Mechanical Engineering Program
2014-1015 Assessment Report

INTRODUCTION

This report documents the assessment done within the Mechanical Engineering (ME) program at Oregon Institute of Technology during the 2014-15 academic year, with the program being delivered both on the main campus in Klamath Falls and at our Seattle campus. Note that the Manufacturing and Mechanical Engineering and Technology (MMET) Department is located on a third Oregon Tech campus, located in Wilsonville, Oregon. Undergraduate MMET programs at the Wilsonville campus consist of the Bachelors of Science Degree in Manufacturing Engineering Technology and the Bachelors of Science Degree in Mechanical Engineering Technology (both of which are also offered at the Klamath Falls and Seattle campuses; and are accredited through ABET ETAC); and they have a number of courses that are common with the BSME program. Thus faculty input from the Wilsonville campus is also considered when assessing the effectiveness of a number of our departmental courses.

The BSME program is using a three year assessment cycle; and this assessment cycle is the same for both the Klamath Falls and Seattle campuses. This cycle is set up so that each outcome is assessed at least once every three years. The outcomes being assessed within the 2014-1015 school year are summarized here, both the assessment being done and results of these assessments.

PROGRAM MISSION STATEMENT AND EDUCATIONAL OBJECTIVES

The mission statement of the ME Program is in line with and built upon the mission statements of the Institution and the Department. The ME program's Mission Statement and Program Educational Objectives are stated as:

Mechanical Engineering Program Mission Statement

The Mechanical Engineering Program at Oregon Institute of Technology is an applied engineering program. Its mission is to provide graduates the skills and knowledge for successful careers in mechanical engineering.

Mechanical Engineering Program Educational Objectives

The program expects graduates to achieve, within several years of graduation, the following objectives. Mechanical Engineering graduates will have

- demonstrated the ability to analyze, design and improve practical thermal and/or mechanical systems.
- shown the ability to communicate effectively and work well on team-based engineering projects.
- succeeded in entry-level mechanical engineering positions regionally and nationally.
- pursued continued professional development, including professional registration if desired.
- successfully pursued engineering graduate studies and research, if desired.

EDUCATIONAL OUTCOMES

The ME program's Student Learning Outcomes are aligned with ABET EAC outcomes. These are stated as:
(a) an ability to analyze and model physical systems or components using (apply knowledge of) mathematics (including multi-variable calculus and differential equations), basic science and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design and realize a physical system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(d) an ability to function on multidisciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) a recognition of the need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice
(m1) Graduates will be able to work professionally in the area of thermal systems
(m2) Graduates will be able to work professionally in the area of mechanical systems.

These outcomes mirror those of the EAC of ABET. Outcomes (a) and (c) have been slightly modified to better represent ABET's Mechanical Engineering program specific criteria. Also, outcomes (m1) and (m2) have been added also to address ABET's Mechanical Engineering program specific criteria.

Three-Year Cycle for Assessment of Student Learning Outcomes
The faculty planned a three-year assessment cycle for the program's student learning outcomes as shown in Table 1.

Student Learning Outcome	2014-15	2015-16	2016-17	ETAC
(a) an ability to apply knowledge of mathematics, science, and engineering	x			b
(b) an ability to design and conduct experiments, as well as to analyze and interpret data			x	c
(c) an ability to 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	x			d
(d) an ability to function on multidisciplinary teams		x		e
(e) an ability to identify, formulate, and solve engineering problems	x			f
(f) an understanding of professional and ethical responsibility		x		i
(g) an ability to communicate effectively			x	g
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context		x		j
(i) a recognition of the need for, and an ability to engage in life-long learning			x	h
(j) a knowledge of contemporary issues			x	j
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice			x	a
(m1) Graduates will be able to work professionally in the area of thermal systems	x			
(m2) Graduates will be able to work professionally in the area of mechanical systems.	x			

Table 1. Assessment Cycle

Summary of 2014-15 Assessment Activities

The Mechanical Engineering faculty conducted formal assessment of five student learning outcomes during 2014-15. These outcomes have been mapped to the curriculum as shown in Appendix I.

At each campus where a degree program is offered the normal assessment for each outcome consists of two direct assessments, and one indirect assessment. The direct assessments are evaluated using an outcome-specific Rubric developed by the Oregon Tech MMET Department and/or the faculty at Oregon Tech. The faculty and Program Directors at each campus determine which courses are used to assess each outcome; they do not have to be the same courses at both campus. The rubrics used for this year’s assessment activities are included in Appendix II of this report.

The indirect assessment used for both campuses is a “senior survey”, which is given spring term to all of the BSME students enrolled in our year-long senior projects sequence. The survey is common for all campuses, but can be sorted to give results for individual campuses. Since the BSME program in Seattle was new last year, there were only 2 students who filled out the survey. Since the results for only 2 students are not statistically significant, all of the indirect results shown in this report include both the Klamath Falls students and the 2 Seattle students.

SLO a. an ability to apply knowledge of mathematics, science, and engineering.

The performance criteria for this learning outcome are:

1. Select and apply math principles to obtain analytical or numerical solution(s) to an engineering problem.
2. Select and apply scientific principles that govern the performance of a given process or system in engineering problem(s).
3. Select and apply engineering principles that govern the performance of a given process or system in engineering problem(s).
4. Select and apply appropriate technology tools (software, equipment, CAD, CNC, instrumentation, etc.) for a given process or system to an engineering problem.

