Portland Community College
Civil and Mechanical Engineering Technology Program
2010 – 2011 Annual Report for Assessment of Outcomes
(For Degree, Certificate or Core Outcomes)

1. Describe changes that have been implemented towards improving students' attainment of outcomes that resulted from outcome assessments carried out in the previous academic year.

In 10-11, all SACs should have reported on the Critical Thinking Core Outcome. Were any changes to content, materials, pedagogy, etc made as a result?

During 2009-2010, the CMET SAC created a plan to assess the Critical Thinking Core Outcome; this plan was to be implemented during 2010-2011. However, for this academic year, this plan was replaced by our focus on AAS degree and certificate outcomes. The two program outcomes identified for assessment are both mapped to the Critical Thinking Core Outcome.

2. Identify the outcomes assessed this year, and describe the methods used. What were the results of the assessment (i.e., what did you learn about how well students are meeting the outcomes)?

a. Describe the method(s) you used.

Include relevant information about:

- The students (how many, where in your program (one class, a group of classes, end of degree?)
- The nature of the assessment (written work, project, exam, performance task, observation etc).
- How was the assessment evaluated?

The two CMET program outcomes assessed this year were: (1) Apply fundamental engineering knowledge to identify, formulate and design successful solutions to real-world technical endeavors; and (2) Utilize appropriate laboratory techniques, engineering equipment and computational technology to collect, analyze, and interpret data to acquire scientific knowledge about a stated problem.

This is the description of our assessment plan as submitted in Fall 2010:

Our present assessment methods for CMET Outcomes 1 & 2 are aligned with the program's heavy emphasis on meeting real-world engineering challenges. Accordingly, we use examinations, experiments, and fieldwork that exercise a student's ability to define a problem from the given data and formulate solutions based on relevant engineering equations and industry standard processes.

This year, we will add *Student Portfolios* to these assessment methods. Each portfolio will contain an assortment of the student's strongest technical work demonstrating their mastery of engineering fundamentals and laboratory techniques.

Portfolio assembly will be aligned with CMET 254 Seminar and evaluations will be based on rubrics developed during this first year

Portfolios were submitted by all CMET 254 students, 28 second-year CMET students, almost all of them planning to graduate this June. Of these, 14 portfolios met the criteria established by the SAC and were evaluated using the attached rubrics (the other portfolios were incomplete, or the work submitted was not appropriate for this evaluation). Each work sample was evaluated by two CMET faculty members. Each of the criteria was scored on a 4-point scale: 1=incomplete, 2=developing, 3=accomplished, and 4=exemplary. We considered a score of 3 to indicate that a student meets the outcome.

Some notes about the methods used:
We were all inexperienced in many aspects of this assessment: working with portfolios, devising and using a rubric, and communicating to the students the type of work samples to submit. We learned a lot about how to improve this process for next year! Below are some of the problems we encountered and some improvements we will make.

