Mechanical Engineering Program
2013-1014 Assessment Report

## INTRODUCTION

This report documents the assessment done within the Mechanical Engineering (ME) program at Oregon Institute of Technology during the 2013-14 academic year. New this year to the Oregon Tech BSME program is the accreditation by extension of the Oregon Tech Seattle BSME program. Accreditation was extended by ABET EAC to Oregon Tech's Seattle campus during the summer of 2013; the BSME program is now offered at both our Klamath Falls, Oregon main campus and our extension campus located in the Seattle area. Thus, starting this year the yearly BSME Assessment Reports will include data for both campuses.

Note that the Manufacturing and Mechanical Engineering and Technology (MMET) Department is located on a third Oregon Tech campus in Wilsonville, Oregon. Undergraduate MMET programs at this 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 core departmental courses.

The ME 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 2013-1014 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.

## ASSESSMENT CYCLE

Assessment within the MMET Department is done on a three-year cycle, with each outcome assessed at least once every three years. The normal assessment of each outcome includes two direct assessments and one indirect assessment. The schedule for assessment activities for the ME Program is shown below in Table 1.

Table 1: BSME Assessment Cycle at Oregon Tech

| *Educational Outcome* | *2013-14* | *2014-15* | *2015-16* |
|---|---|---|---|
| *Review Program Mission and Educational Objectives* | | *x* | |
| Assess Program Educational Objectives | | | x |
| Graduates will have the 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. | | x | |
| Graduates will have the ability to design and conduct experiments, as well as to analyze and interpret data. | x | | |
| Graduates will be able 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. | | x | |
| Graduates will be able to function on multi-disciplinary teams. | | | x |
| e) Graduates will be able to identify, formulate, and solve engineering problems. Graduates will be able to analyze and model physical systems or components using principles of engineering, basic science and mathematics (including multivariate calculus and differential equations) to model, analyze, design, and realize physical systems or components. | | x | |
| f) Graduates will have an understanding of professional and ethical responsibility. | | | x |
| g) Graduates will have the ability to communicate effectively. | x | | |
| h) Graduates will have the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. | | | x |
| i) Graduates will recognize the need for, and have the ability to engage in life-long learning. | x | | |
| j) Graduates will have knowledge of contemporary issues. | x | | |
| k) Graduates will be able to use the techniques, skills, and modern engineering tools necessary for engineering practice. | x | | |
| 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 | |

Note that ME Program Mission and Program Educational Objectives (PEO) and the program Student Learning Outcomes (SLO) are also included on this three-year assessment cycle.

## MISSION STATEMENT AND PROGRAM EDUCATIONAL OBJECTIVES REVIEW

The MMET Faculty reviewed the following items during convocation on September 18, 2013: 1) program mission, 2) educational objectives, 3) EAC Student Learning Outcomes (a-j; plus m1 and m2) and 4) yearly cycle of assessment including mission, objectives and outcomes. The Faculty of MMET, with representatives from the three campuses determined that the current educational objectives and learning outcomes accurately represent the department's views about our BSME program. During that meeting, new faculty members were informed as to how the assessment system works in our department and that they would participate in the process in the future through collecting and scoring student work from their assigned classes as needed for the SLO's under consideration in any particular year.

As a follow-up on closing-the-loop items identified in the 2012-2013 report, faculty had a conversation about teamwork and the possibility of having either/both MECOP students coming off an internship or seniors that have already completed senior projects to come in and talk to teams about the importance of accountability, timeliness and professionalism, not only related to group projects at school but how important that is in industry settings. The second item discussed was that more emphasis would be placed on requiring and reviewing engineering drawings across the programs to reinforce the importance of communicating design intent and assuring completeness on drawings for projects and assignments.

A follow up survey was distributed to all IAC members soliciting feedback on the programs in general and the specific program educational objectives. Fourteen members of the IAC responded providing comments about the current program and recommendations for potential improvements. In general the comments focused on the strength of the hands on nature of the MMET programs and called for additional emphasis on team based projects and communication skills, especially oral communication. At the Spring 2014 IAC meeting held on April 19$^{th}$ in Klamath Falls and attended by faculty and industry representatives in Wilsonville, the PEO's for the BSME program were reviewed and approved.

## SUMMARY OF 2013-2014 ASSESSMENT ACTIVITIES

As seen in the above assessment cycle, outcomes b, g, i, j, and k were scheduled to be assessed during the 2013-14 academic year. In addition, an Oregon Tech university-wide outcome on Critical Thinking was also assessed. The results of these assessments are shown below, starting with the Oregon Tech Critical Thinking outcome.

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 this year, there were no students who filled out the survey. Thus, all of the indirect results shown in this report are for the Klamath Falls students only.

