

MSU Departmental Assessment Plan 2011-2012

Department: Civil Engineering

Department Head: Brett Gunnink

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Degrees/Majors/Options Offered by Department

Bachelor of Science of Civil Engineering

Bachelor of Science of Civil Engineering – Bioresources Option

Bachelor of Science of Construction Engineering Technology

Mission Statements

College of Engineering

Mission - The College of Engineering at Montana State University will serve the State of Montana and the nation by

- (a) fostering lifelong learning,
- (b) integrating learning and discovery,
- (c) developing and sharing technical expertise,
- (d) empowering students to be tomorrow's leaders.

Vision - The College of Engineering at Montana State University will be an outstanding collaborative community that achieves excellence in learning, innovation, discovery, and knowledge transfer. To realize this vision, the college will

- (a) leverage shared interests and talents among faculty and students in order to create knowledge across disciplinary lines,
- (b) effectively and efficiently balance breadth with depth in undergraduate education in order to prepare students for the global workforce,
- (c) be a leader in innovation and discovery in our identified focus areas,
- (d) successfully integrate research and innovation into the learning experience of both undergraduate and graduate students,
- (e) be recognized for the level of knowledge transfer to industry, governments, and citizens in the state of Montana.

Civil Engineering Department

Mission - Foremost, we will provide undergraduate education founded on a rigorous treatment of engineering fundamentals coupled with modern engineering tools. We see competency in mathematics, physical science, and engineering mechanics as crucial to our mission. We will provide graduate education opportunities in a majority of traditional civil engineering areas. The department will maintain sufficient breadth to provide post-baccalaureate education focused on professional practice. The department will provide graduate opportunities in a subset of focus areas coupled to vibrant research programs with sound external funding.

Vision - Montana State University's Department of Civil Engineering anticipates that the engineering and construction community will evolve quickly with several very fundamental precepts for success. Among these is the premise that the engineers and constructors of the future will continue to rely on fundamental engineering science and contemporary computational tools to guide their choices. We therefore choose to focus on fundamental engineering basics and the application of modern engineering tools. Our civil and environmental engineering programs will be acknowledged for their strong emphasis and rigor in engineering science, design, and applications. Our construction programs will be acknowledged for their emphasis on engineering and management skills and the application of those skills to the construction industry. The

emphasis of these programs will continue to be preparation of students for professional practice in the engineering and construction industries.

Incorporating our vision into the traditional mission of a land grant institution leads to a strong emphasis on undergraduate education. However, in making this a substantial portion of our mission, we must also look beyond the undergraduate classroom. To ensure a quality faculty, and up-to-date curricula, we must ensure a vibrant, broad-based graduate program at the master's level and a smaller subset of specialty areas at the doctorate level. A strong masters program also positions the department favorably for the possibility of future changes in professional degree requirements and is consistent with our vision for education at MSU. The graduate program is essential to attract good faculty and provide for their professional development, and to provide opportunities for students interested in study beyond the baccalaureate degree.

CIVIL ENGINEERING & BIO RESOURCES OPTION

Civil Engineering Program Educational Objectives

The civil engineering baccalaureate educational program objectives were adopted in their current form in April of 2003. Program constituents reconsidered these objectives in 2006 and re-adopted them without revision at that time.

The Civil Engineering Bachelor of Science Program is a traditionally structured program that provides graduates with a strong background in math, basic sciences and engineering mechanics, and prepares graduates to become registered professional engineers capable of practicing civil engineering in the areas of environmental, geotechnical, structural, transportation and water resources engineering. The background of graduates who select the Bio-Resources option is focused on soil, water resources and environmental concerns. The educational objectives of the Civil Engineering Bachelor of Science Program describe what graduates can expect to accomplish during the first years after graduation.

All graduates can expect to be able to:

1. Enter the profession of Civil Engineering and advance in the profession to become registered professional engineers and leaders in the field of Civil Engineering.
2. Work on multi-disciplinary teams and effectively communicate with Civil Engineers of various sub-disciplines, architects, contractors, the public and public agents, scientists and others to design and construct Civil Engineering projects.
3. Begin to develop expertise in one of the sub-disciplines of Civil Engineering and engage in the life-long learning necessary to advance in the Civil Engineering profession.
4. Contribute to society and the Civil Engineering profession through involvement in professional related and/or other service activity.
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.

Some graduates can expect to be able to

6. Enter the surveying profession and become licensed to practice surveying.
7. Begin careers in the construction industry.
8. Earn advanced degrees in Civil Engineering or other fields.

