

**Assessment Report
Bachelor of Science in Construction Engineering Technology
Montana State University
2015 – 2016 Academic Year**

Department: Civil Engineering

Department Head: Jerry Stephens

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Date: Fall 2016, Reporting Period Academic Year 2015 – 2016

Programs: BS Construction Engineering Technology

Background

The following annual performance assessment of the Construction Engineering Technology Program at Montana State University was prepared in the context of the program Assessment Plan prepared by the CE Department in February 2011. The Construction Engineering Technology Program at Montana State University has approximately 200 undergraduate students, and is accredited by the Accreditation Board for Engineering and Technology (ABET®).

ABET reaccreditation of the Construction Engineering Technology Program is underway (these reviews are on a six year review cycle), with a program self-study having been submitted to ABET in summer of 2015, a site visit completed by an ABET program evaluator in Fall 2015, and issuance by ABET in Spring 2016 of a program audit form with a single concern related to our program educational objectives. A response to this concern (as described below) was sent to ABET. While a final statement of ABET's accreditation action for the construction engineering technology program was expected in August 2016, this statement was not received before the end of this assessment cycle.

Summary of Assessment Plan

CET Program Educational Objectives

The Construction Engineering Technology Bachelor of Science Program is a technically rigorous, production oriented, and construction specialty neutral program that prepares graduates to enter and advance to leadership positions in the construction industry. The curriculum provides a well-rounded, four-year, technically specialized university education culminating in a Bachelor of Science degree in Construction Engineering Technology (CET). Knowledge of mathematics and physical sciences along with applied courses in business management, law, and human relations form a background to transform design, research and planning ideas into physical reality using contemporary construction practices. Faculty with industry experience instruct students in surveying, estimating, scheduling, quality control, safety, testing, and field analysis.

Graduates use their skills and abilities to construct transportation systems, utilities, buildings, dams, public health and environmental systems, irrigation, industrial facilities, municipal and public works, and also in surveying, mapping, and support of engineering design. Building, industrial, and heavy highway construction are emphasized with particular attention directed toward preparation for employment in management and supervisory positions in both field and office operations.

This curriculum provides the education necessary to work with engineers, architects, contractors, technicians, and owners. The student in this curriculum can be employed as field supervisor, estimator, scheduler, or superintendent; he or she may progress to project/operations manager, and further to the highest levels of company executive. Because effective communication is essential in carrying out management responsibilities, students in this curriculum are required to demonstrate good oral and written communication skills in their undergraduate studies. Other possible positions are employment with consulting engineers and architects in support activities involving plans and planning, acquisition of design data, surveying, construction inspection for quantity and quality control, sales engineering, plant expansion, and maintenance management activities.

Students planning to take the comprehensive examination on surveying fundamentals as the initial step to becoming licensed as a registered land surveyor should review the educational requirements for admission to this examination. Students who desire both the CET degree and land surveyor registration must complete a Land Surveying Minor.

Students are required to take the Constructor Qualification Examination Level I (CQE) administered by the American Institute of Constructors (AIC) which must be taken the semester that a student expects to graduate. Seniors are eligible to take the Fundamentals of Engineering (FE) examination administered by the National Council of Examiners for Engineering and Surveying (NCEES), which is required by the Montana Board of Professional Engineers and Land Surveyors to become a licensed professional engineer. Students who plan to take the FE examination are encouraged to take additional selected courses in calculus, dynamics, and thermodynamics.

The construction engineering technology baccalaureate program educational objectives were adopted in April of 2003. These objectives describe what graduates can expect to accomplish during the first years after graduation. Program constituents reconsidered these objectives in 2006 and re-adopted them without revision at that time. Standard assessment activities in academic year 2013 - 2014 resulted in modifications to the program educational objectives. Further modifications were made to these program educational objectives during this past year (2015 – 2016), initiated by comments from our program evaluator during an ABET reaccreditation visit to the MSU campus at our regularly scheduled six year interval. The specific reason and manner in which the program educational objectives were changed is described in more detail in a subsequent section of this assessment report.

The revised, and now adopted, program educational objectives for our Construction Engineering Technology program are:

All graduates of the MSU Construction Engineering Technology Program can expect to be able to:

1. enter the construction industry and advance toward leadership positions in the construction industry,
2. work on multi-disciplinary teams and effectively communicate with constructors, architects, engineers, the public and public agents, scientists and others to complete construction projects,
3. continue to develop professionally through work experiences and continuing education, expanding their knowledge base and keeping abreast of advances in construction and engineering practice,
4. contribute to society and the construction industry through involvement in professional related and/or other service activity, and
5. promote and advance the integrity of the construction industry, holding paramount the safety, health and welfare of their co-workers and the public, and striving to comply with the principles of sustainable development.

The Construction Engineering Technology Program Objectives are published in the University Course Catalog and Civil Engineering Department website.

