APPENDIX E. CONTINUOUS IMPROVEMENT PROCESS DOCUMENTS

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Part I

Metrics for Program Outcomes (a-k)

Description:

The following metrics are used to assess the program outcomes (a) – (k). Each outcome instrument is scored with a 1, 3, or a 5.

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Table E-I.1: Metric for Assessing Outcome (a)

Metric Title	(a) Apply Knowledge of Math, Science, and Engineer		
Performance Criteria	**Low Performance:1**	**Moderate Performance:3**	**Exemplary Performance:5**
Proficient in Fundamental Concepts and Skills	· No application of statistics to analysis of data	· Minor errors in statistical analysis of data	· Correctly analyzes data sets using statistical concepts
	· No use of math software	· Some use of math software	· Uses mathematical software
	· Calculations not performed or performed incorrectly by hand	· Minor errors in calculations by hand	· Executes calculations correctly By hand
	· Mathematical terms are interpreted incorrectly or not at all	· Most mathematical terms are interpreted correctly	· Translates academic theory into engineering applications and accepts limitations of mathematical models of physical reality
	· Does not understand the application of calculus and linear algebra in solving engineering problems	· Shows nearly complete understanding of applications of calculus and/or linear algebra in problem-solving	· Shows appropriate engineering interpretation of mathematical and scientific terms
Proficient in Theoretical and Practical Relationships	· Does not appear to grasp the connection between theory and the problem	· Some gaps in understanding the application of theory to the problem and expects theory to predict reality	· Translates academic theory into engineering applications and accepts limitations of mathematical models of physical reality
	· Does not understand the connection between mathematical models and chemical, physical, and/or in engineering systems	· Chooses a mathematical model or scientific principle that applies to an engineering problem, but has trouble in model development	· Combines mathematical &/or scientific principles to formulate chemical and physical models for relevant to engineering
Proficient in basic science	Student applies basic science concepts as minimal components of work or has major misconceptions.	Student applies concepts from basic science as significant components of work with few errors.	Student applies concepts from basic science as essential components of work with virtually no conceptual errors.

Table E-I.2: Metric for Assessing Outcome (b)

Metric Title	(b) Desg/Cond Exps & Anal/Intrp Data and Info		
Performance Criteria	**Low Performance:1**	**Moderate Performance:3**	**Exemplary Performance:5**
Conducts the design of experiments.	Has not designed experiments.	Has shown some knowledge in the design of experiments.	Has demonstrated on a regular basis the skill of designing experiments.
Operates equipment and collects data for analysis.	Has not demonstrated an interest in learning how to operate experimental equipment.	Is interested in learning how to operate experimental equipment, but has not shown high proficiency.	Quickly developed expertise in using laboratory equipment.
Compares results for experimental measurements to the literature and conducts interpretation of results in written reports.	Has shown no interest in evaluating experimental data developed in the Metallurgy labs to that found in the literature.	Resists using experimental data developed in the Metallurgy labs to that found in the literature.	Makes a major effort to compare engineering result obtain in Metallurgy labs to that found in the literature.
Is able to collect global information and to use this information in evaluation and interpretation of laboratory data	Has poor library and literature searching skills and shows no interest in improving these skills.	As adequate library and literature searching skills. Has demonstrated these skills in written laboratory reports.	Has demonstrated exemplary skill at finding quality information from the global society on Metallurgy laboratory topics.

Table E-I.3: Metric for Assessing Outcome (c)

Metric Title	(c) Optimally Select Materials and Materials Treat		
Performance Criteria	**Low Performance:1**	**Moderate Performance:3**	**Exemplary Performance:5**
Understand the engineering design process	Demonstrates weak understanding of engineering design and decision-making process.	Demonstrates basic comprehension of major aspects of engineering design in the conversion of resources.	Demonstrates advanced comprehension of engineering design process, including optimal conversion of resources for the benefit of the human race.
Formulate possible engineering solutions	Poorly articulated statement of engineering design problem; immature strategy for solution.	Reasonable statement of engineering design problem; designs acceptable strategy for solution.	Clearly states and articulates engineering design problem; designs efficient strategy for solution.
Master the iterative process in engineering design	Completes few or none of necessary iterations in decision-making process for solution.	Completes some of the necessary iterations in decision-making process to arrive at solution.	Completes all necessary iterations in decision-making process to arrive at solution.
Recognize and observe constraints in engineering design	Fails to specify materials, uses them in ways that exceed their service properties, or pays little attention to optimizing materials properties or cost.	Partially or marginally specifies material properties, uses materials in ways that unnecessarily pushes their properties, or uses less-than-optimal materials.	Exhaustively specifies materials, uses them in ways that clearly meet their properties, and pays close attention to optimizing materials properties and cost.

Table E-I.4: Metric for Assessing Outcome (d)

Metric Title	(d) Function Well on Teams		
Performance Criteria	**Low Performance:1**	**Moderate Performance:3**	**Exemplary Performance:5**
Responsible Participation	Is absent from team meetings or work sessions >50% of the time	Absent occasionally, but does not inconvenience group	Routinely present at team meetings or work sessions
	Routinely fails to prepare for meetings	Prepares somewhat for group meetings, but ideas are not clearly formulated	Is prepared for the group meeting with clearly formulated ideas
Interaction Skills	Claims work of group as own or frequently blames others	Makes subtle references to other's poor performance or sometimes does not identify contributions of other team members	Shares credit for success with others and accountability for team results
	Does not willingly assume team roles	Takes charge when not in the position to lead	Demonstrates the ability to assume a designated role in the group
	Is discourteous to other group members	Is not always considerate or courteous towards team members	Is a courteous group member
Assimilation and Receptiveness Skills	Does work on his/her own; does not value team work	Occasionally works as a loner or interacts to a minor extent with extra-disciplinary team members	Cooperates with others (outside of the discipline)
	Has no knowledge of disciplines outside of metallurgical engineering	Has some knowledge of other disciplines, but gets lost in discussions with extra-disciplinary team members	Has knowledge of technical skills, issues and approaches germane to disciplines outside of metallurgical engineering

Table E-I.5: Metric for Assessing Outcome (e)

Metric Title	(e) Identify, Formulate, and Solve Engineering Pro		
Performance Criteria	**Low Performance:1**	**Moderate Performance:3**	**Exemplary Performance:5**
Identify	Does not see the connection between theory and practical problem solving	Connects theoretical concepts to practical problem-solving when prompted	Can relate theoretical concepts to practical problem solving
	Does not realize when major components of the problem are missing	Is missing some of the pieces of the whole problem	Demonstrates understanding of how various pieces of the problem relate to each other and the whole
Formulate	Is unable to predict or defend problem outcomes	Occasionally predicts and defends problem outcomes	Can predict and defend problem outcomes
	Demonstrates solutions implementing simple applications of one formula or equation with close analogies to class/lecture problems	Demonstrates solution with integration of diverse concepts or derivation of useful relationships involving ideas covered in course concepts; however, no alternative solutions are generated	Demonstrates creative synthesis of solution and creates new alternatives by combining knowledge and information
Solve	The answer is incorrect and not checked for its reasonableness	The answer is nearly correct, but properly labeled (within reasonable and logical range of the correct answer—it's in the "ballpark")	The answer is correct and properly labeled
	No attempt at checking the obviously incorrect solution no commentary	The solution is correct, but not checked in other ways	The solution is correct and checked in other ways when it can be; the interpretation is appropriate and makes sense

Table E-I.6: Metric for Assessing Outcome (f)

Metric Title	(f) Know Professional and Ethical Responsibilities		
Performance Criteria	**Low Performance:1**	**Moderate Performance:3**	**Exemplary Performance:5**
Carries out responsibilities in a professional and ethical manner	Receives a poor rating by the faculty on the ethics and professional practice writing in assigned subjects	Receives a satisfactory rating by the faculty on the ethics and professional practice writing in assigned subjects	Receives an excellent rating by the faculty on the ethics and professional practice writing in assigned subjects
Understands basic engineering principles and practices, in terms of professional ethics and behavior	Demonstrate little understanding of, or concern for, professional ethics in written essay and during classroom discussions.	Demonstrate basic understanding of, or concern for, professional ethics in written essay and during classroom discussions.	Demonstrate sound understanding of, or concern for, professional ethics in written essay and during classroom discussions

Table E-I.7: Metric for Assessing Outcome (g)

Metric Title	(g) Communicate Effectively		
Performance Criteria	**Low Performance:1**	**Moderate Performance:3**	**Exemplary Performance:5**
The content of the written or oral presentation is effective.	Demonstrates poor justification for the document, makes numerous errors, cannot focus on the subject, is not following the rules of writing or speech.	The audience can understand the content and context of the document or presentation, but the document or oral presentation is not well organized.	Will organized written or oral presentation. The presentation holds the attention of the audience. The presentation is prepared at the proper level for the intended peer group.
The organization of memorandum and technical reports is consistent with styles accepted by the person's primary professional engineering society.	No effort to conform technical writing style required by the instructor.	Make an effort to follow the rules of writing, position figure and table of captions, and placement of citations within a technical report.	The student is careful organizing and writing technical reports. All figure and table captions stand-alone from the report, and references are carefully cited throughout the document.
The design of slides shows an understanding of vision limitation of the audience and the total time the presenter plans to spend on the visual aid during oral presentations.	The simple rules for audio-visual presentation are not followed.	Some understand of the font size on slides and the amount of information being transmitted per slide is apparent.	Large readable font is used, only one thought or idea is presented on a slide, and comfortable easy to read presentation colors are used.

Table E-I.8: Metric for Assessing Outcome (h)

Metric Title	(h) Know Global Societal Context of Engineering		
Performance Criteria	**Low Performance:1**	**Moderate Performance:3**	**Exemplary Performance:5**
Has the broad education necessary to understanding impact of engineering solutions in global and societal context	In the global and societal practice writing in assigned subjects, students show marginal ability of applying general education knowledge to engineering problems. Work addresses a problem that directly affects global or society issues	In the global and societal practice writing in assigned subjects, students show general ability of applying general education knowledge to engineering problems. Work addresses a problem that directly affects global or society issues	In the global and societal practice writing in assigned subjects, students show outstanding ability of applying general education knowledge to engineering problems. Work addresses a problem that directly affects global or society issues
Awareness of contemporary state of knowledge and relationship to engineering solutions	Little attempt is made to link work to current issues; work has little value except as a student exercise.	Literature review demonstrates adequate knowledge of the current sate of the problem; work addresses useful information or insight into of contemporary issue.	Literature review demonstrates detailed knowledge of the current sate of the problem; work addresses a question at the forefront of a contemporary issue.
Recognition of the need for, and ability to engage in, life-long learning	Shows little understanding of the need to remain aware of changing societal and global conditions.	Demonstrate general understanding of the need to remain aware of changing societal and global conditions.	Demonstrate clear understanding of the need to remain aware of changing societal and global conditions.

Table E-I.9: Metric for Assessing Outcome (i)

Metric Title	(i) Engage in Life-Long learning		
Performance Criteria	**Low Performance:1**	**Moderate Performance:3**	**Exemplary Performance:5**
Ability to adapt to changing technology.	Has only limited ability to adapt to new and changing technology.	Shows reasonable flexibility and ability to make use of new and changing technology	Shows great flexibility in updating skills and making use of new and changing technology
Understanding of the need to continually update one's skills and knowledge.	Shows little awareness of, or concern for, the necessity of updating skills and continuing to learn	Shows basic awareness of the necessity of updating skills, gaining new skills, and continuing to learn throughout life.	Shows clear awareness of the necessity of updating skills, gaining new skills, and continuing to learn throughout life.

Table E-I.10: Metric for Assessing Outcome (j)

Metric Title	(j) Know Contemporary Issues		
Performance Criteria	**Low Performance:1**	**Moderate Performance:3**	**Exemplary Performance:5**
Ability to identify basic problems and contemporary issues in engineering.	Student fails to comprehend at least some major aspects of basic problems and issues.	Student demonstrates reasonable ability to understand problems and addressing issues.	Student shows clear ability to comprehend basic problems and flexibility in addressing challenges and issues.
Application of knowledge of contemporary issues to Metallurgical Engineering	Demonstrates little ability to apply knowledge of contemporary issues to Metallurgical Engineering problems in more than narrowly defined areas.	Demonstrates reasonable ability to apply knowledge of contemporary issues to Metallurgical Engineering problems in most important areas.	Demonstrates clear ability to apply knowledge of contemporary issues to Metallurgical Engineering problems in almost all-important areas.

Table E-I.11: Metric for Assessing Outcome (k)

Metric Title	(k) Use Engineering Techniques, Skills, and Tools		
Performance Criteria	**Low Performance:1**	**Moderate Performance:3**	**Exemplary Performance:5**
Capable of using tools such as Excel, SolidWorks, MathCAD ---	Is not using computer-based and other resources. Demonstrates an unwillingness to develop computer or library skills.	Is using computer and library resources to the extent that are presented in class handouts. Is not exploring the global context of the subject matter being presented	Is able to research, apply and articulate information beyond the information presented in the textbook and class holdouts.
Proficient in operating equipment used in the laboratory program such as the MTS machine, rolling mill, hardness tester ---	Shows no interest in learning how to operate laboratory equipment. Has not used the Virtual Laboratory web site.	Make an effort to learn how to use laboratory equipment, but is willing to let another person take charge in the group.	Comes to class with current knowledge about the equipment, and has used the laboratory equipment Virtual Laboratory to develop first hand experience in regard to vocabulary and safety.
Understands the engineering design method and can apply this method in developing solutions to engineering problems.	Has not demonstrated the concept of need as it pertains to engineering design and economics.	Has shown some understanding as to why a part is designed or redesigned for the betterment of society.	Understands all the elements of design from the beginning statement of need to placing the product on the market.

Part II

Assessment Forms

Description:

Table E-II.1: Score Card Input Form - Sample for Outcome (a) ---------- E-14
Each Outcome instrument is assessed using a Score Card Input Form that is filed
with the instrument documents (student work, etc.). The data from these forms is compiled on an Outcome Summary.

Table E-II.2 Outcome Summary - Sample for Outcome (a) ---------- E-15
All Score Card Summaries for one year are consolidated onto the Assessment Summary

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Table E-II.3 Outcome Assessment Summary ---------- E-16
Outcome Assessment Summaries are used to populate the Grand Summary data base from which the outcome assessment results are rendered into many useful graphical collections.

Table E-II.4: Outcome Review Form ---------- E-17
The results of each Outcome Review (for one year) are summarized on the longitudinal Outcome Review Summary form. The completed forms for outcomes (a)–(k) are shown in Part V below.

Table E-II.5: Outcome Review Summary Form ---------- E-18
The completed forms for outcomes (a)–(k) are shown in Part V below.

Table E-II.1: Outcome Assessment Score Card Input Form (Sample for Outcome (a))

Outcome Score Card		**(a)**	*(a) Apply knowledge of math, science, and engineering*			
Instrument **Acd.Year:**_____ **Description: (Course, etc.)** _____ **Instrument: (Final Exam , etc.)** _____		Team / Student	Proficient in Fundamental Concepts and Skills	Proficient in Theoretical and Practical Relationships	Proficient in basic science	
	EnvEng					
☐ Check Here if Teams		1				
		2				
		3				
		4				
		5				
		6				
		7				
		8				
		9				
		10				
		11				
		12				
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		25				
		26				
		27				
		28				
		29				
		30				
		31				
		32				
		33				
		34				
Reviewer's Initials: _____		35				
Date:_____		36				

Enter only a 1, 3, or 5

Leave blank any column that does not apply

Designate every EnvEng student by entering the student's initials in Column D

Table E-II.2 Outcome Assessment Score Card (Sample for Outcome (a))

Outcome Summary			*(a) Apply knowledge of math, science, and engineering*		
Average Summary		***Max***			
# Assessments		***Min***			
# Averages		***Ave***			
Instrument	**Team / Student**		Proficient in Fundamental Concepts and Skills	Proficient in Theoretical and Practical Relationships	Proficient in basic science
Inst_1	Check if Teams				
MET 320 - Annually (Fall)	Student	1			
. Final Exam	Student	2			
1	Add Student	**Max**			
Reviewer's Initials	Remove All	**Min**			
		Average			
Inst_2	Check if Teams				
MATH 373 - Annually (Fall/Spring)	Student	1			
. Project Reports	Student	2			
Method 1	Add Student	**Max**			
Reviewer's Initials	Remove All	**Min**			
		Average			
Inst_3	Check if Teams				
MET 422 - Even years (Fall)	Student	1			
. Final Exam	Student	2			
Method 1	Add Student	**Max**			
Reviewer's Initials	Remove All	**Min**			
		Average			
Inst_4	Check if Teams				
MET 310 - Even years (Spring)	Student	1			
. Selected Hour Exam	Student	2			
Method 1	Add Student	**Max**			
Reviewer's Initials	Remove All	**Min**			
		Average			
Inst_5	Check if Team				
Other Course Work	Student	1			
. From Campus Assess Comm.	Student	2			
Method 1	Add Student	**Max**			
Reviewer's Initials	Remove All	**Min**			
		Average			
Inst_6	Check if Team				
General	Student	1			
. FE Exam	Student	2			

Table E-II.3: Assessment Summary form

Assessment Metric Summary

Calendar Year 2008

Outcome	Description	Performance Objective 1	Performance Objective 2	Performance Objective 3	Performance Objective 4	
a						Instrument Average
#Totals/#Aves						Max Ave Min
b						Instrument Average
#Totals/#Aves						Max Ave Min
c						Instrument Average
#Totals/#Aves						Max Ave Min
d						Instrument Average
#Totals/#Aves						Max Ave Min
e						Instrument Average
#Totals/#Aves						Max Ave Min
f						Instrument Average
#Totals/#Aves						Max Ave Min
g						Instrument Average
#Totals/#Aves						Max Ave Min
h						Instrument Average
#Totals/#Aves						Max Ave Min
l						Instrument Average
#Totals/#Aves						Max Ave Min
j						Instrument Average
#Totals/#Aves						Max Ave Min
k						Instrument Average
#Totals/#Aves						Max Ave Min

Table E-II.4: Outcome Review Form

Outcome Review Form Met Eng

Calendar Year: _____
Outcome: (a) Apply Knowledge of Math, Science, and Engineering
Reviewer: _____
Date: _____

Please complete the following table and indicate if 1) any instruments were missing or incomplete and 2) if you reassessed any instrument.