## OIT wide outcome: Critical Thinking

The Oregon Tech university-wide Critical Thinking outcome is stated as follows:

"Graduates will be able to think through difficult problems and judge their assumptions models and means in formulating solutions and determine expected accuracy of their judgments."

### Klamath Falls Campus Assessment:

Direct Assessment #1 Klamath Falls Campus

At the Klamath Falls campus this outcome was directly assessed Winter 2014 in MECH 417 Fluid Mechanics II, which has both a lecture and a laboratory component as part of the course; 20 BSME students took part in this assessment. A laboratory project was selected that covered three different disciplines, where an answer was not calculable using normal methods. Lead was superheated and poured into a gated trough. The trough was at a slight angle (~10 degree) and made of 3 inch wide by 1 inch tall C channel that is quarter inch thick. The students had to calculate how far the molten lead would run until it solidified. The three disciplines covered were material science, fluids and heat transfer. The hopes of the project were to obtain a summative assessment of their critical thinking in developing models to predict the behavior.

Critical Thinking was evaluated using 3 categories (see appendix II for the rubric); the categories and the resultant scores are shown in Table 2 below:

Table 2. Fluid Mechanics II Assessment Results for OIT Critical Thinking

| Performance Criteria | Minimum Acceptable Performance | Results |
|---|---|---|
| Assumptions | 80% score 3 or 4 | 90% (18/20) |
| Clarification | 80% score 3 or 4 | 90% (18/20) |
| Evaluation | 80% score 3 or 4 | 95% (19/20) |

Instructor comments: Over the 3 weeks of the lab, students asked many questions. Rather than leave them hanging, the summative assessment became more and more a formative assessment in order to produce a more capable student. So the results may be skewed high. However, their inquiries showed a healthy curiosity, which is also important to critical thinking. Therefore, although the study lacked purity, I believe it is valid enough and also produces a better student and should therefore be used again in the future.

Indirect Assessment Klamath Falls

This outcome was also assessed as part of the yearly MMET Departmental Exit Survey of our Senior-Level students, which gives us an indirect measurement of this outcome. The results for critical thinking of Seniors showed of 18 responses on a scale of 1 (no/limited proficiency) to 4 (highly proficient) that our seniors self-evaluated with 33% indicating Proficiency (score of 3) and 67% indicating High Proficiency (score of 4).

**Seattle Campus Assessment:**

This outcome was not assessed at the Seattle Campus. In the future we need to make sure that the Seattle Campus participates in both the ABET and Oregon Tech university-wide assessment exercises.

**SLO b. An ability to design and conduct experiments, as well as to analyze and interpret data.**

The performance criteria for this learning outcome are:
Ability to conduct experiments.
Ability to analyze and interpret data.
Ability to use experimental results to improve processes.

**Klamath Falls Campus Assessment:**

At the Klamath Falls campus assignments in MECH 437 Heat Transfer II and MECH 417 Fluid Mechanics II were used to assess this outcome; both of these course contain both a lecture and a laboratory component. Unfortunately the student work for both of these assessment activities cannot be found.

Direct Assessment #1 Klamath Falls Campus

The faculty assessed this outcome in MECH 417 Fluid Mechanics II Winter 2014, using a rubric-graded laboratory assignment. There were 26 mechanical engineering students involved in the assessment. The results are shown in Table 3 below.

Table 3. Fluid Mechanics II Assessment Results for SLO b, Experimentation

| Performance Criteria | Minimum Acceptable Performance | Results |
|---|---|---|
| Design an experiment | 80% score 3 or 4 | 88% 23/26 |
| Conduct an experiment | 80% score 3 or 4 | 92% 24/26 |
| Analyze data | 80% score 3 or 4 | 80% 21/26 |

Strengths: The students showed an overall eagerness to dive in and apply their knowledge.

Weaknesses: None.

Actions: None.

Direct Assessment #2 Klamath Falls Campus

The data for this assignment was collected from MECH 437 Heat Transfer II during the Winter 2012 term, using a rubric-graded laboratory assignment. This data was then assessed during the 2013 – 2014 assessment cycle. There were 21 mechanical engineering students involved in the assessment. The results are shown in Table 4 below.

Table 4. Heat Transfer II Assessment Results for SLO b, Experimentation

| Performance Criteria | Minimum Acceptable Performance | Results |
|---|---|---|
| Design an experiment | 80% score 3 or 4 | 86% 18/21 |
| Conduct an experiment | 80% score 3 or 4 | 90% 19/21 |
| Analyze data | 80% score 3 or 4 | 90% 19/21 |

Strengths: Ability to apply and investigate.

Weaknesses: Some lacking depth of analysis but adequate overall.