Klamath Falls Campus Assessment:

Direct Assessment #1 Klamath Campus

The faculty assessed this outcome in MECH 315 Winter term 2015, using an assignment scored with a rubric. This assessment was administered to students from all majors in the MMET Department. There were 36 mechanical engineering students involved in the assessment; the results are shown in Table 2. Note that this assignment did not address the forth performance criteria, “selects and applies appropriate technology tools”; this performance criteria only applies to our ETAC programs.

Performance Criteria	Assessment Method	Measurement Scale	Minimum Acceptable Performance	Results
Selects & applies math principles	Rubric-scored exam questions	1-4 proficiency scale	80% score 3 or 4	100%
Selects & applies scientific principles	Rubric-scored exam questions	1-4 proficiency scale	80% score 3 or 4	100%
Selects & applies engineering principles	Rubric-scored exam questions	1-4 proficiency scale	80% score 3 or 4	100%
Selects & applies appropriate technology tools	Rubric-scored exam questions	1-4 proficiency scale	80% score 3 or 4	N/A

Table 2. ME Assessment Results for SLO a, Fall 2014, Klamath Campus

Strengths: The students all scored well in this assessment, noted specifically as: Successful identification of system type; Proper application of relevant scientific/engineering principles.

Weaknesses: Computational Errors; Neglect of Dimensional Units; Disrespect of Significant Figures.

Actions: Reiterate importance of checking all computations, including appropriate units, and expressing correct significant figures.

<u>Direct Assessment #2 Klamath Campus</u>

The faculty assessed this outcome in MECH 316 Machine Design II Fall term 2014, using a project scored with a rubric. This assessment was administered only to mechanical engineering students in the MMET Department. There were 12 mechanical engineering students involved in the assessment, the results are shown in Table 3.

Performance Criteria	Assessment Method	Measurement Scale	Minimum Acceptable Performance	Results
Selects & applies math principles	Rubric-scored exam questions	1-4 proficiency scale	80% score 3 or 4	100%
Selects & applies scientific principles	Rubric-scored exam questions	1-4 proficiency scale	80% score 3 or 4	100%
Selects & applies engineering principles	Rubric-scored exam questions	1-4 proficiency scale	80% score 3 or 4	83%
Selects & applies appropriate technology tools	Rubric-scored exam questions	1-4 proficiency scale	80% score 3 or 4	100%

Table 3. ME Assessment Results for SLO a, Fall 2014, Klamath Campus

Strengths: The results indicate that the students met faculty expectations for all criteria assessed.

Weaknesses: None indicated by the results or instructor feedback.

Actions: None needed at this time, continue assessment as designed.

Direct Assessment #3 Klamath Campus

The faculty assessed this outcome in MECH 480 Winter term 2015, using an assignment scored with a rubric. There were 30 mechanical engineering students involved in the assessment; the results are shown in Table 4. Note that this assignment did not address the forth performance criteria, “selects and applies appropriate technology tools”; this performance criteria only applies to our ETAC programs.

Performance Criteria	Assessment Method	Measurement Scale	Minimum Acceptable Performance	Results
Selects & applies math principles	R`ubric-scored exam questions	1-4 proficiency scale	80% score 3 or 4	90%
Selects & applies scientific principles	Rubric-scored exam questions	1-4 proficiency scale	80% score 3 or 4	90%
Selects & applies engineering principles	Rubric-scored exam questions	1-4 proficiency scale	80% score 3 or 4	83%
Selects & applies appropriate technology tools	Rubric-scored exam questions	1-4 proficiency scale	80% score 3 or 4	N/A

Table 4. ME Assessment Results for SLO a, Fall 2014, Klamath Campus

Strengths: The students all scored well in this assessment; some areas to be noted include: Successful identification of system type; Proper application of relevant scientific/engineering principles.

Weaknesses: Some areas were: Computational Errors; Neglect of Dimensional Units; Disrespect of Significant Figures.

Actions: Reiterate importance of checking all computations, including appropriate units, and expressing correct significant figures.

Seattle Campus Assessment:

Direct Assessment #1 Seattle Campus

The faculty assessed this outcome in MECH 316 Machine Design II Winter term 2015, using an assignment scored with a rubric. There were 13 mechanical engineering students who participated in the assessment. The results are shown in Table 5.

Performance Criteria	Assessment Method	Measurement Scale	Minimum Acceptable Performance	Results
Selects & applies math principles	Rubric-scored exam questions	1-4 proficiency scale	80% score 3 or 4	84.6%
Selects & applies scientific principles	Rubric-scored exam questions	1-4 proficiency scale	80% score 3 or 4	100%
Selects & applies engineering principles	Rubric-scored exam questions	1-4 proficiency scale	80% score 3 or 4	100%
Selects & applies appropriate technology tools	Rubric-scored exam questions	1-4 proficiency scale	80% score 3 or 4	69.2%

Table 5. Assessment Results for SLO a, winter 2015, Seattle Campus

Strengths: Most students demonstrated the ability to apply theoretical knowledge gained during their education to real-world problems.

Weaknesses: Some students were overwhelmed and struggled to approach the problem in a n engineering manner.

Action: I'm going to include more design project type assignments in the course and curriculum to improve on their abilities.

Direct Assessment #2 Seattle Campus

The faculty assessed this outcome in MECH 313 Thermodynamics II Winter term 2015, using an assignment scored with a rubric. There were 16 mechanical engineering students who participated in the assessment. The results are shown in Table 6.

