**Assessment Report**
**Bachelor of Science in Construction Engineering Technology**
**Montana State University**
**2014 – 2015 Academic Year**

Department: Civil Engineering

Department Head: Jerry Stephens

Assessment Coordinators: Penny Knoll and Jerry Stephens

Date: Fall 2015, Reporting Period Academic Year 2014 – 2015

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 MSU has approximately 200 undergraduate students, and is accredited by the Accreditation Board for Engineering and Technology (ABET®).

Note that 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 planned by an ABET program evaluator in Fall 2015, issuance by ABET in Spring 2016 of a program audit form, and final notice of ABET's accreditation action expected in August 2016.

## 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 the modified program educational objectives presented below.

All graduates 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. engage in the life-long learning necessary to advance professionally in the construction field,
4. contribute to society and the construction industry through involvement in professional related and/or other service activity, and

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 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 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

The CET baccalaureate program outcomes used by the MSU CET program through Spring 2015 (i.e., Spring Semester of this assessment period) were approved by the CE faculty in August of 2006. At that time, the CE faculty decided to adopt outcomes consistent with ABET criteria for CET programs. These outcomes as implemented at MSU were:

Graduates of the MSU Construction Engineering Technology program have:

a. An appropriate mastery of the knowledge, techniques, skills and modern tools of Construction Engineering Technology, and are capable of:
    a. Utilizing modern instruments, methods, and techniques to implement construction contracts, documents and codes
    b. Evaluating materials and methods for construction projects
    c. Utilizing modern surveying methods for construction layout
    d. Determining forces and stresses in elementary structural systems
    e. Estimating material quantities and costs
    f. Employing productivity software to solve technical problems
    g. Producing and utilizing design, construction and operations documents
    h. Performing economic analyses and cost estimates related to design, construction, and maintenance of systems in the construction technical specialties
    i. Selecting appropriate construction materials and practices
    j. Applying principles of construction law and ethics
    k. Applying basic technical concepts for the solution of construction problems involving hydraulics and hydrology, geotechnics, structures, construction scheduling and management, and construction safety, and
    l. Performing standard analysis and design in structural elements.
b. Ability to apply current knowledge and adapt to emerging applications of mathematics science, engineering and technology
c. An ability to conduct, analyze and interpret experiments, and apply experimental results to improve processes
d. An ability to apply creativity in the design of systems, components, or processes appropriate to construction
e. An ability to function effectively on teams
f. An ability to identify, analyze and solve technical problems
g. An ability to communicate effectively
h. A recognition of the need for and an ability to engage in lifelong learning
i. An ability to understand professional, ethical and social responsibilities
j. A respect for diversity and a knowledge of contemporary professional, societal and global issues
k. A commitment to quality, timeliness and continuous improvement

The general and program specific ABET outcomes for CET programs were revised for the 2011-2012 and 2012-2013 accreditation cycles, respectively. The revised ABET general and program specific outcomes are:

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

These revisions added more clarity in meaning as well as additional distinctions between student outcomes for associate versus baccalaureate degree programs. That being said, our interpretation of the earlier outcomes (used through this past year) was consistent with their articulation in the current ABET criteria. These revised ABET outcomes were discussed and adopted by our program during this assessment cycle (specifically, in the summer of 2015). Note that we typically update our outcomes in light of changes in ABET criteria. Our process in this case was a little more protracted than usual, in part due to unexpected transitions in department staff over

the past 3 years, particularly the unfortunate passing in 2013 of the department's ABET assessment coordinator, and having an interim department head for academic years 2012-2013 and 2013-2104.

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. Exam topic areas and the program outcomes they address (indicated by letter(s) in parenthesis following each topic area – corresponding to our earlier outcomes as listed above) include:

- Engineering Concepts (a,b,c,d,f)
- Management Concepts (a)
- Materials, Methods & Plan reading (a)
- Bidding & Estimating (a)
- Budgeting/Costing & Control (a)
- Planning, Scheduling & Control (a)
- Construction Safety (a)
- Surveying and Project Layout (a)
- Project Administration (a,k)

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 one 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. This capstone project review is an especially important assessment tool for program outcomes h, i, j, and k. 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 also 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 are used for all programs). For each outcome, students are asked to indicate if their curriculum was highly effective, effective, neutral, ineffective, or completely ineffective in realizing it. These responses have been numerically represented using a scale of 0 – completely ineffective - to 4 – highly effective. In this accreditation cycle, our metric that triggers action is three consecutive surveys with a mean query response below 2.5.