Course	Instrument	Missing	Reassessed

Review Results:
Each review always consists of two elements: curriculum results and assessment processes.

Recommendations

Curriculum Result
Perform a critical analysis on the accuracy, validity, and value of this outcome's assessment based on the Outcome Summary. This review may also include a review of the actual assessment documents but such depth is not typically required. Note any significant differences among instruments, performance criteria, and instrument assessors. Compare the assessed performance with previous years' performance and recommend curriculum improvements, as needed. The improvement does not need to be curriculum specific, but it would be helpful to suggest possible improvements for faculty consideration. If no improvement is needed, state that the curriculum is performing adequately. If a problem may be developing but there is inadequate evidence on which to act, note that the outcome should be watched and note the concern.

(Insert review here)

Assessment Process
Comment on the adequacy of the assessment instruments and related processes. Suggest possible changes that would improve the assessment of this outcome. Possible discussion might include such things as the adequacy of triangulation by multiple assessment methods, statistical variations from small class size, sparse student participation, etc. If the process appears to be functioning adequately, state that.

(Insert review here)

Table E-II.5 Outcome Review Summary Form

Outcome Review

yyyy	(-) Outcome	Reviewer	
		Date	

Instruments for Review

Course	Instrument	Used

Reviews

Curriculum

Previous Curriculum Action Review Summary

Curriculum Review Summary

Code	*Curriculum Action Title*	*Curriculum Action Brief Description*

Assessment Process

Previous Assessment Process Action Review Summary

Assessment Process Review Summary

Code	*Assessment Process Acti*	*Assessment Process Action Brief Description*

Part III

Outcome Assessment Results
For all Instrument Collections up to and Including 2009

Contents

1. Tabular Outcome Assessments Summaries
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2. Longitudinal Outcome Assessments Charts
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   - Outcome (b): ---------- E-34
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   - Outcome (d): ---------- E-36
   - Outcome (e): ---------- E-37
   - Outcome (f):---------- E-38
   - Outcome (g): ---------- E-39
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   - Outcome (i):---------- E-41
   - Outcome (j):---------- E-42
   - Outcome (k): ---------- E-43

Table E-IV-1 2004 Assessments Summary

Assessment Metric Summary

Calendar Year 2004

Outcome	Description	Performance Obje	Performance Obje	Performance Obje	Performance Objective 4		
a	(a) Apply know ledge of math, science,	Proficient in Fundamental Concepts and	Proficient in Theoretical and Practical	Proficient in Basic Science		Instrument Average	
#Totals/#Ave		4.33	4.82	4.27		Max	3.82
240		3.77	3.82	3.73		Ave	3.77
15		3.00	3.00	3.00		Min	3.73
b	(b) Design and Conduct experiments Analyze and interpret data and information	Conducts the design of experiments.	Operates equipment and collects data for analysis.	Compares results for experimental measurements to the literature and conducts	Is able to collect global information and to use this information in evaluation and	Instrument Average	
#Totals/#Ave			3.80	4.20	4.20	Max	3.96
41			3.80	3.85	3.96	Ave	3.87
5			3.80	3.50	3.71	Min	3.80
c	(c) Optimally select material and design materials	Understand the engineering design process	Formulate possible engineering solutions	Master the iterative process in engineering design	Recognize and observe constraints in engineering	Instrument Average	
#Totals/#Ave		4.56	4.28	4.28	4.50	Max	4.03
92		3.78	3.99	3.88	4.03	Ave	3.92
16		3.00	3.45	3.06	3.56	Min	3.78
d	(d) Function w ell on teams	Responsible Participation	Interaction Skills	Assimilation and Receptiveness		Instrument Average	
#Totals/#Ave		5.00	5.00	5.00		Max	4.71
144		4.39	4.71	4.56		Ave	4.55
12		3.33	4.00	4.00		Min	4.39
e	(e) Identify, formulate, and solve	Identify	Formulate	Solve		Instrument Average	
#Totals/#Ave		4.07	4.20	3.93		Max	3.49
177		3.49	3.40	3.25		Ave	3.38
9		2.41	2.41	2.41		Min	3.25
f	(f) Know professional and ethical responsibilities and practices	Carries out responsibilities in a professional and ethical manner	Understands basic engineering principles and practices, in			Instrument Average	
#Totals/#Ave		5.00	5.00			Max	4.00
32		4.00	3.33			Ave	3.67
5		3.00	2.00			Min	3.33

Table E-IV-1 2004 Assessments Summary (cont'd)

g	(g) Communicate effectively	The content of the written or oral presentation is effective.	The organization of memorandum and technical reports is consistent with styles accepted by the person's primary professional engineering society.	The design of slides shows an understanding of vision limitation of the audience and the total time the presenter plans to spend on the visual aid during oral presentations.			Instrument Average	
#Totals/#Ave		4.78	4.50	4.70			Max	4.34
85		4.03	3.80	4.34			Ave	4.06
15		2.00	2.50	4.10			Min	3.80
h	(h) Know engineering's global societal context	Has the broad education necessary to understanding impact of engineering solutions in global and societal context	Awareness of contemporary state of knowledge and relationship to engineering solutions	Recognition of the need for, and ability to engage in, life-long learning			Instrument Average	
#Totals/#Ave		5.00	5.00				Max	4.50
28		3.75	4.50				Ave	4.13
4		2.50	4.00				Min	3.75
i	(i) Engage in life-long learning	Ability to adapt to changing technology.	Understanding of the need to continually update one's skills and knowledge.	Cognitive Level Assessment			Instrument Average	
#Totals/#Ave				3.89			Max	3.89
9				3.89			Ave	3.89
1				3.89			Min	3.89
j	(j) Know contemporary issues	Ability to identify basic problems and contemporary issues in engineering.	Application of knowledge of contemporary issues to Metallurgical Engineering				Instrument Average	
#Totals/#Ave		3.60	3.60				Max	3.60
20		3.60	3.60				Ave	3.60
2		3.60	3.60				Min	3.60
k	(k) Use engineering techniques, skills, and tools	Capable of using tools such as Excel, SolidWorks, MathCAD ---	Proficient in operating equipment used in the laboratory program such as the MTS machine, rolling mill, hardness tester ---	Understands the engineering design method and can apply this method in developing solutions to engineering problems.			Instrument Average	
#Totals/#Ave		4.29	3.60	4.33			Max	3.77
90		3.77	3.20	2.99			Ave	3.32
13		3.00	3.00	1.00			Min	2.99

Table E-IV-2 2005 Assessments Summary

Assessment Metric Summary

Calendar Year 2005

Outcome	Description	Performance Objective 1	Performance Objective 2	Performance Objective 3	Performance Objective 4		
a	(a) Apply know ledge of math, science,	Proficient in Fundamental Concepts and	Proficient in Theoretical and Practical	Proficient in Basic Science		Instrument Average	
#Totals		5.00	5.00	5.00		Max	4.62
94		4.44	4.62	4.20		Ave	4.42
12		4.00	4.00	3.00		Min	4.20
b	(b) Design and Conduct experiments Analyze and interpret data and information	Conducts the design of experiments.	Operates equipment and collects data for analysis.	Compares results for experimental measurements to the literature and conducts	Is able to collect global information and to use this information in evaluation and interpretation of	Instrument Average	
#Totals		5.00	4.00	5.00	3.67	Max	4.56
40		4.47	3.67	4.56	3.67	Ave	4.09
8		3.93	3.33	3.67	3.67	Min	3.67
c	(c) Optimally select material and design materials	Understand the engineering design process	Formulate possible engineering solutions	Master the iterative process in engineering design	Recognize and observe constraints in engineering	Instrument Average	
#Totals		5.00	5.00	5.00	5.00	Max	4.20
50		4.10	4.11	4.04	4.20	Ave	4.11
15		3.00	2.34	2.33	2.45	Min	4.04
d	(d) Function w ell on teams	Responsible Participation	Interaction Skills	Assimilation and Receptiveness		Instrument Average	
#Totals		5.00	5.00	4.39		Max	4.53
58		4.41	4.53	4.00		Ave	4.31
8		4.06	4.30	3.61		Min	4.00
e	(e) Identify, formulate, and solve	Identify	Formulate	Solve		Instrument Average	
#Totals		4.40	4.20	5.00		Max	4.36
77		4.16	3.93	4.36		Ave	4.15
9		4.00	3.50	4.00		Min	3.93
f	(f) Know professional and ethical responsibilities and practices	Carries out responsibilities in a professional and ethical manner	Understands basic engineering principles and practices, in			Instrument Average	
#Totals		5.00	5.00			Max	4.67
10		4.33	4.67			Ave	4.50
6		4.00	4.00			Min	4.33

g	(g) Communicate effectively	The content of the written or oral presentation is effective.	The organization of memorandum and technical reports is consistent with styles accepted by the person's primary professional engineering society.	The design of slides shows an understanding of vision limitation of the audience and the total time the presenter plans to spend on the visual aid during oral presentations.		Instrument Average	
#Totals		5.00	5.00	5.00	4.00	Max	4.52
137		4.14	4.33	4.52	4.00	Ave	4.25
21		3.13	3.50	3.71	4.00	Min	4.00
h	(h) Know engineering's global societal context	Has the broad education necessary to understanding impact of engineering solutions in global and societal context	Awareness of contemporary state of knowledge and relationship to engineering solutions	Recognition of the need for, and ability to engage in, life-long learning		Instrument Average	
#Totals		3.00	4.00			Max	3.50
8		3.00	3.50			Ave	3.25
4		3.00	3.00			Min	3.00
I	(i) Engage in life-long learning	Ability to adapt to changing technology.	Understanding of the need to continually update one's skills and knowledge.	Cognitive Level Assessment		Instrument Average	
#Totals		4.00	5.00		3.00	Max	5.00
6		4.00	5.00		3.00	Ave	4.00
3		4.00	5.00		3.00	Min	3.00
j	(j) Know contemporary issues	Ability to identify basic problems and contemporary issues in engineering.	Application of knowledge of contemporary issues to Metallurgical Engineering			Instrument Average	
#Totals		3.00	5.00			Max	5.00
4		3.00	5.00			Ave	4.00
2		3.00	5.00			Min	3.00
k	(k) Use engineering techniques, skills, and tools	Capable of using tools such as Excel, SolidWorks, MathCAD ---	Proficient in operating equipment used in the laboratory program such as the MTS machine, rolling mill, hardness tester ---	Understands the engineering design method and can apply this method in developing solutions to engineering problems.		Instrument Average	
#Totals		5.00	5.00	4.79		Max	4.00
109		3.97	4.00	3.83		Ave	3.93
12		3.00	3.00	3.00		Min	3.83

Table E-IV-3 2006 Assessments Summary

Assessment Metric Summary

Calendar Year 2006

Outcome	Description	Performance Objective 1	Performance Objective 2	Performance Objective 3	Performance Objective 4		
a	(a) Apply know ledge of math, science,	Proficient in Fundamental Concepts and	Proficient in Theoretical and Practical	Proficient in Basic Science		Instrument Average	
#Totals		4.33	4.52	4.60		Max	3.96
247		3.77	3.91	3.96		Ave	3.88
15		3.13	3.40	3.42		Min	3.77
b	(b) Design and Conduct experiments Analyze and interpret data and information	Conducts the design of experiments.	Operates equipment and collects data for analysis.	Compares results for experimental measurements to the literature and conducts	Is able to collect global information and to use this information in evaluation and interpretation of	Instrument Average	
#Totals		4.60	4.70	4.20	3.90	Max	4.06
142		4.00	4.06	3.79	3.12	Ave	3.74
12		3.40	3.67	3.50	1.50	Min	3.12
c	(c) Optimally select material and design materials	Understand the engineering design process	Formulate possible engineering solutions	Master the iterative process in engineering design	Recognize and observe constraints in engineering	Instrument Average	
#Totals		4.00	3.90	3.80	4.20	Max	3.93
95		3.61	3.74	3.30	3.93	Ave	3.65
15		3.00	3.67	3.00	3.52	Min	3.30
d	(d) Function w ell on teams	Responsible Participation	Interaction Skills	Assimilation and Receptiveness		Instrument Average	
#Totals		5.00	5.00	4.88		Max	4.58
112		4.51	4.58	4.16		Ave	4.42
11		3.21	3.46	3.18		Min	4.16
e	(e) Identify, formulate, and solve	Identify	Formulate	Solve		Instrument Average	
#Totals		4.52	4.29	4.29		Max	3.93
283		3.85	3.91	3.93		Ave	3.90
15		3.25	3.25	3.25		Min	3.85
f	(f) Know professional and ethical responsibilities and practices	Carries out responsibilities in a professional and ethical manner	Understands basic engineering principles and practices, in			Instrument Average	
#Totals		5.00	5.00			Max	4.42
71		4.42	4.36			Ave	4.39
9		3.33	3.00			Min	4.36

Table E-IV-3 2006 Assessments Summary (Cont'd)

g	(g) Communicate effectively	The content of the written or oral presentation is effective.	The organization of memorandum and technical reports is consistent with styles accepted by the person's primary professional engineering society.	The design of slides shows an understanding of vision limitation of the audience and the total time the presenter plans to spend on the visual aid during oral presentations.		Instrument Average	
#Totals		5.00	5.00	5.00		Max	4.23
117		4.23	3.83	4.16		Ave	4.07
16		3.33	2.33	3.67		Min	3.83
h	(h) Know engineering's global societal context	Has the broad education necessary to understanding impact of engineering solutions in global and societal context	Awareness of contemporary state of knowledge and relationship to engineering solutions	Recognition of the need for, and ability to engage in, life-long learning		Instrument Average	
#Totals		5.00	5.00	2.33		Max	3.91
73		3.91	3.77	2.33		Ave	3.34
8		3.33	2.00	2.33		Min	2.33
I	(i) Engage in life-long learning	Ability to adapt to changing technology.	Understanding of the need to continually update one's skills and	Cognitive Level Assessment		Instrument Average	
#Totals		4.80	5.00			Max	5.00
15		4.80	5.00			Ave	4.90
2		4.80	5.00			Min	4.80
j	(j) Know contemporary issues	Ability to identify basic problems and contemporary issues in engineering.	Application of knowledge of contemporary issues to Metallurgical Engineering			Instrument Average	
#Totals		3.80	3.00			Max	3.80
10		3.80	3.00			Ave	3.40
2		3.80	3.00			Min	3.00
k	(k) Use engineering techniques, skills, and tools					Instrument Average	
#Totals		4.33	4.33	4.60		Max	3.96
132		3.85	3.89	3.96		Ave	3.90
12		3.63	3.40	3.42		Min	3.85

