CRITERION 3. PROGRAM OUTCOMES

The terms and definitions used throughout this report are consistent with ABET publications and guidelines. Appendix F contains a glossary of important terms used throughout this document.

As of 2004 the program discontinued keeping records by academic year in favor of a strict calendar year system. Using the calendar year reduces confusion and consequent errors in data management. Furthermore, it simplifies labeling, for example, from 2008-2009 to simply 2008 or 2009. All assessment and evaluation information is recorded and reported strictly by calendar year.

A. Process for Establishing and Revising Program Outcomes

Program outcomes were established in 2002. Initially, the same (a)-(k) outcomes suggested by ABET were selected. Program faculty members attended numerous national assessment conferences and ABET seminars during that period so as to equip themselves with current ideas and best practices. During this period the initial (a)-(k) had grown to include several additional outcomes. Some outcomes such as communication were broken into two separate outcomes: oral and written. However, by the end of 2002, the need for such separations appeared weak and so was not adopted. Suggested new outcomes were also abandoned because they were found to be unrelated to a focused and systematic continuous improvement process. Consequently, the original (a)-(k) were adopted as the program outcomes. This selection is reviewed and discussed several times a year by program faculty: usually during the periodic outcome reviews. The same suggestions arise as were proposed in 2002 and are rejected for the same reasons they were rejected then. Program faculty members remain vigilant through ABET seminars and by serving as continuous improvement consultants for new technical and societal trends that may need to be addressed by additional outcomes; however, none has risen to the level of importance warranting adoption.

B. Program Outcomes

The Outcomes for the Metallurgical Engineering Program correspond to the criteria for accrediting engineering programs during the 2010-2011 accreditation cycle so no additional mapping is needed. These outcomes are as follows:

a) Apply Knowledge of Math, Science, and Engineering
b) Design and Conduct Experiments and Analyze and Interpret Data and Information
c) Optimally Select Material and Design Materials Treatment and Production Processes
d) Function Well on Teams
e) Identify, Formulate, and Solve Engineering Problems
f) Know Professional and Ethical Responsibilities and Practices
g) Communicate Effectively
h) Know Engineering's Global Societal Context
i) Engage in Life-Long learning
j) Know Contemporary Issues
k) Use Engineering Techniques, Skills, and Tools

All program continuous improvement system (CIS) program documents are posted on the program CIS website: www.ABETMetEng.org/SD . This website reflects all of the program CIS documents, which reside on and are backed up on program computers. The website provides for selective controlled user access. All program faculty members have complete download access to all CIS documents. The

introduction of new documents to the CIS is controlled by the program designated CIS officer who is currently Dr. Howard.

C. Relationship of Program Outcomes to Program Educational Objectives

Table 3-1 shows the relationship of the metallurgical engineering program objectives to the program outcomes.

Table 3-1. The relationship between Metallurgical Engineering program objectives and EC2000 Criteria

SDSM&T / MET ENG	a Apply Know.	b Design, Anal Exp	c Design Select	d Teams	e Prob. Solve	f Ethics	g Comm.	h Global	i Life long	j Cont Issues	k Tools
1 Apply Met Eng Principles.											
2 Meet Societal Needs											
3 Grow Prof & Personally.											
4 Serve Comm. & Profession.											

D. Relationship of Courses in the Curriculum to the Program Outcomes

Table 3-2 is a quality function deployment matrix (QFDM) that shows the relationship of curricular elements, which are shown along the top row, to the program outcomes, which are shown in the first column. A value of *9* indicates the curricular element is high important to the program outcome; whereas, a *1* indicates a low importance. No value indicates that there is no functional relationship. A non-linear scale (*0, 1, 3, 9*) is used to give emphasis to most important curricular elements since two elements rating 3 would not be as significant to achievement of a particular outcome s one element rated 9. Table 3-2 groups similar courses into groups and also shows extra-curricular elements since the program graduate is formed by both course work and extra-curricular activities.

A second QFDM for specific courses in the metallurgical engineering program is shown in Table 3-3. The table at the bottom indicates the total importance to program outcomes of each element. The last column shows the number of *high importance* elements (highest rated) for each outcome.

The QFDM is used to determine where in the curriculum action should be directed to achieve improvement in a particular outcome. Of course, this information also satisfies this element of the self study.