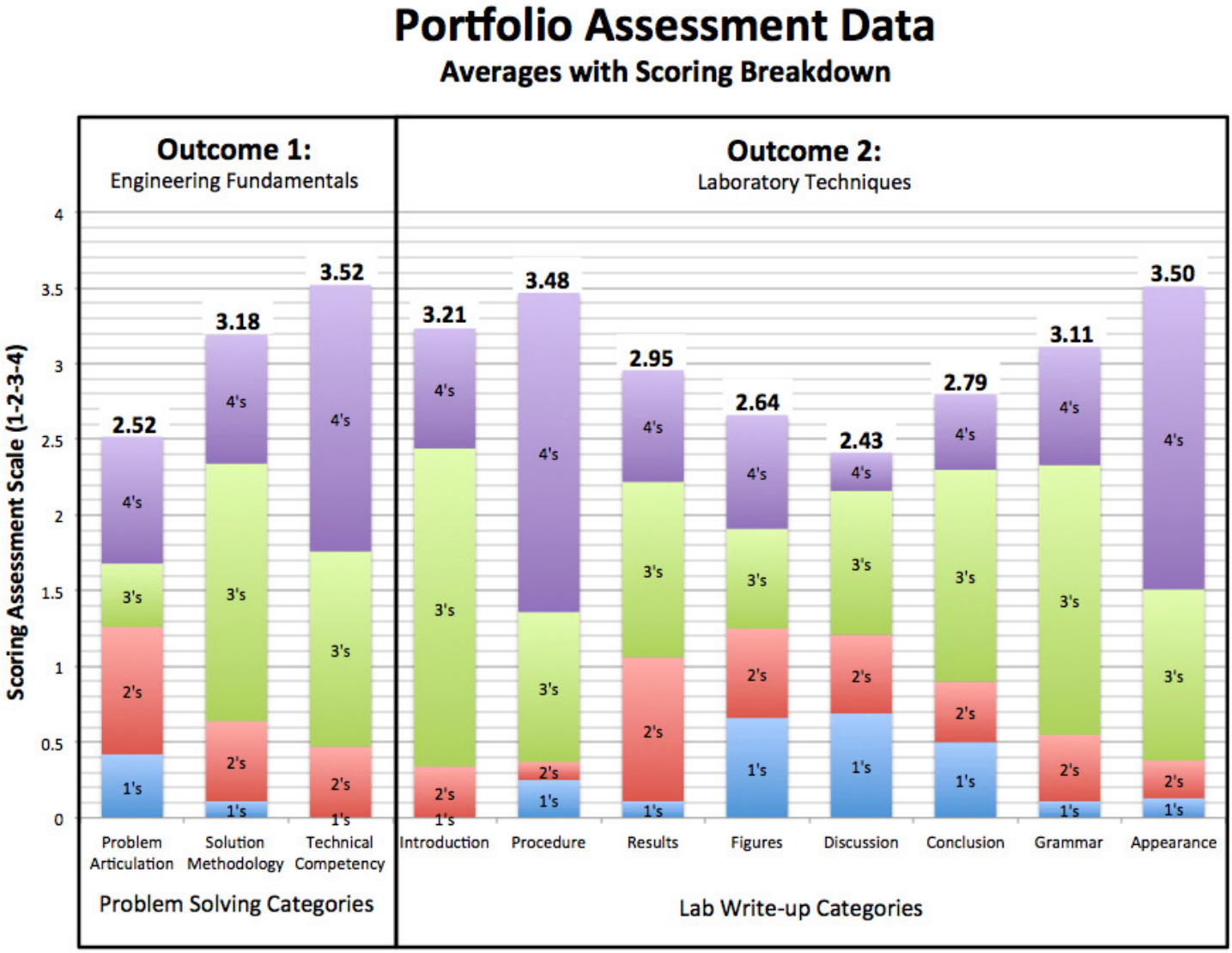
1) Some of the work samples that were submitted could not be used for this evaluation, partly because we were trying to "piggyback" the work sample evaluations onto the portfolio project the students were already submitting. These were the instructions given to the students: "The portfolio you will submit for the CMET 254 Seminar will include at least three work samples of calculations, drawings, and/or lab or field reports. At least one sample must be mostly calculations; at least one sample must be a lab or field report. The calculations may be homework or test problems from any CMET course, or may be work done outside of class that uses knowledge learned in class – be sure that this is a sample of your best work. The lab or field report may be from any CMET course; the best choice would include data collection, analysis and calculations, and a spreadsheet or drawing. Using a group project is fine." Some of the samples submitted were incomplete or not the type of work requested; in some cases, samples selected by the students were appropriate for a job interview, but not for our evaluation. This is why we had only 14 portfolios that met the criteria for the evaluation, and one additional portfolio that was evaluated only for outcome #1. Next time, we will give more specific instructions to the students, or else ask for samples separately from the portfolios, and also not have them submit test problems.
2) Some of the work had instructors' comments and grading marks on them. We felt that this detracted from their usefulness for this evaluation, and also made them inappropriate for a job interview. Next time, we will have students make corrections before submitting samples, and provide photocopies instead of originals.
3) Another problem that arose was that students' names were on the portfolios, so the work samples were not anonymous. We felt that we could have been more impartial in the scoring if names had not been attached to the work. Next time, we will come up with a way to increase the level of anonymity.
4) In some cases, the work samples were outside of the technical expertise of some of the evaluators (such as thermodynamics or land surveying), so it was difficult to properly assess the students' work. Next time, we may need to limit the list of courses from which students would pick their work samples.

b. Results: What did you learn?