Table E-IV-4 2007 Assessments Summary

Assessment Metric Summary

Calendar Year **2007**

Outcome	Description	Performance Objec	Performance Objec	Performance Objec	Performance Objective 4		
a	(a) Apply know ledge of math, science,	Proficient in Fundamental Concepts and	Proficient in Theoretical and Practical	Proficient in Basic Science		Instrument Average	
#Totals		4.37	4.69	3.27		Max	4.03
153		3.75	4.03	3.20		Ave	3.66
10		3.27	3.53	3.14		Min	3.20
b	(b) Design and Conduct experiments Analyze and interpret data and information	Conducts the design of experiments.	Operates equipment and collects data for analysis.	Compares results for experimental measurements to the literature and conducts interpretation of	Is able to collect global information and to use this information in evaluation and interpretation of	Instrument Average	
#Totals		3.67	3.80	4.07	3.46	Max	3.80
91		3.67	3.80	3.53	2.82	Ave	3.45
9		3.67	3.80	3.00	1.00	Min	2.82
c	(c) Optimally select material and design materials treatment and	Understand the engineering design process	Formulate possible engineering solutions	Master the iterative process in engineering design	Recognize and observe constraints in engineering	Instrument Average	
#Totals		4.69	4.18	3.91	4.05	Max	3.70
270		3.58	3.70	3.33	3.48	Ave	3.53
12		2.78	3.22	2.56	3.00	Min	3.33
d	(d) Function w ell on teams	Responsible Participation	Interaction Skills	Assimilation and Receptiveness		Instrument Average	
#Totals		4.47	3.93	4.14		Max	4.14
57		3.78	3.93	4.14		Ave	3.95
5		3.31	3.93	4.14		Min	3.78
e	(e) Identify, formulate, and solve engineering	Identify	Formulate	Solve		Instrument Average	
#Totals		3.67	3.81	3.93		Max	3.75
126		3.67	3.40	3.75		Ave	3.61
6		3.67	2.85	3.57		Min	3.40
f	(f) Know professional and ethical responsibilities and practices	Carries out responsibilities in a professional and ethical manner	Understands basic engineering principles and practices, in terms of professional			Instrument Average	
#Totals		4.07	5.00	4.14		Max	4.17
95		3.64	4.17	4.14		Ave	3.99
8		3.22	3.00	4.14		Min	3.64

Table E-IV-4 2007 Assessments Summary (Cont'd)

g	(g) Communicate effectively	The content of the written or oral presentation is effective.	The organization of memorandum and technical reports is consistent with styles accepted by the person's primary professional engineering society.	The design of slides shows an understanding of vision limitation of the audience and the total time the presenter plans to spend on the visual aid during oral presentations.		Instrument Average	
#Totals		4.25	4.07	4.73		Max	4.19
153		3.80	3.64	4.19		Ave	3.88
13		3.22	3.22	3.63		Min	3.64
h	(h) Know engineering's global societal context	Has the broad education necessary to understanding impact of engineering solutions in global and societal context	Awareness of contemporary state of knowledge and relationship to engineering solutions	Recognition of the need for, and ability to engage in, life-long learning		Instrument Average	
#Totals		3.53	3.53	2.78		Max	3.37
96		3.10	3.37	2.78		Ave	3.08
7		2.33	3.22	2.78		Min	2.78
i	(i) Engage in life-long learning	Ability to adapt to changing technology.	Understanding of the need to continually update one's skills and knowledge.	Cognitive Level Assessment		Instrument Average	
#Totals		4.47	4.33	2.43		Max	4.47
101		4.47	4.01	2.43		Ave	3.64
4		4.47	3.69	2.43		Min	2.43
j	(j) Know contemporary issues	Ability to identify basic problems and contemporary issues in engineering.	Application of knowledge of contemporary issues to Metallurgical Engineering			Instrument Average	
#Totals		3.79	3.67			Max	3.70
69		3.70	3.67			Ave	3.68
4		3.64	3.67			Min	3.67
k	(k) Use engineering techniques, skills, and tools	Capable of using tools such as Excel, SolidWorks, MathCAD ---	Proficient in operating equipment used in the laboratory program such as the MTS machine, rolling mill, hardness tester ---	Understands the engineering design method and can apply this method in developing solutions to engineering problems.		Instrument Average	
#Totals		5.00	4.67	5.00		Max	4.37
122		4.28	4.37	4.13		Ave	4.26
11		3.86	4.07	3.71		Min	4.13

Table E-IV-5 2008 Assessments
Summary

Assessment Metric Summary

Calendar Year 2008

Outcome	Description	Performance Obje	Performance Obje	Performance Obje	Performance Objective 4		
a	(a) Apply knowledge of math, science,	Proficient in Fundamental Concepts and	Proficient in Theoretical and Practical	Proficient in Basic Science		Instrument Average	
#Totals/		5.00	4.71	4.00		Max	3.86
170		3.86	3.38	3.06		Ave	3.43
15		2.00	2.00	2.00		Min	3.06
b	(b) Design and Conduct experiments Analyze and interpret data and information	Conducts the design of experiments.	Operates equipment and collects data for analysis.	Compares results for experimental measurements to the literature and conducts interpretation of	Is able to collect global information and to use this information in evaluation and interpretation of	Instrument Average	
#Totals/		4.67	4.67	4.52	4.52	Max	4.40
145		2.83	4.40	4.08	4.16	Ave	3.87
13		1.00	4.00	3.00	3.50	Min	2.83
c	(c) Optimally select material and design materials	Understand the engineering design process	Formulate possible engineering solutions	Master the iterative process in engineering design	Recognize and observe constraints in engineering	Instrument Average	
#Totals/		4.71	4.43	4.67	4.43	Max	4.31
155		4.29	4.12	4.31	3.87	Ave	4.14
13		4.00	3.92	3.83	3.33	Min	3.87
d	(d) Function well on teams	Responsible Participation	Interaction Skills	Assimilation and Receptiveness		Instrument Average	
#Totals/		3.29	5.00	3.67		Max	4.14
26		3.29	4.14	3.67		Ave	3.70
4		3.29	3.29	3.67		Min	3.29
e	(e) Identify, formulate, and solve engineering	Identify	Formulate	Solve		Instrument Average	
#Totals/		4.33	4.63	4.67		Max	3.95
215		3.95	3.92	3.72		Ave	3.86
14		3.63	3.29	3.25		Min	3.72
f	(f) Know professional and ethical responsibilities and practices	Carries out responsibilities in a professional and ethical manner	Understands basic engineering principles and practices, in terms of			Instrument Average	
#Totals/		4.54	4.85			Max	4.43
62		4.43	4.27			Ave	4.35
8		4.33	3.67			Min	4.27

Table E-IV-5 2008 Assessments Summary (Cont'd)

g	(g) Communicate effectively	The content of the written or oral presentation is effective.	The organization of memorandum and technical reports is consistent with styles accepted by the person's primary professional engineering society.	The design of slides shows an understanding of vision limitation of the audience and the total time the presenter plans to spend on the visual aid during oral presentations.		Instrument Average	
#Totals/#		4.43	5.00	5.00		Max	4.24
248		4.15	4.24	4.03		Ave	4.14
17		3.67	3.62	3.25		Min	4.03
h	(h) Know engineering's global societal context	Has the broad education necessary to understanding impact of engineering solutions in global and societal context	Awareness of contemporary state of knowledge and relationship to engineering solutions	Recognition of the need for, and ability to engage in, life-long learning		Instrument Average	
#Totals/#		5.00	5.00	4.43		Max	4.48
79		4.48	4.31	4.41		Ave	4.40
9		4.00	3.67	4.38		Min	4.31
I	(i) Engage in life-long learning	Ability to adapt to changing technology.	Understanding of the need to continually update one's skills and knowledge.	Cognitive Level Assessment		Instrument Average	
#Totals/#		4.78	5.00			Max	4.43
79		4.43	4.40			Ave	4.41
6		4.08	3.45			Min	4.40
j	(j) Know contemporary issues	Ability to identify basic problems and contemporary issues in engineering.	Application of knowledge of contemporary issues to Metallurgical Engineering			Instrument Average	
#Totals/#		4.33	3.67			Max	4.24
19		4.24	3.67			Ave	3.95
3		4.14	3.67			Min	3.67
k	(k) Use engineering techniques, skills, and tools	Capable of using tools such as Excel, SolidWorks, MathCAD ---	Proficient in operating equipment used in the laboratory program such as the MTS machine, rolling mill, hardness tester ---	Understands the engineering design method and can apply this method in developing solutions to engineering problems.		Instrument Average	
#Totals/#		5.00	4.71	5.00		Max	4.33
118		3.75	4.33	4.28		Ave	4.12
12		2.00	4.00	3.50		Min	3.75

Table E-IV-6 2009 Assessments Summary

Assessment Metric Summary

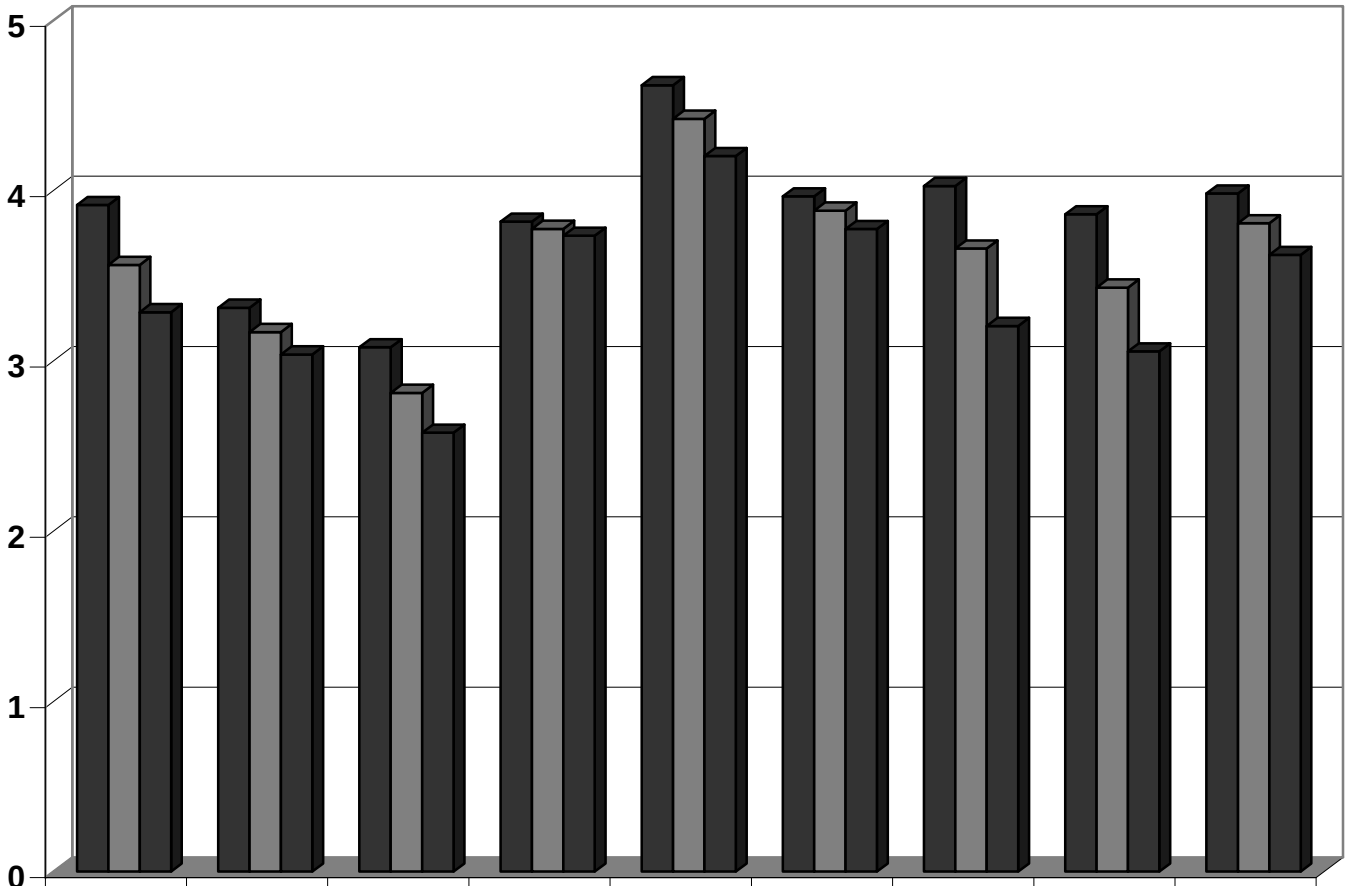
Calendar Year 2009

Outcome	Description	Performance Objec	Performance Objec	Performance Objec	Performance Objective 4		
a	(a) Apply know ledge of math, science,	Proficient in Fundamental Concepts and	Proficient in Theoretical and Practical	Proficient in Basic Science		Instrument Average	
#Totals		5.00	4.42	4.00		Max	3.98
105		3.82	3.98	3.62		Ave	3.81
10		3.08	3.53	3.33		Min	3.62
b	(b) Design and Conduct experiments Analyze and interpret data and information	Conducts the design of experiments.	Operates equipment and collects data for analysis.	Compares results for experimental measurements to the literature and conducts interpretation of	Is able to collect global information and to use this information in evaluation and interpretation of	Instrument Average	
#Totals		3.67	4.33	4.00	3.67	Max	3.55
54		3.00	3.55	3.22	2.78	Ave	3.14
11		2.33	2.33	2.33	2.33	Min	2.78
c	(c) Optimally select material and design materials	Understand the engineering design process	Formulate possible engineering solutions	Master the iterative process in engineering design	Recognize and observe constraints in engineering	Instrument Average	
#Totals		4.40	5.00	4.13	4.40	Max	4.42
202		3.91	4.42	3.85	3.83	Ave	4.00
17		3.33	4.00	3.50	3.33	Min	3.83
d	(d) Function w ell on teams	Responsible Participation	Interaction Skills	Assimilation and Receptiveness		Instrument Average	
#Totals		5.00	4.67	4.20		Max	4.11
111		4.11	4.10	3.76		Ave	3.99
11		3.33	3.00	3.00		Min	3.76
e	(e) Identify, formulate, and solve engineering	Identify	Formulate	Solve		Instrument Average	
#Totals		3.67	3.50	4.33		Max	3.33
61		3.33	3.25	3.33		Ave	3.31
8		3.00	3.00	2.71		Min	3.25
f	(f) Know professional and ethical responsibilities and practices	Carries out responsibilities in a professional and ethical manner	Understands basic engineering principles and practices, in terms of			Instrument Average	
#Totals		4.33	4.33			Max	3.71
32		3.44	3.71			Ave	3.58
7		2.00	2.50			Min	3.44

Table E-IV-6 2009 Assessments Summary (Cont'd)