Table 3-2 Metallurgical Engineering - Quality Function Deployment Matrix

Desired Outcomes		Processes	Advising	Indiv. faculty/student assistance	MET 351/2 - Junior Design	MET 464/5 - Senior Design	Scholarship program	MATH sequence	H&SS curriculum	Laboratory Curriculum	MET Eng Lecture courses	Elective Courses	out-of-dept tech electives	GE electives or MET 110	PE, Music, Band, MS	Student Organization Activities	Learning Assistance Centers	Library services	ENGL Sequence	Study Groups	MET electives	Free Electives	Chem and Physics Sequence	Placement office Programs	Number of "high importance"
System will	Retain students		9	9			9		3	1		1	1	3	3	3	3			3		1		1	3
	Facilitate student employment		3	9			1		1	9	9	9	3		1	1		1	3		3			9	5
Graduates will	Solve Mat & Met Eng problems			3	3	3		1		9	9	1	1					9		3	1	1	1		3
	Apply knowledge of math, science, and engineering (a)			3	3	3	1	9		3	9	3	1	1			3	1		1	3		3		2
	Design and Conduct experiments (b1)			1	3	3		3	1	9	1							1			1		1		1
	Analyze and interpret data and information (b2)			1	9	3		3		9	9		1	1				1		1	1		3		3
	Optimally select material (c1)			1	3	9		1		1	3							1		1	3				1
	Design materials treatment and production processes (c			1	3	3		1		1	3							1		1	3				
	Function well on teams (d)		1		9	9			1	3	1			3	3	9			1		1		1		3
	Identify, formulate, and solve engineering problems (e)			1	9	9		3		3	9	1				1		1			3		1		3
	Know professional and ethical responsibilities and practi		1	1	3	1			1		3			3				1			1				
	Communicate effectively (g)			1		3		1	1	9	1			1					9	3	1				2
	Know engineering's global societal context (h)			1	3	3			9	1	3			3		1		1		1	1				1
	Engage in life-long learning (i)		1	1	1	1			1	9	1	2	1			1		9		1	3	9			3
	Know contemporary issues (j)			1					9		3					1		1			1				1
	Use engineering techniques, skills, and tools (k)			3	1	1				9	3			3				1			1				1
			15	37	50	51	11	22	27	76	67	17	8	18	7	17	6	29	13	15	27	11	10	10		

LEGEND

9 High importance
3 Medium Importance
1 Low Importance
No importance

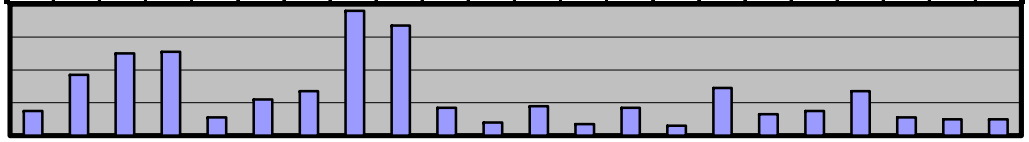
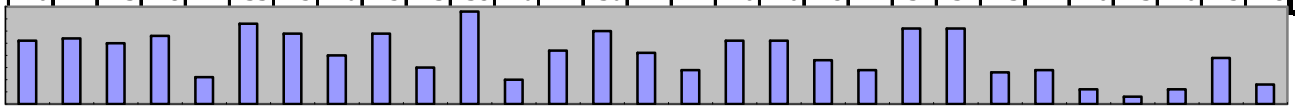


Table 3-3 Quality Function Deployment Matrix for Metallurgical Engineering Courses

Outcome Criteria	Course																													
	MET 110	MET 220	MET 220L	MET 231	MET 232	MET 310	MET 310L	MET 320	MET 321	MET 330	MET 330L	MET 332	MET 351	MET 352	MET 422	MET 433	MET 440	MET 440L	MET 443	MET 445	MET 464	MET 465	Math sequence	H&SS curriculum	Elective Courses	PE, Music, Band, MS	ENGL Sequence	Met Electives	Chem/Physics Seq	Number of "high importance
(a) Apply mathematics, science and engineering principles	3	**5**	3	3	**5**	**5**	3	**5**	3	**5**	**5**	**5**	1	1	**5**	5	3	3	**5**	**5**	1	1	**5**		3			3	3	12
(b) Ability to design and conduct experiments and interpret data	3	3	**5**	1		3	**5**	3	3	3	**5**		1	1	3		3	5		3	1	1	3					1	3	4
(c) Ability to design a system, component, or process to meet design	1				3	3	3	3	**5**				**5**	**5**	**5**	3	3	3	3	1	**5**	**5**	1					3		6
(d) Ability to function on multidisciplinary teams	**5**	1	3	**5**		1	1				**5**		3	**5**			1	3	3	1	**5**	**5**		1		3	1	1	1	6
(e) Ability to identify, formulate, and solve engineering problems	1	**5**	3	3	3	3	3	3	**5**	**5**	**5**	**5**	3	**5**	**5**	1	**5**	3	3	1	**5**	**5**	3		1			3	1	10
(f) Understanding of professional and ethical responsibility	**5**	3	1	1		3	1	1	**5**	1	3		3	3			3	1		1	3	3		1				1		2
(g) Ability to communicate effectively	**5**	3	**5**	3		3	**5**	1	3		3		3	**5**			3	**5**	1	1	**5**	**5**	1	1			**5**	1		8
(h) The broad education necessary to understand the impact of engineering		3		**5**		3	1	1			3													**5**				1		2
(i) Recognition of the need for and an ability to engage in life-long learning				3		3	1				3						1				1	1		1	2			3		0
(j) Knowledge of contemporary issues		3		1		1	1		**5**	1	1						1							**5**				1		2
(k) Ability to use the techniques, skills, and modern engineering tools necessary	3	1	**5**	3		**5**	**5**	3			**5**		3	**5**	3	**5**	3	3	3	1	**5**	**5**						1		8
	26	27	25	28	11	33	29	20	29	15	38	10	22	30	21	14	26	26	18	14	31	31	13	14	6	3	6	19	8	



E. Documentation

An automated digital system is used to store all outcome data and to processes it into a format that is easily evaluated. All data is stored and backed up on program computers and uploaded for all program faculty members to view and download. Hard copies of all instruments assessed (student work, etc.) are maintained in the CIS hard copy archives.

The annual outcome assessment schedule is summarized in Figure 3-1.