Consistency of the Program Educational Objectives with the Mission of the Institution

The mission of the College of Engineering has technical expertise at its core while recognizing that this technical expertise must be sustained through life-long learning. This need for life-long learning applies across the College to all its constituents, student, alumni and faculty. Further, the College envisions its faculty, students, and alumni assuming leadership roles in their professions and in society. These themes of technical expertise, life-long learning and leadership are reinforced in the Civil Engineering Department's mission and vision statements and the Construction Engineering Technology Program's objectives.

It is possible to map institution mission with program educational objectives. In this context, the *Institution* is perceived to be the College of Engineering. The mission of the College of Engineering maps to the Civil Engineering Department's educational objectives as demonstrated in the following table:

Table 1. Map of COE mission to MSU CE educational objectives.

Key:	(a) fostering lifelong learning	(b) integrating learning and discovery	(c) developing and sharing technical expertise	(d) empowering students to be tomorrow's leaders
3 = highly related				
2 = moderately related				
1 = somewhat related				
All Graduates:				
1. ... enter the profession and advance to become registered professional engineers ...	2		2	2
2. work on multi-disciplinary teams ...		1		
3. ... develop expertise in one of the sub-disciplines ... engage in the life-long learning ...	3	2	1	
4. contribute to society and the ... profession ...	1		1	2
5. conduct affairs in a highly ethical manner ... safety, health and welfare of the public ... principles of sustainable development.			1	2
Some Graduates:				
6. ... surveying profession ...				
7. begin careers in the construction industry				
8. earn advanced degrees ...	2	3	1	

It is no surprise that the college vision and mission statements do not map to CE department educational objectives with a higher correlation than shown in Table 1. The College has a mandate to achieve at a very high level in all three of the traditional land-grant charges: teaching, research and service. The College serves a much broader constituency than does the department. The department does indeed support vigorous research and outreach components, but these tend to not be the focus of our educational objectives which are primarily tailored to our undergraduate programs.

Program Constituencies

The constituents of the baccalaureate program in civil engineering at MU are both served by and serve the program. The relationship between the program and constituents is symbiotic. The constituents are MSU civil engineering students, faculty, and alumni, as well as the employers of MSU students, faculty and alumni. Further, the civil engineering profession is a constituency as the first objective of the program is to prepare students to enter the profession of civil

engineering. All have a vested interest in continuing and improving excellence in the MSU civil engineering baccalaureate program.

Process for Establishing Program Educational Objectives

Program educational objectives for the Civil Engineering Program at MSU have evolved from goal-like objectives that were part of our previous pre-EC2000 ABET review conducted in 1997. In December, 2000, the department completed an ABET2000 plan including objectives, outcomes and processes for evaluating objectives and assessing outcomes. In the fall of 2002, the department TAC-accredited Construction Engineering Technology program was reviewed by ABET as a pilot review under the new TAC outcomes-based accreditation criteria. Based on this review, our ABET2000 plan was revised in a fashion that redefined program objectives in a manner consistent with ABET expectations in early 2003. We have maintained these objectives since then, mostly because we feel that they are adequate, appropriate, and match the spirit of our program, but also because a moving target is difficult to achieve. We have discussed the objectives at faculty retreats, and remain dedicated to them as presented here.

Achievement of Program Educational Objectives

Current program objectives are focused on the expected accomplishment of graduates during the first few years after graduation. Thus, the most effective evaluation tools are those that track the accomplishments of the graduates. Secondary indicators that evaluate achievement of program objectives exist in the demand for the program by program constituents. Thus, the department has identified the following tools for evaluation of program objectives.

1. Employer Survey through the Career Fair
 - a. Conducted by Career Services
 - b. Completed twice a year by employers of MSU graduates
 - c. Table 2 maps Employer Survey Question with CE program objectives
2. Graduate Employment Survey
 - a. Conducted by Career Services
 - b. Compiled annually
3. Fundamentals of Engineering (FE) Exam
 - a. A requirement for graduation is to take the FE exam
 - b. Overall pass rate is an indicator of achievement of program objectives
4. Departmental External Advisory Committee
 - a. Annually provides evaluations of achievement of program objectives based on provided material (Employer Survey, Employment Survey, FE Exam Results), and/or any experiences or interactions that you have had with the MSU Civil Engineering program or alumni.
 - b. Results documented yearly and summarized in the Annual Report.

All evaluation instruments have been implemented. Since AY 2000-2001, graduating students have been **required** to take the Fundamentals of Engineering Exam. The departmental advisory committee has met annually since at least 1995. Career Services has been surveying graduates and employers since 2003.