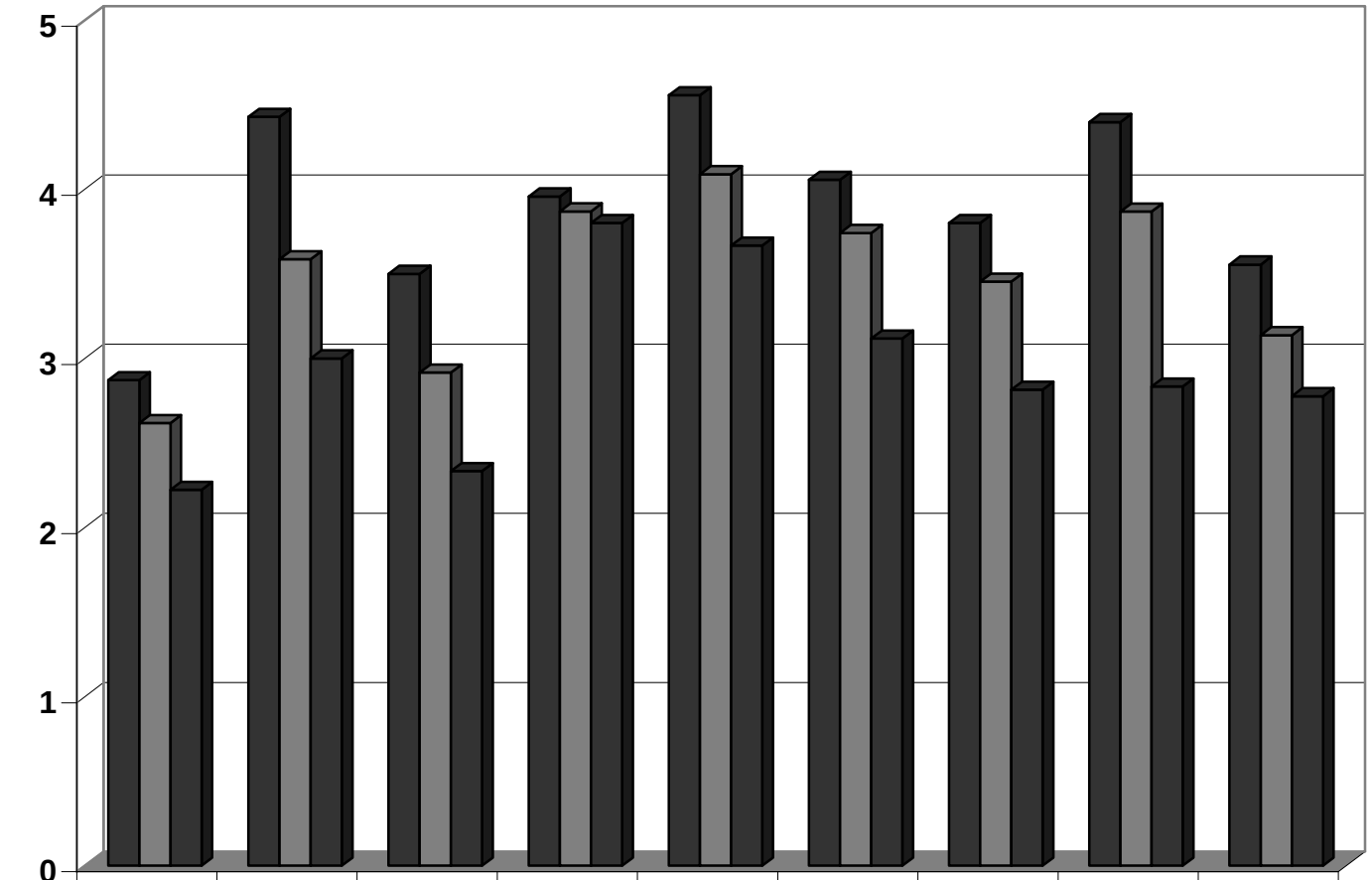
g	(g) Communicate effectively	The content of the written or oral presentation is effective.	The organization of memorandum and technical reports is consistent with styles accepted by the person's	The design of slides shows an understanding of vision limitation of the audience and the total time the presenter plans		Instrument Average	
#Total		4.40	4.50	4.80		Max	4.38
206		4.11	4.24	4.38		Ave	4.24
16		3.50	4.00	4.00		Min	4.11
h	(h) Know engineering's global societal context	Has the broad education necessary to understanding impact of engineering	Awareness of contemporary state of knowledge and relationship to engineering	Recognition of the need for, and ability to engage in, life-long learning		Instrument Average	
#Total		4.00	4.39			Max	4.13
59		4.00	4.13			Ave	4.07
5		4.00	3.67			Min	4.00
I	(i) Engage in life-long learning	Ability to adapt to changing technology.	Understanding of the need to continually update one's	Cognitive Level Assessment		Instrument Average	
#Total		4.67	4.67	4.00	4.33	Max	4.67
87		4.67	4.67	3.88	4.33	Ave	4.39
5		4.67	4.67	3.76	4.33	Min	3.88
j	(j) Know contemporary issues	Ability to identify basic problems and contemporary	Application of knowledge of contemporary issues to			Instrument Average	
#Total		4.00	4.00			Max	3.86
40		3.86	3.83			Ave	3.85
4		3.72	3.67			Min	3.83
k	(k) Use engineering techniques, skills, and tools	Capable of using tools such as Excel, SolidWorks, MathCAD ---	Proficient in operating equipment used in the laboratory program such as the MTS	Understands the engineering design method and can apply this method in developing		Instrument Average	
#Total		4.33	4.67	4.33		Max	4.44
33		4.33	4.44	4.17		Ave	4.31
7		4.33	4.33	4.00		Min	4.17

Outcome (a) Apply knowledge of math, science, and engineering



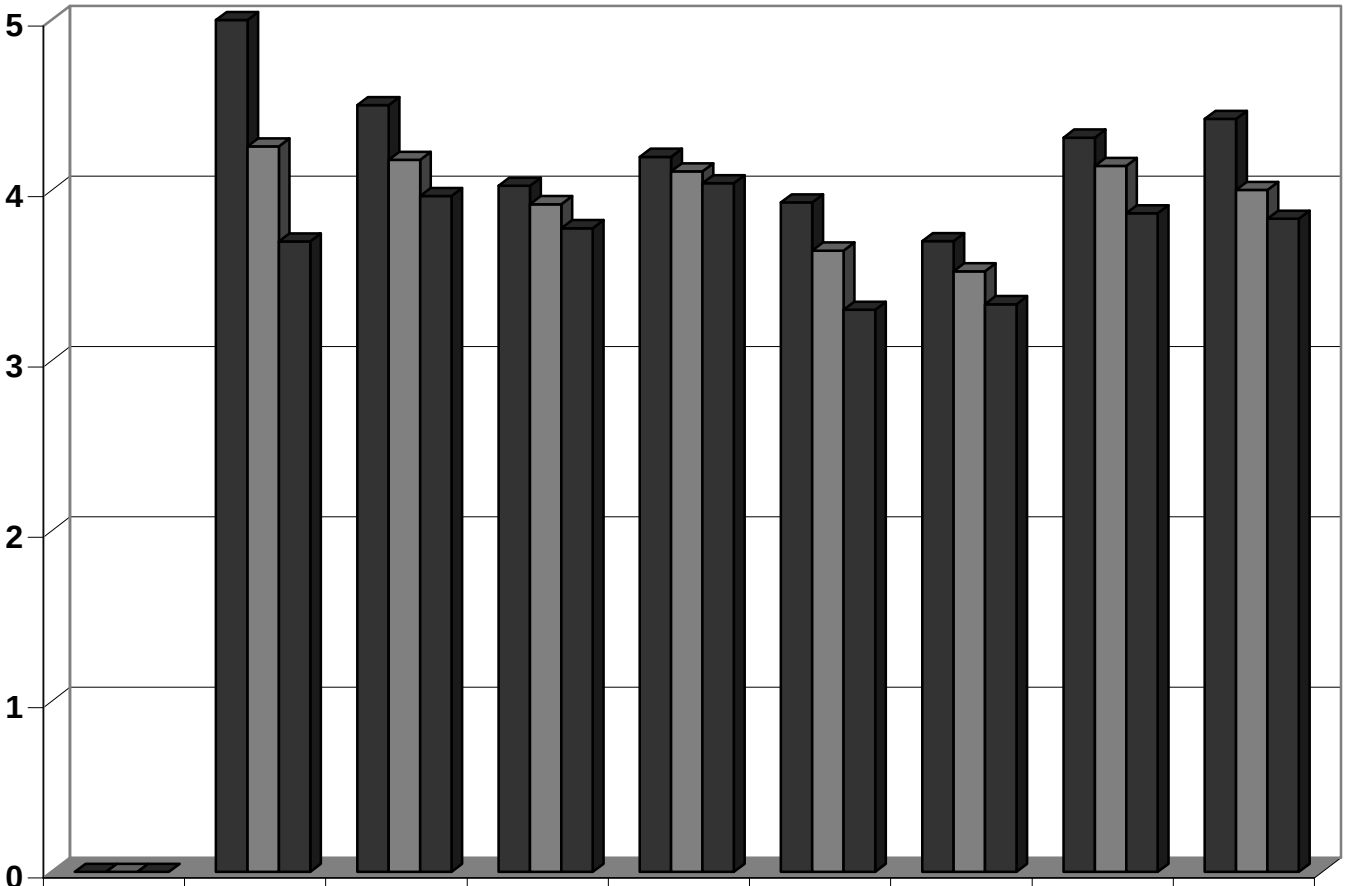
	2001	2002	2003	2004	2005	2006	2007	2008	2009
L	3.91	3.31	3.08	3.82	4.62	3.96	4.03	3.86	3.98
A	3.56	3.17	2.81	3.77	4.42	3.88	3.66	3.43	3.81
H	3.29	3.04	2.58	3.73	4.20	3.77	3.20	3.06	3.62

Outcome (b) Design and Conduct experiments Analyze and interpret data and information



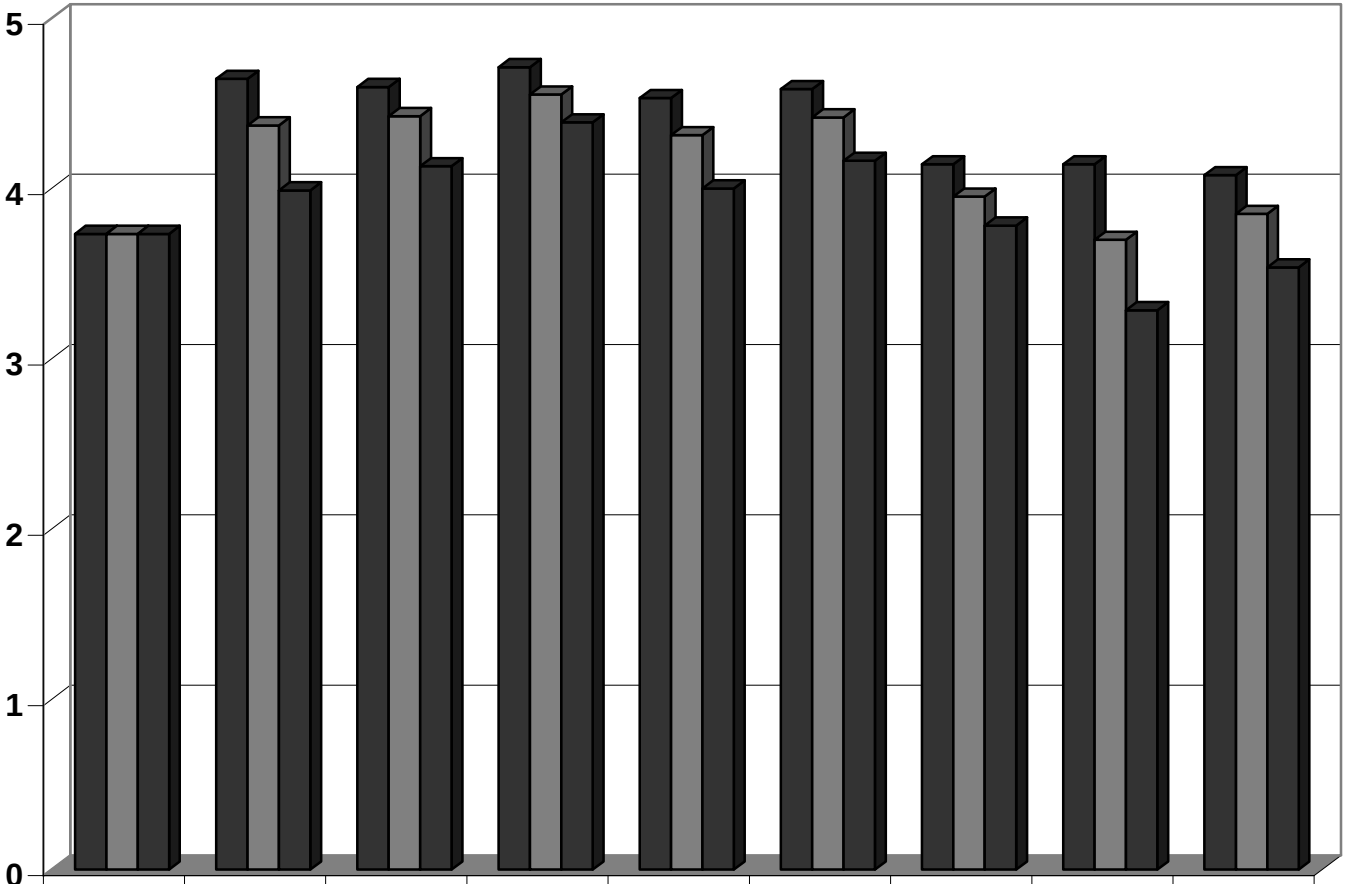
	2001	2002	2003	2004	2005	2006	2007	2008	2009
L	2.87	4.43	3.50	3.96	4.56	4.06	3.80	4.40	3.55
A	2.62	3.59	2.92	3.87	4.09	3.74	3.45	3.87	3.14
H	2.22	3.00	2.33	3.80	3.67	3.12	2.82	2.83	2.78

Outcome (c) Optimally select material and design materials treatment and production processes



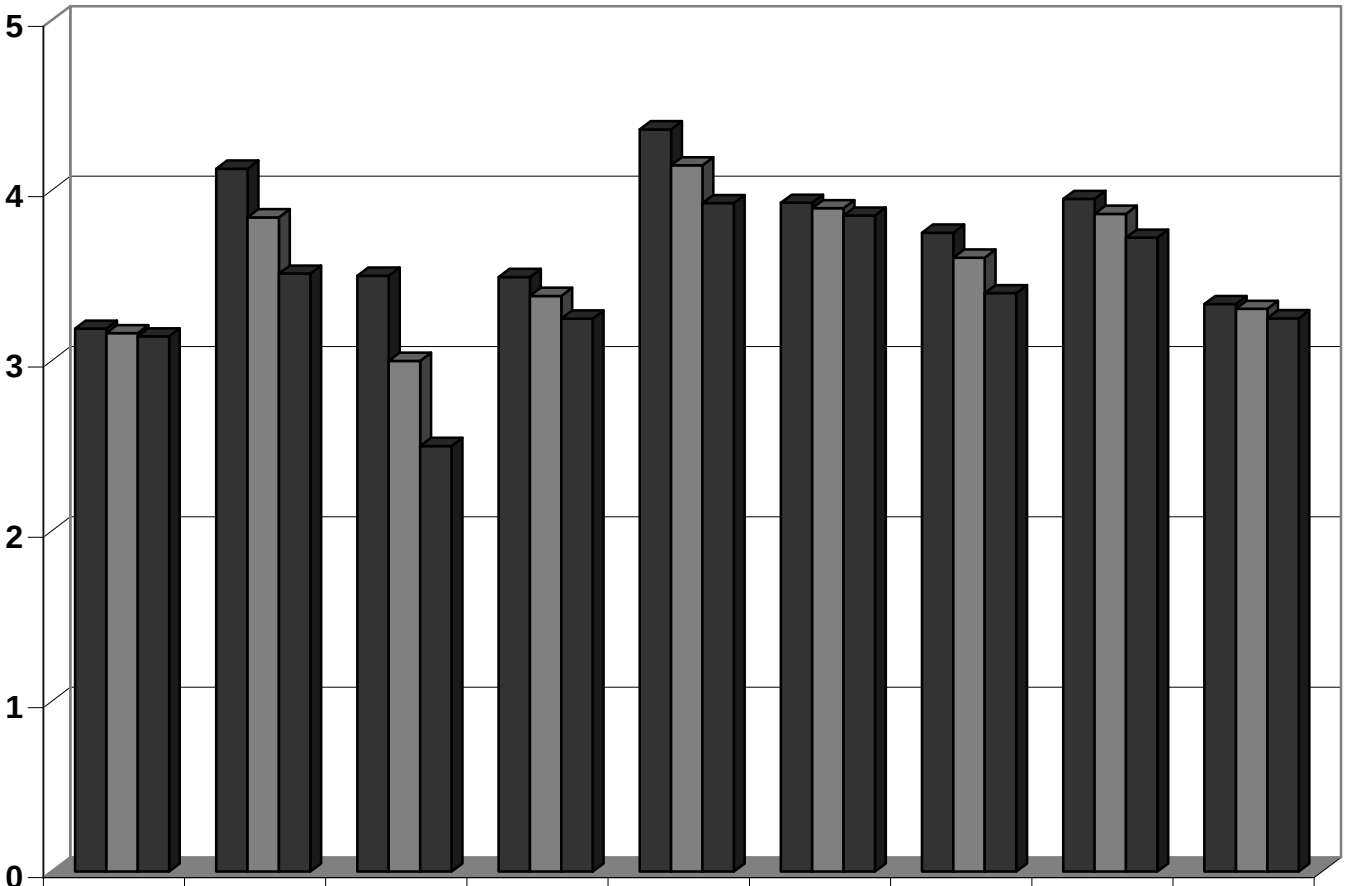
	2001	2002	2003	2004	2005	2006	2007	2008	2009
L	0.00	5.00	4.50	4.03	4.20	3.93	3.70	4.31	4.42
A	0.00	4.26	4.18	3.92	4.11	3.65	3.53	4.14	4.00
H	0.00	3.70	3.97	3.78	4.04	3.30	3.33	3.87	3.83