How well did your students do? Do the assessment results match your aspirations for your students?
Did your assessment indicate any areas or aspects in which student achievement could be better?
(If your assessment was scored in some way, it would be helpful to report some of that information. Scores that can be taken apart into meaningful components are often helpful in determining areas that might need attention.)

We tabulated the results of the rubric evaluations, and calculated the mean and standard deviation for each criterion; this tabulation is attached at the end of this document. For Outcome #1 (engineering fundamentals), two of the three criteria had mean scores of 3.18 or higher, and the mean of the three values was 3.07. For Outcome #2 (laboratory techniques), six of the eight criteria had mean scores of 2.79 or higher, and the mean of the eight values was 3.01. Since we had decided that a score of 3 indicated that students met the criteria, the assessment results fairly well matched our aspirations for the students. We also noted that the three lowest-scoring criteria (with mean scores between 2.43 and 2.64) also had the highest standard deviations (each was higher than 1.00), indicating that the work was very inconsistent from student to student, and may not be statistically useful data.

The chart shown below represents a visual summary of our CMET student portfolio assessments. Atop each bar in the chart is the *average* rubric score (tabulated on a scale of 1 to 4). *Within* each bar are color-coded stacks helping to show the scoring distribution within each rubric category.



Visually, we can confirm that categories receiving the highest proportion of "4's" tended to correspond with higher average scores; likewise, the categories receiving higher proportions of "1's" and "2's" generally fared less favorably. Interestingly, one can also observe that categories with similar overall averages (e.g., "Technical Competency" and "Procedure") achieve their scores with a fairly different scoring distribution.

Excellent results associated with Outcome 1's "Technical Competency" reflect CMET's historically heavy emphasis on problem solving skills. Feedback from past graduates consistently praise how our program's technical rigor has helped them in their post-PCC careers. As such, we will continue present practices of in-class boardwork, team projects, and maintaining a quality-focused discipline.

High marks on Outcome 2's "Appearance" were somewhat expected since students were allowed to select their own portfolio pieces and presumably they thought well enough to choose higher quality work. There was considerable discussion over whether or not students should be asked to redo past work in order for their presentation skills to really shine. Although this was not done this year, we might consider having them do so for their 2011-2012 portfolios in hopes of seeing scores approaching Level 4.

"Problem Articulation" results were more disappointing. Although not abysmal, we feel that this is a relatively easy area in which to excel. The review panel did note, however, that at least a portion of this score could be tied to inconsistent expectations from teacher to teacher. Some instructors explicitly require separate "Given" and "Find" statements, whereas others feel student solutions should be just that assuming the problem setups are sufficiently defined in the texts. Establishing consistent faculty expectations is an improvement opportunity area for the CMET program.

The lowest overall portfolio score relates to Outcome 2's "Discussion". Inadequate *discussion* indicates a lack of self-reflection pertaining to engineering labs. We need to ensure our students are not merely going through the motions of getting to the "right answer" as quickly as possible to complete their assignments. The review team acknowledged that this is an area for improved future emphasis; yet, at the same time there was considerable speculation that at least part of this low score could be attributed to some student portfolio lab write-ups actually including the discussion portion within the "Conclusion" section. Seeing that the scores associated with lab Conclusions do not appear skewed particularly high, it would appear that lab write-up "Discussion" represents a genuine program growth opportunity.

Data Summary: The combined averages of Outcomes 1 and 2 are both just slightly over Level 3 – respectably high overall results. We are also pleased to see that the average scores as well as the distribution of scores correlate well to the qualitative assessments that surfaced during our review discussions.

We identified three areas in which student achievement could be better, based on the criteria with the lowest scores in our rubrics: (1) figures, graphs, and tables in lab reports; (2) discussion in lab reports; and (3) problem articulation in work samples featuring calculations.

3. **Identify any changes that should, as a result of this assessment, be implemented towards improving students' attainment of outcomes.**

This is an important part of what is expected as a result of assessment. It is not enough to say "'we are doing great". We are expected to be self-examining, and curious about what we might do better.

For the outcome of "Apply fundamental engineering knowledge to identify, formulate and design successful solutions to real-world technical endeavors," we had a good discussion among SAC members about the ways in which we teach our students about organizing and presenting solutions to engineering problems. We concluded that we need to be more consistent from instructor to instructor about the format of both homework solutions and lab reports, and to make sure that we have communicated to students what is "exemplary" engineering work.