Performance Criteria	Assessment Method	Measurement Scale	Minimum Acceptable Performance	Results
Selects & applies math principles	Rubric-scored exam questions	1-4 proficiency scale	80% score 3 or 4	93.75%
Selects & applies scientific principles	Rubric-scored exam questions	1-4 proficiency scale	80% score 3 or 4	87.5%
Selects & applies engineering principles	Rubric-scored exam questions	1-4 proficiency scale	80% score 3 or 4	87.5%
Selects & applies appropriate technology tools	Rubric-scored exam questions	1-4 proficiency scale	80% score 3 or 4	87.5%

Table 6. Assessment Results for SLO a, Winter 2015, Seattle Campus

Strengths: Most students set up the problem correctly and followed the logical steps in solving the problem.

Weaknesses: Some students did not sufficiently label their thermodynamic sketches.

Action: Emphasize the importance of fully annotated sketches and diagrams in problem solving.

<u>Indirect Assessment #1 MMET Undergraduate Exit Survey (Both KF and Seattle)</u>
During the spring term, each graduating senior completes an exit survey. The survey includes questions on how well the program prepared the student on each SLO. This survey data is reviewed by faculty to determine any strengths or weaknesses as perceived by students on this SLO. Student responses over the past three years have been aggregated for this report. There were a total of 30 responses from Klamath Falls seniors and 2 responses from Seattle seniors; for a total of 32 responses. Student responses from all locations indicate that 96.5% of all BSME students felt prepared in this outcome; see Table 7 below.

	Highly Prepared	Prepared	Inadequately Prepared
Outcome a	51.7%	44.8%	3.5%

Table 7. ME Indirect Assessment for SLO a, Senior Exit Surveys 2014-15

Summary Recommendations for Outcome (a):

The results shown above indicate that both the Klamath Falls and Seattle students are effectively able to apply knowledge of mathematics, science, and engineering

<u>SLO c. an ability to 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.</u>

The performance criteria for this learning outcome are

1. Identify an appropriate set of realistic constraints and performance criteria.
2. Generate one or more creative solutions to meet the criteria and constraints.
3. Create a detailed design within realistic constraints.
4. Plan and manage a small technical project.

Klamath Falls Campus Assessment:

<u>Direct Assessment #1 Klamath Campus</u>

The faculty assessed this outcome in MECH 316 Machine Design II Fall term 2014, using a design project scored with a rubric. There were 12 mechanical engineering students involved in the assessment. The results are shown in Table 8.

Performance Criteria	Assessment Method	Measurement Scale	Minimum Acceptable Performance	Results
Identify constraints & criteria	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	100%
Generate solutions	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	58%
Create a design	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	100%
Plan and manage a project	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	100%

Table 8. ME Assessment Results for SLO c, Fall 2014, Klamath Campus

Strengths: Students were able to examine different potential failure modes for design of parts.

Weaknesses: Incomplete analysis on part of some students, missing calculation.

Actions: Emphasize all necessary calculations in problem description.

Seattle Campus Assessment:

Direct Assessment #1 Seattle Campus

The faculty assessed this outcome in MECH 316 Machine Design II Winter term 2015, using an assignment scored with a rubric. There were13 mechanical engineering students involved in the assessment. The results are shown in Table 9. Note that the forth performance criteria "Plan and manage a project" was not assessed. This criteria is not a component of the EAC student outcomes, but is included in the MMET assessments as it applies to the ETAC criteria.

Performance Criteria	Assessment Method	Measurement Scale	Minimum Acceptable Performance	Results
Identify constraints & criteria	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	76.9%
Generate solutions	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	76.9%
Create a design	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	69.2%
Plan and manage a project	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	N/A

Table 9. ME Assessment Results for SLO c, Winter 2015, Seattle Campus

Strengths: Most students did a very good job of selecting reasonable components and designing an appropriate shaft.

Weaknesses: Some students struggled to apply the textbook knowledge to real-world problems.

Actions: I'm going to include more design project type problems in my courses.

Indirect Assessment #1 MMET Undergraduate Exit Survey (both KF and Seattle)

During the spring term, each graduating senior completes an exit survey. The survey includes questions on how well the program prepared the student on each SLO. This survey data is reviewed by faculty to determine any strengths or weaknesses as perceived by students on this SLO. Student responses over the past three years have been aggregated for this report. There were a total of 30 responses from Klamath Falls seniors and two responses from Seattle seniors; for a total of 32 responses. Student responses from all locations indicate that 86.2% of students felt prepared in this outcome. Details are included in Table 10 below.

	Highly Prepared	Prepared	Inadequately Prepared
Klamath Falls	31.0%	55.2%	13.8%

Table 10. BSME Indirect Assessment for SLO c, Senior Exit Surveys 2014-15

Summary Recommendations for Outcome (c):

The results shown above indicate that both the Klamath Falls and Seattle students are effectively able to design a system, component, or process to meet desired needs within realistic constraints. It is recommended that this outcome be assessed with at least 2 direct assessments at each campus.

SLO e. an ability to identify, formulate, and solve engineering problems.

The performance criteria for this learning outcome are
1. Identify an engineering problem.
2. Make appropriate assumptions.
3. Formulate a plan which will lead to a solution.
4. Apply engineering principles to analyze the problem.
5. Document results in an appropriate format.

Klamath Falls Campus Assessment:

Direct Assessment #1 Klamath Campus

The faculty assessed this outcome in MECH 437 Heat Transfer II Winter term 2015, using a lab report scored with a rubric. There were 32 mechanical engineering students involved in the assessment. The results are shown in Table 11.

Performance Criteria	Assessment Method	Measurement Scale	Minimum Acceptable Performance	Results
Identify an engineering problem	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	96.7%
Analysis & assumptions	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	100%
Formulate a plan	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	100%
Apply engineering principles	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	100%
Document results	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	93.3%

Table 11. ME Assessment Results for SLO e, Winter 2015, Klamath Campus

Strengths: Students have relatively good analytical and report writing skills.