Outcome (d) Function well on teams



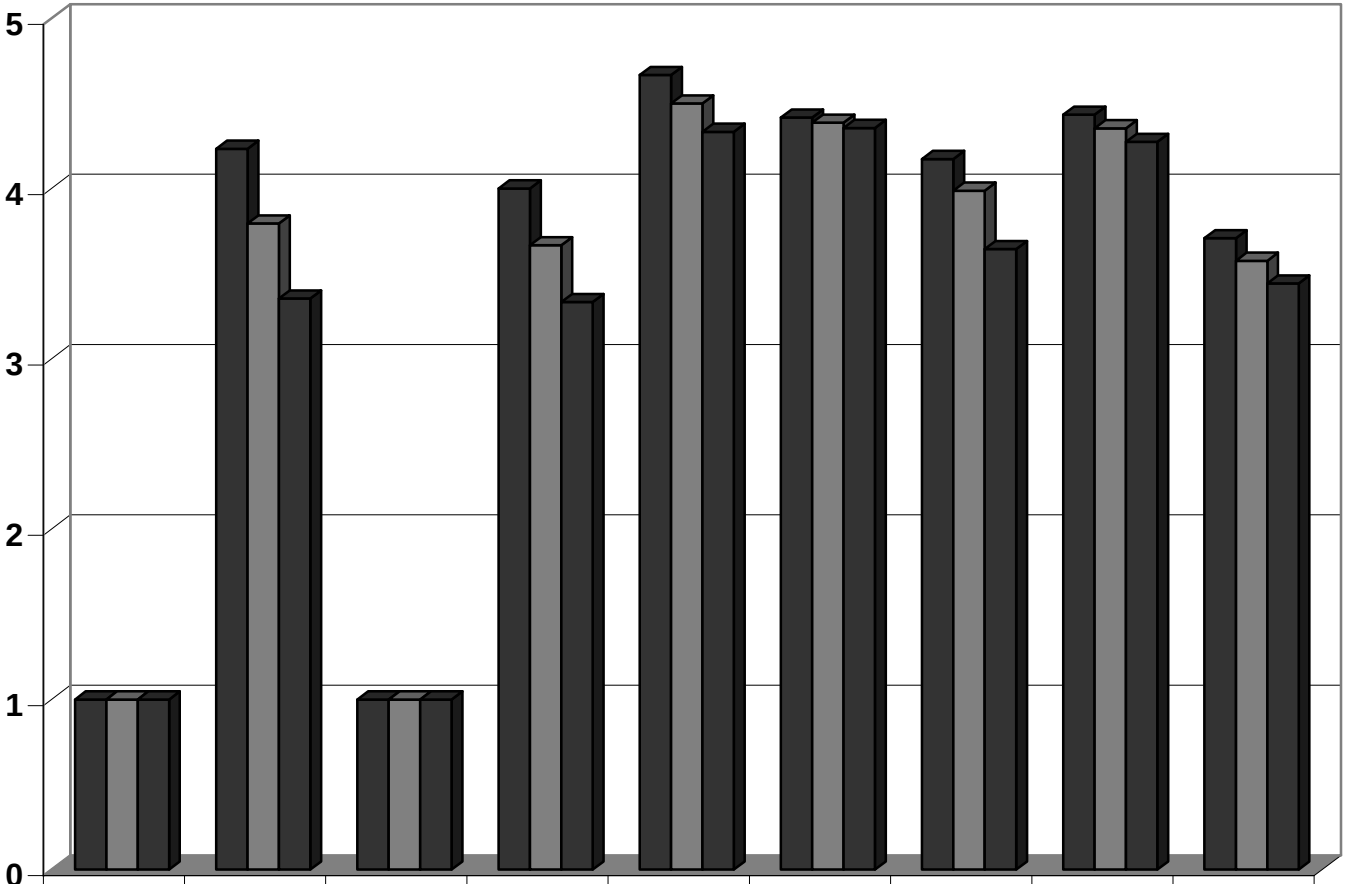
	2001	2002	2003	2004	2005	2006	2007	2008	2009
L	3.73	4.64	4.60	4.71	4.53	4.58	4.14	4.14	4.08
A	3.73	4.37	4.43	4.55	4.31	4.42	3.95	3.70	3.85
H	3.73	3.99	4.13	4.39	4.00	4.16	3.78	3.29	3.54

Outcome (e) Identify, formulate, and solve engineering problems



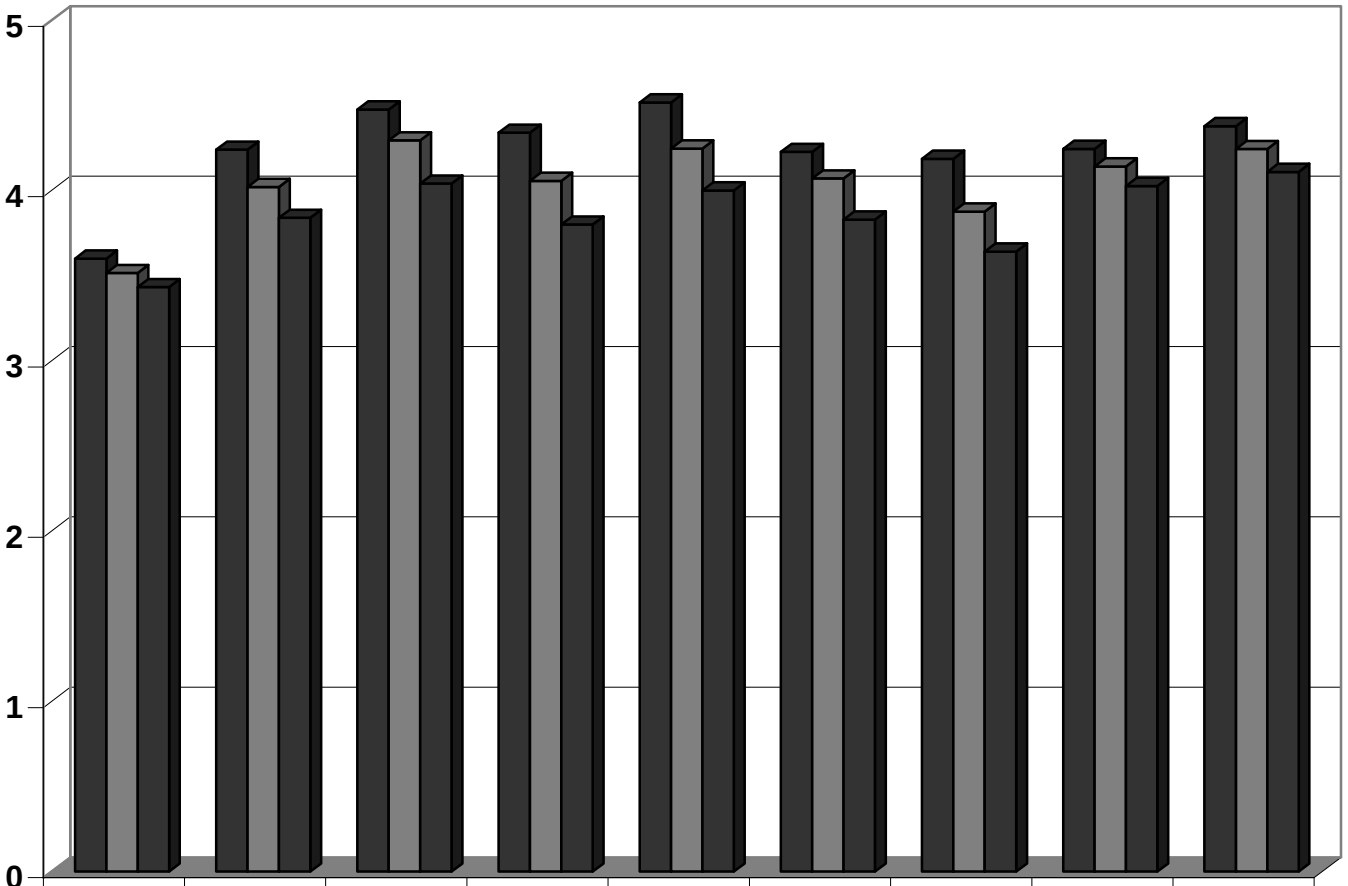
	2001	2002	2003	2004	2005	2006	2007	2008	2009
L	3.19	4.13	3.50	3.49	4.36	3.93	3.75	3.95	3.33
A	3.16	3.84	3.00	3.38	4.15	3.90	3.61	3.86	3.31
H	3.14	3.51	2.50	3.25	3.93	3.85	3.40	3.72	3.25

Outcome (f) Know professional and ethical responsibilities and practices



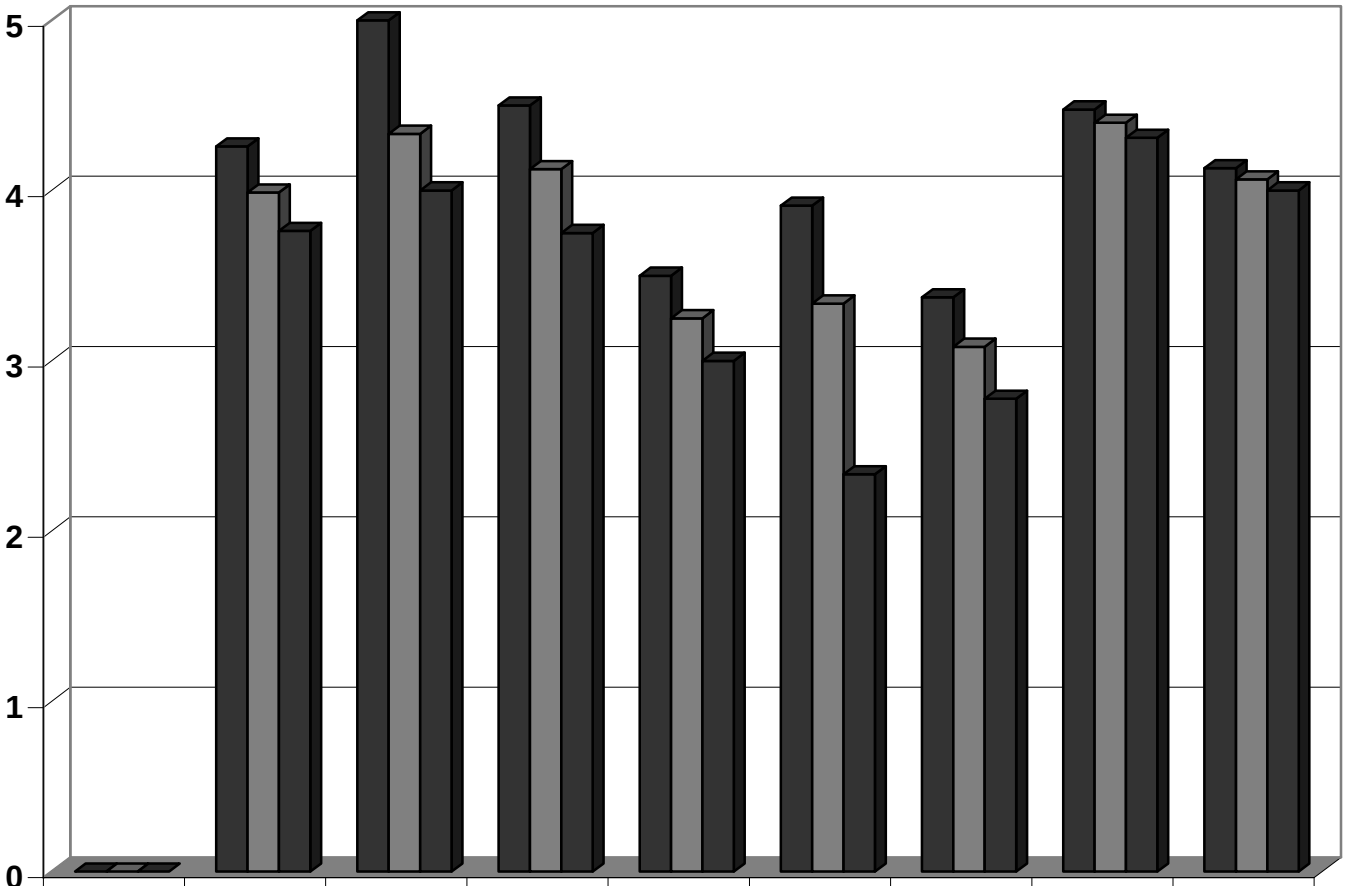
	2001	2002	2003	2004	2005	2006	2007	2008	2009
L	1.00	4.23	1.00	4.00	4.67	4.42	4.17	4.43	3.71
A	1.00	3.79	1.00	3.67	4.50	4.39	3.99	4.35	3.58
H	1.00	3.36	1.00	3.33	4.33	4.36	3.64	4.27	3.44

Outcome (g) Communicate effectively



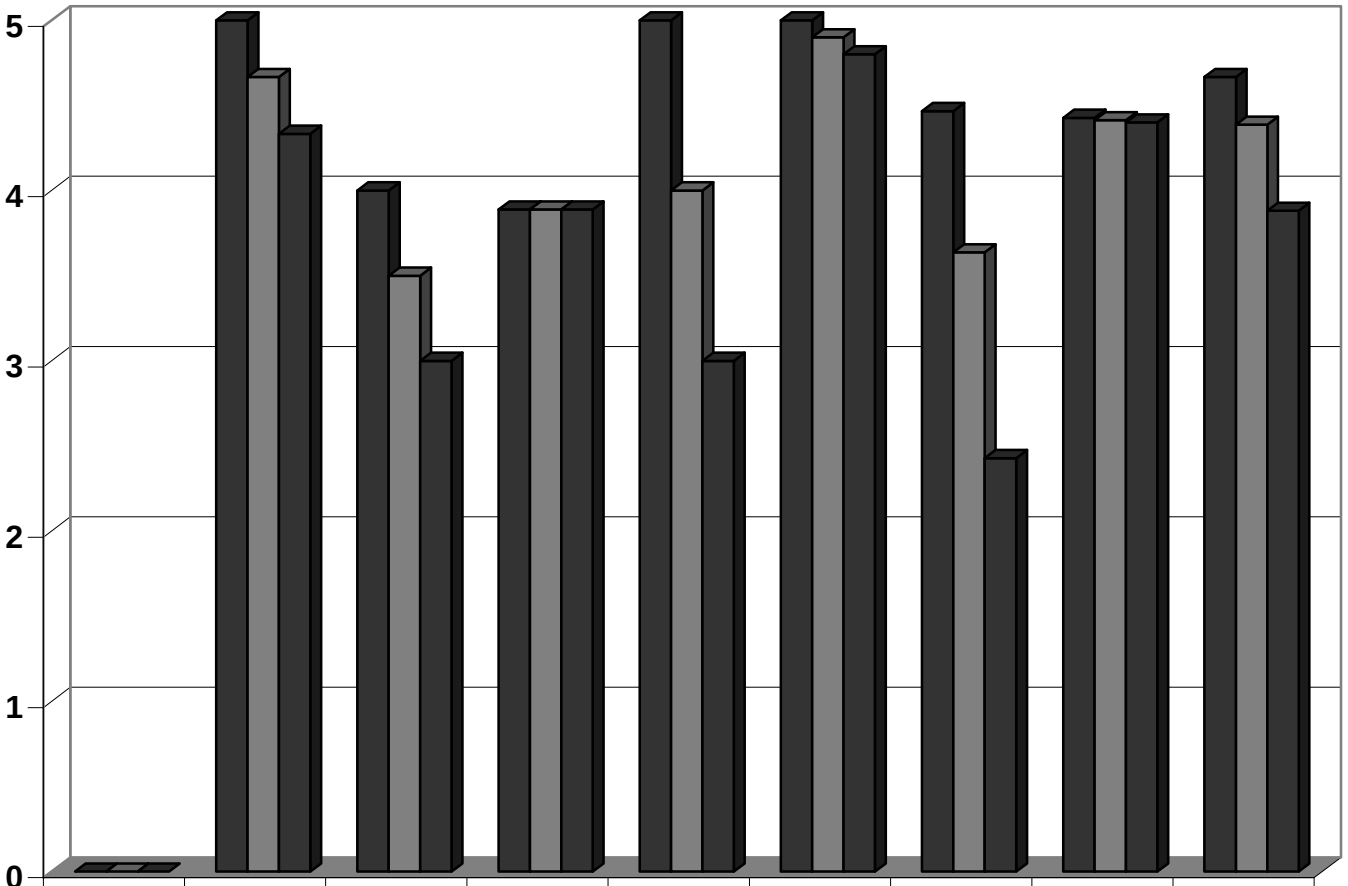
	2001	2002	2003	2004	2005	2006	2007	2008	2009
L	3.60	4.24	4.48	4.34	4.52	4.23	4.19	4.24	4.38
A	3.52	4.02	4.30	4.06	4.25	4.07	3.88	4.14	4.24
H	3.43	3.84	4.04	3.80	4.00	3.83	3.64	4.03	4.11