An Instrument Inventory is the name used to refer to the collection of (student assignment, exams, etc.) used in the assessment process. Table 3-4 is the 2009 Instrument Inventory. It is a Microsoft Excel® list that shows the instruments (assignments, exams, etc.) used to assess a particular outcome. The Instrument Inventory is used to create all the files and forms needed by the automated digital system that ultimately digitally renders all of the assessment data into tabular and graphical forms that may be parsed by a variety of ways: outcome, year, etc.

Each outcome is assessed using several instruments. Additionally, an attempt is made to use a combination of assessment methods so as to achieve assessment triangulation. The assessment methods are grouped as follows:

- Method 1: Archival Records/ Portfolios
- Method 2: Standardized Exams, Simulations, Performance Appraisals, External Examiner, and Oral Exam.
- Method 3: Surveys, Exit Interviews

Since the program employs an alternating junior/senior cohort curriculum, odd year inventories differ from even year inventories. (Again, all records are by calendar year.) In addition to the planned even/odd year changes in inventory that occur, outcomes are changed for a variety of reasons primarily to improve the assessment process in keeping with the continuous improvement goal. Table 3-5 shows the Instrument Inventory for 2008. The first row is the same for both tables but has been truncated in Table 3-5 to preserve font size in the longer table.

Each instrument is assessed by a program faculty member. The assessment results are written (manually or digitally) on the instrument's specifically created corresponding Microsoft Excel® Assessment Score Card and transmitted to the program CIS officer (currently Dr, Howard) who enters the score card into the automated system. A typical score card is shown in Table 3-6.

The assessor always delivers to the CIS officer a hard copy of the score card attached to the underlying instrument. For example, if the instrument is the MET 320 final exam, the score card on which the assessment scores are recorded is attached to the final exams. This bundle of hard copies topped the attached score card is filed into the CIS archives. The CIS officer is the only person permitted to enter information into the automated digital system or into the hard copy archive; however, all faculty members have unlimited access to the information. The hard copy archives normally reside in the department office (MI 115) but will be placed at any location requested by the program evaluator. Furthermore, the program evaluator will be provided full download access to the automated digital system upon request to the program head: Dr. Kellar.

In addition to the assessment archival records, the program will make available copies of all exams, texts, syllabi, other student work not in the assessment archive, etc. The relationship of each course to the achievement of outcomes is shown in Tables 3-7 and 3-8 for 2008 and 2009.

The plan for organizing and presenting materials in the resource room for the ABET on-site visit is as follows:

By Course

Course materials for all SDSM&T Met Eng courses used to meet graduation requirements for the degree BS in Metallurgical Engineering will be arranged by course on tables in the resource room. These materials will consist of the following:

- Syllabus
- Text
- Graded representative samples of all exams
- Graded representative samples of all graded homework
- Graded representative samples of all lab reports
- A compilation of all handouts and supplementary materials

By Outcome

A directory of all outcomes and the material assessed will be posted above these documents.

Materials used to assess outcomes will be arranged by outcome on tables in the resource room. There will be no referencing of materials within course files or on the web site.

By Objective

A directory of all objectives and the material assessed will be posted above these documents.

Materials used to assess objectives will be arranged by objective on tables in the resource room. There will be no referencing of materials on the web site.

F. Achievement of Program Outcomes

One of the department's self-imposed requirements is that the program's entire Continuous Improvement System (CIS) resides on a website so that it is available to all faculty and constituents at any time and place. The program's efforts can be better appreciated by viewing the methodologies, tools, and results of the continuous improvement process located at www.ABBBETmeteng.org/SD . The web site is the culmination of the tremendous investment in time and effort in creating the current continuous improvement system. The program faculty members elected to make markups of the web site and procedural changes in real time during collaborative meetings. This procedure means that improvements to the system are made immediately and disseminated to all faculty and interested constituents.

The Web site includes many automation features for updating data collection and compilation primarily through VBA macros and linked Excel Worksheets. For example, many surveys are conducted on-line using Survey Monkey©. No student work resides on the Continuous Improvement Web Site. The site currently contains extensive files arranged by Objective Evaluation, Assessment of Outcomes, Continuous Improvement System, Metrics, Maps, Reports, etc. Student work resides either on the campus Digital Archival Tool or in hard copy form in the departmental office. The department was an early supporter and user of the campus Digital Archive Tool where students can upload their digital work for subsequent faculty retrieval and assessment. Of course, all confidential information is always protected. (See "Summary of Archive Features at www.abetmeteng.org/SD/Resources-External/ArchivalPlan-AssessmentMaterials.htm for more information on the Archive.)

All objective evaluation and outcome assessment records, compilations, reviews, actions, reports, syllabi, vitae, and many other continuous-improved related documents are available on-line at the address: www.abetmeteng.orgg/SD .

Outcomes are assessed using a system that employs the following major elements:

- A set of specifically identified instruments (up to eight) is used to assess each outcome
- Each outcome is assessed by three assessment methods: *assessment triangulation*
- Each outcome is assessed using specifically stated metrics consisting of between two and four *performance criteria* each with associated specifics that characterize specific levels of student performance.
- The assessment of each instrument results in numerical scores.