Actions: The student work should be collected nearer to the assessment cycle year; this assessment was made using student work from two years ago.

Indirect Assessment #1 MMET Undergraduate Exit Survey

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.

In spring of 2014, 20 ME students in senior projects completed an exit survey. Students were asked to *"Please rate how well the Mechanical Engineering Program prepared you in the following areas: To design and conduct experiments, as well as to analyze and interpret data."* Table 5 shows the results of this inquiry.

Table 5: Senior Project Exit Survey, Experimentation

| | Highly Prepared | Prepared | Inadequately Prepared |
|---|---|---|---|
| To design and conduct experiments/analyze data | 55.6% | 38.9% | 5.6% |

One student still felt unprepared for experimentation or analysis. Most however feel highly prepared.

**Seattle Campus Assessment:**

At the Seattle campus this outcome was directly assessed in MET 160 Materials I; this course contains both a lecture and a laboratory component.

Direct Assessment #1 Seattle Campus

The faculty assessed this outcome in MET 160 Materials I Winter 2014, using a rubric-graded laboratory assignment. There were 6 mechanical engineering students involved in the assessment. The results are shown in Table 6 below.

Table 6. Materials I Assessment Results for SLO b, Experimentation

| Performance Criteria | Minimum Acceptable Performance | Results |
|---|---|---|
| Conduct an experiment | 80% score 3 or 4 | 100% |
| Analyze Data | 80% score 3 or 4 | 100% |
| Use the results to improve a process | 80% score 3 or 4 | 100% |

Indirect Assessment #1 MMET Undergraduate Exit Survey

Since the BSME program in Seattle was new this year, there were no students who filled out the survey.

**Summary Recommendations for Outcome (b):**

The results shown above indicate that both the Klamath Falls and Seattle students have good experimentation skills. However, the MMET Department needs to do a better job in saving the student work used for our assessment process.

**SLO (g) Communication: Graduates will have the ability to communicate effectively.**

This outcome was broken up into two different portions, written communications and oral communications.

The performance criteria for written communication are:

Clearly conveys purpose and main ideas (purpose and ideas).
Organizes written material effectively (organization)
Supports main ideas adequately with detail and/or research (support).
Uses appropriate voice, word choice and sentence structure (style).
Uses standard English (conventions).
Documents support correctly and responsibly (documentation).

The performance criteria for oral communication are:

Supports thesis adequately with detail and/or research, and documents support correctly and responsibly (content).
Organizes oral material effectively (organization)

Presents appropriately for audience and purpose (style).
Speaks clearly and correctly, using standard English (delivery).
Uses visual communication effectively (visuals).

**Klamath Falls Campus Assessment:**

At the Klamath Falls campus a written assignment given in Senior Projects was used to assess the written portion of this outcome. In Klamath Falls no oral assessment was done.

Direct Assessment #1 Klamath Falls Campus

The faculty assessed the written portion of this outcome in Senior Projects II Winter 2014, using a rubric-graded student paper on life-long learning, and combined results from two sections: Professor Moravec and Professor Stuart. There were 10 mechanical engineering students involved in the assessment. The results are shown in Table 7 below.

Table 7 Senior Project II Assessment Results for SLO g, Written Communication

| Performance Criteria | Minimum Acceptable Performance | Results |
|---|---|---|
| Purpose and Ideas | 80% score 3 or 4 | 100% |
| Organization | 80% score 3 or 4 | 100% |
| Support | 80% score 3 or 4 | 100% |
| Style | 80% score 3 or 4 | 100% |
| Conventions | 80% score 3 or 4 | 100% |
| Documentation | 80% score 3 or 4 | 40% |

The students scored well in all areas of this assessment except for Documentation. More emphasis on proper documentation should be given by the faculty.

Indirect Assessment #1 MMET Undergraduate Exit Survey

In spring of 2014, 20 ME students in senior projects completed an exit survey. Students were asked to *"Please rate how well the Mechanical Engineering Program prepared you in the following areas: To have the ability to communicate effectively."* Table 8 shows the results of this inquiry.

Table 8 : Senior Project Exit Survey, Communication

| | Highly Prepared | Prepared | Inadequately Prepared |
|---|---|---|---|
| To have the ability to communicate effectively | 77.8% | 11.1% | 11.1% |

Most students feel highly prepared – although 2 felt the opposite. The students' confidence seems to come out in their presentations. The Industry Advisory Council however continues to emphasize a desire to improve communication skills in graduates. It is unclear if they are speaking of students from all colleges or ours specifically. This questions needs to be addressed to the council more directly.

**Seattle Campus Assessment:**

At the Seattle campus the oral portion of this outcome was directly assessed in one course, Senior Project I; no written assessment was done.