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 (note that previous to this academic year, employers at MSU Career Fairs completed a much more detailed survey of their assessment of student career preparedness closely aligned with the department's student outcomes).

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.

As stated above for the Program Objectives assessment process, 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 2014 – 2015**

As stated above, Program Educational Objectives are to be evaluated each year by the Department's External Advisory Board and its faculty. 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.

The numerical results of the External Advisory Board review of the Construction Engineering Technology Program Objectives during the 2014-2015 academic year are presented in Table 1. The minimum average scores relative to the suitability and achievement of these objectives were 8.6 and 8.2, respectively, well above the action trigger level of 7.

At the CE Department retreat in August (2015), 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? 2013 | 2014 | 2015 | Met? 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|
| 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 | 8.8 | 9.3 | 9 |
| 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 | 7.9 | 8.1 | 8.3 |
| 3. engage in the life-long learning necessary to advance professionally in the construction field | 9.1 | 9.4 | 8.6 | 8.5 | 8.9 | 8.4 |
| 4. contribute to society and the construction industry through involvement in professional related and/or other service activity, and | 8.5 | 9 | 8.6 | 7.8 | 9 | 8.2 |
| 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 | 8.1 | 9 | 9.3 |
| 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 Outcomes Assessment – Academic Year 2014 – 2015

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.

<u>Constructor Qualification Exam (CQE)</u>

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 (1.34, Fall 2014, 1.42, Spring 2015), as they have done for the past five years and more.

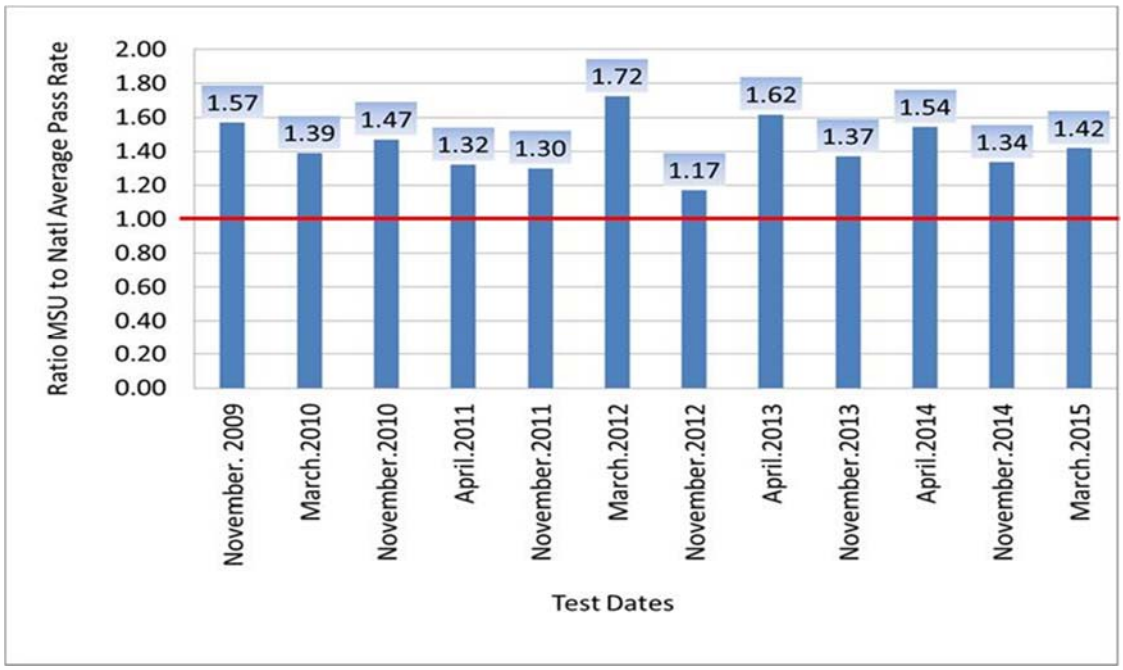


Figure 1. Ratio of MSU pass rate to national pass rate on CQE Level 1 Exam.