Table 2. Map of Career Services Employer Survey Questions with CE Program Objectives

Key:

3 = highly related

2 = moderately related

1 = somewhat related

		MSU Civil Engineering Objective				
		1. All graduates can expect to be able to enter the profession of Civil Engineering and advance in the profession to become registered professional engineers and leaders in the field of Civil Engineering.	2. All graduates can expect to be able to work on multi-disciplinary teams and effectively communicate with Civil Engineers of various sub-disciplines, architects, contractors, the public and public agents, scientists, and others to design and construct Civil Engineering projects.	3. All graduates can expect to be able to begin to develop expertise in one of the sub-disciplines of Civil Engineering and engage in the life-long learning necessary to advance in the Civil Engineering profession.	4. All graduates can expect to be able to contribute to society and the Civil Engineering profession through involvement in professional related and/or other service activity.	5. All graduates can expect to be able to 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.
Career Services Employer Survey	Adequate knowledge in appropriate field	3	2	3	1	2
	Ability to apply knowledge in practice	3	2	3	1	2
	A desire to continue learning	3	1	3	3	2
	Capacity to work with minimum supervision	1	2	2	1	1
	Ability to communicate verbally	2	3	2	2	1
	Ability to communicate well in writing	2	3	2	2	1
	Capacity for co-operation and teamwork	2	3	2	2	1
	Capacity to make decisions	2	2	2	1	3
	Strong management/supervisory skills	1	2	2	2	2
	Ability to access and use information	2	2	2	1	3
	Ability to think creatively	2	2	2	1	3
	Resourcefulness	1	2	1	1	2
	Capacity to function in multicultural/global context	1	2	1	1	1
	Capacity to act ethically	2	1	1	2	3
Weighted Objective Score		4.12	4.03	4.09	4.08	4.11

Process for Evaluating Achievement of CE Program Objectives

Annually, each August prior to the start of the new school year, the department will hold a 1 day retreat. One of the agenda items at these retreats will be the review of assessment data and the evaluation of program outcomes and objective. Prior to these retreats, the department head and/or program coordinator will prepare and distribute an Annual Program Assessment Report. The report will include recent and historical assessment data and a comparison of assessment results with metric goals. If assessment results fall below metric goals, the faculty will be 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 will 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. The DAC will also be apprised of the evaluation of program outcomes and objectives conducted by the faculty at the August faculty retreat. Their input on this evaluation will be solicited. Minutes for this retreat will document actions taken by the faculty. Minutes for this retreat and minutes from subsequent curriculum committee meetings will be included in the Annual Program Assessment Report.

CE Program Objective Evaluation Form

The following form is used to evaluate achievement of program objectives. Annually the departmental External Advisory Committee completes the evaluation. The metric goal for this evaluation is an average score of 7 for each objective.

CE Program Objective Evaluation Form

Please evaluate the extent to which you believe MSU Civil Engineering graduates meet the following objectives on a scale of 0 (not at all) to 10 (completely), and the extent to which you believe this is a suitable objective, similarly scaled from 0 (not at all suitable) to 10 (completely suitable). Your evaluation may be based on the attached material (Employer Survey, Employment Survey, FE Exam Results), and/or any experiences or interactions that you have had with the MSU Civil Engineering program or alumni.

Program objectives describe what graduates can expect to accomplish during the first years after graduation.

1. All graduates can expect to be able to enter the profession of Civil Engineering and advance in the profession to become registered professional engineers and leaders in the field of Civil Engineering.

MSU CE graduates meet this expectation _____
This is a suitable objective for MSU CE graduates _____

2. All graduates can expect to be able to work on multi-disciplinary teams and effectively communicate with Civil Engineers of various sub-disciplines, architects, contractors, the public and public agents, scientists and others to design and construct Civil Engineering projects.

MSU CE graduates meet this expectation _____
This is a suitable objective for MSU CE graduates _____

3. All graduates can expect to be able to begin to develop expertise in one of the sub-disciplines of Civil Engineering and engage in the life-long learning necessary to advance in the Civil Engineering profession.

MSU CE graduates meet this expectation _____

This is a suitable objective for MSU CE graduates _____

4. All graduates can expect to be able to contribute to society and the Civil Engineering profession through involvement in professional related and/or other service activity.

MSU CE graduates meet this expectation _____

This is a suitable objective for MSU CE graduates _____

5. All graduates can expect to be able to 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.

MSU CE graduates meet this expectation _____

This is a suitable objective for MSU CE graduates _____

Civil Engineering Program Outcomes

The following describes the CE program outcomes and the related assessment process.

CE Baccalaureate Program Outcomes

The following current CE Baccalaureate Program Outcomes were approved by the CE faculty in August of 2006. At that time, the CE faculty decided to adopt outcomes consistent with ASCE Body of Knowledge (BOK) and new ABET program criteria for CE programs.