Direct Assessment #1 Seattle Campus

The faculty assessed the oral portion of this outcome in Senior Projects I Fall 2013, using a rubric-graded presentation. There were 6 mechanical engineering students involved in the assessment. The results are shown in Table 9 below.

Table 9 Senior Project I Assessment Results for SLO g, Oral Communication

| Performance Criteria | Minimum Acceptable Performance | Results |
|---|---|---|
| Content | 80% score 3 or 4 | 100% |
| Organization | 80% score 3 or 4 | 100% |
| Style | 80% score 3 or 4 | 83% |
| Delivery | 80% score 3 or 4 | 100% |
| Visuals | 80% score 3 or 4 | 100% |

The students scored well in all areas of this assessment.

Indirect Assessment #1 MMET Undergraduate Exit Survey

Since the BSME program in Seattle was new this year, there were no students who filled out the survey.

**Summary Recommendations for Outcome (g):**

The results shown above indicate that both the Klamath Falls and Seattle students have good communication skills. However, both written and oral communications skills need to be better assessed at both campuses.

**OUTCOME (i) Lifelong learning Graduates will recognize the need for, and have the ability to engage in life-long learning.**

The performance criteria for this learning outcome are:

1. Identify and discuss the concept of lifelong learning.
2. Demonstrate awareness of the need for professional development to remain current.
3. Describe short- and long-term career plans.

**Klamath Falls Campus Assessment:**

In Klamath Falls this outcome was assessed in only one course, MECH 491 Senior Project II. Note that this outcome was assessed in two of the three sections of MECH 491 offered during the 2013 – 2014 academic year.

Direct Assessment #1 Klamath Campus

The faculty assessed this outcome in MECH 491 Senior Project II, winter 2014, using a rubric-graded written assignment. There were 10 BSME students involved in the assessment. The results are shown in Table 10 below.

Table 10. Lifelong learning assessment Klamath Falls

| Performance Criteria | Minimum Acceptable Performance | Results |
|---|---|---|
| Lifelong learning | 80% at 3 or 4 | 100% |
| Professional Development | 80% at 3 or 4 | 100% |
| Short and long term career plans | 80% at 3 or 4 | 100% |

The students scored well in all areas of this assessment.

Indirect Assessment #1 MMET Undergraduate Exit Survey

Of 20 graduates canvassed, 3 plan to continue their education – all with OIT. Also, when asked how well they, "recognize the need for, and have the ability to engage in life-long learning." They responded as follows in Table 11:

Table 11. Survey Results for SLO i, Lifelong learning, spring term 2014, Senior Projects,

| Performance Criteria | Highly prepared | Prepared | Inadequately prepared |
|---|---|---|---|
| Lifelong learning | 55.6% | 38.9% | 5.6% |

All except for one student felt prepared or highly prepared.

**Seattle Campus Assessment:**

At the Seattle campus the oral portion of this outcome was directly assessed in one course, Senior Project I during Fall 2013.

Direct Assessment #1 Seattle Campus

The faculty assessed this outcome in MECH 490 Senior Project I, fall 20143, using a rubric-graded written assignment. There were 6 BSME students involved in the assessment. The results are shown in Table 12 below.

Table 12. Lifelong learning assessment Seattle

| Performance Criteria | Minimum Acceptable Performance | % |
|---|---|---|
| Lifelong learning | 80% at 3 or 4 | 83% |
| Professional Development | 80% at 3 or 4 | 100% |
| Short and long term career plans | 80% at 3 or 4 | 100% |

The students scored well in all areas of this assessment.

Indirect Assessment #1 MMET Undergraduate Exit Survey

Since the BSME program in Seattle was new this year, there were no students who filled out the survey.

**Summary Recommendations for Outcome (i):**

The results shown above indicate that both the Klamath Falls and the Seattle students have the ability to engage in life-long learning. However, this outcome should be evaluated with at least two direct assessments at both Klamath Falls and Seattle.

**OUTCOME (j) Contemporary Issues Graduates will have a knowledge of contemporary issues**

No direct assessment for this outcome was completed at either campus. This outcome needs to be directly addressed at both campuses before our next ABET visit.

Indirect Assessment #1 MMET Undergraduate Exit Survey

In spring of 2014, 20 ME students in senior projects completed an exit survey. Students were asked to *"Please rate how well the Mechanical Engineering Program prepared you in the following areas: To have knowledge of contemporary issues."* Table 13 shows the results of this inquiry.

Table 13 : Senior Project Exit Survey, Contemporary Issues

| | Highly Prepared | Prepared | Inadequately Prepared |
|---|---|---|---|
| To have knowledge of Contemporary Issues | 44.4% | 44.4% | 11.1% |

The majority of the students felt that they were either Prepared or Highly Prepared.