Process for Evaluating CET Program Educational Objectives

The annual process by which we review and, when warranted, revise our program educational objectives has several steps, as are generally described in the Departmental Assessment Plan. The program educational objectives are reviewed with the faculty at the annual retreat held in August each year prior to the academic year, and any outstanding recommendations from the past year are discussed and acted on, as necessary. Changes in objectives can be initiated by the department head, program coordinator, curriculum committee and External Advisory Board. In the latter regard, in the spring of each year we discuss and evaluate our educational objectives as an agenda item with our departmental External Advisory Board comprised of 17 members active in the consulting engineering and construction industry. More specifically, the Board members are provided with a copy of the program educational objectives each year prior to the annual meeting. They are asked to review the objectives preparatory to their discussion at the meeting. At the conclusion of the meeting, each board member is asked to assess a) the extent to which they believe MSU Civil Engineering graduates meet the Program Objectives (on a scale of 0 to 10), b) the extent to which they believe the Objectives are suitable for the program (again on a scale of 0 to 10), and c) if the Objectives need to be revised. On the quantitative assessment of suitability, the metric goal for this evaluation is an average score of 7 for each objective. In August of each year, the sentiment of the Advisory Board (and any other input received during the year on the program objectives) is conveyed to the faculty at the annual retreat, at which time the faculty also discuss and evaluate our program educational objectives. If there is consensus, adjustments are made to the objectives, and if not, then no action is taken.

Note that the program educational objectives assessment process outlined above is considerably less involved than that presented in the 2011 Assessment Plan. In 2012, ABET changed their procedural requirements relative to stringent assessment of program educational objectives.

ABET removed the requirement for a program to demonstrate graduate attainment of program educational objectives; ABET now only requires periodic review of these Objectives to ensure they are consistent with the mission of the institution and needs of the profession. In response to this policy change, the Civil Engineering Department developed the evaluation process described above. Further note that while the 2011 Assessment Plan calls for the department head and/or program coordinator to prepare and distribute an Annual Program Assessment Report prior to this retreat, the decision was made two years ago to present assessment data at this retreat, and to prepare the annual Assessment Report thereafter, including proposed activities for continuous improvement for the next year.

Program Outcomes

Following historical practice at MSU, the CET baccalaureate program outcomes are consistent with ABET criteria for CET programs. These outcomes, adopted by MSU in 2015, are:

Graduates of the MSU Construction Engineering Technology program have:

- a. an ability to select and apply the knowledge, techniques, skills, and modern tools of the discipline to broadly-defined engineering technology activities
- b. an ability to select and apply a knowledge of mathematics, science, engineering, and technology to engineering technology problems that require the application of principles and applied procedures or methodologies;
- c. an ability to conduct standard tests and measurements; to conduct, analyze, and interpret experiments; and to apply experimental results to improve processes;
- d. an ability to design systems, components, or processes for broadly-defined engineering technology problems appropriate to program educational objectives;
- e. an ability to function effectively as a member or leader on a technical team;
- f. an ability to identify, analyze, and solve broadly-defined engineering technology problems;
- g. an ability to apply written, oral, and graphical communication in both technical and non-technical environments; and an ability to identify and use appropriate technical literature;
- h. an understanding of the need for and an ability to engage in self-directed continuing professional development;
- i. an understanding of and a commitment to address professional and ethical responsibilities including a respect for diversity;
- j. a knowledge of the impact of engineering technology solutions in a societal and global context; and
- k. a commitment to quality, timeliness, and continuous improvement.

with the following more tightly focused program specific outcomes:

- ap. utilize techniques that are appropriate to administer and evaluate construction contracts, documents, and codes;
- bp. estimate costs, estimate quantities, and evaluate materials for construction projects;

- cp. utilize measuring methods, hardware, and software that are appropriate for field, laboratory, and office processes related to construction;
- dp. apply fundamental computational methods and elementary analytical techniques in sub-disciplines related to construction engineering.
- ep. produce and utilize design, construction, and operations documents;
- fp. perform economic analyses and cost estimates related to design, construction, and maintenance of systems associated with construction engineering;
- gp. select appropriate construction materials and practices;
- hp. apply appropriate principles of construction management, law, and ethics, and;
- ip. perform standard analysis and design in at least one sub-discipline related to construction engineering

Outcomes are provided to all department faculty members at the annual faculty retreat, and are archived and available on request from the Department Head.

Processes to Assess CET Program Outcomes

The following tools are used to assess whether MSU CET Program Outcomes are being met.

Constructor Qualifications Exam (CQE)

A requirement for graduation is the Constructor Qualifying Exam – Level 1. This nationally normalized exam is taken by students when they are enrolled in the capstone class, ETCC 499R. The exam is given both during the fall and spring semester each year. Performances in exam topic areas are indicators of achievement of program outcomes. While all students must take the exam, passing the exam is not required to graduate.

The School Report for this exam, which is administered by the American Institute of Constructors (AIC) - Constructor Certification Commission, includes comparisons of MSU averages in each subject with national averages. The School Report also identifies minimum acceptable scores for each subject area. The School Reports for the CQE exam will be included in the Annual Program Assessment Report.

The metric goal for the pass rate on the CQE is that the pass rate for MSU students should exceed the national average pass rate. Further, the school average for each area score on the CQE should exceed the national average. Finally, none of the areas on the exam should be identified as an area of weakness by the AIC- Constructor Certification Commission. If the score in a particular subject area is less than the minimum acceptable score then the area is flagged as an area of weakness.

Capstone Project Review

Each semester, the program coordinator reviews students' capstone project reports, and debriefs each student team on the project. The program coordinator will summarize these debriefs and the summary will be included in the Annual Program Assessment Report.

Senior Exit Interviews

Interviews with graduating seniors are conducted by the department head each semester. In these interviews small groups of graduating seniors are asked to reflect and comment on the strengths and weaknesses of the program. The department head compiles the results of these interviews and includes the compilation in the Annual Program Assessment Report.