The comparative performance by specific topic area on the CQE over the past three years of MSU CET students relative to the national average is reported in Figure 2. Referring to Figure 2, MSU CET students performed better on 8 out of 10 areas of the CQE in AY 2014 – 2015,

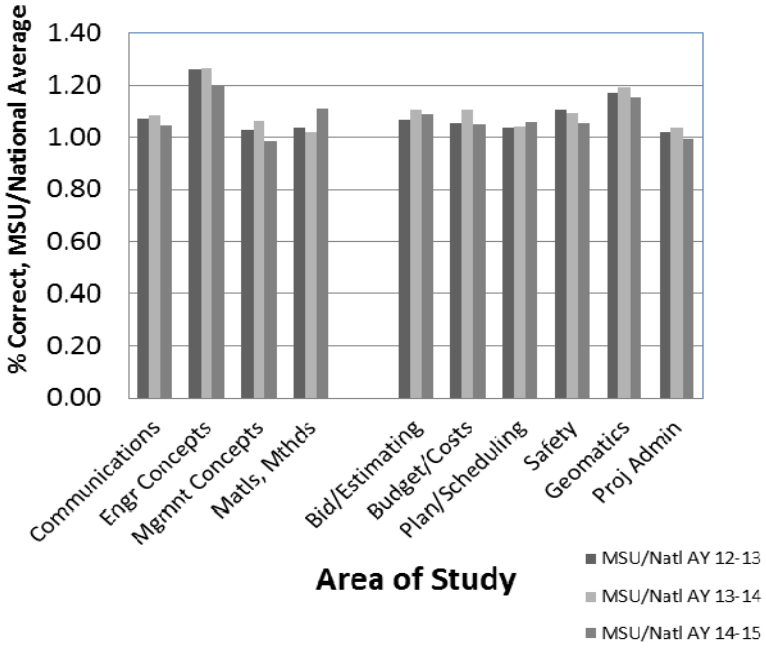


Figure 2. Ratio, CET Program Topic Scores vs. National Average for AY 2014-2015

dropping slightly below national performance in the areas of management concepts and project administration. Strongest performance was in the areas of engineering concepts (with a ratio of 1.20) and geomatics (with a ratio of 1.15); the performance ratios across other topic areas covered by the exam ranged from 0.98 to 1.11.

The comparative performance by specific topic area on the CQE over the past three 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 2014-2015, MSU CET students dropped below the minimum passing level of performance in five areas, engineering concepts, management concepts, materials and methods, bidding and estimating, and geomatics. Comparative performance ratios across these topics ranged from 0.92 to 0.95. In three of these cases, namely engineering concepts, management concepts, and geomatics, the 2014-2015 assessment cycle is the first time in past three years that performance has dropped below the AIC minimum threshold. Performance in these areas will be closely looked at in the next assessment cycle to see if this trend persists. In two of these cases, namely materials and methods, and bidding and estimating, performance below the AIC minimum threshold has persisted for at least three years. This consistent trend in nominally sub-AIC minimum performance will be discussed during the next academic year. 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 would be expected to have a positive impact in these regards over time. Further, 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 would be expected to positively affect this situation.