**Summary Recommendations for Outcome (j):**

The results shown above indicate that the Klamath Falls students feel that they have knowledge of contemporary issues. However, this outcome should be evaluated with at least two direct assessments at both Klamath Falls and Seattle.

**OUTCOME (k) Techniques Skills and Tools Graduates will have a working knowledge of techniques, skills, and tools**

The performance criteria for this learning outcome are:

1. Use computers and a wide range of programs effectively
2. Appropriate mastery of modern engineering tools.
3. Use the techniques and skills necessary for engineering practice.

**Klamath Falls Campus Assessment:**

At the Klamath Falls campus this outcome was assessed in one course, MET 375 Solid Modeling.

Direct Assessment #1 Klamath Campus

The faculty assessed this outcome in MET 375 Solid Modeling fall term 2013, using an assignment scored with a rubric. There were 10 BSME students involved in the assessment. The results are shown in Table 14 below.

Table 14. Assessment Results for SLO k, Fall 2013 Klamath Falls

| Performance Criteria | Minimum Acceptable Performance | Results |
|---|---|---|
| Use computers and a wide range of programs effectively | 80% score 3 or 4 | 100% |
| Appropriate mastery of modern engineering tools. | 80% score 3 or 4 | 100% |
| Use the techniques and skills necessary for engineering practice. | 80% score 3 or 4 | 70% |

Strengths: Students are beginning to see the 3D model as more than a single file and can be revised in the future which a useful understanding in the industry.

Weaknesses: Students need to include more detail in their solid models.

Action: Redesign the assignment with more specific instructions and require review of the material as the student develops the work.

Indirect Assessment #1 MMET Undergraduate Exit Survey

In spring of 2014, 20 ME students in senior projects completed an exit survey. Students were asked to *"Please rate how well the Mechanical Engineering Program prepared you in the following areas: To have knowledge of contemporary issues."* Table 15 shows the results of this inquiry.

Table 15 Survey Results for SLO K, Modern Tools

| Performance Criteria | Highly prepared | Prepared | Inadequately prepared |
|---|---|---|---|
| Modern Tools | 61.1% | 38.9% | 0.0% |

All of the students participating in the survey felt that they were either Prepared or Highly Prepared to use the techniques, skills, and modern engineering tools necessary for engineering practice.

**Seattle Campus Assessment:**

At the Seattle campus this outcome was assessed in MECH 351 Finite Element Analysis.

Direct Assessment #1 Seattle Campus

The faculty assessed this outcome in MECH 351 Finite Element Analysis Spring term 2014, using an assignment scored with a rubric. There were 7 BSME students involved in the assessment. The results are shown in Table 16 below.

Table 16. Assessment Results for SLO k, Spring 2014 Seattle

| Performance Criteria | Minimum Acceptable Performance | Results |
|---|---|---|
| Use computers and a wide range of programs effectively | 80% score 3 or 4 | 86% |
| Appropriate mastery of modern engineering tools. | 80% score 3 or 4 | 86% |
| Use the techniques and skills necessary for engineering practice. | 80% score 3 or 4 | 86% |

Strengths that were demonstrated by the students in this exercise: In general the students were very competent with using CAD and FEA tools.

Weaknesses that were demonstrated by the students in this exercise: Some students still have difficulty understanding the problem constraints. Several students also struggled with understanding how to properly apply boundary conditions.

Proposed actions to improve the assessment or students performance: Improve the problem statement to better describe the constraints; and place additional emphasis on how to determine reasonable boundary conditions.

Indirect Assessment #1 MMET Undergraduate Exit Survey

Since the BSME program in Seattle was new this year, there were no students who filled out the survey.

**Summary Recommendations for Outcome (k):**

The results shown above indicate that both the Klamath Falls and the Seattle students can effectively use the techniques, skills, and modern engineering tools necessary for engineering practice. However, this outcome should be evaluated with at least two direct assessments at both Klamath Falls and Seattle.

## SUMMARY OF STUDENT LEARNING OUTCOMES & ACTIONS TAKEN

This year the BSME Program at both Klamath Falls and Seattle assessed outcomes b, d, g, i, j, and k; plus an Oregon Tech-specific outcome on Critical Thinking. 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 (most noticeably outcome j, contemporary issues). Also, since the BSME program just started at the Seattle campus there were no students available to take the indirect-assessment senior survey.

