Annual Conference and Exposition, Seattle, Washington. 10.18260/p.24758.
8. Rogers, G. (2006), *Direct and Indirect Assessment.* http://www.abet.org/wp-content/uploads/2015/04/direct-and-indirect-assessment.pdf
9. Cliver, R. (2015), *Accrediting a Program in Engineering Technology* Paper presented at 2015 ASEE Annual Conference and Exposition, Seattle, Washington. 10.18260/p.23481.