Tables 3-4 and 3-5 show the instruments used to assess each outcome in years 2009 and 2008. The instruments are arranged from top down by outcome criteria in column one. Columns two through four show the instruments used to assess each outcome criterion. The first of these three columns contains instruments that are classified as *archival records* (student work) or *portfolios* – the first of the three legs of assessment triangulation. The next column contains instruments that are characterized as *standardized exams, simulations, performance appraisals, external exams, external examiners*, or *oral exams* – the second leg of triangulation assessment. The third leg of the assessment triangle instruments appears in the last column and includes *surveys* and *exit interview* instruments. Not all of these assessment tools are used for each outcome assessment but a concerted effort is made to gain triangulation for each outcome. In rare cases some instruments listed might not be assessed each year. The minimal requirement for assessment is that each outcome be assessed by at least one instrument each year. Of course, the goal and usual practice is for a much broader assessment.

The assessment procedure for each instrument culminates with numerical scores that are compiled on a *Score Card.* All program faculty members participate in scoring instruments. All tools and results are available to them via web site posting. The results from the several instruments for one outcome are summarized on a *Outcome Summary* as shown in Table 3-9 for outcome (a) in 2008. Each outcome has a similar summary Score Card customized for the specific outcome. All Score Cards are automatically summarized by linked worksheets to an *Assessment Summary*. Table 3-10 is the *Assessment Summary* for 2008. These results are also available in graphical format for analysis as shown in Figure 3-2. The number of individual assessments and the total number of instrument-metrics applied are noted in he first column. This last number equals the number of columns completed on the Score Card for each instrument while the first number is the total entries on the Score Card. The assessment results for a particular outcome over time are available as shown in Figure 3-3 for outcome (k) from 2001-2010.

A faculty review is completed for each outcome. Each review results in an Outcome Review Report. A typical report is shown in Table 3-11. These reviews form the basis of discussion among the program faculty members when deciding on what changes are to be made to improve the outcome assessment process. Longitudinal reviews over time are auto generated. Table 3-12 shows such a review for Outcome (a). Actions arising from the Outcome Review Reports are categorized as either

- Curricular Actions or
- Assessment Process Improvement Actions.

Figure 3.4 shows the Grand Summary of all outcome assessments for the nine years from 2001 through 2009. The vertical scale is a measure of achievement with 5 being the highest level of achievement possible. The average that is plotted for each outcome for each year derives from the Assessment Summary for each year. The numerical values appear at the bottom of the chart. The overall average of all outcomes over all years is 3.8. Even though the goal is 5, student ability and effort limits the maximum achievable score even with flawless program operation. Consideration is being given to norming assessment scores to class GPA so as to obtain a better measure of program performance.

A complete set of all data, metrics, and reviews are available in Appendix E.

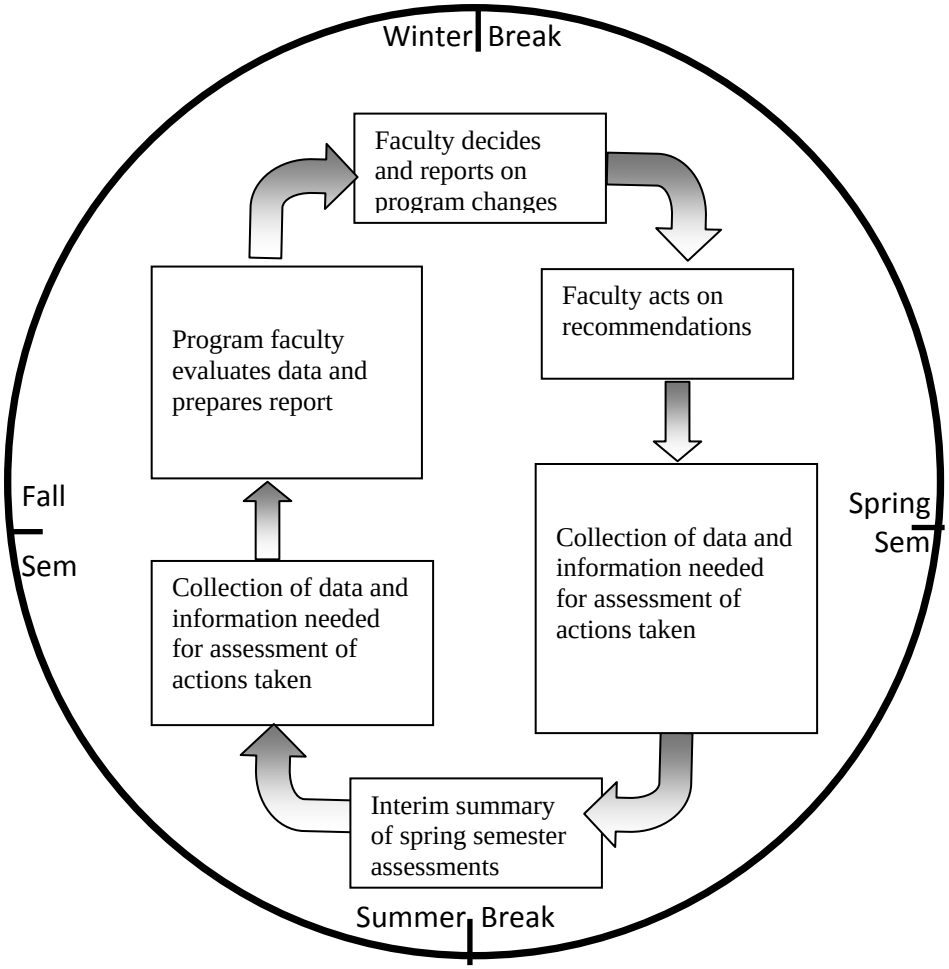


Figure 3-1 Annual cycle of continuous improvement for the metallurgical engineering program