## RELATED CHANGES DUE TO PRIOR ASSESSMENTS

Last year's action items –

1) How to track increasing oral presentations and see if conditions improve
    a. Oral presentations have been added to MET 112 (Sloan)
    b. Oral reports will continue in MECH 360 (Stuart)

2) What projects will be added and how to determine the effects
    a. Project level assignments have expanded in MECH 417 (Fluids II), MECH 407 (CFD), MECH 315/6 (Machine Design), and with the new course MECH 407 ( Combustion engines).
    b. Swanson and Sloan will be monitoring these courses to determine the extent project level problems teach as compared to previous, smaller labs and assignments.

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

1) Sign up faculty ownership to revise assessment assignments

2) Review Pre-requisites for each MECH course.

3) Assess Outcome j before the next ABET visit.

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

5) 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 (b): Experiments

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

I = Introduced
R = Reinforced
E = Emphasized

# OUTCOME (g): Communications

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

I = Introduced
R = Reinforced
E = Emphasized

# OUTCOME (i): Life-long Learning

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

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## OUTCOME (j): Contemporary Issues

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

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E = Emphasized

## OUTCOME (k): Techniques, Skills, and Modern Tools

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

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# Appendix 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 Experiments**

**ETAC-c: ability to conduct, analyze and interpret experiments and apply experimental results to improve processes**
**EAC-b: Graduates will have the ability to design and conduct experiments, as well as to analyze and interpret data.**

| Performance Criteria | (1) Limited or No Proficiency | (2) Some Proficiency | (3) Proficiency | (4) High Proficiency | Score |
|---|---|---|---|---|---|
| **Ability to conduct experiments** | Has trouble carrying out pre-defined experiments. | Able to conduct experiments with some direction. | Able to set up and carry through pre-defined experiments obtaining useful data. | Able to conduct experiments obtaining solid data appropriate to the investigation at hand. | |
| **Ability to analyze and interpret data** | Has difficulty analyzing experimental data. Presentation and reporting of results is confusing and hard to follow. | Able to analyze experimental data with general direction and guidance. | Ability to analyze experimental data. Can present and report results in an orderly and understandable manner. | Shows ability to analyze experimental data independently extracting and presenting insightful results. | |
| **Ability to use experimental results to improve processes** | Has trouble applying experimental results to improve processes. | Able to use results to improve processes with significant guidance. | Can use results to improve processes with guidance. | Has ability to apply experimental results to improve processes. | |

| OIT Public Speaking Rubric | | | | |
|---|---|---|---|---|
| **Performance Criteria** | **No/Limited Proficiency (1)** | **Some Proficiency (2)** | **Proficiency (3)** | **High Proficiency (4)** |
| **Content** | Few or no attributed sources. Supporting materials lack credibility and/or don't relate to thesis. Limited or no attempt to inform or persuade. | Some attributed sources used. Supporting materials are somewhat credible and/or don't clearly relate to thesis. Attempt to inform or persuade. | Adequate number of credible and appropriately attributed sources used. Supporting materials relate to thesis. Informs or persuades. | A variety of credible and appropriate sources used. Supporting materials relate in an exceptional way to a focused thesis. Informs or persuades. |
| **Organization** | Lacks organizational structure. Introduction and/or conclusion missing. No transitions used. | Organizational structure present but unclear with underdeveloped introduction and conclusion. Transitions are awkward. | Appropriate organizational pattern used and easy to follow with developed introduction and satisfying conclusion. Main points are smoothly connected with transitions. | Organizational pattern is compelling and moves audience through speech with ease. Introduction draws in the audience and conclusion is satisfying. Main points are smoothly connected with transitions. |
| **Style** | No understanding of audience regarding topic or purpose of speech. Little enthusiasm and passion for topic. No regard for time constraints. | Some understanding of audience regarding topic or purpose of speech. Some enthusiasm and passion for topic. Some regard for time constraints. | Competent understanding of audience regarding topic and purpose. Enthusiasm and passion for topic. Speech given within time constraints. | Thorough understanding of audience regarding topic and purpose. Clear enthusiasm and passion for topic. Speech given within time constraints. |
| **Delivery** | No gestures or eye contact. Monotone voice or insufficient volume. Little poise. Reading of notes only. Abundant oral fillers and nonverbal distractions. | Some gestures and eye contact. Ineffective use of language and voice. Little poise. Heavy reliance on notes. Multiple oral fillers and nonverbal distractions. | Adequate use of gestures, eye contact, language, and voice. Poised with minor reliance on notes. Limited oral fillers and nonverbal distractions. | Effective use of gestures, eye contact, vivid language, and voice to add interest to speech. Poised with use of notes for reference only. No oral fillers and nonverbal distractions. |
| **Visuals** | No visuals or poorly-designed and documented visuals that distract from speech or do not create interest. Limited reference to visuals or so much reference delivery is hindered. | Visuals present, but simply designed with limited use of documentation. Visuals are referred to but do not create interest. Visuals may interfere with delivery. | Well-designed and documented visuals that clarify speech and create interest. Visuals are referred to and sufficiently discussed, while not interfering with delivery. | Well-designed and documented visuals that clarify speech, create interest, and hold attention of the audience. Visuals are sufficiently discussed and effectively integrated into speech. |