For the past several years, the CE Department has obtained student input on its programs through a senior exit survey administered electronically by the central administration. For students from the College of Engineering, this survey has questions specifically configured to assist in outcomes assessment for engineering curriculums (although, outcomes a-k from the ABET – EAC general criteria were used for all programs). This survey is no longer being conducted. Thus, the department is investigating alternate approaches to obtaining direct student perspective on our program and its outcomes. While useful information is obtained from the senior exit interviews, it is important to note that this input a) tends to focus on the concerns of individual students, b) tends to focus on program weaknesses, and c) can be difficult to objectively summarize. A written survey may overcome some of these limitations of the interviews.

MSU Career Services Salary Survey

MSU Career Services conducts a survey of graduating seniors. The “MSU Career Services Annual Salary Report” provides quantitative information concerning starting salaries and job placement rates for program graduates. Consistently high job placement rates coupled with consistency in program execution indicates industry finds our objectives to be pertinent, and that our intended outcomes are being attained.

Career Fair Employer Surveys

Employers that participate in MSU Career Fairs complete a survey on student career preparedness, communication skills, and interview preparedness.

Department External Advisory Board

The Department External Advisory Board meets annually for a one day meeting. The External Advisory Board meeting agenda includes review and evaluation of program objectives and outcomes. The External Advisory Board, composed of representatives from the engineering consulting and construction industries, is apprised of the faculty evaluation of the program objectives and outcomes and is tasked with performing their own independent evaluation of them. This evaluation consists of discussion and completion of an assessment of the extent to which they believe MSU Construction Engineering Technology graduates meet Program Outcomes on a scale of 1–very poor, to 6 - excellent. The goal for this evaluation is that 80 percent of the responses are 4 – good or better. Their input is included in the Annual Program Assessment Report.

Department Curriculum Committee

The Department Curriculum Committee while often responding to input from other assessment tools also provides direct heuristic input regarding achievement of program outcomes. The Curriculum Committee represents the faculty that interacts with students on a daily basis across all areas of the curriculum. There is no group that understands the

nuances of student strengths and weaknesses relative to program outcomes better than the faculty. This input is included in the Annual Program Assessment report.

Similar to the annual review process for Program Objectives, each August prior to the start of the new school year, the department has a one day retreat. One of the agenda items at these retreats is review of assessment data and the evaluation of program objectives and outcomes. At these retreats, the department head and/or program coordinator distributes recent and historical assessment data and a comparison of assessment results with metric goals. If assessment results fall below metric goals, the faculty are responsible for developing a strategy or strategies for improving these levels of achievement. A drop below metric goal levels for one exam or survey will not necessarily require action. However, several occurrences of scores below metric goal levels will require corrective action. In the event that all scores exceed metric goal levels, the faculty may use assessment data to identify weaker areas of student performance and choose to develop strategies for improvement. The faculty strive to continually improve the program. While the whole faculty participates in strategy development, implementation of these strategies is assigned to the curriculum committee, the program coordinator, the department head or department staff as appropriate for implementation.

Program Educational Objectives Assessment – Academic Year 2015 – 2016

As stated above, Program Educational Objectives are evaluated each year by the Department's External Advisory Board and its faculty. Changes in objectives can be initiated by the department head, program coordinator, curriculum committee and External Advisory Board. The External Advisory Board, composed of representatives from the engineering consulting and construction industries, are asked as part of their annual meeting to assess a) the extent to which they believe MSU Construction Engineering Technology graduates meet the program objectives (on a scale of 0 to 10), b) the extent to which they believe the objectives are suitable for the program (again on a scale of 0 to 10), and c) if the objectives need to be revised. On the quantitative assessment, the metric goal for this evaluation is an average score of 7 for each objective. The Civil Engineering faculty review the program objectives at the beginning of the year, and with due consideration of any recommendations from the External Advisory Board, revise them as appropriate.

This past year during MSU's regularly scheduled ABET reaccreditation site visit, the CET program evaluator expressed concerns with the wording of two of MSU's program educational objectives.

The concern was with Program Educational Objective 3 and 5, and was centered on the manner in which these specific objectives resembled student outcomes more than educational objectives. Repeating these program educational objectives as stated at that time:

All graduates of the MSU Construction Engineering Technology Program can expect to be able to:

3. engage in the life-long learning necessary to advance professionally in the construction field,

5. conduct their affairs in a highly ethical manner holding paramount the safety, health and welfare of the public and striving to comply with the principles of sustainable development.

The Department Head and Program Coordinator reviewed our Program Educational Objectives in light of the identified concern, and drafted potential revisions to Objectives 3 and 5 to address this concern:

All graduates of the MSU Construction Engineering Technology Program can expect to be able to:

3. continue to develop professionally through work experiences and continuing education, expanding their knowledge base and keeping abreast of advances in construction practice,
5. promote and advance the integrity of the construction industry, holding paramount the safety, health and welfare of the public, and striving to comply with the principles of sustainable development.

These proposed revisions were reviewed with the program evaluator, and determined to be consistent with the definition and intent of program educational objectives.

Generally following our process to review and modify our program educational objectives, the proposed changes were put before our External Advisory Board members for comment (by email), accompanied by background information on outcomes and objectives. The Board members were asked to review and provide input on the proposed changes. Nine Board members actively responded to this review request, with their responses all generally indicating concurrence with the proposed changes, and two members offering small, but significant revisions to the proposed wording (these further revisions are underlined below):

All graduates of the MSU Construction Engineering Technology Program can expect to be able to:

3. continue to develop professionally through work experiences and continuing education, expanding their knowledge base and keeping abreast of advances in construction and engineering practice,
5. promote and advance the integrity of the construction industry, holding paramount the safety, health and welfare of their co-workers and the public, and striving to comply with the principles of sustainable development.