Table 3-4 Instrument Inventory for 2009

Criteria	**Method 1** Archival Records/Portfolios	**Method 2** Standardized Exams, Simulations, Performance Appraisals, External Examiner, and Oral Exam	**Method 3** Surveys, Exit Interviews
a Apply knowledge of math,	**MET 320** - Annually (Fall) . Final Exam **MATH 373** - Annually (Fall/Spring) . Project Reports or Equiv	**MET 465** . FE Exam **MET 465** . Local Exam	**MET 465** . Senior Survey
b Design and Conduct experiments Analyze and interpret data and	**MATH 373** - Annually (Fall/Spring) . Regression Analysis Problem **MET 231** - Annually (Fall/Spring) . Hardness and Statistics Labs	**MET 465** . FE Exam **MET 465** . Local Exam	**MET 465** . Senior Survey
c Optimally select material and design materials treatment and production processes	**MET 465 - Annually (Fall/Spring)** . Final Design Reports **MET 465** . Design Fair Presentation Evaluations	**MET 465** . Faculty Eval of Oral Final Report **MET 465** . Local Exam	**MET 465** . Senior Survey
d Function well on teams	**MET 465 - Annually (Fall/Spring)** . Final Design Reports	**MET 465** . Local Exam	**MET 465** . Senior Survey **MET 465 - Annually** . Student Self Eval
e Identify, formulate, and solve engineering problems	**MET 321** - Odd years (Spring) . Final Exam (or All Exams)	**MET 465** . FE Exam **MET 465** . Local Exam	**MET 465** . Senior Survey
f Know professional and ethical responsibilities and practices	**MET 465 - Annually (Fall/Spring)** . Final Design Report	**MET 465** . FE Exam **MET 465** . Local Exam	**MET 465** . Senior Survey
g Communicate effectively	**MET 231** - Annually (Fall/Spring) . Charpy Impact Lab **MET 330** - Odd Years (Fall) . Student Choice Lab Report **MET 465** . Final Design Reports **MET 465** . Design Fair Presentation Evaluations	**MET 465 - Annually (Spring)** . Faculty Eval of Oral Final Report **MET 465** . Local Exam	**MET 465** . Senior Survey
h Know engineering's global societal context	**MET 321** - Odd years (Spring) . Material Consumption in Adv **MET 321** - Odd years (Spring) . Cost, Conc, Conservation, Creativity **MET 465** - Annually (Fall/Spring) . Design Report Check List on Global-	**MET 465** . Local Exam	**MET 465** . Senior Survey
i Engage in life-long learning	**MET 321** - Odd years (Spring) . Cognitive Devel Writing Assignment	**MET 465** . Local Exam	**MET 465** . Senior Survey
j Know contemporary issues	**MET 321** - Odd years (Spring) . Contemporary Issues Writing	**MET 321 or Other** . Local Exam	**MET 465** . Senior Survey
k Use engineering techniques, skills, and	**MET 220** - Annually (Spring) . Microtrack Lab Report **MATH 373** - Annually (Fall/Spring) . Regression-Optimization-LP hmwk **MATH 373** - Annually (Fall/Spring) . Project Reports	**MET 465** . FE Exam **MET 465** . Local Exam	**MET 465** . Senior Survey

Table 3-5 Instrument Inventory for 2008

Criteria	**Method 1** Archival Records/Portfolios	**Method 2** Standardized Exams, Simulations,	**Method 3** Surveys, Exit Interviews
a Apply knowledge of math, science, and engineering	**MET 320** - Annually (Fall) . Final Exam **MATH 373** - Annually (Fall/Spring) . Project Reports **MET 422** - Even years (Fall) . Final Exam **MET 310** - Even years (Spring) . Selected Hour Exam	**MET 465** - Annually (Spring) . Local Exam **MET 465** - Annually (Spring) . FE Exam	**MET 465** - Annually . Senior Survey
b Design and Conduct experiments Analyze and interpret data and information	**MATH 373** - Annually (Fall/Spring) . Regression Analysis Problem **MET 231** - Annually (Fall/Spring) . Hardness and Statistics Labs **MET 440** - Even years (Spring) . SPC Assignments	**MET 465** - Annually (Spring) . Local Exam **MET 440** . Hardness QC Lab Sim **MET 465** - Annually (Spring) . FE Exam	**MET 465** - Annually . Senior Survey
c Optimally select material and design materials treatment and production processes	**MET 465** - Annually (Spring) . Final Design Reports	**MET 465 -** Annually (Spring) . Faculty Eval of Oral Final Report **MET 465 - Annually (Spring)** . Local Exam	**MET 465** - Annually . Senior Survey
d Function well on teams	**MET 465** - Annually (Spring) . Final Design Reports	**MET 465** - Annually (Spring) . Local Exam	**MET 465** - Annually . Senior Survey **MET 465** - Annually . Student Self Eval
e Identify, formulate, and solve engineering problems	**MET 422** - Even years (Fall) . Final Exam (or All Exams) **MET 310** - Even Years (Spring) . Final Exam (or All Exams) **MET 440** - Even Years (Spring) . Final Exam (or All Exams)	**MET 465** - Annually (Spring) . Local Exam **MET 465** - Annually (Spring) . FE Exam	**MET 465** - Annually . Senior Survey
f Know professional and ethical responsibilities and practices	**MET 310** - Even Years (Spring) . Ethics & Professional Practice Writing **MET 465** - Annually (Spring) . Final Design Report	**MET 465** - Annually (Spring) . Local Exam **MET 465** - Annually (Spring) . FE Exam	**MET 465** - Annually . Senior Survey
g Communicate effectively	**MET 231** - Annually (Fall/Spring) . Charpy Impact Lab **MET 465 - Annually (Spring)** . Final Design Reports **MET 310** - Even Years (Spring) . Student Choice Lab Report **MET 465** - Annually (Spring) . Design Fair Presentation Evaluations	**MET 465** - Annually (Spring) . Faculty Eval of Oral Final Report **MET 465** - Annually (Spring) . Local Exam	**MET 465** - Annually . Senior Survey
h Know engineering's global societal context	**MET 310** - Even Years (Spring) . Global and Societal Writing Assign **MET 465** - Annually (Fall/Spring) . Design Report Check List on Global-	**MET 465** - Annually (Spring) . Local Exam	**MET 465** - Annually . Senior Survey
i Engage in life-long learning	**MET 310** - Even years (Spring) . Cognitive Devel Writing Assignment **MET 440** - Even years (Spring) . Updated Lifelong Learning Plan	**MET 465** - Annually (Spring) . Local Exam	**MET 465** - Annually . Senior Survey
j Know contemporary		**MET 465** - Annually (Spring)	**MET 465** - Annually