To satisfy the academic prerequisites for the professional practice of civil engineering, MSU civil engineering graduates will be able to:

1. apply knowledge of mathematics, science, and engineering
2. design and conduct experiments and analyze and interpret experimental data
3. design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
4. function as a member of a multidisciplinary team
5. identify, formulate and solve engineering problems
6. explain professional and ethical responsibility
7. compose and present effective written, verbal and graphical communications
8. draw upon a broad education to explain the impact of engineering solutions in a global, economic, environmental and societal context
9. explain the need for, and demonstrate the capacity for, life-long learning
10. explain contemporary issues as they relate to the solution of engineering practice
11. apply the techniques, skills and modern tools necessary for engineering practice
12. [MS Programs Only] synthesize and evaluate knowledge in a specialized area related to civil engineering
13. explain the elements of project management, construction and asset management
14. explain the fundamentals of business, public policy and administration
15. explain the role of the leader, leadership principle, and attitudes conducive to effective professional practice of civil engineering.

MSU Outcomes Relationship to MSU Objectives, Curriculum and ABET Outcomes a-k

Table 4 (page 14) maps MSU Objectives with MSU Outcomes. The relationships between MSU Outcomes and ABET Outcomes a-k are included, in parenthesis, in the MSU statement of MSU CE Baccalaureate Outcomes listed in the previous paragraphs. These same relationships are mapped in Tables 5 and 6 (pages 15 and 16).

Processes to Produce CE Program Outcomes

Completion of coursework is the mainstay to direct us toward our objectives and produce students who satisfy the ABET Outcomes a-k as well as the Department of Civil Engineering Baccalaureate Outcomes. Table 7 (page 17) maps the MSU CE Curriculum with MSU Outcomes.

Processes to Assess CE Program Outcomes

The following instruments are used to assess whether MSU CE Program Outcomes are being met.

1. Fundamentals of Engineering Exam
 - All CE students are required to take the FE exam in order to graduate.
 - The assessment process documents program performance in each topic area of the Civil Engineering discipline specific exam.
 - Student performance in each topic area is compared to metric goals.
 - Results are documented yearly and summarized in the Annual Assessment Report.
2. Student Portfolio Review
 - Representative student work from the following classes is collected. This work comprises the student portfolios that are reviewed.
 - CE 332, Engineering Hydraulics
 - CE 401, Professional Practice & Ethics
 - CE 457, Senior Project I
 - CE 458, Senior Project II
 - A team consisting of 3 members of the department curriculum committee and 2 members of the departmental External Advisory Committee reviews the portfolios and assesses student performance relative to program outcomes.
 - Student performance related to each outcome is compared to metric goals.
 - Results are documented every third year and summarized in the Annual Assessment Report.
3. Student Interviews
 - The Department Head or appointee conducts interviews with students.
 - Each student provides input concerning department commendations and recommendations for improvement.
 - Results are documented yearly and summarized in the Annual Assessment Report.
4. Departmental External Advisory Committee
 - Provides heuristic assessment of students' achievement of program outcomes.
 - Provides input concerning department commendations and recommendations for improvement.
 - Results are documented yearly and summarized in the Annual Assessment Report.
5. Student performance related to each outcome is compared to metric goals
 - Results documented and summarized in the Annual Report.
6. CE Faculty/Curriculum Committee
 - Due to high degree of interest in student success and high degree of interaction between MSU CE faculty and program constituents, the CE faculty is well-informed about constituent issues/concerns with CE programs. Therefore CE faculty input is invaluable in the continuous quality improvement efforts of the department.

- Department faculty retreat conducted annually to review assessment data and add the heuristic insight of the CE faculty to this data while making program improvement decisions.

An example of the type of instrument to be used in the future to assess student achievement relative to program outcomes is included at the end of this document.

Metric Goals for CE Program Outcomes

Metric goals for outcomes were established in consultation with the department External Advisory Committee. The first applies to FE exam results. Our goal is to exceed the national pass rate for civil engineering students taking the civil exam and for the MSU student performance to exceed the national performance in each subject area of the exam.

The second form of metric goal applies to direct and indirect assessments of program outcomes where reviewers (faculty, alumni, and employers) are making assessments of student ability relative to program outcomes. These metric goals apply to results of student portfolio assessment, and alumni and employer surveys. For each of the program outcomes, each reviewer will be asked to assess the students’ abilities on a 6 point scale (1- very poor, 2-poor, 3-fair, 4-good, 5-very good, 6-excellent). For example:

Based on your review of student work, what is your assessment of MSU student’s abilities with respect to the following program outcomes?

1. Demonstrate skills in math, science, and engineering with an emphasis on solving engineering problems utilizing fundamental engineering principals including engineering logic, traditional analytical methods, modern software, and experimental apparatus.

1-very poor	2-poor	3-fair	4-good	5-very good	6- excellent
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Our metric goal for program outcome as evaluated by this process is that 80% of the responses be good or higher.