Outcome (h) Know engineering's global societal context



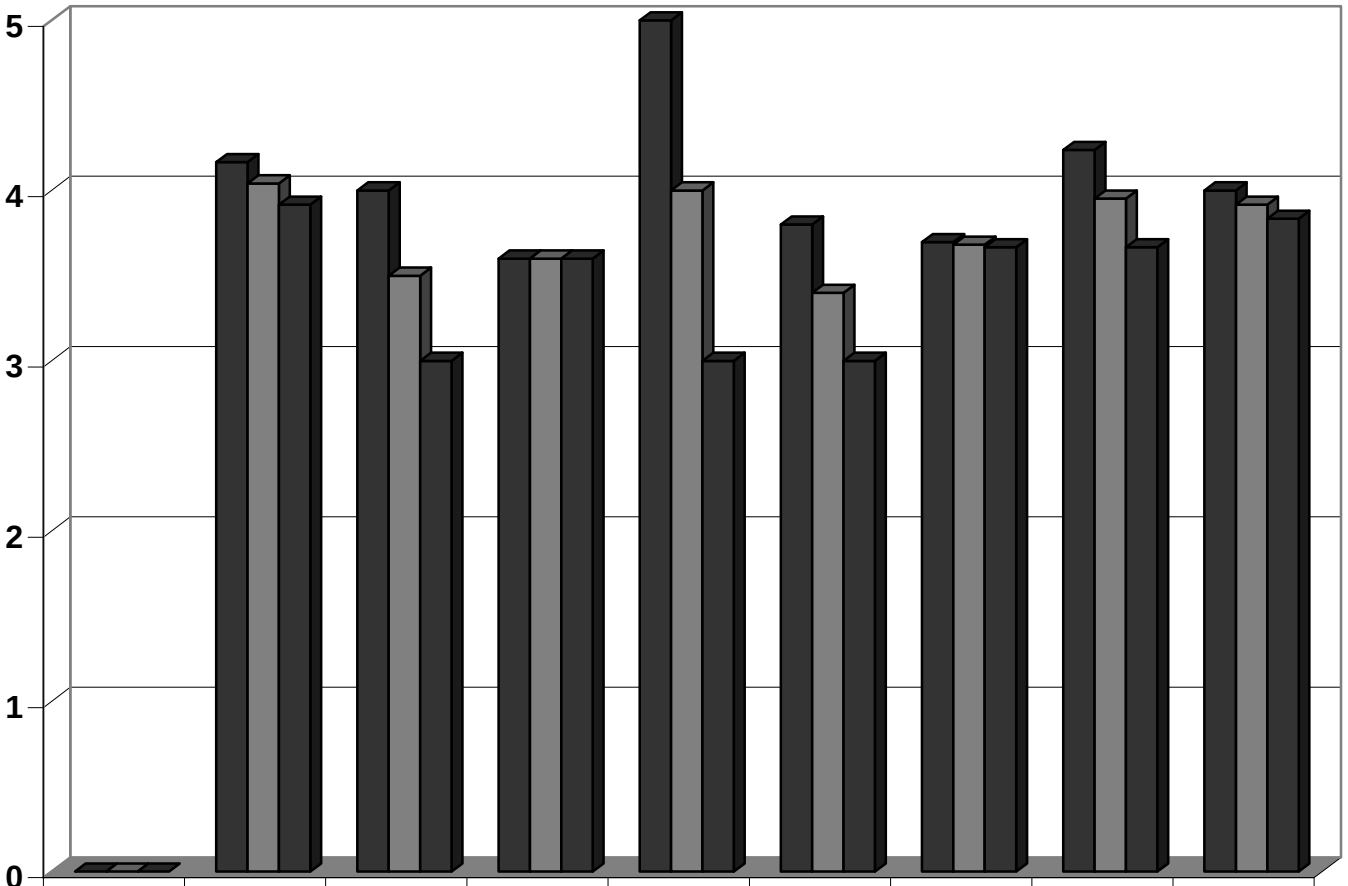
	2001	2002	2003	2004	2005	2006	2007	2008	2009
L	0.00	4.26	5.00	4.50	3.50	3.91	3.37	4.48	4.13
A	0.00	3.99	4.33	4.13	3.25	3.34	3.08	4.40	4.07
H	0.00	3.76	4.00	3.75	3.00	2.33	2.78	4.31	4.00

Outcome (i) Engage in life-long learning



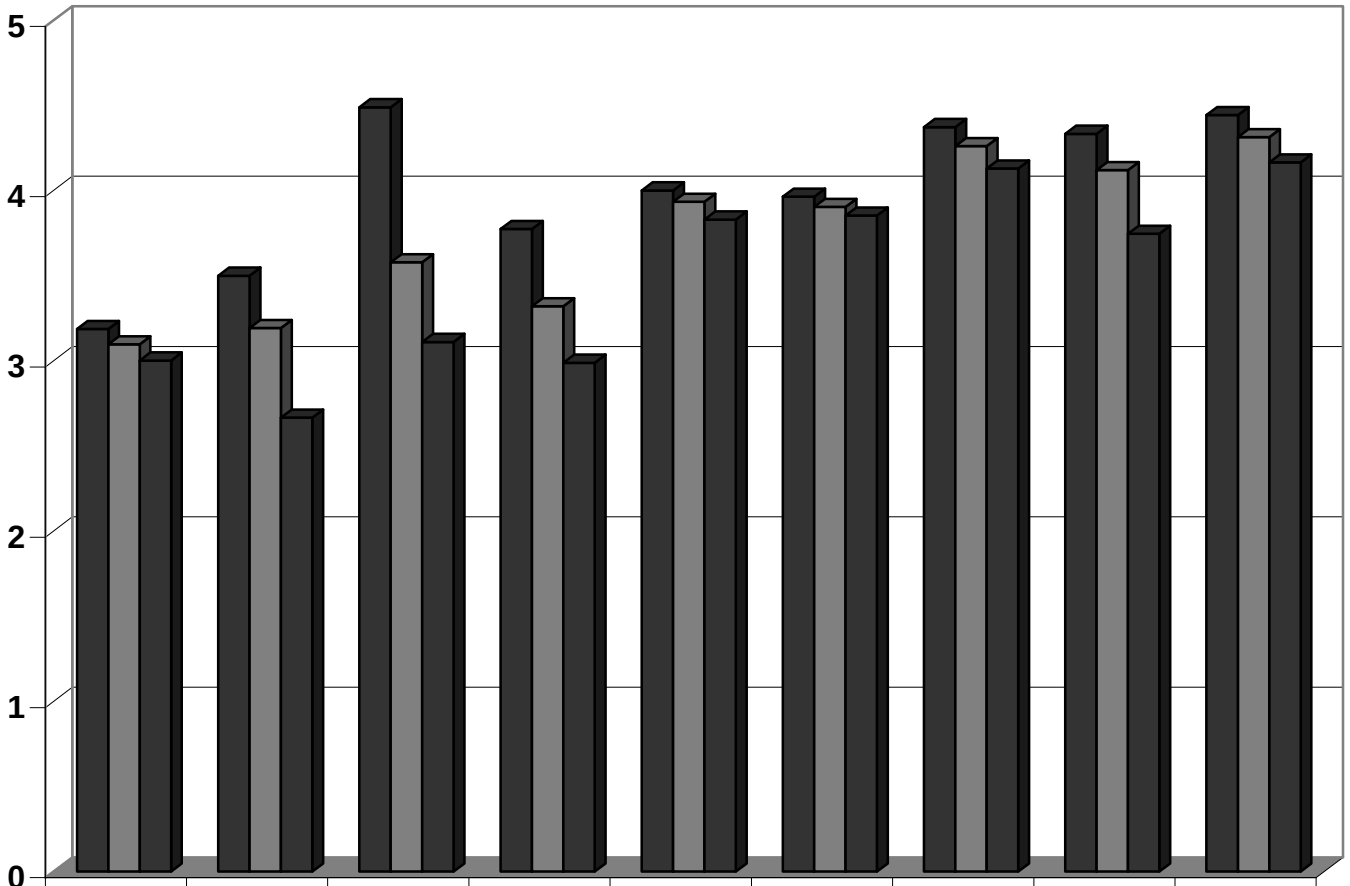
	2001	2002	2003	2004	2005	2006	2007	2008	2009
L	0.00	5.00	4.00	3.89	5.00	5.00	4.47	4.43	4.67
A	0.00	4.67	3.50	3.89	4.00	4.90	3.64	4.41	4.39
H	0.00	4.33	3.00	3.89	3.00	4.80	2.43	4.40	3.88

Outcome (j) Know contemporary issues



	2001	2002	2003	2004	2005	2006	2007	2008	2009
L	0.00	4.17	4.00	3.60	5.00	3.80	3.70	4.24	4.00
A	0.00	4.04	3.50	3.60	4.00	3.40	3.68	3.95	3.92
H	0.00	3.92	3.00	3.60	3.00	3.00	3.67	3.67	3.83

Outcome (k) Use engineering techniques, skills, and tools



	2001	2002	2003	2004	2005	2006	2007	2008	2009
L	3.19	3.50	4.49	3.77	4.00	3.96	4.37	4.33	4.44
A	3.10	3.19	3.58	3.32	3.93	3.90	4.26	4.12	4.31
H	3.00	2.67	3.11	2.99	3.83	3.85	4.13	3.75	4.17

Part IV

Outcome Assessment Summaries
2004-2009

Outcome Review Summaries: (a)-(k): ---------- See § Criterion 4, pp. (4-10) to (4-35)

These summaries show the evaluation of previous year actions and the statement of new actions.

Part V

Program Objective Surveys

Contents

Focus Group Summaries

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Table E-V-1 Constituent Focus Group Report for 2009

Constituent Focus Group

B.S. Metallurgical Engineering Program
South Dakota School of Mines and Technology

Date

Thursday, April 22, 2010, 11:30 AM -1:00 PM

Summary

- We need to emphasize ethics and serving society across the curriculum and implement more of this in design.
- We require our students to take CHEM 112 and 112. We looked at CHEM 114 curriculum and topics are covered in our courses somewhere so we made this an elective but we advise them to take CHEM 114 and 114L over BIOL 151.They could take BIOL 151 as an elective
- Industry said Statistics are very important and need to be stressed and we have implemented Statistics in each course. Bill will summarize who is doing what and where for ABET purposes.
- Industry also said characterization of materials is very useful and we do this in MET 330L. Our curriculum has a lot more lab time than others across the country do.
- They also said some business and psychology would be useful and we feel this is covered under the Gen Ed requirements. We like the idea but don't know if we want to require it.
- Another suggestion was some economics and/or accounting. We are limited to 136 hours and it would be impossible to implement these, but the students could take this thru Black Hills, they are always free to take extra credits.
- The comment about students having a background in quantum physics would mostly apply to graduate students and they have the ability to take this as an undergraduate.
- Safety is more and more emphasized and we need better signage. We also need to make sure equipment doesn't move from lab to lab.
- Have Dr. Medlin give a lecture in design on intellectual property, non-compete agreements and patents.
- Multidisciplinary teams are of increasing importance and we do this already in cross listed courses and junior and senior design.
- It appears our Objective statements are adequate and are being met.

Participants Representing Program Constituents

Students enrolled in the BS Metallurgical Engineering Program

- Austin Nelson, Recent BS Met Eng SDSM&T graduate

Private Industry and Public Agencies who employ our graduates

- Mike Deamer, Nucor Steel
- Shawn Veurink, RPM Associates
- Grant Crawford (by phone), Intel Corp

Other SDSM&T Departments and their Students who enroll in MET courses

- Dr. Dan Dolan, ME Dept SDSM&T

Graduate Programs that our BS Metallurgical Engineering graduates may enter

- Austin Nelson, MES SDSM&T
- Grant Crawford, Recent Univ Arizona PhD Candidate

Meeting Format

The goal was to glean for the MET program your best ideas, suggestions, and insights regarding

1. The MET program Objectives
2. The MET curriculum
3. The performance and preparation of graduates of the MET program

Because some participants were on a phone connection, discussion was somewhat structured in a round-robin format. Kate posed the questions and then "called on" each participant for input. Reactions and/or additions to any person's comments were also solicited.

No focus group, however structured, yields information that is perfectly logical and sequential according to the questions asked. This one was no different.

The input is summarized below. The perspective (i.e., student, industry, other SDSM&T departments, and graduate programs) is noted, but names are not used.

Are the MET Program Objectives being met?

- All participants agreed the Objectives are being met
- The student perspective was that
    - Students are very well prepared to apply metallurgical engineering principles
    - Dr. Howard does a good job of stressing *ethics and serving society but these topics could be more strongly and generally emphasized in all courses*
    - The significant amount of time students spend in the lab is very useful and important
    - Communication skills are amongst the most important objectives.
    - Knowing how to communicate and work with people who think differently than you think or who come from different backgrounds is essential; the extensive lab work helps develop these communication skills.
- Industry perspective was that
    - MET graduates are very well prepared to work in practical situations and to apply their skills in the workplace. This observation could be made about SDSM&T graduates in general.
    - Mines graduates come into the workplace with a "full tool box" of skills and knowledge of experimental methods.
    - The program objectives are good, and the curriculum is well designed to meet them
    - MET graduates do meet everything expressed in the program objectives.
    - MET graduates are good thinkers.
    - MET graduates are involved in the community

    - MET graduates have good writing skills in comparison to other graduates
- Perspective from "other SDSM&T programs" was that the program objectives are good. Values are very strongly emphasized in the objectives, and this is good (The other participants assented to this observation about values by nodding their heads in agreement.)

From your experience and your review, does the curriculum meet the needs of the graduates?

- The student perspective was that
    - Regarding preparation in chemistry versus biology *students should be counseled or even required to take chemistry*. Having a choice conveyed that both were of equal importance. The student believed preparation in chemistry was more critical than preparation in biology.
    - Students could perhaps be given information on why biology might be necessary or advisable to take so they could make an informed decision.
    - Communication skills are critical—especially interpersonal communication skills
    - The EE 301 course was very helpful in developing an understanding of the application of some MET content.
    - Regarding preparation in the characterization of materials, student reported working with x-ray diffraction and benefiting greatly from that experience.
- Industry perspective was that
    - Chemistry is more relevant than biology and biology should be an elective. Medical technologies make biology relevant, but chemistry is critical in the curriculum.
    - The curriculum gives a good foundation, but an even stronger preparation in communication skills would be optimal.
    - Students speak well in front of groups
    - Statistics are very important and need to be stressed.
    - Regarding statistics, much of industry is into ISO and CS [sic.] certification, so an understanding of statistics is a critical and necessary part of student preparation.
    - A course in the characterization of materials or training in materials characterization would be very useful—perhaps on an elective level
    - Regarding the ability to characterize materials, students really need to know how to use tools for doing the materials characterizations
    - Some preparation in business, company dynamics, business psychology, entrepreneurial psychology, or background in how a business is run would be most useful. If there is no room in the core curriculum, this content could perhaps be addressed via a general education requirement.
    - A background in economics and/or accounting is extremely valuable in new employees.
    - The engineering economics course is useful; perhaps it could be modified to bring in some business background and/or content
- Perspective from "other SDSM&T programs" was that
    - Chemistry is what <u>must</u> be taken but biology is highly relevant.

    - The individual time and attention given to MET majors by the program faculty is impressive. Faculty members work with students on an individual basis on projects.
- Perspective from graduate programs was that
    - The strong focus on metallurgy is a real strength

From your experience, how do program graduates perform?

- The student perspective was that
    - The only thing that hindered him as a graduate was graduating in December
    - He felt very confident as a graduate
    - Physics I and II did not prepare him well for graduate-level work. He believes that students should be given background in quantum physics if they are being pushed to pursue graduate studies.
- Industry perspective was that
    - Program graduates are extraordinarily well prepared. One person related a story that must be repeated since it cannot be summarized: This person was on a team at his company that worked to select a few schools nationwide from which to recruit graduates. The project was of long duration (e.g., a year's time) and examined all schools nationwide. The team picked five schools, and Mines was one of them.
    - Program graduates leave SDSM&T well prepared and are well supported in making the transition from school to the workplace.
    - One graduate of SDSM&T said that picking the school was definitely the best education decision he ever made.
    - Another graduate of SDSM&T now in industry reported being put in a training course as a new employee along with 30+ others, many of whom were from some very "big name" schools. He did not feel unprepared for anything he encountered and did very well. He reported being able to "hit the ground running" as a new graduate from the MET program.
    - The focus on metallurgical engineering makes for good graduates. Some programs in "materials sciences" are too thin and the curriculum is too strung out across topics. The MET program at SDSM&T is sufficiently concentrated and focused.
- Perspective from "other SDSM&T programs" was that
    - Working with MET students who are getting ready to graduate has shown that the program graduates are very well prepared.
    - MET students tend not to speak up soon enough in the design process when they are serving on multidisciplinary teams. Speaking up confidently and early from one's disciplinary perspective is critical in matters related to integrated mechanical / metallurgical design and material selection.
- Perspective from graduate programs was that - N/A

Other

As a 'best practice,' and given the very strongly positive nature of the comments overall, I asked directly for suggestions for improvements. When none were forthcoming, I asked if

anyone could offer the program thoughts on what the future holds for metallurgy graduates. Specifically, I asked if anyone could address trends he sees. The feedback was as follows:

- From the industry perspective:
  - Safety is more and more emphasized
  - Robotics and automation is increasing
  - EPA requirements and safety requirements are an increasingly important part of the workplace
  - Materials one might not even think of a hazardous waste are now looked at, so waste disposal is an important topic
  - Expose students to intellectual property, non-compete agreements, patents and etc. These items come up on a regular basis for a small business owner. One participant reported that the laser engineers working in his company frequently interact with many aerospace customers and need the background to avoid crossing the intellectual properties borders between customers.
- Perspective from "other SDSM&T programs" was that
  - Multidisciplinary perspectives are of increasing importance to workplace interactions
  - The workplace is increasingly organized around projects and teams
  - The co-curricular experience is a good place to look for ways to achieve even more preparation in project work and team experience.