Table 3-6 Typical Score Card

2009 Outcome Score Card	(a)	*(a) Apply knowledge of math, science, and engineering*			
MET_320 FinalExam	Team / Student	Proficient in Fundamental Concepts and Skills	Proficient in Theoretical and Practical Relationships	Proficient in Basic Science	
	Max	**5.00**	**5.00**	**5.00**	
	Ave	**3.08**	**4.42**	**4.00**	
	Min	**1.00**	**1.00**	**1.00**	
	1	3	5	5	
	2	3	1	3	
	3	1	1	1	
	4	5	5	5	
	5	5	5	3	
	6	5	3	3	
	7	3	5	3	
	8	5	5	3	
	9	1	5	5	
	10	1	1	3	
	11	5	5	3	
	12	1	5	3	
	13	5	5	5	
	14	5	5	5	
	15	5	5	5	
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	18	1	5	3	
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Method	1
Count	72
Assessor's Initials	SMH
Date	1/9/2010

Table 3-7 Course-to-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 3-8 Course-to-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

Table 3-9 Typical Outcome Summary

Outcome Summary			**2008**	*(a) Apply knowledge of math, science, and engineering*			
Average Summary			***Max***	5.00	4.71	4.00	
170 # Assessments			***Ave***	3.86	3.38	3.06	
15 # Averages			***Min***	2.00	2.00	2.00	
Instrument				Proficient in Fundamental Concepts and Skills	Proficient in Theoretical and Practical Relationships	Proficient in Basic Science	
MET_320							
(a) FinalExam	1	Method	**Max**	5.00	5.00		
SMH	54	# Assessments	**Ave**	4.26	3.59		
1/20/09			**Min**	1.00	1.00		
MATH_373							
(a) ProjectReports	1	Method	**Max**	3.00	3.00	3.00	
SMH	6	# Assessments	**Ave**	2.00	2.00	2.00	
1/1/08			**Min**	1.00	1.00	1.00	
MET_422							
(a) FinalExam	1	Method	**Max**	5.00	5.00		
SMH	34	# Assessments	**Ave**	5.00	3.12		
1/24/08			**Min**	5.00	1.00		
MET_310							
(a) SelectedHourExam	1	Method	**Max**	5.00	5.00	5.00	
WMC	36	# Assessments	**Ave**	3.17	3.17	3.17	
5/28/08			**Min**	1.00	1.00	1.00	
MET_465							
(a) LocalExam	2	Method	**Max**		5.00		
SMH	7	# Assessments	**Ave**		4.71		
7/25/08			**Min**		3.00		
MET_465							
(a) FEExam	2	Method	**Max**	5.00			
SMH	15	# Assessments	**Ave**	4.07			
12/31/08			**Min**	1.00			
MET_465							
(a) SeniorSurvey	3	Method	**Max**	5.00	5.00	5.00	
SEN	18	# Assessments	**Ave**	4.67	3.67	4.00	
1/6/09			**Min**	3.00	3.00	3.00	
		Method	**Max**				
		# Assessments	**Ave**				
			Min				