The proposed revisions and suggestions from the External Advisory Board were presented to the Department faculty at a meeting, again with an explanation/discussion of the fundamental concept of objective versus outcome. Following discussion of the substance and wording of the proposed revisions, the Program Educational Objectives as proposed and revised by the External Advisory Board were accepted by the faculty without further change. The External Advisory Board re-visited our Program Educational Objectives at their annual meeting in February (in accordance with our Program Assessment Plan), and re-affirmed adoption of the revised Program Educational Objectives as presented immediately above.

The subsequent numerical results of the External Advisory Board comprehensive review of the Construction Engineering Technology Program Educational Objectives at the February 2016

meeting are presented in Table 1. The minimum average scores relative to the suitability and achievement of these objectives were 8.7 and 8, respectively, well above the action trigger level of 7.

At the CE Department retreat in August (2016), the faculty reviewed the program educational objectives and the External Advisory Board assessment of them. The faculty re-affirmed the pertinence and importance of the Program Educational Objectives in their current form.

Table 1. External Advisory Board Assessment of CET Program Educational Objectives

OBJECTIVE	Suitable?				Met?			
	2013	2014	2015	2016	2013	2014	2015	2016
All graduates of the Construction Engineering Technology Program can expect to be able to:								
1. enter the construction industry and advance toward leadership positions in the construction industry	9.8	9.7	9.4	10	8.8	9.3	9	9.7
2. work on multi-disciplinary teams and effectively communicate with constructors, architects, engineers, the public and public agents, scientists and others to complete construction projects	9.4	9.3	9.9	10	7.9	8.1	8.3	9
3. engage in the life-long learning necessary to advance professionally in the construction field	9.1	9.4	8.6	9.3	8.5	8.9	8.4	9.5
4. contribute to society and the construction industry through involvement in professional related and/or other service activity, and	8.5	9	8.6	8.7	7.8	9	8.2	8
5. conduct their affairs in a highly ethical manner holding paramount the safety, health and welfare of the public and striving to comply with the principles of sustainable development.	9.4	9.6	9.9	8.7	8.1	9	9.3	8.3
Some graduates of the Construction Engineering Technology Program can expect to be able to:								
6. enter the surveying profession and become licensed to practice surveying; or	7	4.6	-	-	7.1	6	-	-
7. earn a Master of Construction Engineering Management degree from	6.9	6.7	-	-	8	8	-	-

Notes: Table 1 - Following this same assessment process, program educational objectives 6 and 7 were eliminated in 2013-2014. Program educational objectives 3 and 5 were modified during the 2015 – 2016 academic year, and the revised and adopted versions of these objectives are presented in this table.

Program Outcomes Assessment – Academic Year 2015 – 2016

As summarized above, Program Outcomes each year are assessed using the following tools:

- Constructor Qualification Exam
- Capstone Project Review
- Senior Exit Interviews
- MSU Career Services Salary Survey
- Career Fair Employer Surveys
- Department External Advisory Board
- Department Curriculum Committee

Assessment data and analysis from each of these instruments is presented below. These data are presented to the faculty at the Department’s annual retreat in August each year, at which time it is thoroughly discussed and action items established for the following academic year.

Constructor Qualification Exam (CQE)

All BSCET students are required to take the CQE Level 1 exam during their graduating senior year. During the semester that a student takes the exam, the student is enrolled in the Capstone class (ETCC 499R). Students do not have to pass the CQE Level 1 to graduate. Pass rates for students from the MSU Civil Engineering Department on the CQE over the past several years are presented in Figure 1. The ratio of MSU to national CQE pass rates during this assessment cycle well exceeded 1.0 (1.11, Fall 2015, 1.27, Spring 2016), as they have done for the past five years and more.

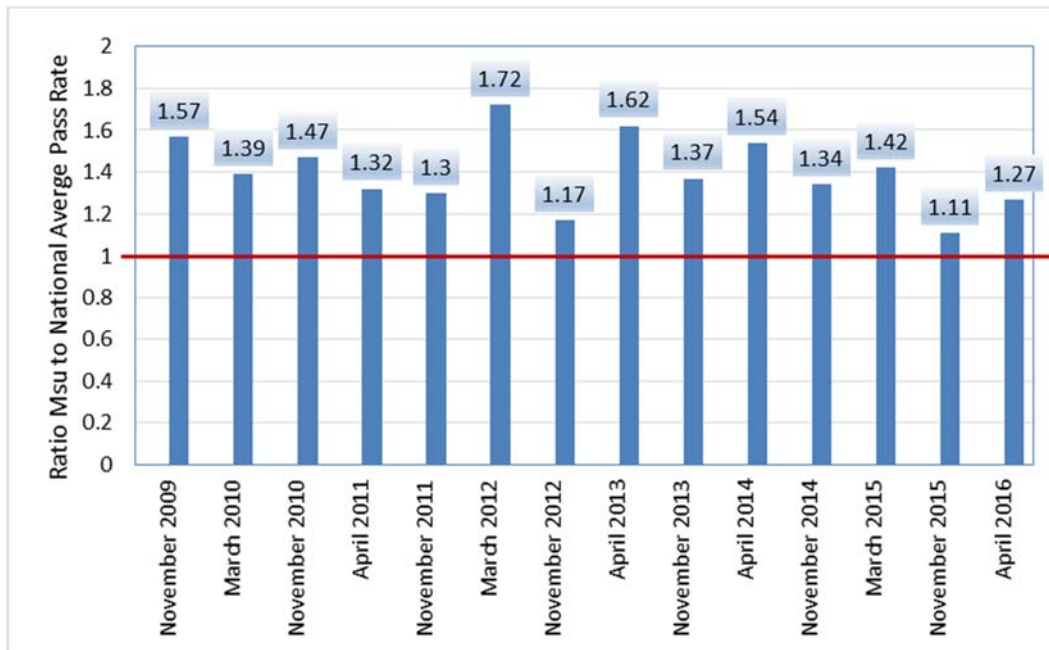


Figure 1. Ratio of MSU pass rate to national pass rate on CQE Level 1 Exam.