MET ENG Constituent Recommended Actions (2010_05_04)

- We need to emphasize ethics and serving society across the curriculum and implement more of this in design.
- Every student should be advised to take CHEM 114 over BIOL 151 unless the student has a compelling profession reason to take BIOL 151.
- Continue to implement statistics problems throughout MET course. Dr. Cross will catalog statistics use within the MET curriculum for review by the faculty.
- Maintain material characterization laboratories as is done in MET 330L.
- Present a favorable acceptance of economics, accounting, business and psychology courses electives to satisfy Gen Ed requirements. Requiring these courses is not advised, however.
- Emphasized safety with new additional signage and secure more safety equipment to preclude migration of equipment from lab to lab.
- Schedule Dr. Medlin to lecture in design on intellectual property, non-compete agreements, and patents.
- Continue to promote multidisciplinary teams.

Table E-V-2 Alumni Focus Group Report for 2004

SUMMARY REPORT OF METALLURGICAL ENGINEERING ALUMNI FOCUS GROUP

2-19-04

[Alumni attending were Annie Thompson, Brooks Henderson, Nick Wald
Alumni invite but unable to attend were Derek Rebsom, Jamie Mathison, Cory Struckman, Eric Swanson, Chad Griswold]

Objective One: Successfully apply metallurgical engineering principles in their employment

1. What areas do you feel you were lacking after being employed? (Do you need more math, stats, chemistry, etc.)

2. What areas of metallurgy are you using in your field? Did you have enough background for going into your field?) Separate the fields (extractive, physical, etc.) and ask questions based on field.

Objective Two: Meet societal needs through science and technology

1. With the background in metallurgy from SDSM&T, are you able to grow with technology as it changes?

2. When you entered your field of employment, do you feel you were ahead, the same, or behind in the technology being used?

Objective Three: Grow professionally and personally

1. Do you belong to any professional organizations?
2. Have you had any training since graduation?
3. Do you keep up with changes in technology since graduation
4. Were you encouraged to join organizations while at SDSM&T? Did you join any organization and if so, did this involvement continue after graduation?

Objective Four: Serve their profession and community

1. Currently what is their position and involvement in material science/metallurgy?
2. Do they belong to organizations that help the community or volunteer help?
3. Are alumni involved in the community outside of work?
4. Are you responsible for your work?
5. Have you published and/or presented your work at conferences?

WebCT Survey Questions

Combine similar questions into one question—e.g., ask how important is a particular item/area in their career and then if they are satisfied with the metallurgical curriculum at SDSM&T in that area.

Keep the length of the survey within reason. Limit the number of open-ended questions.

There could be space for comments (optional).

Table E-V-3 Alumni Survey Report for 2008

How much does your current employment involve metallurgical engineering?	Number
Frequently	33
Sometimes	8
Rarely	8
Never	2

Employer's Primary Business	Number
Primary Metals	9
Manufacturing	14
Electronic materials	4
Recycling, Enviroment	1
Material use, performance, or properties	9
Education	3
Other engineering	1
Other	7

Which of the following skills do you use in your work? (Check all that apply.)	Number
Report Writing	42
Oral Presentations	42
Team Interactions	44
Technical Computations	38
Advanced Engineering Tools and Equipment	36
Design	29

How do you serve your profession or local community? (Check all that apply.)	Number
Member of one or more Professional Societies	5
Service on Professional Boards or Societies	27
Community Volunteer	22
Attend Community Activities	27
Other Service	10

Numbers represent number of responses out of 51 respondents. Survey return was 51/54.

Table E-V-3 Alumni Survey Report for 2008 (Cont'd)

Single Response Survey Questions

Item	Very High	High	Low	Very Low
To what extent do you feel that your job meets societal needs through science and tec	32	15	3	
How satisfied are you with the overall effectiveness and value of your SDSM&T Met E	26	25		
How satisfied are you with your ability to use analytical methods and solve engineering	26	25		
How important in your position is the use of analytical methods to solve engineering pr	25	19	4	2
How satisfied are you with your ability to use computational methods and solve engine	20	26	5	
How important in your position is the use of computational methods to solve engineeri	15	19	12	4
How satisfied are you with your ability to use math, science, and engineering principles	26	24	1	
How important in your position is the use of math, science, and engineering principles	28	13	8	1
How satisfied are you with your ability to make engineering decisions?	27	22	1	
How important in your position is the making of engineering decisions?	30	10	9	1
How satisfied are you with your ability to design engineering systems?	8	32	11	
How important in your position is the design of engineering systems?	12	12	16	9
How satisfied are you with your ability to work in teams?	32	18	1	
How important in your position is working in teams?	34	11	3	2
How satisfied are you with your ability to use communication skills?	31	20		
How important in your position is the use of communication skills?	41	8		1
How satisfied are you with your ability to use instruments and measurement tools?	26	22	2	
How important in your position is the use of instruments and measurement tools?	25	15	8	2
How satisfied are you with your ability to anticipate the societal impacts of your work?	13	32	5	
How important in your position is the anticipation of societal impacts?	20	13	14	3
How satisfied are you with your ability to recognize the potential environmental impact	11	35	5	
How important in your position is the recognition of potential environmental impacts?	23	14	10	3

Table E-V-4 Alumni Survey Report for 2004

Alumni Survey Data for 2003 from 4-6 year Alumni

#	Topic	4 Point High Scale
1	How much does your current employment involve metallurgical engineering?	3.00
4	Extent alumnus feels that current position meets societal needs through science and technology	3.15
7	How satisfied are you with the overall effectiveness and value of your SDSM&T Met Eng education?	3.38
2	Employer's primary pusiness	/Other=31% /OtherEng=8% /ed=0% /Mat use & perform=23% /Recy&Envir=0% /ElectMat=0% /Manufac=23% /PrimaryMet=15%
3	Skills used in current employment	/Design=46% /Adv tools & Equip=54% /Tech Computations=69% /Team Interact=85% /Oral pres77% /Report Writing=85%
5	Service to the professional and local community	/Profess Soc=54% /Ser on Prof Boards & Soc=23% /Comm Volunteer=31% / Comm Activities=38% / Other Service=23% No Pub Servce 23%
6	Continued professional and personal growth	/cont'd Prof Ed=23% /Prof Short Courses=54% / Active in Prof Soc=46% /Read Tech Lit= 92% /Read Non-Tech Lit=54% /Non-Tech Edu Cat Prog=38%

The following appear in Satisfaction-Importance groups		Satisfaction	Importance
8-9	Use of analytical methods to solve engineering problems	3.46	3.00
10-11	Use of computational methods to solve engineering problems	3.31	2.85
12-13	The use of math, science, and engineering principles	3.69	3.23
14-15	Making engineering decisions	3.54	3.31
16-17	Designing engineering systems	3.00	2.92
18-19	Working in teams	3.54	3.46
20-21	Communicating	3.38	3.77
22-23	Instruments and measurement tools	3.38	3.23
24-25	Anticipating societal impacts	2.92	2.54
26-27	Recognition of potential environment impact	2.92	3.00

Table E-V-5 Advisory Board Report for 2009

Report from

The Advisory Board
For the Department of Materials and Metallurgical Engineering
At
SDSM&T

Review Date: October 16, 2009

Team Members Participating (in person, by phone, or in later correspondence):

Everett Bloom	Oak Ridge National Laboratory - Retired
Wendy Craig	MacSteel
Chris Misterek	John Deere
Ray Peterson	Aleris International
Shane Vernon	Nucor Steel
Shawn Veurink	RPM and Associates
Richard Wensel	Micron Technology

SUMMARY

The faculty and staff of the Materials and Metallurgical Engineering Department at the South Dakota School of Mines and Technology (SDSM&T) have made outstanding progress in addressing fundamental issues impacting the department since our last on-site Advisory Board Review. In particular they have skillfully navigated the transitional period of three faculty retirements (out of five positions) during a period when the school administration did not seem particularly interested in sustaining the department. They have increased the number of students in the department and they have dramatically increased their outside research funding. All actions have improved the strength of the department and benefited the larger goals of the school.

The Department continues to produce quality students who are well accepted by industry and academia, both regionally and nationally. The future concerns for the Department to address include planning for and executing the transition of a retiring faculty with the concurrent hiring of a qualified replacement, providing opportunities for a full spectrum of materials science curricula, and increasing the faculty level by at least one member. The addition of one more faculty member could help increase the breadth of class offerings and allow faculty members the opportunity to continue to seek more outside research funding opportunities.

The B.S. Metallurgical Degree Program educational objectives remain current and appropriate. Alumni surveys and feedback from board members on the program's alumni performance in the workplace indicate that the objectives are being met and that no specific changes in curriculum beyond the suggestions below are needed.

Observations by the AB Regarding The Department of Materials and Metallurgical Engineering

Strengths:

1. The faculty of Materials and Metallurgical Engineering Department has taken a strongly proactive approach to improving the department. They addressed most of the major concerns of the AB in our last on site review in 2002 (several teleconferences have been held in the interim). Two of the five faculty positions are partially endowed with the possibility of becoming fully endowed. Self assessment rates by recent alumni (for ABET) were extremely high and the overall impression by alumni was that they were well prepared for their careers. The new Samurai Sword Senior Project was laid out in a manner so that all students contributed in different ways to a single goal, much like a company would operate. Students were able to succeed or fail in their own areas and learn from the experience. The faculty also creatively modified the class schedule such that class sizes could be increased through combining grade levels. The larger classes produced a stronger and more dynamic teaching environment.

2. Strong progress in undergraduate student enrollment has been made resulting in the highest levels of enrollment in 18 years. This is not an accident, but the result of active involvement by the faculty members. They have added programs and activities to increase student involvement with the department and the materials profession, thereby engendering more student interest. Some of these programs and activities include:
   - A weekly blacksmithing workshop that is entertaining, but still ties back into the students' education by linking processing paths to microstructure and properties.
   - A Samurai sword Senior Design Project covering all areas of metallurgy.
   - Integrating the artistic side of Materials Science with the industrial side. Examples include blacksmithing, glass blowing, jewelry crafting, and copper working.
   - Extra efforts to attract and retain non-traditional students to the metallurgy field (women and minorities) through the WIME program and an NSF REU.
   - Outreach to scientifically oriented high school students with the ASM Materials Camp.

3. The five teaching and one research faculty members are currently responsible for bringing in over $6.7M of external research funding (17 total awards). This equates to $1.3M per faculty member – at or near the top for any department within SDSM&T. They are supervising approximately 15 Masters students and approximately 10 PhD students. Development and expansion of MS / PhD programs has helped to bring in external funding as well as new equipment.

4. As already mentioned the enrollment numbers for students in the Materials and Metallurgical Engineering Department are at all time highs. In addition to the active student recruitment program, the Department has developed a strong scholarship program so that over two-thirds of the undergraduate students receive some form of scholarship stipend. The graduating seniors experience a high placement rate in many types of industries and research facilities both regionally and nationally. Additionally a significant portion of the students progress on to graduate level programs (1 in 3 goes on)

with approximately 40 % enrolling outside of SDSM&T. The graduating students are of a high caliber and are in demand due to strong technical backgrounds and good work ethics.

Opportunities and Concerns:

1. The Department continues to have a focus on traditional metallurgy. This is both strength and a weakness. Very few schools still produce students who can go into a traditional metallurgical operation and not require significant on the job training. On the hand, the world of Materials Science is much larger than it used to be (ceramics, biomaterials, polymers, electronic materials, composites, etc.) and training in other areas might open doors for the students. Perhaps one or two survey classes could be a partial remedy.

2. Dr. Howard is nearing retirement. It is critical that the proper replacement be found for him and that this transition proceeds as smoothly as possible.

3. As the number of research projects within the Department has increased, the need for project management tools has become critical. Examples of information that need to be collected and tracked for the multiple projects includes: PI and researcher hours, purchases and expenses, and progress to goals. Outside assistance has been offered.

4. Some class space, laboratories, and offices need infrastructure upgrades and repair to meet current standards. There have been some new additions of equipment to the Departmental laboratories in recent years, but not a lot of change. While expensive and difficult to do, the faculty and school need to ensure that laboratories are current so the students can be adequately prepared for future jobs or additional training at research universities.

5. The Department should find more opportunities for students to work in summer or co-op jobs to gain experience. This is an area where alumni and other contacts could be used beneficially.

6. Faculty numbers are still low for the number of enrolled students and the level of research funding being performed. Many MSE departments have student to faculty ratios of about 12 : 1. This department is 16 : 1. With five faculty members, the department is always just one step away from a dilemma should a member be lost. Adding another faculty member with the correct skill set could also be a method to broaden the department’s range of abilities and class offerings.

Table E-V-6 Advisory Board Report for 2007

Met Advisory Board Teleconference (Dec 2, 2007)

Those present: Dr. Kellar, Dr. Howard, Dr. Medlin, Dr. West, Dr. Cross, Cindy Hise

Those calling in: Wendy Craig, Shane Vernon, Ray Peterson

Welcome and Introductions

It has been a couple of years since we met with the Advisory Board and since then we went through an ABET review, had 3 faculty retire (Dr. Stone, Dr. Marquis and Dr. Han) and hired 2 faculty (Dr. Medlin and Dr. West)

Dr. Medlin joined us 2 years ago when Dr. Stone retired. He is originally from Nebraska. In industry worked for LTD Steel, Temkin and Zimmer. Dr. Medlin teaches 2 new courses Met 601 Biomaterials and Met 492 Forensic Engineering.

Dr. West joined us 1 ½ years ago from the University of Tennessee, Knoxville. His interests include High Temperature Alloys and Welding. Dr. West works closely with the AMP Center on campus. Dr. West teaches a new course Met 430 Welding Engineering.

Ray said he was glad to see the new classes, and asked if any of the classes have disappeared? Dr. Kellar said yes some of Dr. Han's classes at the graduate level including Hydrometallurgy are not taught anymore.

Shane said he was pleased to see a Welding and Steelmaking course at the undergraduate level.

Dr. Cross took over some of Dr. Han's courses including Met 310 Aqueous Extraction and Mes 712 Interfacial Phenomena.

Dr. Kellar reported on

Enrollment-For quite a few years prior to 2006 the B.S. enrollment was between 42-48 students. We now have 65, the largest the program has been in over 15 years. Our undergraduate degree is still Metallurgy and we have a shared MS and PhD in Materials Engineering & Science with chemistry and physics. Our goal is for 80 students in the program. We can accommodate that number of students and there is a need for that number in Industry.

Placement-A big number of our graduates go to Caterpillar, Nucor, John Deere, Micron and RPM, with a lot staying here for their M.S. degree. The reemergence of the Mining Industry has helped our program. Most of our students have multiple offers by graduation. Last year Metallurgists started at $57,000.00 a year.

Scholarships-Two thirds of our undergraduates get scholarship support. Our students are very competitive in National Societies for scholarships. SDSM&T is about to announce the 50 million dollar capitol campaign. The department has three new endowed scholarships, Lorin and Mary Brass established the Lorin and Mary Brass Metallurgical Engineering Scholarship, Tami Nelson established the Hurlbert Scholarship and Ken and Helen Han established an endowed scholarship.

Industrial Support-We are very fortunate to have companies like Caterpillar and John Deere have supporting our program.

Outreach/Recruiting-We hold a weekly Hammer In on Friday's for any student to come do some blacksmithing on the forge. Dr. Medlin has secured NSF funding to do extra curricular activities. Craig Willan donated a trailer we are making into a mobile lab with blacksmithing and metallography to use as a recruiting tool to visit area middle and high schools. We formed the Women in Metallurgical Engineering task group to help recruit more female students. This task group includes: Tami Nelson, Lisa Schlink, Jeanne Eha and Wendy Craig. We held a metal clay working luncheon that 8 girls attended and molded jewelry. After fired and polished it is 99.9% silver. We know of 3 girls who want to do this so we will continue this next semester. Freeport is sponsoring Lisa's travel here in February, she will speak at a luncheon for prospective high school students.