Process for Applying Assessment Results

Annually, each August prior to the start of the new school year, the department will hold a 1 day retreat. One of the agenda items at these retreats will be the review of assessment data and the evaluation of program outcomes and objective. Prior to these retreats, the department head and/or program coordinator will prepare and distribute an Annual Program Assessment Report. The report will include recent and historical assessment data and a comparison of assessment results with metric goals. If assessment results fall below metric goals, the faculty will be 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 will 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. The DAC will also be apprised of the evaluation of program outcomes and objectives conducted by the faculty at the August faculty retreat. Their input on this evaluation will be solicited. Minutes for this retreat will document actions taken by the faculty. Minutes for this retreat and minutes from subsequent curriculum committee meetings will be included in the Annual Program Assessment Report.

Timetable and Responsibilities

Table 3 (page 13) documents the timetable for element of the continuous improvement plan for the MSU Civil Engineering program. If the plan element is part of the assessment process it is identified in *italics*. If the plan element includes the evaluation of assessment data it is identified in **bold**.

Table 3. Timetable and Responsibilities for CE program continuous improvement plan

Plan Element	Timetable	Responsibility
<i>FE Exam</i>	<i>Fall Semester</i>	<i>Program Coordinator</i>
<i>MSU Career Services Employer Survey</i>	<i>Fall Semester</i>	<i>MSU Career Services Director</i>
<i>Senior Exit Interviews</i>	<i>Fall Semester</i>	<i>Department Head</i>
<i>Student Portfolio Review</i>	<i>Every Third Year.</i>	<i>Program Coordinator</i>
Department Advisory Committee Meeting <i>(Objective evaluation & Outcome Assessment)</i>	Fall Semester	Department Head
<i>FE Exam</i>	<i>Spring Semester</i>	<i>Program Coordinator</i>
<i>MSU Career Services Employer Survey</i>	<i>Spring Semester</i>	<i>MSU Career Services Director</i>
<i>MSU Career Services Annual Salary Survey</i>	<i>Spring Semester</i>	<i>MSU Career Services Director</i>
<i>Senior Exit Interviews</i>	<i>Fall Semester</i>	<i>Department Head</i>
<i>Capstone Project Review</i>	<i>Fall Semester</i>	<i>Program Coordinator</i>
Department Curriculum Committee Meetings	Academic Year as needed	Curriculum Committee Chair & Curriculum Committee
<i>Annual Program Assessment Report</i>	<i>Summer</i>	<i>Department Head, and Program Director</i>
Department Faculty Retreat	August	Department Head, Program Coordinator, and Faculty

Table 4. Map of MSU CE Program Objectives and Outcomes.

Key:	1. ... math, science, and engineering ...	2. ... experiments ... interpret data...	3. ... design a system, component ...	4. ... multi-disciplinary teams ...	5. ... solve engineering problems ...	6. ... professional and ethical responsibility.	7. ... communicate effectively.	8. ... impact ... global and societal ...	9. ... life-long learning.	10. ... contemporary issues.	11. ... modern engineering tools ...	12. ... knowledge in specialized area ...	13. ... project management, construction ...	14. ... business, public policy, admin ...	15. ... leadership principles ...
All Graduates:															
1. ... enter the profession and advance to become registered professional engineers ...	3	3	3	2	3	2	3	3	3	2	3	3	1	2	3
2. work on multi-disciplinary teams ...	1	1	2	3	2	2	2	3	2	3	1	3	3	2	2
3. ... develop expertise in one of the sub-disciplines ... engage in the life-long learning ...	3	3	2	2	3	2	3	2	2	2	3	2	2	2	1
4. contribute to society and the ... profession ...	1	1	2	2	2	3	2	2	2	3	1	2	1	2	2
5. conduct affairs in a highly ethical manner ... safety, health and welfare of the public ... principles of sustainable development.	2	1	2	3	3	3	2	3	2	2	1	1	2	2	1
Some Graduates:															
6. ... surveying profession ...	2	3	1	1	3	2	2	2	2	1	3	2	1	1	1
7. begin careers in the construction industry	2	3	1	2	3	2	2	2	2	2	1	2	3	2	2
8. earn advanced degrees ...	3	3	2	2	3	2	2	2	2	2	2	3	1	1	2