The comparative performance by specific topic area on the CQE over the past four years of MSU CET students relative to the national average is reported in Figure 2. Referring to Figure 2, MSU CET students performed better than the national average on all areas of the CQE in AY 2015 – 2016. Strongest performance was in the areas of engineering concepts (with a ratio of 1.20) and geomatics (with a ratio of 1.17); the performance ratios across other topic areas covered by the exam ranged from 1.01 to 1.11.

The comparative performance by specific topic area on the CQE over the past four years of MSU CET students relative to the minimum acceptable level of performance established by the AIC-Constructor Certification Commission is reported in Figure 3. In 2015-2016, MSU CET students dropped below the minimum passing level of performance in two areas, materials and methods, and bidding and estimating, with comparative performance ratios in these topics of 0.99 and 0.97, respectively. Note that relative to engineering concepts, management concepts, and geomatics, where performance in the 2014-2015 assessment cycle had dropped slightly below the AIC minimum threshold, in 2015-2016 performance again exceeded this threshold.

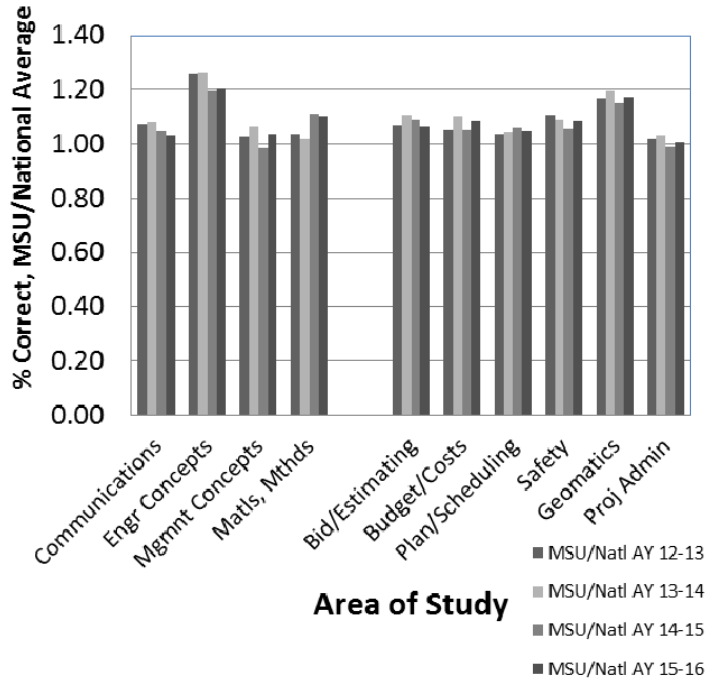


Figure 2. Ratio, CET Program Topic Scores vs. National Average for AY 2014-2015

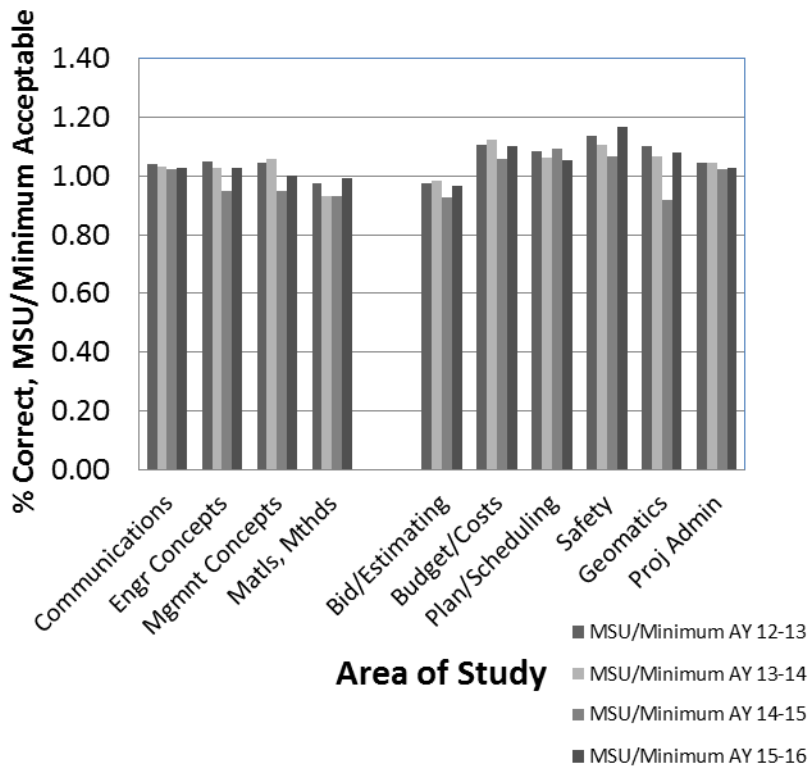


Figure 3. Ratio, MSU CQE Topic Scores vs. Minimum Acceptable AIC Scores for AY 2015-2016

In the case of materials and methods, and bidding and estimating, performance below the AIC minimum threshold has persisted for at least four years. That being said, in both cases performance was better in 2015-2016 compared to the previous year, and this situation will continue to be closely reviewed to ensure this positive trend continues. Note that at the conclusion of AY 2013 – 2014, the decision was made to initiate a review of, and attendant changes in the core construction curriculum, which potentially is having a positive impact in these regards over time. Further, at that time the decision was made to increase the contact hours in the ECIV 308 (Construction Practices) lab from one to two hours per week, which also could be having a positive effect on this situation.