Weaknesses: none.

Actions: none.

<u>Direct Assessment #2 Klamath Campus</u>

The faculty assessed this outcome in MECH 351 Finite Element Analysis Fall term 2014, using a lab report scored with a rubric. There were 19 mechanical engineering students involved in the assessment. The results are shown in Table 12.

Performance Criteria	Assessment Method	Measurement Scale	Minimum Acceptable Performanc e	Results
Identify an engineering problem	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	100%
Analysis & assumptions	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	84.2%
Formulate a plan	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	94.7%
Apply engineering principles	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	84.2%
Document results	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	94.7%

Table 12. ME Assessment Results for SLO e, Fall 2015, Klamath Campus

Strengths: Good understanding of FEA procedure; Identifiying the problem and formulating the plan to solve the problem.

Weaknesses: Setting the appropriate constraints (creating a new coordinate system for the second support) when using Creo Simulate; Computational errors; Neglect of dimensional units. .

Actions: Emphasize the importance of dimensional units; Spend more time practicing on how to apply appropriate constraints and external moment when performing FEA using Creo Simulate.

Seattle Campus Assessment:

Direct Assessment #1 Seattle Campus

The faculty assessed this outcome in MECH 437 Heat Transfer II Summer term 2015, using an assignment scored with a rubric. There were10 mechanical engineering students involved in the assessment. The results are shown in Table 13.

Performance Criteria	Assessment Method	Measurement Scale	Minimum Acceptable Performanc e	Results
Identify an engineering problem	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	100%
Analysis & assumptions	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	80%
Formulate a plan	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	100%
Apply engineering principles	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	100%
Document results	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	90%

Table 13. ME Assessment Results for SLO e, Summer 2015, Seattle Campus

Strengths: The students scored at or above the minimum acceptable performance score.

Weaknesses: None identified.

Actions: None.

Indirect Assessment #1 MMET Undergraduate Exit Survey (both KF and Seattle)

During the spring term, each graduating senior completes an exit survey. The survey includes questions on how well the program prepared the student on each SLO. This survey data is reviewed by faculty to determine any strengths or weaknesses as perceived by students on this SLO. Student responses over the past three years have been aggregated for this report. There were a total of 30 responses from Klamath Falls seniors and 2 responses from Seattle seniors; for a total of 32 responses. Student responses from all locations indicate that 96.5% of students felt prepared in this outcome. Details are included in Table 14.

	Highly Prepared	Prepared	Inadequately Prepared
Klamath Falls	51.7%	44.8%	3.5%

Table 14. ME Indirect Assessment for SLO e, Senior Exit Surveys 2014-15

Summary Recommendations for Outcome (e):

The results shown above indicate that both the Klamath Falls and Seattle students are effectively able to identify, formulate, and solve engineering problems. It is recommended that this outcome be assessed with at least 2 direct assessments at each campus.

SLO ME1. Graduates will be able to identify, formulate and solve thermal systems problems.

The performance criteria for this learning outcome are:

1. Identify an engineering problem
2. Make appropriate assumptions
3. Formulate a plan which will lead to a solution
4. Apply engineering principles to analyze the problem
5. Document results in an appropriate format

Klamath Falls Campus Assessment:

Direct Assessment #1 Klamath Campus

The faculty assessed this outcome in MECH 437 Heat Transfer II Winter term 2015, using a design project scored with a rubric. There were 30 mechanical engineering students involved in the assessment. The results are shown in Table 15.

Performance Criteria	Assessment Method	Measurement Scale	Minimum Acceptable Performance	Results
Identify an engineering problem	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	73%
Analysis & assumptions	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	63%
Formulate a plan	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	60%
Apply engineering principles	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	97%
Document results	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	97%

Table 15. ME Assessment Results for SLO ME1, Winter 2015, Klamath Campus

Strengths: Students have relatively good analytical and report writing skills.

Weaknesses: Students had difficulty identifying the problem, making assumptions and formulating a plan to solve the problem.

Actions: Spend more time emphasizing the importance of problem identification, assumptions and formulating a plan to solve the problem.

Seattle Campus Assessment:

Direct Assessment #1 Seattle Campus

The faculty assessed this outcome in MECH 437 Heat Transfer II Summer term 2015, using an assignment scored with a rubric. There were 10 mechanical engineering students involved in the assessment. The results are shown in Table 16.

Performance Criteria	Assessment Method	Measurement Scale	Minimum Acceptable Performance	Results
Identify an engineering problem	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	100%
Analysis & assumptions	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	80%
Formulate a plan	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	100%
Apply engineering principles	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	100%
Document results	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	90%

Table 16. ME Assessment Results for SLO ME1, Summer 2015, Seattle Campus

Strengths: The students scored at or above the minimum acceptable performance score

Weaknesses: None identified.

Actions: None.

Direct Assessment #2 Seattle Campus

The faculty assessed this outcome in MECH 323 heat Transfer I Spring term 2015, using an assignment scored with a rubric. There were 19 mechanical engineering students involved in the assessment. The results are shown in Table 17.

Performance Criteria	Assessment Method	Measurement Scale	Minimum Acceptable Performance	Results
Identify an engineering problem	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	78.9%
Analysis & assumptions	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	94.7%
Formulate a plan	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	89.5%
Apply engineering principles	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	89.5%
Document results	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	89.5%

Table 17. ME Assessment Results for SLO ME1, Spring 2015, Seattle Campus

Strengths: Students tackled the problem different ways and generally solved the problem correctly.

Weaknesses: Students did not include all of the important information in defining the problem.

Actions: This part of clearly identifying the engineering problem will be stressed in the future.