Table 5. Map of MSU CE Program Outcomes with MSU Assessment Instruments

Key: 1 - measured, but not strong indicator 2 - measured reasonably well 3 - measured well							
	FE exam	Senior Exit Interviews	Departmental EAC	Documented Direct Assessments	Application in Design Experience	Curriculum Committee	Total
MSU Outcome							
1. ... math, science, and engineering ...	2	2	2	3	1	2	12
2. ... experiments ... interpret data...	1		2	1	1	1	6
3. ... design a system, component ...	1	2	3	2	3	2	13
4. ... multi-disciplinary teams ...		2			3		5
5. ... solve engineering problems ...	3	2	3	3	3	3	17
6. ... professional and ethical responsibility.	1	1	2	2	2	1	9
7. ... communicate effectively.		2	1	3	3	2	11
8. ... impact ... global and societal ...		1	2	1	1		5
9. ... life-long learning.	1	2	1		1		5
10. ... contemporary issues.		1	2	1	2	2	8
11. ... modern engineering tools ...	2	2	2	3	3	3	15
12. ... knowledge in specialized area ...	3	1	2	2	3	3	14
13. ... project management, construction ...	1	1			1	1	4
14. ... business, public policy, admin ...		1	1	2			4
15. ... leadership principles ...		1	1		2		4
Significance of Tool	15	21	24	23	29	20	

Table 6. Map of ABET Outcomes with MSU Assessment Instruments

Key: 1 - measured, but not strong indicator 2 - measured reasonably well 3 - measured well							
	FE exam	Senior Exit Interviews	Departmental EAC	Documented Direct Assessments	Application in Design Experience	Curriculum Committee	Total
MSU Outcome							
1. ... math, science, and engineering ...	2	2	2	3	1	2	12
2. ... experiments ... interpret data...	1		2	1	1	1	6
3. ... design a system, component ...	1	2	3	2	3	2	13
4. ... multi-disciplinary teams ...		2			3		5
5. ... solve engineering problems ...	3	2	3	3	3	3	17
6. ... professional and ethical responsibility.	1	1	2	2	2	1	9
7. ... communicate effectively.		2	1	3	3	2	11
8. ... impact ... global and societal ...		1	2	1	1		5
9. ... life-long learning.	1	2	1		1		5
10. ... contemporary issues.		1	2	1	2	2	8
11. ... modern engineering tools ...	2	2	2	3	3	3	15
12. ... knowledge in specialized area ...	3	1	2	2	3	3	14
13. ... project management, construction ...	1	1			1	1	4
14. ... business, public policy, admin ...		1	1	2			4
15. ... leadership principles ...		1	1		2		4
Significance of Tool	15	21	24	23	29	20	

CONSTRUCTION ENGINEERING TECHNOLOGY

CET Program Educational Objectives

The Construction Engineering Technology (CET) 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 educational objectives of the Construction Engineering Technology Bachelor of Science Program describe what graduates can expect to accomplish during the first years after graduation.

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.

Some graduates can expect to be able to:

6. enter the surveying profession and become licensed to practice surveying; or
7. earn a Master of Construction Engineering Management degree from MSU or other graduate degrees.

The Construction Engineering Technology Program Objectives are published in the 2010-2012 Course Bulletin for Montana State University and at http://www.coe.montana.edu/ce/layer_two_docs/mission_vision_plan.html.

Assessment of CET Program Educational Objectives

The department used several tools to assess achievement of program educational objectives. These tools and how they are used are discussed in the following paragraphs.

Constructor Qualification Exam (CQE)

A requirement for graduation is the Constructor Qualifying – Level I Exam. This nationally normalized exam is taken by students when they are enrolled in the capstone class, CET 408R. The exam is given both during the fall and spring semester each year. Pass rate on this exam is an indicator of level of achievement of program objectives. Results from this exam will be included in the Annual Program Assessment Report.

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. Results from this survey will be included in the Annual Program Assessment Report.

MSU Career Services Employer Survey

MSU Career Services conducts the “MSU Employer Partner Career Fair Survey”. This survey is given to employers who participate in the MSU career fairs. This survey collects responses to the following question “please rate how well you believe MSU graduates/interns employed in your organization during the last three years have demonstrated each attribute, skill or quality by rating them on a scale of 1 to 5 (1 – to a very limited extent to 5 – to a very great extent).

1. Adequate knowledge in appropriate field
2. Ability to apply knowledge in practice
3. A desire to continue learning
4. Capacity to work with minimal supervision
5. Ability to communicate verbally
6. Ability to communicate well in writing
7. Capacity for cooperation and teamwork
8. Capacity to make decisions
9. Strong management/supervisory skills
10. Ability to access and use information
11. Ability to think creatively
12. Resourcefulness
13. Capacity to function in multicultural/global context
14. Capacity to act ethically

Results from this survey will be included in the Annual Program Assessment Report.