Capstone Project Review

The program coordinator reviews capstone project reports each semester and makes an assessment of how well students are prepared to attain our student outcomes. Further, selected practitioners attend the final capstone project presentations and provide feedback to the students and the program coordinator on the technical content and quality of delivery of these presentations.

Similar to the past few years, while student performance on their capstone projects was good this year, the faculty and practitioners involved continued to note opportunities for improvement, particularly in student oral and written communications skills. These issues are being addressed by introducing more written and oral communication exercises across the construction curriculum.

Senior Exit Interviews

At the end of both fall and spring semesters the department head met with graduating seniors in the Construction Engineering Technology program to collect their input on program strengths and weaknesses, as well as their suggestions on program changes.

Similar to the last assessment cycle, common program strengths cited by the students include:

- Some very good instructors, instructors that genuinely care about students and their success
- Some very good courses, such as Concrete Technology (ETCC 310 – Steve Morrival), Estimating and Bidding (ECIV 307), Reno (AIC) Estimating Competition Preparation (ECIV 492), and more
- Well prepared to enter the work force, with several good job opportunities/offers

Repeated concerns/suggestions stated by the students include:

- EGEN 310 is still broken
- There are significant issues with ARCH 241, notably related directly to the instructor
- More emphasis/electives in heavy civil would be good
Two track program? Heavy civil and commercial?
- More CAD – more integration of CAD across the curriculum – require BIM class?
- Need a plans course
- Need more on sustainability
- Need some construction senior electives

- Provide some review for the CQE
- More practical electrical engineering class
- More practical examples, but smaller projects with different elements

Exit interview input is reviewed with the faculty at the annual retreat in August as part of setting activities for the following year to ensure continuous improvement of our programs.

MSU Career Services Salary Survey

Another strong indicator of the degree at which program outcomes have historically been realized is the marketability of program graduates. MSU Career Services collects placement data for MSU students annually and publishes it in the MSU salary survey. Table 2 summarizes MSU construction engineering technology graduate placement data taken from the 2008 salary survey until the 2013 salary survey (the most recent available at the time of this report). Response rates to this survey are high, averaging 82 percent over the 5 year period. Placement rates have been steadily increasing from a low rate of 57 percent in 2008 (coincident with a distinct decrease in economic activity nationwide), to a rate of 95 percent in 2013 (coincident with a regional resurgence in the economy).

Table 2. Construction Engineering Technology graduate employment data.

Year	2009	2010	2011	2012	2013	2014	Average
Total CET Graduates	52	56	47	48	33	43	46.5
Total CET Responses	35	32	31	33	21	25	29.5
Response Rate	0.67	0.57	0.66	0.69	0.64	0.58	0.64
Fulltime Employed in Field	16	27	26	28	20	24	23.5
Fulltime not Employed in Field	3	2	1	4	0	1	1.8
Part-time Employed	1	0	1	0	0	0	0.3
Unemployed	5	2	1	1	1	0	1.7
Continuing Education	1	0	2	0	0	0	0.5
Continuing Ed and Employed	3	1	0	0	0	0	0.7
% Respondents Employed							
Proportion Employed FT in Field or Continuing Education	0.57	0.88	0.90	0.85	0.95	0.96	0.85

Career Fair Employer Surveys

Montana State University annually hosts two career fairs, one each in the fall and spring semesters. Employers at the career fair are directly asked to comment on our student's preparedness a) to enter the workforce and b) to interview with their company. Performance is assessed numerically on a scale of 1 to 5, with 1 corresponding to "to a very limited extent", and

5 to “to a very great extent.” The action trigger for this assessment tool is three consecutive reportings with a category average below 3.5.

Results from the career fair employer surveys for the two career fairs during the 2015 – 2016 academic year were not available at the time this report was prepared. This information will be added to this report when it becomes available.

Department External Advisory Board

The Department’s External Advisory Board meets annually to review from a professional practice perspective almost all aspects of the Department’s programs. The majority of the Board’s input is obtained at the annual meeting by the CE Department Head and CET Program Coordinator. This information is then disseminated to Department faculty and committees.

Program Outcomes are directly evaluated each year by the Department’s External Advisory Board. The Board is asked to assess the extent to which they believe MSU Construction Engineering Technology graduates meet the program outcomes on a scale of 1–very poor, to 6 - excellent. The goal for this evaluation is that 80 percent of the responses are 4 – good or better.

The numerical results of the External Advisory Board review of the Construction Engineering Technology program outcomes over the last four years are presented in Table 3 below. It is important to note that at least for 2015 – 2016, the External Advisory Board was asked to continue to use the immediate past program outcomes for this assessment. The current and past program outcomes are substantially the same in intent and content (as discussed in more detail in the 2014 – 2015 CET Program Assessment Report), and using them for this evaluation allows for historical continuity in assessing trends in achievement of program outcomes.