| OIT Essay Rubric | | | | |
|---|---|---|---|---|
| **Performance Criteria** | **Limited Proficiency (1)** | **Some Proficiency (2)** | **Proficiency (3)** | **High Proficiency (4)** |
| **Purpose and Ideas** | Writing has limited or no focus. Purpose and main ideas are unclear and require inference from reader. | Reader can discern the purpose and main ideas although they may be overly broad or simplistic. | Writing is clear and focused. Reader can easily understand the purpose and main ideas. | Purpose and main ideas are exceptionally focused, clear, and interesting. |
| **Organization** | Order and structure are unclear. Introduction and conclusion are underdeveloped or missing. | Order and structure are overly formulaic. Introduction and conclusion may be underdeveloped or too obvious. | Order and structure are clear and easy to follow. Introduction draws in the reader and conclusion brings satisfying closure. | Order and structure are compelling and move the reader through the text easily. Introduction draws in the reader and conclusion brings satisfying closure. |
| **Support** | Development is minimal. Some supporting details may be irrelevant or repetitious. | Supporting details are relevant, but are limited or rather general. Support may be based on clichés, stereotypes, or questionable sources or evidence. | The main ideas are well developed by supporting details. When appropriate, use of outside sources provides credible support. | Main ideas are well developed by strong support and rich details. When appropriate, use of outside sources provides strong, credible support. |
| **Style** | Voice is inappropriate for topic, purpose, or audience. Wording is incorrect or monotonous, detracting from impact. Sentences tend to be choppy, rambling, and awkward. | Voice is inconsistent for topic, purpose, and audience. Wording is quite ordinary, lacking interest, precision, and variety, and may rely on clichés. Sentences tend to be mechanical rather than fluid with an overuse of simple sentence structures. | Voice is generally appropriate for topic, purpose, and audience. Generally, wording conveys message in an interesting, precise, and natural way. Sentences are carefully crafted with variations in structure. | Voice is appropriate for topic, purpose, and audience. Wording is fresh and specific, with a striking and varied vocabulary. Sentences are highly crafted, with varied structure that makes reading easy and enjoyable. |
| **Conventions** | Numerous errors in usage, spelling, punctuation, and/or grammar. Errors sometime impede readability. Substantial editing needed. | Writing contains punctuation, spelling, and/or grammar errors, but they do not impede readability and are not extensive. Moderate need for editing. | Writing demonstrates control of standard writing conventions and uses them effectively to enhance communication. Few errors. | Writing demonstrates strong control of standard writing conventions and uses them well to enhance communication. Very few or no errors. |
| **Documentation** | Documentation has major errors or is not present. | Documentation has frequent errors. | Documentation is correct except for a few errors. | Documentation is meticulous. |

## OIT Lifelong Learning Rubric

| Performance Criteria | Limited or No Proficiency (1) | Some Proficiency (2) | Proficiency (3) | High Proficiency (4) | Score |
|---|---|---|---|---|---|
| **1. Lifelong learning** | Fails to identify the need for "lifelong learning" and/or omits discussion of their own learning and relevant examples. | Misses important elements in discussing "lifelong learning," applying concepts to their own learning or providing a relevant example. | Defines the concept of "lifelong learning." Demonstrates self-awareness by accurately identifying strengths/ weaknesses in their own ability to learn independently. Gives a relevant example. | Defines the concept of "lifelong learning" and its importance. Demonstrates self-awareness by accurately discussing strengths/ weaknesses in their own ability to learn independently. Gives relevant example(s). | |
| **2. Professional Development** | Fails to identify professional development opportunities. | Discusses professional development opportunities that are either inappropriate or irrelevant. | Identifies appropriate professional development opportunities. | Identifies and thoroughly discusses appropriate professional development opportunities. | |
| **3. Short- and long-term career plans** | Vaguely describes career goals and/or does not include a plan to meet them. | Career goals after graduation do not include both long and short term plans and/or the plan is unrealistic. | Describes short- and long-term career goals after graduation. Includes a realistic plan to meet these goals. | Describes short- and long-term career goals after graduation. Includes a realistic, thorough, and thoughtful plan to meet these goals. | |