Department Advisory Committee

The Department Advisory Committee (DAC) meets in the fall annually for a 1-2 day meeting. The DAC agenda very frequently includes review and/or assessment and/or evaluation of program objectives and outcomes. As part of these meetings the DAC meets with groups of students and faculty members. The DAC will be asked to provide input regarding the assessment of program outcomes and objectives. The DAC will also be apprised of the evaluation of program outcomes and objectives conducted by the faculty at the August faculty retreat. Their input on this evaluation will be solicited. The Minutes for the meetings of the DAC will document their input and be included in the Annual Program Assessment report.

Metric Goals for CET Program Outcomes

The metric goal for the pass rate on the CQE exam is that the pass rate for MSU students should exceed the national average pass rate.

The metric goals for the “MSU Employer Partner Career Fair Survey” data are that the average response for each question in the survey should be greater than 3.

Evaluation of CET Program Educational Objectives

Annually, each August prior to the start of the new school year, the department will hold a 1 day retreat. One of the agenda items at these retreats will be the review of assessment data and the evaluation of program outcomes and objective. Prior to these retreats, the department head and/or program coordinator will prepare and distribute an Annual Program Assessment Report. The report will include recent and historical assessment data and a comparison of assessment results with metric goals. If assessment results fall below metric goals, the faculty will be 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 will 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. The DAC will also be apprised of the evaluation of program outcomes and objectives conducted by the faculty at the August faculty retreat. Their input on this evaluation will be solicited. Minutes for this retreat will document actions taken by the faculty. Minutes for this retreat and minutes from subsequent curriculum committee meetings will be included in the Annual Program Assessment Report.

Construction Engineering Technology Program Outcomes

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. An 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

Table 9 (page 25) maps MSU CET Program Objectives and Outcomes. Table 10 (page 26) maps MSU CET program outcomes and curriculum.

Assessment of CET Program Outcomes

The department used several tools to assess achievement of program outcomes. These tools and how they are used are discussed in the following paragraphs. Some of the same tools that are used to assess program objectives can also be used to assess program outcomes.

Constructor Qualification 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, CET 408R. 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 include:

- Communication Skills (g)
- 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 program outcomes that are assessed by the exam topic area are shown in parentheses after the topic area. The School Report for this exam includes comparisons of MSU averages, in each subject, with national averages. The School Report for this American Institute of Constructors (AIC) – Constructor Certification Commission administered exam also identifies minimum acceptable scores for each subject area. 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. The School Reports for the CQE exam will be include in the Annual Program Assessment Report.

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 senior are asked to reflect and comment on the strengths and weaknesses of the program. The department head will compile the results of these interviews and include the compilation in the Annual Program Assessment Report.

Department Advisory Committee

The Department Advisory Committee (DAC) meets in the fall annually for a 1-2 day meeting. The DAC agenda very frequently includes review and/or assessment and/or evaluation of program objectives and outcomes. As part of these meetings the DAC meets with groups of students and faculty members. The DAC will be asked to provide input regarding the assessment of program outcomes and objectives. The DAC will also be apprised of the evaluation of program outcomes and objectives conducted by the faculty at the August faculty retreat. Their input on this evaluation will be solicited. The Minutes for the meetings of the DAC will document their input and be included in the Annual Program Assessment report.

Department Curriculum Committee

The Department Curriculum Committee (DCC) while often responding to input from other assessment tools also provides direct heuristic input regarding achievement of program outcomes. The DCC represents the faculty that interacts with students on a daily basis. There is no group that understands the nuances of student strengths and weaknesses relative to program outcomes better than the faculty. Minutes for the meetings of the DAC will document their input and be included in the Annual Program Assessment report.

Metric Goals for CET Program Outcomes

The metric goals for program outcomes are that the school average for each area score on the CQE Level 1 exam should exceed the national average. A further metric goal is that none of the areas on the exam are identified as an area of weakness by the AIC – Constructor Certification Commission.

Evaluation of CET Program Outcomes

Annually, each August prior to the start of the new school year, the department will hold a 1 day retreat. One of the agenda items at these retreats will be the review of assessment data and the evaluation of program outcomes and objective. Prior to these retreats, the department head and/or program coordinator will prepare and distribute an Annual Program Assessment Report. The report will include recent and historical assessment data and a comparison of assessment results with metric goals. If assessment results fall below metric goals, the faculty will be 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 will 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. The DAC will also be apprised of the evaluation of program outcomes and objectives conducted by the faculty at the August faculty retreat. Their input on this evaluation will be solicited. Minutes for this retreat will document actions taken by the faculty. Minutes for this retreat and minutes from subsequent curriculum committee meetings will be included in the Annual Program Assessment Report.

Timetable and Responsibilities

Table 8 documents the timetable for element of the continuous improvement plan for the MSU Construction Engineering Technology program. If the plan element is part of the assessment process it is identified in *italics*. If the plan element includes the evaluation of assessment data it is identified in **bold**.