The overall average 2015-2016 score of 5 out of 6 was similar to, and nominally better than, that for the previous year of out of 4.9/6. Similar to the past several years, 100 percent of the responses are 4 or better (the trigger for mandatory action is if less than 80 percent of the responses are 4 or better). Similar to several previous years, student communication abilities received the lowest average Board assessment (4.3 out of 6), followed by the ability to understand professional, ethical and social responsibilities (4.5 out of 6). The External Advisory Board has often expressed concerns about the communications skills of our graduates, and we continue to work on improving them. Note that at this point in time, all results are presented as a simple average of responses received, rather than in terms of percent of responses at or exceeding a particular rating.

The External Advisory Board also had the opportunity to directly review selected student work, which this assessment cycle consisted of:

Student Graded Assignments (posted on secure EAB website)

SRVY 230, Introduction to Surveying

ECIV 405, Scheduling and Planning

The Board was pleased with the content and quality of this work.

Table 3. Assessment of program outcomes by the External Advisory Board.

OUTCOME	Out of 6				Change
	2013	2014	2015	2016	
1. an appropriate mastery of the knowledge, techniques, skills and modern Construction Engineering Technology, and are capable of:					
a. utilizing modern instruments, methods, and techniques to implement	4.2	5	5.0	4.7	0.99
b. evaluating materials and methods for construction projects	4.2	5.4	5.1	5.3	1.08
c. utilizing modern surveying methods for construction projects	4.2	5.2	4.4	5.0	1.09
d. determining forces and stresses in elementary structural systems	4	4.8	4.8	-	-
e. estimating material quantities and costs	4.4	5.2	5.2	5.3	1.08
f. employing productivity software to solve technical problems	3.8	4.3	4.8	-	-
g. producing and utilizing design, construction and operations documents	4	4.8	4.8	4.7	1.03
h. performing economic analyses and cost estimates related to design,	4	4.8	4.8	4.7	1.04
i. selecting appropriate construction materials and practices	4.4	5.2	4.8	4.7	0.98
j. applying principles of construction law and ethics	3.4	5	5.2	4.7	1.04
k. apply basic technical concepts for the solution of construction problems	4.2	5.3	5.0	5.5	1.14
l. performing standard analysis and design of structural elements	4.4	4.8	4.6	-	-
2. an ability to apply current knowledge and adapt to emerging applications of	4.4	5.6	4.8	4.6	0.93
3. an ability to conduct, analyze and interpret experiments and apply	4.5	5	4.0	5.0	1.11
4. an ability to apply creativity in the design of systems, components or	4.3	5.2	5.1	5.0	1.03
5. an ability to function effectively on teams	5.2	5.4	5.4	5.7	1.07
6. an ability to identify, analyze and solve technical problems	4.8	5.4	5.3	5.3	1.02
7. an ability to communicate effectively	4.2	4	4.8	4.3	0.99
8. a recognition of the need for and an ability to engage in life-long learning	4.3	4.8	5.0	5.0	1.06
9. an ability to understand professional, ethical and social responsibilities	4.8	5	5.2	4.5	0.90
10. a respect for diversity and a knowledge of contemporary professional,	4.3	4.6	4.5	4.8	1.07
11. a commitment to quality, timeliness and continuous improvement	4.5	5.6	5.5	5.3	1.02
Average	4.3	5	4.9	5	1.06

Notes: Table 3 – Following our program review process, the Program Outcomes were modified in 2014 and 2015. The new outcomes, initiated by ABET better articulate the earlier outcomes. These earlier outcomes were still used for this part of this assessment (and are shown in this Table), to allow trends in outcome achievement over time to be more readily recognized.

Additionally the External Advisory Board heard presentations from students participating in the primary student organizations in the department (ASCE, AGC, EWB, ITE) on their activities during the year. The students were complemented on these activities and the quality of their presentations on them.

At this year's External Advisory Board meeting, the Board was actively brought into the department's review of our core construction curriculum, consisting of:

- ECIV 307 Estimating and Bidding
- ECIV 308 Construction Practice
- ECIV 404 Heavy Construction Equipment and Methods
- ECIV 405 Scheduling and Packaging
- ECIV 492 Reno Preparation Class
- ETCC 499 Capstone

Early during 2016, as part of this review, the CET program coordinator conducted an informal survey of selected members of the Montana Contractor's Association to identify what they considered to be important content in our construction curriculum. While the results of this survey were not fully analyzed in the context of our construction curriculum at the time of the meeting, sufficient work had been done to recognize broad areas in which we should simply consider adding elective classes, consisting of:

- heavy civil estimating and planning
- construction law
- sustainability in construction
- construction productivity
- computer aided design and construction

The External Advisory Board was asked to select two courses that should be pursued (the department had identified a funding source – a department endowment established by the Washington Foundation - to develop and teach two classes each year. Sustainability in construction garnered almost unanimous support across the group. Opinions varied considerably on the second class to be taught, with consensus eventually developing for construction project administration (which would include productivity). The department subsequently submitted a course request to the university approval process to teach a sustainability in construction class (ECIV 406) starting Spring 2017.

During the remainder of Spring semester 2016 and immediately following its conclusion the CET program coordinator and construction faculty continued to work on possible revisions to the suite of core construction classes. This work was completed by the beginning of July 2016, and detailed outlines of the material to be covered in each class was sent to the members of the External Advisory Board for review and comment. Several Board members offered feedback/suggestions on the proposed curriculum content. Curriculum revisions subsequently began to be made for Fall semester 2016. Implementation of these course revision/updates is expected to take at least one year.