Indirect Assessment #1 MMET Undergraduate Exit Survey (both KF and Seattle)

During the spring term, each graduating senior completes an exit survey. The survey includes questions on how well the program prepared the student on each SLO. This survey data is reviewed by faculty to determine any strengths or weaknesses as perceived by students on this SLO. Student responses over the past three years have been aggregated for this report. There were a total of 30 responses from Klamath Falls seniors and 2 responses from Seattle seniors; for a total of 32 responses. Student responses from all locations indicate that 86.2% of students felt prepared in this outcome. Details are included in Table 18.

	Highly Prepared	Prepared	Inadequately Prepared
Klamath Falls	17.2%	69.0%	13.8%

Table 18. ME Indirect Assessment for SLO ME1, Senior Exit Surveys 2014-15

Summary Recommendations for Outcome (me1):

The results shown above indicate that both the Klamath Falls and Seattle students are effectively able to work professionally in the area of thermal systems. It is recommended that this outcome be assessed with at least 2 direct assessments at each campus.

SLO ME2. Graduates will be able to identify, formulate and solve mechanical systems problems.

The performance criteria for this learning outcome are:

1. Identify an engineering problem
2. Make appropriate assumptions
3. Formulate a plan which will lead to a solution
4. Apply engineering principles to analyze the problem
5. Document results in an appropriate format

Klamath Falls Campus Assessment:

Direct Assessment #1 Klamath Campus

The faculty assessed this outcome in MECH 316 Machine Design II Fall term 2014, using a design project scored with a rubric. There were 12 mechanical engineering students involved in the assessment. The results are shown in Table 19.

Performance Criteria	Assessment Method	Measurement Scale	Minimum Acceptable Performance	Results
Identify an engineering problem	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	100%
Analysis & assumptions	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	100%
Formulate a plan	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	100%
Apply engineering principles	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	100%
Document results	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	92%

Table 19. ME Assessment Results for SLO ME2, Fall 2014, Klamath Campus

Strengths: Students have relatively good analytical and report writing skills.

Weaknesses: Students had difficulty identifying the problem, making assumptions and formulating a plan to solve the problem.

Actions: Spend more time emphasizing the importance of problem identification, assumptions and formulating a plan to solve the problem.

Direct Assessment #2 Klamath Campus

The faculty assessed this outcome in MECH 480 Vibrations Winter term 2015, using a problem scored with a rubric. There were 30 mechanical engineering students involved in the assessment. The results are shown in Table 20.

Performance Criteria	Assessment Method	Measurement Scale	Minimum Acceptable Performance	Results
Identify an engineering problem	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	100%
Analysis & assumptions	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	83%
Formulate a plan	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	67%
Apply engineering principles	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	33%
Document results	Rubric-scored project	1-4 proficiency scale	80% score 3 or 4	100%

Table 20. ME Assessment Results for SLO ME2, Winter 2015, Klamath Campus

Strengths: Successful identification of system type; Proper application of relevant scientific/engineering principles.

Weaknesses: Frequency Response Misconceptions; Computational Errors; Neglect of Dimensional Units; Disrespect of Significant Figures.

Actions: Reiterate importance of understanding basic concepts, checking all computations, including appropriate units, and expressing correct significant figures.

Seattle Campus Assessment:

No Seattle campus assessments were completed for this outcome.

Action: This outcome needs to be assessed during the 2015 – 2015 assessment cycle.

Indirect Assessment #1 MMET Undergraduate Exit Survey (both KF and Seattle)

During the spring term, each graduating senior completes an exit survey. The survey includes questions on how well the program prepared the student on each SLO. This survey data is reviewed by faculty to determine any strengths or weaknesses as perceived by students on this SLO. Student responses over the past three years have been aggregated for this report. There were a total of 30 responses from Klamath Falls seniors and 2 responses from Seattle seniors. Student responses from all locations indicate that 96.5% of students felt prepared in this outcome. Details are included in Table 21.

	Highly Prepared	Prepared	Inadequately Prepared
Klamath Falls	58.6%	37.9%	3.5%

Table 21. ME Indirect Assessment for SLO ME1, Senior Exit Surveys 2014-15

Summary Recommendations for Outcome (me2):

The results shown above indicate that both the Klamath Falls and Seattle students are effectively able to work professionally in the area of thermal systems. One area that should be watched is the students' ability to apply engineering principles. It is recommended that this outcome be assessed with at least 2 direct assessments at each campus.

SUMMARY OF STUDENT LEARNING OUTCOMES & ACTIONS TAKEN

This year the BSME Program at both Klamath Falls and Seattle assessed outcomes a, c, e, me1, and me2. The students at both campuses performed well in all of the assessments given. However, for several outcomes the MMET Department did not give the students two direct assessments at each campus. Also, since the BSME program started last year at the Seattle campus there were only two students available to take the indirect-assessment senior survey.

FUTURE ACTION ITEMS – to be completed before next assessment cycle, fall 2015

1) Assess Outcome me1 at the Seattle campus before the next ABET visit.

2) Organize the material on the T-drive to make it easier to find our assessment material.

3) Assess each outcome with two direct methods and one indirect method; and do this at both the main campus in Klamath Falls and the Seattle campus.

APPENDIX I

Student Learning Outcomes - Curriculum Maps

The curriculum maps below show the courses in which each SLO is introduced, emphasized or reinforced. This is a continuum as most SLOs are considered in all courses. However, the maps presented indicate the courses most instrumental in obtaining each SLO.