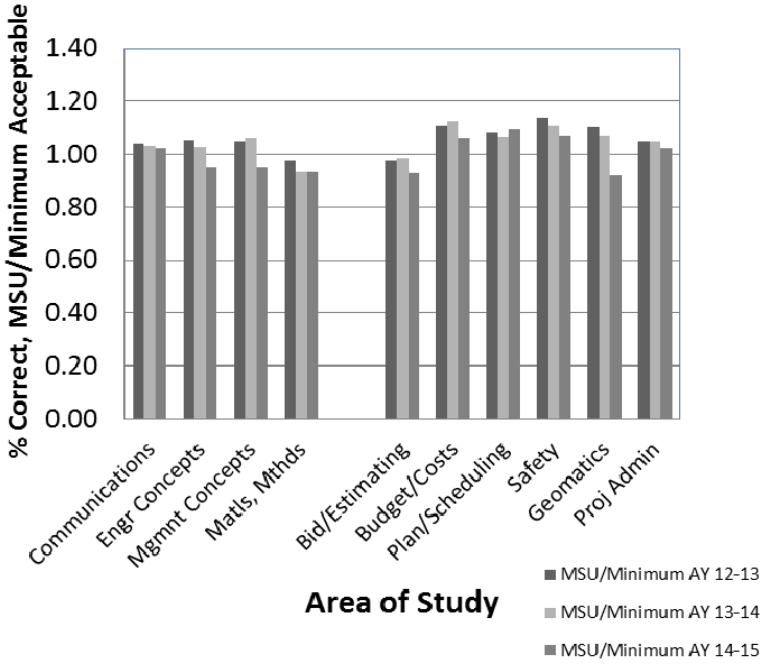


Figure 3. Ratio, MSU CQE Topic Scores vs. Minimum Acceptable AIC Scores for AY 2014-2015

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.

For this past academic year, student performance on their capstone projects was good, although both the faculty and practitioners involved noted opportunities for improvement, particularly in student oral and written communications skills. In this regard, some students showed a lack of confidence in their presentation skills. These issues are being addressed by introducing more written and oral communication exercises across the construction curriculum. The practitioners also noted that the students would benefit from a more thorough understanding of intent and content of contract documents.

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.

Common program strengths cited by the students include:

- quality of faculty - good teachers, with a good command of the material, and an obvious commitment to the students
- quality of program – well prepared to enter the workforce and begin their careers, received an education, not just training
- strong career fair – have outstanding professional opportunities, broad mixture of type of jobs available and geographic locations

Repeated concerns/suggestions stated by the students include:

- EGEN 310 – poorly serves CET students as an introductory, interdisciplinary engineering design class; need to separate CE/CET students within this broad cohort and work on a project on which CE/CET students can be engaged and contribute
- More blue print reading
- Curriculum is heavy on commercial construction and light on heavy civil
- More use of graphics/BIM/contemporary software
- More real projects as examples
- Too much material in capstone, change to two 2-credit class sequence

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.

A summary of student responses to a centrally administered senior exit survey over the past five years by program outcome is presented in Figure 4. Average student outcome assessments generally range from 2.1 (somewhat effective) to 3.3 (effective), with an average value of approximately 3 out of 4.

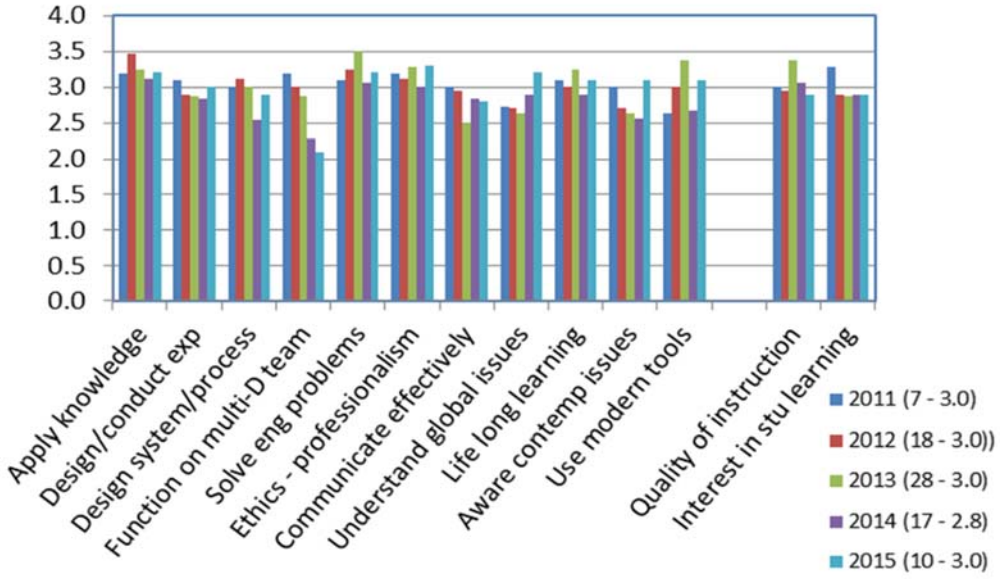


Figure 4. Summary of centrally administered senior surveys.