Questions/Comments-
Advisory Board was pleased we made it through the retirement phase. Dr. Kellar said because of the people we hired it was an easy transition.
It was asked if we are getting pressure from the State to have 80 students or is that just our goal. Dr. Kellar said a little of both, but 80 is optimal for us.
Shane said there are only a few strictly Metallurgy undergraduate programs left in the United States, this is our nitch.
Dr. Howard mentioned we will be sending out a Survey Monkey to Employers of our students to see how they compare with students from other schools for ABET.

The Advisory Board concurred that the department and BS Met Eng program is functioning well and that no actions are needed beyond the above suggestions and recommendations noted above.

Additional input from our Advisory Board member Wensel submitted by email after review of the above minutes:

- I like the bio-materials and forensics classes. Bio is something I always thought we were lacking, at least an intro to it. Forensics is similar to failure analysis, which has always been at least 50% of my job when dealing with manufacturing. More emphasis on FA is something I always thought would be good since it's not only useful in industry, but it ties together concepts you learn from so many different classes. Bringing together concepts and showing practical applications was, to me, very cool and helpful.
- I really like the blacksmithing stuff too. That is a really popular thing lately (at least in MT/ID). Making it available to all students, including high school students, is a great idea. You should set up some sort of contest to see which student makes the most interesting art, furniture, engineering structure, tool, whatever. Maybe approach the art aspect and put things on display? I think one area often overlooked at tech schools is how having a science

background helps at ton when you're an artist, especially if you're doing sculptures and such. I see you mention architecture, which is another area. And you tied it to attracting women, very clever, a great idea.

- On a similar note: do you do industry projects or senior design for this kind of stuff? My old college roommate (Wayne) is a tattoo artist and I visited him in Chicago at Christmas. He's designing his own little tattoo guns and having them cast at some place in Chicago. It might be cheaper for him to have someone design a few for him, actually cast them, and then have him try them out. It's a pretty cool device that requires a lot more engineering than you'd think: lightweight, comfortable to hold, looks good, cheap to make, material properties that allow it to be rigid yet minimize vibrations, etc. Anyway, if you're looking for senior design ideas for things that can actually make, let me know and I'll hook you up.
- On slide 10 where you talk about where students go, I think it's too broad. For instance, isn't Electronic Materials a subset of Materials. Maybe do 2 slides, one is general, another breaks it down. For instance, main groups could include: manufacturing, materials, and minerals. Then break it down, i.e.: manufacturing can be: heavy equipment, medical, electronic, etc. Materials can be bio, electronic, ferrous, non-ferrous, etc. Why do all this? So you can figure out where people are going and what to address in coursework, and how to target prospective students. After all, working in a mine isn't exactly attractive, but working on a titanium hip might be (again, especially for the women).
- If you're targeting women, why not get Deb Carlson involved with this stuff? If you have to boot me off so be it, it might be more valuable to have a woman if you're going to have a representative from the electronics industry?
- The scholarships are going well.

Table E-V-7 Advisory Board Report for 2004

Advisory Board Comments: April 29, 2004

Jon,

I thought the phone conference went very well. You got your important points across to the group. I can see you have given the AB's comments some thought and action. Also I can see that a lot of work has gone into the ABET preparation.

I have several general comments:

1. I think we don't teach enough about economic or business analysis. I do remember learning about the time value of money and that sort of knowledge helps me when doing that sort of analysis for writing Capital Expenditure Requests. What I didn't get was how to analyze and breakdown the costs at a plant and determines what the impact might be by changing the process in some manner.

2. I think it is good to discuss Ethics, but I'm not sure you can teach someone ethics. Maybe you can teach them the consequences of making poor ethical decisions.

3. Senior Design Project Idea - I helped out some seniors at UMR with a project to lay out an ingot casting line for a small aluminum plant. I have asked them to analyze cost, productivity, design, etc as if they were the project manager. I've attached a brief summary below. If you wanted to use this, I'd be happy to help.

4. I personally feel that Communications is either the first or second most important skill a young engineer can have. Both formal and informal modes of communication are critical. No matter how good your ideas are, if you can't get them across to your colleagues, supervisors and subordinates, you will not be successful. The best way to be recognized and advance in a company is to make a good presentation on everything you do - memos, talking, presentations, etc.

Thanks again for updating us.

Ray
1) I'm actually surprised you guys did so much since last year. I figured the IAB was going to recommend things and nothing would happen, but oh was I wrong. Nice job: getting a recruiter, new classes (electronic mat?, welding), addressing Dr. Stone and others retiring, getting more grants, offering classes every other year, etc. I like the recruiting part best. IMO, you need to push the "cooler" industries, like mine. Not many kids can look at an axle and get excited about increasing it's hardness, but they will get more excited when you show them how small circuits are on a computer chip and how that relates to their stupid little video games.

2) I disagreed about the economics point (I think John Walenta brought it up?). I do engineering. And to a point economics is involved, but I found that I learned nearly all of that through Dr. Han. Han brought up many examples of cost in his classes: like if you can cut $0.01/ton-ore

from a ball mill, you'll save the company millions. I'm sure things are different in small companies, but in a large company we have huge sales, marketing, and accounting depts. They do the money stuff, we just give them options and recommendations. If I need details the accountants do that for me. So I don't see that more economics are needed, it's all really common sense stuff at my level. If a student has aspirations to start their own business or work for a small company they should be encouraged to take several financial courses, their advisors can help them plan that.

3) Ethics. This is a real tough one. It's super important because you need good ethics, especially to get along with others. But can you teach it? Would I have the same ethics as Dr. Howard? I doubt it. Big companies like Micron offer tons of classes on this, and they are helpful. But I think you really learn by working in teams: through interaction and learning from others. I know you've heard it before, but nothing you could teach would have given me the ethics I got through KTEQ. So encourage students to be active in campus or even community roles, that's where they'll pick up on ethics. Get them to volunteer time to charities. I actually look for that stuff on resumes.

4) Communication. This is another one that is key to succeeding. One of the biggest reasons people don't succeed at work is because they can't communicate. And I don't mean good grammar, although that is important. It's more like: make sure you share info and don't horde it; know when to meet with someone, when a call is OK, and when email is OK; communicate so your thoughts are well understood; communicate in a friendly manner; know your audience, etc. Like I said in the call, you could use the alumni more on this. Why not give our numbers out as contacts for things other than jobs? I'd certainly be willing to help. Perhaps for some projects you can make the students communicate with someone in industry? A senior design project comes to mind but maybe some lab examples are applicable too? Like if you're teaching heat treating, why not have the students ask questions to someone at Cat to get practical answers? If nothing else, have them ask us for practical applications of class concepts. I think this not only helps them connect concepts to real world applications but gets them to communicate with supposed "professionals". And if they're going on spring break somewhere, encourage them to stop and visit an alumnus for a plant tour. Whatever you do, don't have them ask for help with homework, I don't think I could do a diffusion problem to save my life. Keep it to real life scenarios.

Part VI

Program Objective Evaluation Reviews
2004-2009

Program Objectives Evaluation summaries ---------- see § Criterion 4, pp. (4-4) to (4-8)

Part VII

Web Site Information

Contents

Web Site Structure ---------- E-66

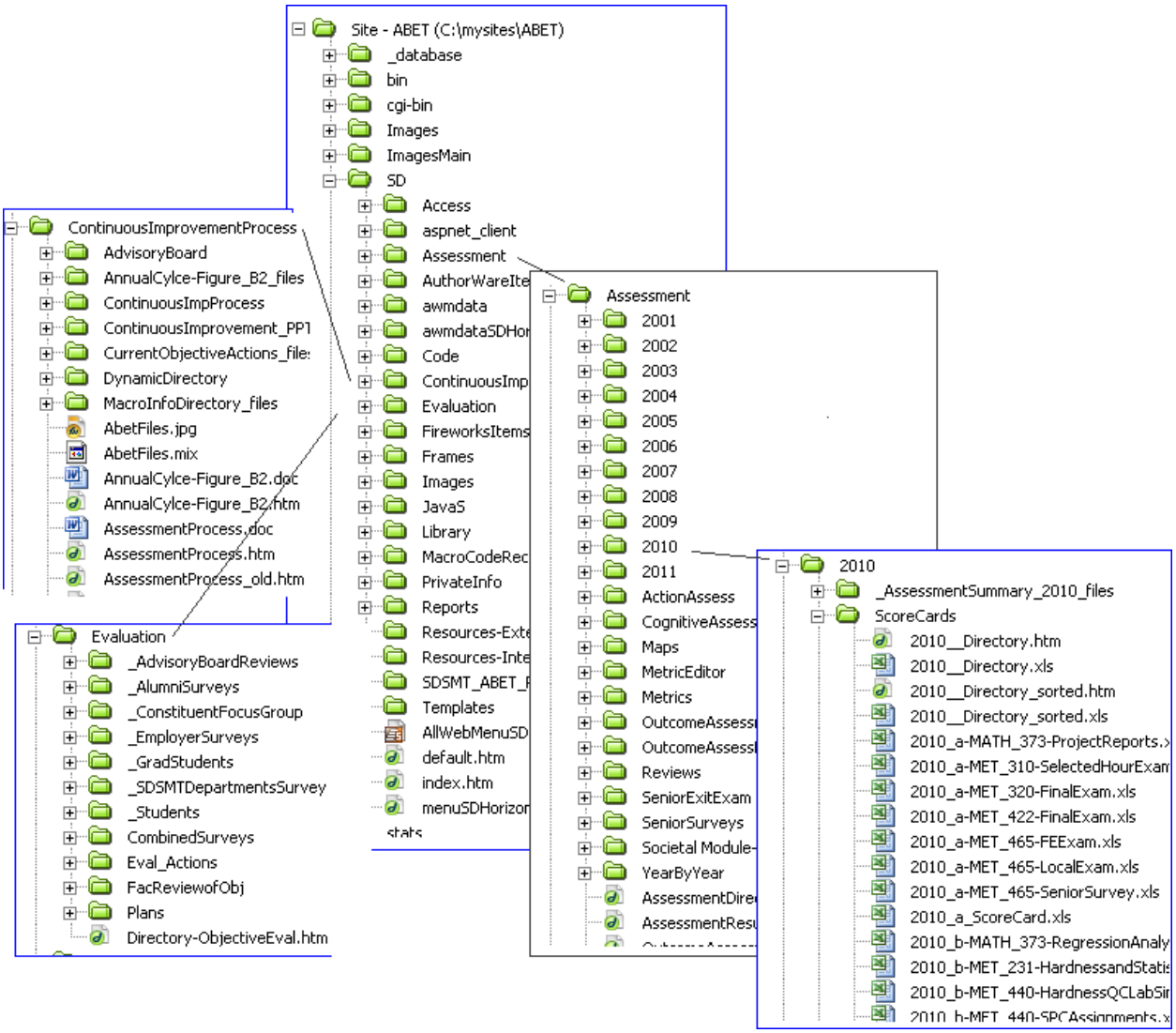

Figure E-VII-1 Structure of the CIS Website (http://www.ABETMetEng.org)

Part VIII

Maps

Contents

Course-to-outcome-and-instrument Maps

2008 ---------- E-68

2009 ---------- E-69

Table E-VIII-1 Course-to-outcome-and-instrument map for 2008

Course	Outcome	Instrument
MATH_373	(a)	ProjectReports
MATH_373	(b)	RegressionAnalysisProblem
MATH_373	(k)	ProjectReports
MATH_373	(k)	Regression-Optimization-LPhmwk
MET_220	(k)	MicrotrackLabReport
MET_231	(b)	HardnessandStatisticsLabs
MET_231	(g)	CharpyImpactLab
MET_310	(a)	SelectedHourExam
MET_310	(e)	FinalExam(orAllExams)
MET_310	(f)	Ethics&ProfessionalPracticeWritingAssignments
MET_310	(g)	StudentChoiceLabReport
MET_310	(h)	GlobalandSocietalWritingAssign
MET_310	(i)	CognitiveDevelWritingAssignment
MET_320	(a)	FinalExam
MET_422	(a)	FinalExam
MET_422	(e)	FinalExam(orAllExams)
MET_440	(b)	HardnessQCLabSim
MET_440	(b)	SPCAssignments
MET_440	(e)	FinalExam(orAllExams)
MET_440	(i)	UpdatedLifelongLearningPlan
MET_440	(k)	CharpyInstrmtdLabReport
MET_465	(a)	FEExam
MET_465	(a)	LocalExam
MET_465	(a)	SeniorSurvey
MET_465	(b)	FEExam
MET_465	(b)	LocalExam
MET_465	(b)	SeniorSurvey
MET_465	(c)	FacultyEvalofOralFinalReport
MET_465	(c)	FinalDesignReports
MET_465	(c)	LocalExam
MET_465	(c)	SeniorSurvey
MET_465	(d)	FinalDesignReports
MET_465	(d)	LocalExam
MET_465	(d)	SeniorSurvey
MET_465	(d)	StudentSelfEval
MET_465	(e)	FEExam
MET_465	(e)	LocalExam
MET_465	(e)	SeniorSurvey
MET_465	(f)	FEExam
MET_465	(f)	FinalDesignReport
MET_465	(f)	LocalExam
MET_465	(f)	SeniorSurvey
MET_465	(g)	DesignFairPresentationEvaluations
MET_465	(g)	FacultyEvalofOralFinalReport
MET_465	(g)	FinalDesignReports
MET_465	(g)	LocalExam
MET_465	(g)	SeniorSurvey
MET_465	(h)	DesignReportCheckListonGlobal-SocietalConsiderati
MET_465	(h)	LocalExam
MET_465	(h)	SeniorSurvey
MET_465	(i)	LocalExam
MET_465	(i)	SeniorSurvey
MET_465	(j)	LocalExam
MET_465	(j)	SeniorSurvey
MET_465	(k)	FEExam
MET_465	(k)	LocalExam
MET_465	(k)	SeniorSurvey

Table E-VIII-2 Course-to-outcome-and-instrument map for 2009

Course	Outcome	Instrument
MATH_373	(a)	ProjectReportsorEquiv
MATH_373	(b)	RegressionAnalysisProblem
MATH_373	(k)	ProjectReports
MATH_373	(k)	Regression-Optimization-LPhmwk
MET_220	(k)	MicrotrackLabReport
MET_231	(b)	HardnessandStatisticsLabs
MET_231	(g)	CharpyImpactLab
MET_320	(a)	FinalExam
MET_321	(e)	FinalExam(orAllExams)
MET_321	(h)	Cost,Conc,Conservation,Creativity
MET_321	(h)	MaterialConsumptioninAdvEconomies
MET_321	(i)	CognitiveDevelWritingAssignment
MET_321	(j)	ContemporaryIssuesWriting
MET_321	(j)	LocalExam
MET_330	(g)	StudentChoiceLabReport
MET_465	(a)	FEExam
MET_465	(a)	LocalExam
MET_465	(a)	SeniorSurvey
MET_465	(b)	FEExam
MET_465	(b)	LocalExam
MET_465	(b)	SeniorSurvey
MET_465	(c)	DesignFairPresentationEvaluations
MET_465	(c)	FacultyEvalofOralFinalReport
MET_465	(c)	FinalDesignReports
MET_465	(c)	LocalExam
MET_465	(c)	SeniorSurvey
MET_465	(d)	FinalDesignReports
MET_465	(d)	LocalExam
MET_465	(d)	SeniorSurvey
MET_465	(d)	StudentSelfEval
MET_465	(e)	FEExam
MET_465	(e)	LocalExam
MET_465	(e)	SeniorSurvey
MET_465	(f)	FEExam
MET_465	(f)	FinalDesignReport
MET_465	(f)	LocalExam
MET_465	(f)	SeniorSurvey
MET_465	(g)	DesignFairPresentationEvaluations
MET_465	(g)	FacultyEvalofOralFinalReport
MET_465	(g)	FinalDesignReports
MET_465	(g)	LocalExam
MET_465	(g)	SeniorSurvey
MET_465	(h)	DesignReportCheckListonGlobal-SocietalConsiderations
MET_465	(h)	LocalExam
MET_465	(h)	SeniorSurvey
MET_465	(i)	LocalExam
MET_465	(i)	SeniorSurvey
MET_465	(j)	SeniorSurvey
MET_465	(k)	FEExam
MET_465	(k)	LocalExam
MET_465	(k)	SeniorSurvey