## OIT Contemporary Issues Rubric

| Performance Criteria | Limited or No Proficiency (1) | Some Proficiency (2) | Proficiency (3) | High Proficiency (4) | Score |
|---|---|---|---|---|---|
| **Address major socio-economic issues** | Little or no understanding (or interest). Unable to put forth more than one side to an issue. | Moderate understanding of national and international issues. Can follow but has trouble expressing more than one side of an issue. | Good understanding of many issues. Understands and can express more than one side of an issue. | Deep understanding of the immediate and long-term implications. Articulately expresses arguments from several viewpoints including the historical perspective. | |
| **Address US political issues** | Little or no understanding (or interest). Unable to put forth more than one side to an issue. | Moderate understanding. Rudimentary understanding of current political issues. | Good understanding. Can express and explain different sides of political issues. | Deep understanding. Can knowledgeably explain current political issues, the underlying problems, and historical perspective. | |

### Rubric for Use of Techniques, Skills, and Modern Engineering Tools

**TAC SLO a: An appropriate mastery of the knowledge, techniques, skills and modern tools of their disciplines**

**EAC SLO k: Graduates will be able to use the techniques, skills, and modern engineering tools necessary for engineering practice.**

| Performance Criteria | (1) Limited or No Proficiency | (2) Some Proficiency | (3) Proficiency | (4) High Proficiency | Score |
|---|---|---|---|---|---|
| **Use computers and a wide range of programs effectively** | Marginal ability with word processor and spreadsheet use. Struggles with other programs and programming | Able to use word processors and spreadsheets to produce reports. Has difficulty with other programs | Able to use word processors and spreadsheets to produce well formatted reports. Able to use other programs and write computer programs | Skilled at word processing and spreadsheet use. Skilled with other programs and able to write longer intricate programs | |
| **Appropriate mastery of modern engineering tools.** | Able to use modern engineering tools with close supervision. Marginal understanding of modern engineering tools. | Able to use modern engineering tools with supervision. | Skilled at using modern engineering tools. | Able to direct others in the use of modern engineering tools. Skilled at using modern engineering tools. | |
| **Use the techniques and skills necessary for engineering practice** | Has little or no understanding of engineering methods. | Some understanding of engineering methods, but has trouble selecting appropriate techniques and designing parts. | Understands basic engineering methods and can, with assistance, design parts. | Has a broad understanding of engineering methods. Able to design parts using engineering techniques and skills. | |

**Institutional Student Learning Outcome #4: Critical Thinking Rubric, Lead pour evaluation: Each area will be judged on student's use of Fluids(F), Heat(H), Materials(M), and Configuration(C) to solve the problem**

| Criteria/Quality | No/Limited Proficiency (1) | Some Proficiency (2) | Proficiency (3) | High Proficiency (4) | Rating (1, 2, 3, 4 pts) | |
|---|---|---|---|---|---|---|
| 1. **Assumptions**: Identifies and explains **problem/question/issue** | Does not understand the nature of the problem | Misrepresents the problem. | Characterizes the problem but misses contributing aspects. | Defines the problem completely and accurately. | F | H |
| | | | | | M | C |
| 2. **Assumptions**: Recognizes contributing factors in **contexts** (i.e., Fluids, thermal, materials, geometry, forces) | Does not bring in relevant equations/science. | Misses some major factors that should come into play. | Acceptably addresses the major factors affecting the problem. | Uses major factors and also identifies the magnitude that minor factors may affect the problem. | | |
| | | | | | | |
| 3. **Clarifications**: Acknowledges other **perspectives** and judges fitness/dismisses other models | Does not address why possible effects may be dismissed | Addresses why some minor effects are dismissed, but inadequately. | Shows why some effects may be dismissed. | Compares relative weight of minor effects to major effects/justifying dismissal. | | |
| | | | | | | |
| 4. **Clarifications**: Identifies and evaluates **assumptions** | Fails to address why any starting conditions or assumptions were chosen | Does not identify all assumptions or misrepresents them | Identifies and evaluates all the important assumptions, but does not address others that may affect the results. | Not only identifies and evaluates all the important assumptions, but also some of the more hidden, more abstract ones. | | |
| | | | | | | |
| 5. **Clarifications** Identifies and evaluates **evidence** | Does not respond to factual evidence. | Inadequately incorporates evidence into the model. | Incorporates evidence in the model, but doesn't show how the revised model will predict evidence. | Shows how the revised model predicts evidence. | | |
| | | | | | | |
| 6. **Evaluation**: Identifies and evaluates **implications**, conclusions, and consequences. | Fails to bridge the gap between phenomena and how they will affect the problem (lead flow distance). | Unable to quantify associations between phenomena and the final problem (lead flow distance). | Models some but not all phenomena appropriately. | Bridges appropriate and quantifiable links between phenomena (cause) and the final problem (effect). | | |
| | | | | | | |
| Score | | | | Total score out of 96 possible | | |