The lowest assessment in the current evaluation period (2014-2015) of 2.1 out of 4 was for ability to function on multidisciplinary teams. This outcome also received the lowest assessment by the students in the last evaluation period (2013-2014) of 2.3 out of 4. As mentioned in the previous assessment report (and in discussions with the faculty and External Advisory Board), this response could well result from known issues with how the college-wide course on interdisciplinary engineering design (EGEN 310R – which includes a significant interdisciplinary team project) is being taught. Concerns with this class were also expressed by the students during their exit interviews with the Department Head. The format of this class is being substantially revised for fall semester 2015.

Comments are also solicited on the senior surveys on program strengths and weaknesses. These comments are scrutinized by the faculty (at the annual retreat) and External Advisory Board (at the annual meeting) for repeated themes within the current year and across consecutive years. While several comments were received in Academic Year 2014 – 2015, no strong or repeated themes were evident.

<u>MSU Career Services Salary Survey</u>

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 | Average |
|---|---|---|---|---|---|---|
| Total CET Graduates | 52 | 56 | 47 | 48 | 33 | 47.2 |
| Total CET Responses | 35 | 32 | 31 | 33 | 21 | 30.4 |
| | | | | | | |
| Response Rate | 0.67 | 0.57 | 0.66 | 0.69 | 0.64 | 0.64 |
| Fulltime Employed in Field | 16 | 27 | 26 | 28 | 20 | 23.4 |
| Fulltime not Employed in Field | 3 | 2 | 1 | 4 | 0 | 2 |
| Part-time Employed | 1 | 0 | 1 | 0 | 0 | 0.4 |
| Unemployed | 5 | 2 | 1 | 1 | 1 | 2 |
| Continuing Education | 1 | 0 | 2 | 0 | 0 | 0.6 |
| Continuing Ed and Employed | 3 | 1 | 0 | 0 | 0 | 0.8 |
| % Respondents Employed | | | | | | |
| Proportion Employed FT in Field or Continuing Education | 0.57 | 0.88 | 0.90 | 0.85 | 0.95 | 0.82 |

Career Fair Employer Surveys

Montana State University annually hosts two career fairs, one each in the fall and spring semesters. Using the new survey that was adopted this assessment period, employers now 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 2014 – 2015 academic year are summarized in Figure 3. Survey responses most pertinent and appropriate in assessing our student outcomes are:

Career Preparedness
Verbal Communication
Nonverbal Communciation

The nominal numerical average score on each of these outcomes was just below 4, which corresponds to "good." No action was taken.