Table 3-10 Typical Assessment Summary

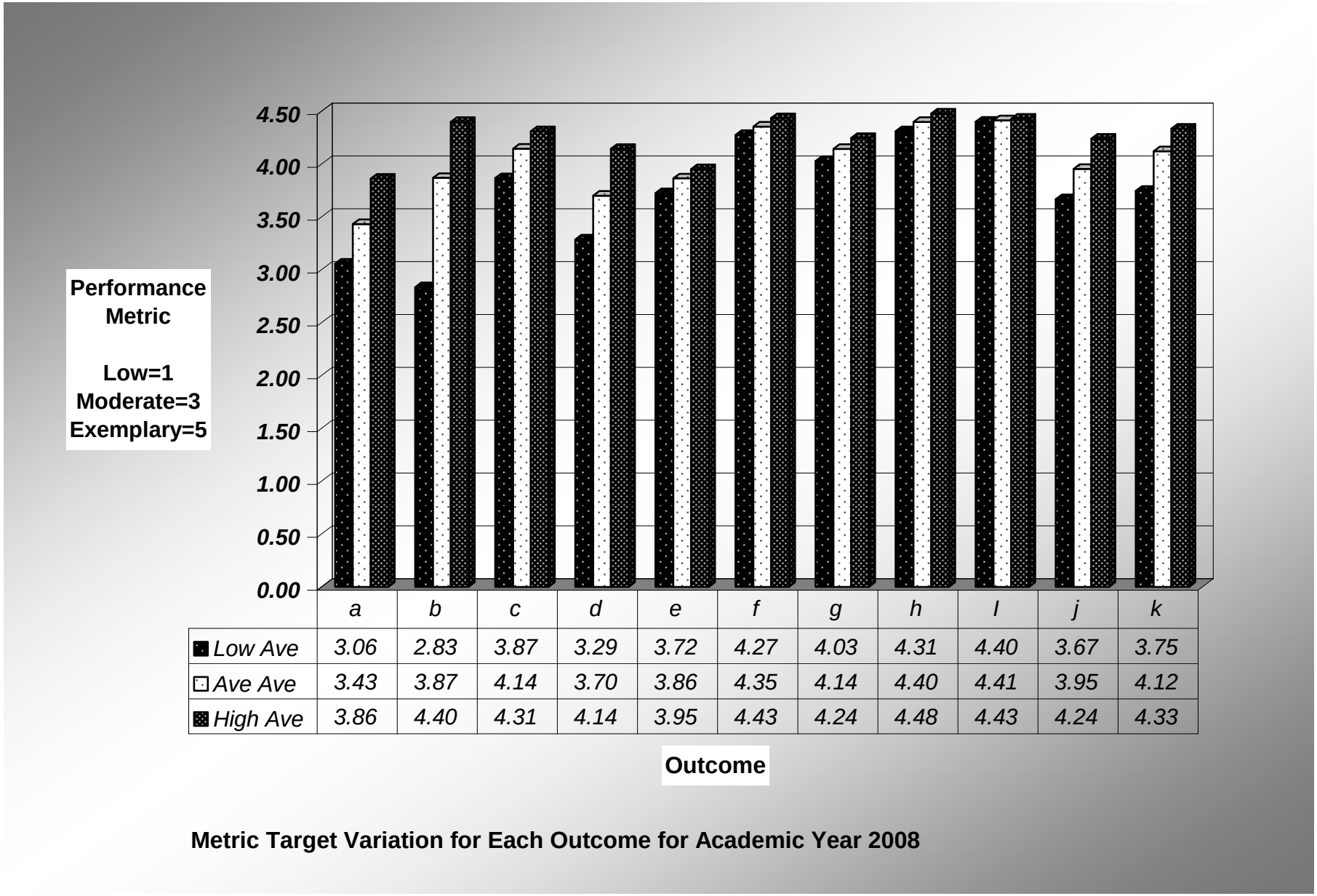
Assessment Metric Summary

Calendar Year 2008

Outcome	Description	Performance Objective 1	Performance Objective 2	Performance Objective 3	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 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		4.71	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 professional			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 3-10 Typical Assessment Summary (Cont'd)