Table 8. Timetable and Responsibilities for CET program continuous improvement plan

Plan Element	Timetable	Responsibility
<i>CQE Exam</i>	<i>Fall Semester</i>	<i>Program Coordinator</i>
<i>MSU Career Services Employer Survey</i>	<i>Fall Semester</i>	<i>MSU Career Services Director</i>
<i>Senior Exit Interviews</i>	<i>Fall Semester</i>	<i>Department Head</i>
<i>Capstone Project Review</i>	<i>Fall Semester</i>	<i>Program Coordinator</i>
Department Advisory Committee Meeting	Fall Semester	Department Head
<i>CQE Exam</i>	<i>Spring Semester</i>	<i>Program Coordinator</i>
<i>MSU Career Services Employer Survey</i>	<i>Spring Semester</i>	<i>MSU Career Services Director</i>
<i>MSU Career Services Annual Salary Survey</i>	<i>Spring Semester</i>	<i>MSU Career Services Director</i>
<i>Senior Exit Interviews</i>	<i>Fall Semester</i>	<i>Department Head</i>
<i>Capstone Project Review</i>	<i>Fall Semester</i>	<i>Program Coordinator</i>
Department Curriculum Committee Meetings	Academic Year as needed	Curriculum Committee Chair & Curriculum Committee
<i>Annual Program Assessment Report</i>	<i>Summer</i>	<i>Department Head, and Program Director</i>
Department Faculty Retreat	August	Department Head, Program Coordinator, and Faculty

Table 9. Map of MSU CET Program Objectives and Outcomes

Key: 3 = highly related 2 = moderately related 1 = somewhat related	a. mastery of knowledge, techniques ...	b. knowledge of math , sciences, engineering...	c. conduct analyze and interpret experiments...	d. creativity in design...	e. function effectively on teams	f. identify, analyze and solve technical problems	g. communicates effectively.	h. lifelong learning	i. professional, ethical and social responsibilities	j. respect for diversity and knowledge	k. commitment to quality timeliness ...
	All Graduates:										
1. enter the construction industry and advance toward leadership positions ...	3	2	1	2	3	3	3	3	3	1	3
2. work on multi-disciplinary teams and effectively communicate ...	2	1	1	2	3	2	3	1	1	1	3
3. engage in the life-long learning	1	1	1	1	1	1	2	3	1	1	2
4. contribute to society and the construction industry ...	3	1	1	1	3	2	3	2	3	3	3
5. conduct their affairs in a highly ethical manner ...	1	1	1	1	1	1	1	2	3	3	3
Some Graduates:											
6. enter the surveying profession ...	3	3	3	1	2	3	3	3	3	1	3
7. earn a graduate degree	3	3	3	3	2	3	3	3	3	1	3

Table 10. Map of MSU CET Program Outcomes and Curriculum

Key: 3 - Primary Attention 2 - Significant Attention 1 - Peripheral Attention	Course or Group Name	Course or Courses	Minimum Total Credit Hours in Group	MSU Outcome													
				a. utilizing ... construction contract ...	b. evaluating material and methods ...	c. ... surveying ...	d. ... forces and stresses ... structural ...	e. estimating material quantities and costs	f. ... productivity software ... technical probs.	g. producing and using construction docs.	h. economic analyses and cost estimates ...	i. selecting construction materials & practices	j. applying ... construction law and ethics	k. basic technical concepts ...	k. analysis and design structural ...		
	Communications	WRIT 101 BUS 201/WRIT 201/WRIT 221 CLS 101/COM 110/US 101 ME 115 + ME 116	11	3						3	3						
	Basic Science	CHMY 121 GEO 101N PHYS 205 + PHYS 206	16														
	Mathematics	M 151Q + M 165Q + M 166Q STAT 216Q	13														
	University Core	IA, IH, IS, (plus ECNS 101IS)	9														
	Engineering Mechanics	EM 205 + EM215 + EM 331	9				3									3	3
	Engineering Topics	ARCH 241 CE 201 CE 307 CE 308 CE 404 CE 405 CET 202 CET 203 CET 302 CET 305 CET 412 CHBE 213 EE 465 MET 465	41	2 2 3 2 2	3 2 3 2	3 3 3	3 3 3	2 2 2	2 3 2	3 3 3	3 2 3 2	1 2 1 1	2 2 3 3				3
	Business Management	ACTG 220/ACTG 201/I&ME 373 BUS 361 ECNS 101IS + ECNS 202 I&ME 325	15								2 3		2				
	Professional Electives		8														
	Design and Professional	ENGR 310 CET 408R	6	1 3	1 1		2 1	1 1	1 3	2 1	1 1		2 3			1 3	