OUTCOME (a): Mathematics, Science & Core Engineering

	Freshman		***Sophomore***		***Junior***		***Senior***	
Fall	CHE 201/04	E	MATH 252	E	MATH 341	E	MECH 323	R
	MET 111	I	MET 242	E	MFG 314		MECH 351	R
	WRI 121		PHY 221	E	MECH 318	R	MECH 490	R
	Hum/Soc Sci		WRI 227		MECH 363	E	WRI 327	
			Econ Elec		MET 375	E	MECH Elec	R
							Hum/Soc Sci	
Winter	CHE 202/05	E	ENGR 211	E	ENGR 212	E	MECH 417	R
	MET 112	I	MATH 254N	E	ENGR 355	E	MECH 437	R
	MFG 103		MATH 361	E	MECH 315	R	MECH 480	R
	WRI 122		PHY 222	E	MECH 360	R	MECH 491	R
					MET 326		PHIL 331	
					SPE 321		Hum/Soc Sci	
Spring	MATH 251	E	ENGR 266	E	HUM 125		ENGR 485	
	MFG 120		ENGR 213	E	MATH 451	E	MGT 345	
	MET 160	E	ENGR 236	E	MECH 313		MECH 436	R
	MET 241	E	MATH 321	E	MECH 316		MECH 492	R
	SPE 111		PHY 223	E	MECH Elec	R	MECH Elec	R
							Hum/Soc Sci	

I = Introduced
R = Reinforced
E = Emphasized

OUTCOME (c): Design of System, Components, or Processes

	Freshman		***Sophomore***		***Junior***		***Senior***	
Fall	CHE 201/04		MATH 252		MATH 341		MECH 323	R
	MET 111	E	MET 242	R	MFG 314		MECH 351	R
	WRI 121		PHY 221		MECH 318	E	MECH 490	E
	Hum/Soc Sci		WRI 227		MECH 363	R	WRI 327	
			Econ Elec		MET 375	R	MECH Elec	R
							Hum/Soc Sci	
Winter	CHE 202/05		ENGR 211		ENGR 212	R	MECH 417	R
	MET 112	E	MATH 254N		ENGR 355	R	MECH 437	R
	MFG 103		MATH 361		MECH 315	R	MECH 480	R
	WRI 122		PHY 222		MECH 360		MECH 491	E
					MET 326		PHIL 331	
					SPE 321		Hum/Soc Sci	
Spring	MATH 251		ENGR 266		HUM 125		ENGR 485	
	MFG 120		ENGR 213	R	MATH 451	R	MGT 345	
	MET 160		ENGR 236		MECH 313	R	MECH 436	R
	MET 241	R	MATH 321		MECH 316	E	MECH 492	E
	SPE 111		PHY 223		MECH Elec	R	MECH Elec	R
							Hum/Soc Sci	

I = Introduced
R = Reinforced
E = Emphasized

OUTCOME (e): Identify, Formulate, and Solve Engineering Problems

	Freshman		***Sophomore***		***Junior***		***Senior***	
Fall	CHE 201/04		MATH 252		MATH 341		MECH 323	E
	MET 111	I	MET 242		MFG 314		MECH 351	E
	WRI 121		PHY 221		MECH 318	E	MECH 490	E
	Hum/Soc Sci		WRI 227		MECH 363	E	WRI 327	
			Econ Elec		MET 375		MECH Elec	E
							Hum/Soc Sci	
Winter	CHE 202/05		ENGR 211		ENGR 212	E	MECH 417	E
	MET 112	I	MATH 254N		ENGR 355	E	MECH 437	E
	MFG 103		MATH 361		MECH 315	E	MECH 480	E
	WRI 122		PHY 222		MECH 360	E	MECH 491	E
					MET 326		PHIL 331	
					SPE 321		Hum/Soc Sci	
Spring	MATH 251		ENGR 266	E	HUM 125		ENGR 485	R
	MFG 120		ENGR 213	E	MATH 451	E	MGT 345	
	MET 160	I	ENGR 236	E	MECH 313	E	MECH 436	E
	MET 241		MATH 321		MECH 316	E	MECH 492	E
	SPE 111		PHY 223		MECH Elec	E	MECH Elec	E
							Hum/Soc Sci	

I = Introduced
R = Reinforced
E = Emphasized

OUTCOME (m1): Thermal Systems Professional Work

	Freshman		***Sophomore***		***Junior***		***Senior***	
Fall	CHE 201/04		MATH 252		MATH 341		MECH 323	E
	MET 111		MET 242		MFG 314		MECH 351	
	WRI 121		PHY 221		MECH 318	E	MECH 490	R
	Hum/Soc Sci		WRI 227		MECH 363	E	WRI 327	
			Econ Elec		MET 375		MECH Elec	R
							Hum/Soc Sci	
Winter	CHE 202/05		ENGR 211		ENGR 212		MECH 417	E
	MET 112		MATH 254N		ENGR 355	E	MECH 437	E
	MFG 103		MATH 361		MECH 315		MECH 480	
	WRI 122		PHY 222	I	MECH 360		MECH 491	R
					MET 326		PHIL 331	
					SPE 321		Hum/Soc Sci	
Spring	MATH 251		ENGR 266		HUM 125		ENGR 485	
	MFG 120		ENGR 213		MATH 451		MGT 345	
	MET 160		ENGR 236		MECH 313	E	MECH 436	
	MET 241		MATH 321		MECH 316		MECH 492	R
	SPE 111		PHY 223		MECH Elec	R	MECH Elec	R
							Hum/Soc Sci	