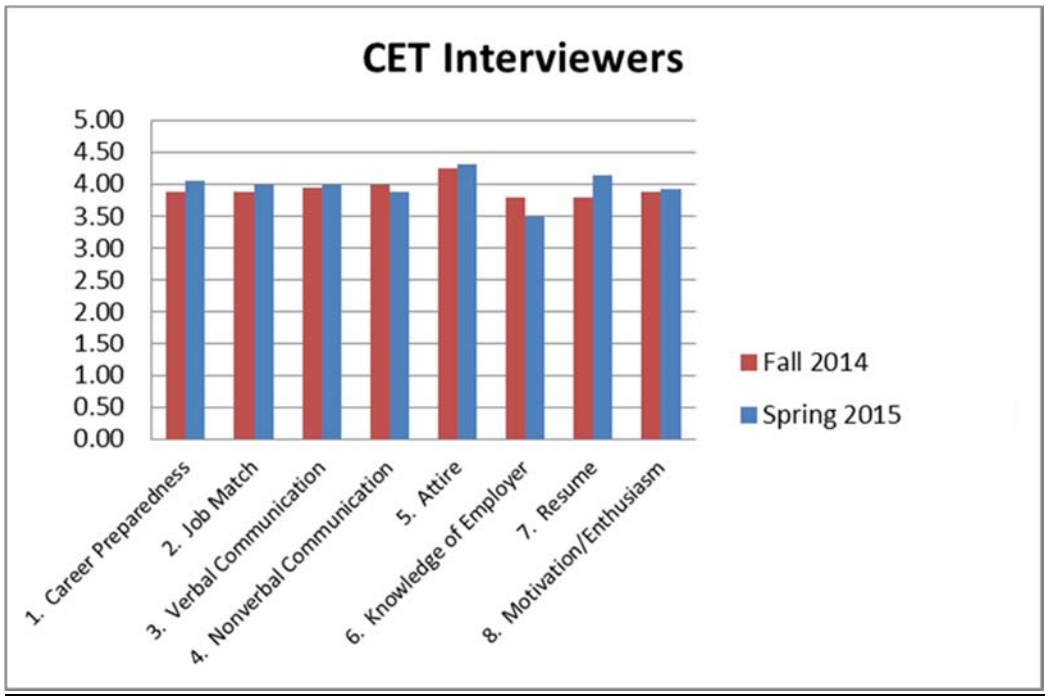


Figure 5. Career Fair employer survey results.

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 three years are presented in Table 3 below. The overall average 2014-2015 score of 4.9 out of 6 was similar to that for the previous year of 5 out of 6. Reviewing these results in Table 3, 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). Counter to the previous two years of assessments, student communication abilities did not receive the lowest average Board assessment; the lowest assessment score was for the ability to conduct, analyze and interpret experiments (4 out of 6), followed by the use of modern surveying methods (4.4 out of 6). In both of these cases, a strong negative trend in these scores over time was not obvious, so no specific action was taken. 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.

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

| OUTCOME | 2013 | Out of 6 2014 | 2015 | Change |
|---|---|---|---|---|
| 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 | 1.00 |
| b. evaluating materials and methods for construction projects | 4.2 | 5.4 | 5.1 | 0.94 |
| c. utilizing modern surveying methods for construction projects | 4.2 | 5.2 | 4.4 | 0.85 |
| d. determining forces and stresses in elementary structural systems | 4 | 4.8 | 4.8 | 1.01 |
| e. estimating material quantities and costs | 4.4 | 5.2 | 5.2 | 0.99 |
| f. employing productivity software to solve technical problems | 3.8 | 4.3 | 4.8 | 1.12 |
| g. producing and utilizing design, construction and operations documents | 4 | 4.8 | 4.8 | 1.01 |
| h. performing economic analyses and cost estimates related to design, | 4 | 4.8 | 4.8 | 0.99 |
| i. selecting appropriate construction materials and practices | 4.4 | 5.2 | 4.8 | 0.93 |
| j. applying principles of construction law and ethics | 3.4 | 5 | 5.2 | 1.03 |
| k. apply basic technical concepts for the solution of construction problems | 4.2 | 5.3 | 5.0 | 0.94 |
| l. performing standard analysis and design of structural elements | 4.4 | 4.8 | 4.6 | 0.95 |
| 2. an ability to apply current knowledge and adapt to emerging applications of | 4.4 | 5.6 | 4.8 | 0.86 |
| 3. an ability to conduct, analyze and interpret experiments and apply | 4.5 | 5 | 4.0 | 0.80 |
| 4. an ability to apply creativity in the design of systems, components or | 4.3 | 5.2 | 5.1 | 0.98 |
| 5. an ability to function effectively on teams | 5.2 | 5.4 | 5.4 | 1.00 |
| 6. an ability to identify, analyze and solve technical problems | 4.8 | 5.4 | 5.3 | 0.99 |
| 7. an ability to communicate effectively | 4.2 | 4 | 4.8 | 1.21 |
| 8. a recognition of the need for and an ability to engage in life-long learning | 4.3 | 4.8 | 5.0 | 1.04 |
| 9. an ability to understand professional, ethical and social responsibilities | 4.8 | 5 | 5.2 | 1.03 |
| 10. a respect for diversity and a knowledge of contemporary professional, | 4.3 | 4.6 | 4.5 | 0.98 |
| 11. a commitment to quality, timeliness and continuous improvement | 4.5 | 5.6 | 5.5 | 0.98 |
| Average | 4.3 | 5 | 4.9 | 0.98 |

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

Student Presentations

ECIV 492 Reno Prep Class

Student Graded Assignments (posted on secure EAB website)

EGEN 115, Engineering Design Graphics

ECIV 405, Scheduling and Planning

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

<u>Department Curriculum Committee</u>

Department curriculum committee discussions/actions during the 2014-2015 academic year that resulted from the action items generated in the 2013-2014 assessment cycle included:

- Thoroughly review and suggest revisions as appropriate in the content and sequencing of the primary construction courses in the CET curriculum.