Department Curriculum Committee

Department curriculum committee discussions/actions during the 2015-2016 academic year that resulted from the action items generated in the 2014-2015 assessment cycle included:

- Continue thorough review and suggest revisions as appropriate in the content and sequencing of the primary construction courses in the CET curriculum:
The curriculum committee was kept apprised of the work being done by the CET program coordinator and construction faculty on the major curriculum review and revision effort, as described above. The curriculum committee endorsed moving forward with a proposal for the sustainability in construction course.
- Continue to work on improving the written communication skills of our students.
Instructors were reminded of the importance of developing our students' writing skills, with a goal of introducing/enhancing quality writing exercises across the curriculum.
- Continue to support and review the potential for significant revision of the College of Engineering's interdisciplinary engineering design course, EGEN 310, relative to achievement of course objectives and student satisfaction with course conduct.
At the annual retreat in August of 2016, the primary instructor/coordinator of EGEN 310 made a presentation on the changes that had been implemented in the class over the past couple of years. These changes include having specific sections of the class populated by students from particular engineering majors, and increased oversight of secondary instructors to better ensure students of a

consistent, high quality experience in the class. The EGEN 310 instructor/coordinator indicated that these and other changes have had a positive impact on the class and student's perception of it. Nonetheless, anecdotal input received by various department faculty about the class still is negative in nature, as is input directly received by the department head from graduating seniors during exit interviews. That being said, some/most of these comments are believed to be from students that had the class prior to/during the current round of changes. Exit interviews/surveys next year are expected to more clearly reflect the experience of students in the revised class. Thus, this action item should be continued into next year.

It is important to note that issues/concerns with EGEN 310 are particularly acute for the CET program, followed by the CE program. Other departments seem to be much more satisfied with the class, although the course design projects/examples seem better aligned with other majors.

- Participate in the COE-wide revisioning the curriculum effort.
The COE Curricular Renewal Committee met during the Fall Semester 2015 and developed recommendations for program changes which were presented to the college at-large at the end-of-the-semester. To a large extent, the committee discovered that current curriculums within the college were doing a good job meeting program needs, with general suggestions to:
 - teach design in a more integrated manner,
 - offer students more opportunities to practice communication skills,
 - incorporate modern tools and best pedagogical practices in the classroom,
 - encourage interdisciplinary experiences,
 - enable students to graduate with the fewest number of credits required, and
 - teach required courses every semester, as resources permit.Without exception, the department supports and already has, or is working toward implementation of these suggestions.
- Based on the CQE results, and as part of the construction curriculum review being conducted, look carefully at the content covered by our program in the areas of materials/methods and bidding/estimating.
These topics have been and continue to be looked at as course content revisions are made as part of the major review being conducted of the core construction curriculum.
- Review our graphics course offerings.
The state-of-the-practice relative to the nature and role of technical graphics in the design and execution of engineering/construction projects continues to evolve, meriting research on what other academic programs are doing in these regards. A faculty member was tasked with investigating what other curriculums are doing. In looking at other programs, the nature and degree of focus of our curriculum on technical graphics is reasonable, i.e., a total of three required course credits, covering hand graphics and computer aided graphics, with a three credit upper

division elective class on BIM. Further, our basic computer aided graphics class uses AutoCAD as a teaching platform, and in both academia and industry, the question remains unanswered if we should instead use Civil3D or even Revit as this platform. Certainly many institutions now teach BIM. In any event, it may be appropriate to combine our 1 credit EGEN 115 hand graphics class with our 2 credit DDSN computer aided drafting class, to more optimally coordinate material between these classes.

- Consider updating our program assessment plan. This plan was developed in 2011; since that time accreditation requirements, program objectives and outcomes, and available data on student performance have changed.
Changes in program attributes and available assessment instruments just this year clearly support the need to update our program assessment plan. That being said, the plan still well supports its intended purpose, and in light of other pressing activities, updating this plan was deferred for at least another year.

Department curriculum committee discussions that merit consideration as action items in the 2015 – 2016 academic year include:

- While the math sequence in our CET curriculum starts with pre-calculus (M151), incoming students increasingly are prepared to immediately enter calculus (M165). Consideration should be given to starting the required math sequence with calculus (M165).
- Related to the first point above, if pre-calculus no longer is part of the required curriculum, four credits of coursework becomes available within our 128 credit degree program. These four credits could be immediately put to good use, potentially in the following manner:
 - the three credit BIM class could be made a required course in the curriculum
 - the current three credit capstone class could be expanded to a two course sequence, each at two credits

Action Items for Academic Year 2016-2017

Based on the above observations and discussions at the August 2016 department retreat, action items for the 2016 – 2017 academic year include:

- Continue to implement revisions in the content of the primary construction courses in the CET curriculum
ECIV 307, ECIV 308, ECIV 404, ECIV 405, ECIV 492, ETCC 499
- Develop and deliver the new sustainability in construction elective class – ECIV 406
- Submit to the university approval process the proposal for a second upper division construction class on construction project administration
- Work on improving the written communication skills of students

- Continue to monitor content and delivery of EGEN 310 to ensure it meets the needs of our students
- Review the content and delivery of ARCH 241 with the School of Architecture to insure appropriate material is being covered and presented in a satisfactory manner
- Look at eliminating M 151 as formal part of the curriculum, with the associated credits being possibly shifted to an expanded capstone experience (a sequence of two, two credit classes) and a required BIM class
- Review and revise our program assessment plan. This plan was developed in 2011; since that time accreditation requirements, program objectives and outcomes, and available data on student performance have changed.