I = Introduced
R = Reinforced
E = Emphasized

OUTCOME (m2): Mechanical Systems Professional Work

	Freshman		***Sophomore***		***Junior***		***Senior***	
Fall	CHE 201/04		MATH 252		MATH 341		MECH 323	
	MET 111		MET 242		MFG 314		MECH 351	E
	WRI 121		PHY 221	I	MECH 318		MECH 490	R
	Hum/Soc Sci		WRI 227		MECH 363		WRI 327	
			Econ Elec		MET 375		MECH Elec	R
							Hum/Soc Sci	
Winter	CHE 202/05		ENGR 211	E	ENGR 212	E	MECH 417	
	MET 112		MATH 254N		ENGR 355		MECH 437	
	MFG 103		MATH 361		MECH 315	E	MECH 480	E
	WRI 122		PHY 222		MECH 360		MECH 491	R
					MET 326		PHIL 331	
					SPE 321		Hum/Soc Sci	
Spring	MATH 251		ENGR 266		HUM 125		ENGR 485	
	MFG 120		ENGR 213	E	MATH 451		MGT 345	
	MET 160		ENGR 236		MECH 313		MECH 436	E
	MET 241		MATH 321		MECH 316	E	MECH 492	R
	SPE 111		PHY 223		MECH Elec	R	MECH Elec	R
							Hum/Soc Sci	

I = Introduced
R = Reinforced
E = Emphasized

APENDIX II
RUBRICS

The rubrics used for the 2013 – 2014 BSME Program assessments are shown below. The proficiency scale for all of the rubrics is as follows:

Proficiency Scale (see rubric)

4 High proficiency

3 Proficiency

2 Some proficiency

1 Limited or no proficiency

Rubric for Math, Science, Engineering & Technology

ETAC SLO b: An ability to apply current knowledge and adapt to emerging applications of mathematics, science, engineering and technology.
EAC SLO a: Graduates will have the ability to apply mathematics, science and engineering.

Performance Criteria	(1) Limited or No Proficiency	(2) Some Proficiency	(3) Proficiency	(4) High Proficiency	Score
Apply math principles to obtain analytical or numerical solution(s) to an engineering problem.	Unable to apply prerequisite math concepts to new problems. Makes significant errors in computation and/or logic.	With extensive guidance, applies prerequisite math concepts to new problems. Computations may not include all important elements or steps. Order may not be logical.	Applies prerequisite math concepts to new problems, but may need some guidance. Correctly performs basic computations in a logical order.	Independently applies prerequisite math concepts to new problems. Selects correct math principles. Performs correct, thorough, clear computations in a logical order.	
Apply scientific principles that govern the performance of a given process or system in engineering problem(s).	Unable to apply prerequisite scientific concepts to new problems. Makes significant errors in computation and/or logic.	With extensive guidance, applies prerequisite scientific concepts to new problems. Computations may not include all important elements or steps. Order may not be logical.	Applies prerequisite scientific concepts to new problems, but may need some guidance. Correctly performs basic computations in a logical order.	Independently applies prerequisite scientific concepts to new problems. Selects correct scientific principles. Performs computations in a logical order.	
Apply engineering principles that govern the performance of a given process or system in engineering problem(s).	Unable to apply prerequisite engineering concepts to new problems. Makes significant errors in computation and/or logic.	With extensive guidance, applies prerequisite engineering concepts to new problems. Computations may not include all important elements or steps. Order may not be logical.	Applies prerequisite engineering concepts to new problems, but may need some guidance. Correctly performs basic computations in a logical order.	Independently applies prerequisite engineering concepts to new problems. Selects correct engineering principles. Performs computations in a logical order.	
Apply appropriate technology tools (software, equipment, CAD, CNC, instrumentation, etc.) for a given process or system to an engineering problem.	Unable to select and apply appropriate technology tools or does not demonstrate understanding of tools selected.	With extensive guidance, selects and properly applies appropriate technology tools. Demonstrates some understanding of tools selected.	Selects and properly applies appropriate technology tools, but may need guidance. Demonstrates basic understanding of tools selected.	Independently selects and properly applies appropriate technology tools. Demonstrates thorough understanding of tools selected.	

Rubric for Designing a System, Component or Process

ETAC SLO d: An ability to apply creativity in the design of systems, components or processes within realistic constraints.
EAC SLO c: Graduates will be able to 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.

Performance Criteria	(1) Limited or No Proficiency	(2) Some Proficiency	(3) Proficiency	(4) High Proficiency	Score
Identify an appropriate set of realistic constraints and performance criteria.	A large number of codes, standards or performance criteria are missing or unclear.	Is able to identify some codes & standards, but important elements are missing. Identifies & documents some performance criteria, but important elements are missing or unclear.	Presents basic relevant codes & standards. Identifies and documents performance criteria in a basic manner.	Thoroughly presents most important, relevant codes & standards applying to project. Clearly identifies & documents in-depth performance criteria.	
Generate one or more creative solutions to meet the criteria and constraints.	Is unable to generate a creative, workable, usable, or realistic solution. Does not recognize constraints or identify criteria.	Generates a solution but does not demonstrate creativity or the ability to think through alternatives. Design may not be workable, usable or realistic. Misses important constraints or criteria.	Generates a basic solution demonstrating creativity in the design. Recognizes basic criteria and constraints.	Generates one or more workable, usable, or creative solutions. Demonstrates ability to see unique alternatives. Recognizes and addresses constraints thoroughly.	
Create a detailed design within realistic constraints.	Is unable to create a design with sufficient detail or documentation. Does not address constraints.	Design has some, but inadequate detail or documentation or does not address constraints.	Creates design with adequate detail and documentation. Incorporates and addresses constraints.	Applies engineering principles. Creates design with high level of detail and appropriate documentation. Thoroughly addresses constraints.	
Plan and manage a small technical project.	Does not develop a task/timeline, does not implement project with success, or does not provide documentation. Does not meet deadline.	Defines task and timeline with some elements missing or unrealistic. Implements project but misses important elements. Documentation is provided but needs more detail. May not meet deadline.	Defines basic tasks and timelines, implements project, including testing and basic documentation, meets deadline.	Defines realistic and detailed tasks and timelines, implements project in exemplary fashion, performs thorough testing, documents important procedures or processes in detail, completes plan on time.	