For the outcome of "Utilize appropriate laboratory techniques, engineering equipment and computational technology to collect, analyze, and interpret data to acquire scientific knowledge about a stated problem," our discussion centered on the discussion/results/conclusion portion of the lab reports. We concluded that instructors need to place greater emphasis on the importance of the interpretation of the data gathered during experiments.

One major positive effect of this assessment is that the CMET SAC took the time to sit down together and discuss our teaching. We shared many effective practices we use in our classrooms, and feel that continuing these discussions will help us all in improving our students' attainment of our program outcomes, and help them to become better engineering technicians.

Appendices:
CTE Assessment plan
Outcome #1 scoring rubric
Outcome #2 scoring rubric
Tabulation of data

CTE Assessment Plan

AAS or Certificate: CMET (Civil and Mechanical Engineering Technology)

1. Outcomes	2. Maps to Core Outcome(s)		3. Assessment Methodologies	4. Year
Apply fundamental engineering knowledge to identify, formulate and design successful solutions to real-world technical endeavors.	X	Communication	Our present assessment methods for CMET Outcomes 1 & 2 are aligned with the program's heavy emphasis on meeting real-world engineering challenges. Accordingly, we use examinations, experiments, and fieldwork that exercise a student's ability to define a problem from the given data and formulate solutions based on relevant engineering equations and industry standard processes. This year, we will add *Student Portfolios* to these assessment methods. Each portfolio will contain an assortment of the student's strongest technical work demonstrating their mastery of engineering fundamentals and laboratory techniques. Portfolio assembly will be aligned with CMET 254 Seminar and evaluations will be based on rubrics developed during this first year.	Year 1: (2010/11)
	X	Community and Environmental Responsibility		
	X	Critical Thinking and Problem Solving		
		Cultural Awareness		
	X	Professional Competence		
		Self-Reflection		
Utilize appropriate laboratory techniques, engineering equipment and computational technology to collect, analyze, and interpret data to acquire scientific knowledge about a stated problem	X	Communication		
	X	Community and Environmental Responsibility		
	X	Critical Thinking and Problem Solving		
		Cultural Awareness		
	X	Professional Competence		
		Self-Reflection		
Utilize the knowledge of visualization skills, computer aided drawing programs and the ability to create and interpret engineering drawings, to design engineering projects within proper industry acceptable standards and conventions.	X	Communication	CMET Outcomes 3, 4, & 5 focus on the development of visual, verbal, and written communication skills and application towards civil, mechanical, and environmental project work. Present assessment methods include a combination of technical examinations, reports, and oral presentations. This second year, the *Student Portfolio* scope will be broadened to include content that demonstrates proficiency in CAD, report writing, and principles in sustainability.	Year 2: (2011/12)
		Community and Environmental Responsibility		
	X	Critical Thinking and Problem Solving		
		Cultural Awareness		
	X	Professional Competence		
		Self-Reflection		
Apply effective communication skills, teamwork, project / time management, ethical engineering practices, and professional responsibility to the development of engineering components and systems.	X	Communication		
		Community and Environmental Responsibility		
	X	Critical Thinking and Problem Solving		
	X	Cultural Awareness		
	X	Professional Competence		
	X	Self-Reflection		
Practice sustainable engineering methodologies.	X	Communication		
	X	Community and Environmental Responsibility		
	X	Critical Thinking and Problem Solving		
	X	Cultural Awareness		
	X	Professional Competence		
	X	Self-Reflection		

Outcome 1:
Apply fundamental knowledge of mathematical, computational, scientific and engineering concepts to identify, formulate and design successful resolutions to real-world civil and mechanical engineering problems.