  Review of the core construction was started, and is expected to be completed in the 2015-2016 academic year. Early results indicate that indeed some adjustments in course content and coordination in material between classes are merited. More significantly, consideration needs to be given to introducing sustainability into the curriculum, perhaps through the addition of a new upper division professional elective on this subject. In the short term, the lab in ECIV

308 was increased from one to two hours per week (starting Fall 2014) and the content and material in ECIV 492 was more closely coordinated with ECIV 308.

- Work on improving the written communication skills of students.
  Central administration was asked to increase the availability of the university's technical writing class, WRIT 221, to students in programs in the Civil Engineering Department. Starting in Spring 2015, the number of sections of WRIT 221 was increased from two to three sections each semester. Additionally, faculty in the department have committed to increasing student written communication exercises across their courses.
- Support and review the results of the 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.
  The COE has begun a critical review of the curriculum college-wide (started summer 2015), and this course has risen to prominence in that discussion. In Fall 2014, a new instructor was hired for EGEN 310, with various sections of the class now being focused on different engineering disciplines. A formal assessment of the new instructor and course structure has not yet been performed.
- Investigate avenues to increase student awareness of contemporary societal and global issues.
  The CET capstone class, ETCC 499, is a logical place to increase student awareness of contemporary societal and global issues as they impact (and are impacted by) infrastructure construction. The capstone class already includes formal assignments requiring students to identify and report on "current events" in construction.
- Review outcomes of curriculum changes summarized above.
  Significant curriculum changes have yet to be completed, and thus review of the outcomes associated with such changes was deferred to a later date.
- Investigate if the credits required by the program for graduation (128 cr) can be reduced, in response to a College request to look at this issue.
  This task is on-going, as part of the college-wide curriculum review. The general consensus among CE faculty is that this would do more harm than good, although the discussion continues.

Other actions resulting from curriculum committee discussions during the year include:

- The new BIM elective (ECIV 309) introduced in Fall 2014 will be increased from 2 to 3 credits in Fall 2015. The capabilities and role of BIM in infrastructure design and construction continues to expand, readily justifying this increase in course credits.

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

- content realignment in the CAD course to reflect current software trends in the profession.
- investigation of increased emphasis on sustainability in the curriculum, in anticipation of ABET changes that have been identified for the next cycle in response to increased emphasis on sustainability in the construction industry.
- a college-wide effort was started in Spring 2015 by the COE Dean to review all COE undergraduate curriculums "from the ground up." This effort is timely, as planning gets

underway for the new Asbjornson Innovation Center, as changes are proposed for the university CORE curriculum, as we prepare for ABET accreditation, and as the college moves forward with many new faculty hires. A COE committee will be formed for this purpose, with a representative from each department.

## Action Items for Academic Year 2015-2016

Based on the above observations and discussions at the August 2015 department retreat, action items for the 2015 – 2106 academic year include:

- Continue thorough review and suggest revisions as appropriate in the content and sequencing of the primary construction courses in the CET curriculum:
  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
  Several years have passed since the last comprehensive review of this suite of classes.

- Continue to work on improving the written communication skills of our students.
  While during this assessment cycle student communication skills were scored as relatively high by the External Advisory Board, historically this has been an area of strong concern. Performance relative to this outcome will continue to be closely reviewed, with the positive accomplishments realized during this assessment cycle hopefully recurring into the future.

- 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.

- Participate in the COE-wide revisioning the curriculum effort.

- 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.

- 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 projects continues to evolve. Research needs to be conducted on what other programs are doing in these regards.

- 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.