Rubric for Solving Engineering Problems

ETAC SLO f: An ability to identify, formulate, analyze and solve engineering problems.
EAC SLO e: Graduates will be able to identify, formulate, and solve engineering problems.

Performance Criteria	(1) Limited or No Proficiency	(2) Some Proficiency	(3) Proficiency	(4) High Proficiency	Score
Identify an engineering problem.	Does not identify the problem clearly.	Defines problem but has missing elements or does not include important information.	Adequately defines problem, including sufficient basic information.	Clearly identifies problem or reiterates given problem, including underlying principles and scope. Demonstrates depth of understanding.	
Make appropriate assumptions.	Does not identify assumptions or constraints, or makes errors in attempting to do so.	Identifies some assumptions and constraints but important elements are missing.	Identifies basic assumptions and constraints.	Clearly delineates realistic constraints & important assumptions that affect solution. Includes assumptions that are workable, usable, and/or valid.	
Formulate a plan which will lead to a solution.	Does not develop a coherent plan to solve the problem.	Develops a marginal plan with some important elements missing.	Develops an adequate plan that leads to a plausible solution.	Develops a coherent and concise plan to solve the problem with alternative strategies and a clear path to solution. Plan smoothly flows from problem statement and assumptions.	
Apply engineering principles to analyze the problem.	Does not use appropriate principles for analysis.	Performs a partial analysis, with some important elements or analyses missing.	Performs basic analysis using appropriate principles to solve problem.	Correctly applies analytical tools or techniques and analyzes problem in depth. Clearly solves the problem.	
Document results in an appropriate format.	Does not follow format or does not include understandable documentation.	Follows format but has missing elements. Documentation is incomplete or unclear.	Follows format and produces understandable documentation.	Follows given format in detail. Documentation is clear, understandable, polished and organized.	

Rubric for Work Professionally in Thermal Systems

EAC SLO m1: An ability to work professionally in the area of thermal systems

Performance Criteria	(1) Limited or No Proficiency	(2) Some Proficiency	(3) Proficiency	(4) High Proficiency	Score
Identify an engineering problem	Does not identify the problem.	Defines problem but has missing elements or does not include important information	Adequately defines problem, including sufficient basic information.	Clearly identifies problem or reiterates given problem, including underlying principles and scope. Demonstrates depth of understanding.	
Make appropriate assumptions.	Does not identify assumptions or constraints, or makes errors in attempting to do so.	Identifies some assumptions and constraints but important elements are missing.	Identifies basic assumptions and constraints.	Clearly delineates realistic constraints & important assumptions that affect solution. Includes assumptions that are workable, usable, and/or valid.	
Formulate a plan with will lead to a solution.	Does not develop a coherent plan to solve the problem.	Develops a marginal plan with some important elements missing.	Develops an adequate plan that leads to a plausible solution.	Develops a coherent and concise plan to solve the problem with alternative strategies and a clear path to solution. Plan smoothly flows from problem statement and assumptions.	
Apply engineering principles to analyze the problem.	Does not use appropriate principles for analysis.	Performs a partial analysis, with some important elements or analyses missing.	Performs basic analysis using appropriate principles to solve problem.	Correctly applies analytical tools or techniques and analyzes problem in depth. Clearly solves the problem.	
Document results in a appropriate format.	Does not follow format or does not include understandable documentation.	Follows format but has missing elements. Documentation is incomplete or unclear.	Follows format and produces understandable documentation.	Follows given format in detail. Documentation is clear, understandable, polished and organized.	

Rubric for Work Professionally in Mechanical Systems

EAC SLO m2: An ability to work professionally in the area of mechanical systems

Performance Criteria	(1) Limited or No Proficiency	(2) Some Proficiency	(3) Proficiency	(4) High Proficiency	Score
Identify an engineering problem	Does not identify the problem.	Defines problem but has missing elements or does not include important information	Adequately defines problem, including sufficient basic information.	Clearly identifies problem or reiterates given problem, including underlying principles and scope. Demonstrates depth of understanding.	
Make appropriate assumptions.	Does not identify assumptions or constraints, or makes errors in attempting to do so.	Identifies some assumptions and constraints but important elements are missing.	Identifies basic assumptions and constraints.	Clearly delineates realistic constraints & important assumptions that affect solution. Includes assumptions that are workable, usable, and/or valid.	
Formulate a plan with will lead to a solution.	Does not develop a coherent plan to solve the problem.	Develops a marginal plan with some important elements missing.	Develops an adequate plan that leads to a plausible solution.	Develops a coherent and concise plan to solve the problem with alternative strategies and a clear path to solution. Plan smoothly flows from problem statement and assumptions.	
Apply engineering principles to analyze the problem.	Does not use appropriate principles for analysis.	Performs a partial analysis, with some important elements or analyses missing.	Performs basic analysis using appropriate principles to solve problem.	Correctly applies analytical tools or techniques and analyzes problem in depth. Clearly solves the problem.	
Document results in a appropriate format.	Does not follow format or does not include understandable documentation.	Follows format but has missing elements. Documentation is incomplete or unclear.	Follows format and produces understandable documentation.	Follows given format in detail. Documentation is clear, understandable, polished and organized.	