	Problem Articulation: *How clearly is the nature of the problem and its accompany solution goals represented by the student's work?*	**Solution Methodology:** *How well do the student's solution processes meet industry standard practices?*	**Technical Competency:** *How well do the intermediate and final problem answers show a mastery of engineering principles?*
4 Exemplary	O Homework solutions are prefaced with a thorough, accurate, neat, yet succinct restatement of the problem's given data and required answers. O Homework's "Given" and "Find" statements are accompanied by cleanly drawn pictures consisting of straight lines, excellent line weight, proper scale, and all annotations necessary to graphically depict the problem.	O Student's solutions flow neatly and logically beginning with a restatement of the problem all the way through each final answer. O Drawings, Free-Body Diagrams, equations, and solution steps are clear and offer sufficient spacing to enable easy reading. O Equations are properly written out and sequentially developed by substituting known values in for variables as the problem unfolds. O Intermediate values are highlighted in a manner that enables reviewers to identify accuracy of each stage. O Final answers are boxed neatly.	O Proper equations are selected and populated with known values and variables needing to be resolved. O Solution mathematics are precisely demonstrated from beginning to end. O Intermediate values are highlighted and accurate. O Final answers are generally accurate to within 2%. O Graphics are neat and robustly annotated. O Assumptions and approximations are clearly spelled out. O Significant digits are appropriate and consistent. O Proper units of measure are carried through the solution from beginning to end.
3 Accomplished	O Homework solutions are prefaced with all required problem "Givens" and "Finds". O Homework's "Givens and Find" statements are accompanied by a fully annotated, accurate sketch depicting the problem to be solved.	O Solution steps are complete and easy to follow. O Drawings and Free-Fody Diagrams are included where necessary. O Appropriate solutions are identified. O Final answers are boxed.	O Correct equations are used. O Solution steps yield both correct intermediate as well as final numeric answers. O Final answer is boxed and paired with proper units of measure and includes an appropriate degree of significant digits.
2 Developing	O Homework solutions begin with a "Given and Find" statement. O Homework solutions are accompanied by a sketch; however, quality of artwork is not up to par due to: ambiguous or erroneous annotation, poor line quality, incorrect orientation, and/or lacking an aesthetic appearance consistent with the engineering trade.	O Student work generally indicates an understanding of the problem, but may not develop a solution that follows a direct path to the answer. O Flow of writing is generally linear, but may be crowed, crooked, or even orthogonal to the problem's orientation. O Answers are intermittently, or poorly identified.	O Student work shows only a general working ability to solve technical problems. O Values at intermediate or final steps may be off by significant amounts. O Units are included, but are inconsistent or incorrect altogether. O Significant figures have not been acknowledged. O Sign and decimal errors exist.
1 Incomplete	O "Given" and/or "Find" elements are missing from setup. O Problem drawing may be missing, messy, or incomplete. O Overall problem setup fails to convey the nature of the problem to be solved.	O Homework problems have missing steps. O Incorrect or superfluous equations are used. O Writing is messy, has poor tone intensity (too light or dark), lacks reasonable horizontal alignment, and/or is laden with residual eraser marks. O Solutions are either missing altogether or are difficult to identify.	O Solutions include significant mathematical errors (not just sign or decimal). O Units are missing or mixed between US and SI. O Final answers are incorrect or lack "boxing". O Missing graphical accompaniment to solution.
	Score: **Comments:**	**Score:** **Comments:**	**Score:** **Comments:**

Student Name: _____ Reviewed by: _____

Lab Report Grading Rubric Report Title: Name_____

	1 Beginning or incomplete	2 Developing	3 Accomplished	4 Exemplary	Score
Introduction	Very little background information provided or information is incorrect.	Some introductory information, but still missing some major points.	Introduction is nearly complete, missing some minor points.	Introduction complete and well-written; provides all necessary background principles for the experiment.	
Experimental procedure	Missing several important experimental details or not written in paragraph format.	Written in paragraph format, still missing some important experimental details.	Written in paragraph format, important experimental details are covered, some minor details missing.	Well-written in paragraph format, all experimental details are covered.	
Results	Results, calculations, or explanations are not provided. The results contain major errors and are incorrect.	Most results, calculations or explanations are provided. There are some errors in the results, calculations, or explanations.	All results are presented and are correct. Supporting calculations and explanations are provided. There are minor errors in the explanation or calculations.	All results are presented and correct. Supporting calculations and explanations are exact and correct.	
figures, graphs, tables, etc.	Figures, graphs, tables contain errors or are poorly constructed, have missing titles, captions or numbers, etc. Units are missing or incorrect More than 4 figures are not referenced in the body of the report.	Most figures, graphs, tables OK, some still missing some important or required features. 2-4 figures are not referenced in the body of the report or missing captions/titles	All figures, graphs, tables are correctly drawn, but some have minor problems or could still be improved. 1 figure exists without a reference in the body of the report or is missing its caption/title.	All figures, graphs, tables are correctly drawn, are numbered and contain titles/captions. All figures are correctly referenced in the body of the report and contain captions/titles.	
Discussion	Very incomplete or incorrect interpretation of trends and comparison of data indicating a lack of understanding of results.	Some of the results have been correctly interpreted and discussed; partial but incomplete understanding of results is still evident.	Almost all of the results have been correctly interpreted and discussed, only minor improvements are needed.	All important trends and data comparisons have been interpreted correctly and discussed, good understanding of results is conveyed.	
Conclusions	Conclusions missing or missing the important points.	Conclusions regarding major points are drawn, but many are misstated, indicating a lack of understanding.	All important conclusions have been drawn, could be better stated.	All important conclusions have been clearly made, student shows good understanding.	
Spelling, grammar, sentence structure	Frequent grammar and/or spelling errors, writing style is rough and immature.	Occasional grammar/spelling errors, generally readable with some rough spots in writing style.	Less than 3 grammar/spelling errors, mature, readable style.	All grammar/spelling correct and very well-written.	
Appearance and formatting	Sections out of order, too much handwritten copy, sloppy formatting, or sections missing. Title page is missing more than 4 components.	Sections in order, contains the minimum allowable amount of handwritten copy, formatting is rough but readable. Report not Double spaced. Title page is missing 2-4 components.	All sections in order, formatting generally good but could still be improved. Title page missing 1 component.	All sections in order, well-formatted, very readable. Title page is correct.	
				Total (32 points maximum)	

Civil and Mechanical Engineering Technology Program
Assessment of Outcomes for AAS degree
2010 - 2011

Lab Report							
Intro	Procedure	Results	figures	Discussion	Conclusion	Grammar	Appearance
4	4	3	1	3	3	3	4
3	4	3	1	4	4	3	4
3	4	2.5	2.5	1	3	2	3.5
4	4	3	3	2	2	2	4
3.5	3	3	1	1	1	3	3
3	4	3	1	1	1.5	2.5	3
3	4	4	4	3	4	4	4
4	4	3.5	4	3.5	3.5	4	4
3.5	4	3	3	4	3	4	4
4	4	4	3.5	3.5	4	4	3.5
3	4	4	4	1	3	4	4
3	3	4	4	3	3	4	4
3	3.5	2	4	1	3	3	3.5
2	3	2.5	2	1	1.5	3	2
4	4	3	1	3	3	3	4
3.5	3.5	4	2.5	3	3	3	3
2	4	2.5	3	2	1	4	4
3	3.5	3	4	3	3	3.5	4
3	4	2	3	3	2.5	3	4
3.5	4	2.5	2	2.5	3	3	4
4	4	4	4	4	4	3.5	4
3.5	4	4	4	3.5	3	3.5	4
3	1	1	1	1	2	1	1
2	1	2	1	1	1	3	2
3	4	2	3	3	2.5	3	3
3	3	3	3	2.5	3	3	3
3.5	2	3	2.5	2.5	3.5	3	3.5
3	3	2	2	2	4	2	4

Mean	3.21	3.48	2.95	2.64	2.43	2.79	3.11	3.50	3.01
St.Dev.	0.58	0.87	0.80	1.16	1.06	0.93	0.74	0.77	

Calculations		
Problem Articulation	Solution Methodology	Technical Competency
1.5	3	3.5
1.5	2	3
3	4	4
3	3.5	3.5
1.5	1	4
2	3	3.5
3.5	2.5	4
3.5	3	4
1	3.5	4
2.5	3	3.5
4	3	3.5
4	4	2
2.5	3	3.5
2	3	3
1	2	2
1	3	3
1.5	3	3
1	2.5	3
4	4	4
4	4	4
3	3.5	4
3	3	4
1.5	3	2.5
2	2	2.5
3.5	4	4
3	4	4
3	3	4
3	3.5	4
1.5	4	4
4	4	4

Mean	2.52	3.18	3.52	3.07
St. Dev.	1.05	0.74	0.63	