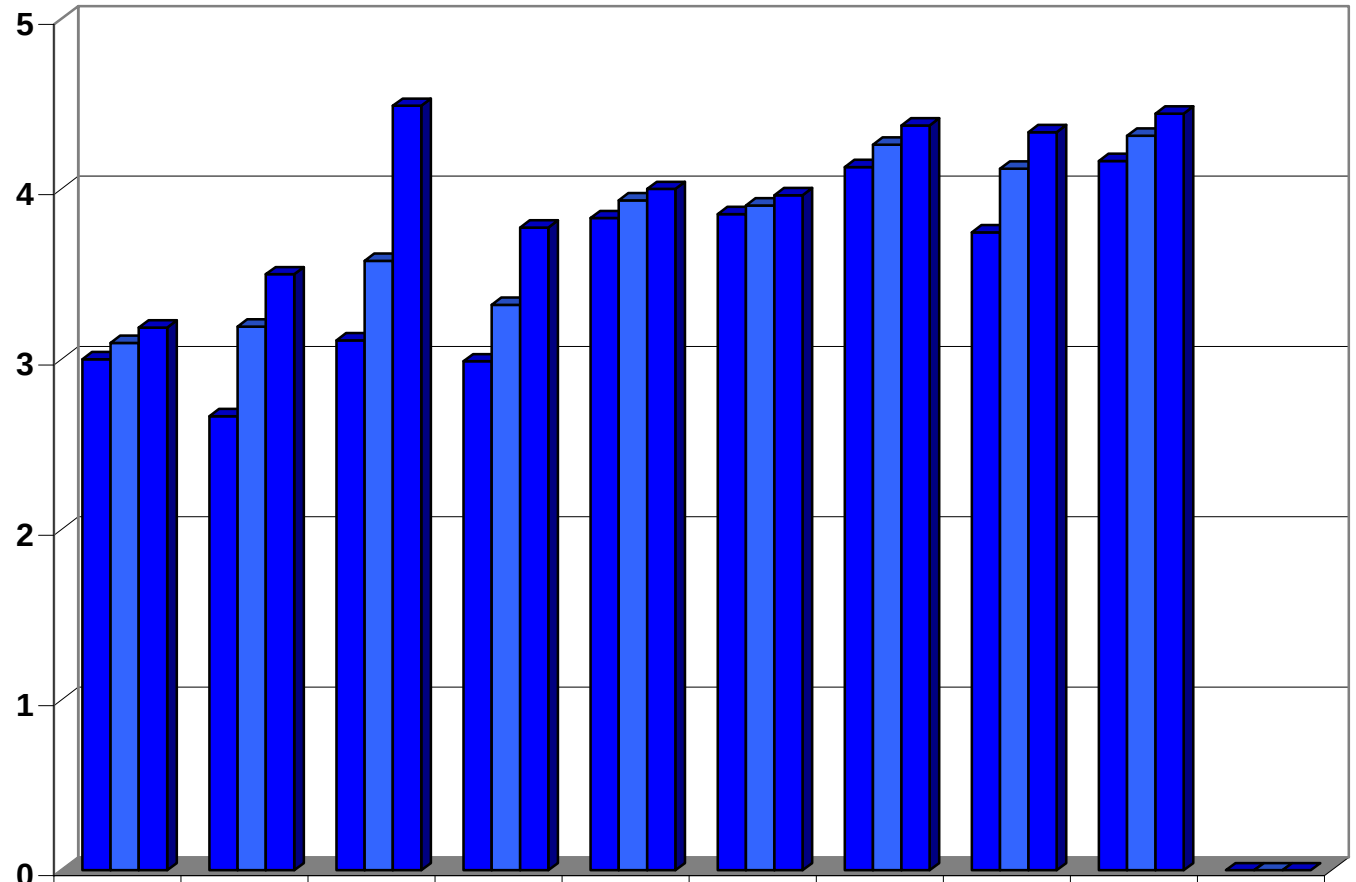
g	(g) Communicate effectively	The content of the written or oral presentation is effective.	The organization of memorandum and technical reports is consistent with styles accepted by the person's primary professional engineering society.	The design of slides shows an understanding of vision limitation 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	



	a	b	c	d	e	f	g	h	I	j	k
Low Ave	3.06	2.83	3.87	3.29	3.72	4.27	4.03	4.31	4.40	3.67	3.75
Ave Ave	3.43	3.87	4.14	3.70	3.86	4.35	4.14	4.40	4.41	3.95	4.12
High Ave	3.86	4.40	4.31	4.14	3.95	4.43	4.24	4.48	4.43	4.24	4.33

Figure 3-2 Assessment Summary for 2008

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



	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
H	3.00	2.67	3.11	2.99	3.83	3.85	4.13	3.75	4.17	0.00
A	3.10	3.19	3.58	3.32	3.93	3.90	4.26	4.12	4.31	0.00
L	3.19	3.50	4.49	3.77	4.00	3.96	4.37	4.33	4.44	0.00

Figure 3-3 Results for Outcome (k) from 2001 to 2010

Table 3-11 Typical Outcome Review Report

Outcome Review Form — Met Eng

Calendar Year: 2008
Outcome: (a) Apply Knowledge of Math, Science, and Engineering
Reviewer: WMC
Date: Jan 8, 2009

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
MET 320	Final Exam		
MET 465	FE Exam		
MATH 373	Project Report		
MET 422	Final Exam		
MET 310	Selected Exam		
MET 465	Senior Survey		
MET 465	Local Exam		

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.

Review

MET 320 MET 320 is a very important course in assessing student outcomes in their applying skills of math, science and engineering. 27 exams were evaluated and the students showed themselves to be generally proficient in their abilities with respect to applying math, science and engineering principles. The Met 320 curriculum indicates a good coverage of math concepts in addition to science subjects.

MATH 373 Math 373 involves considerable opportunities for applying knowledge of math, science and engineering. Two project reports were evaluated. These reports were average to poor.

MET 465 FE Exam 15 evaluations from the FE Exam were assessed. These evaluations indicated the student proficiency at applying math, science, and engineering principles were generally good with an average slightly above 4.

MET 465 Local Exam A local exam testing students over material directly from the curriculum was given to all graduating seniors. 15 evaluations from the local exam were assessed. As in 2007, the scores were outstanding.

MET 465 Senior Survey A short survey exam was given to graduating senior. The outcome assessments indicated that the students taking this survey were good to excellent in their abilities when applying math, science and engineering.

Table 3-11 Typical Assessment Progress Report (Continued)

MET 422 Seventeen students were evaluated by a examining the courses final exam. The quality of the student work appears to be good to very good with respect to applying math, science and engineering knowledge. The students performed exceptionally well in their proficiency in basic fundamental concepts and skills, but were only adequate in using theoretical and practical relationships. Much of the material covered by MET 422 appears to be directed at this goal.

MET 310 Twelve students were evaluated by a examining a selected exam. The quality of the student work appears to be adequate with respect to applying math, science and engineering knowledge. Much of the material covered by MET 310 is directed at this goal.

Previous Year Comparison

MET 310 and 422 are offered in alternating years and both were taught by different Professors between the two years. For the MET 320 course, all three areas decreased in 2008 as compared to 2007. For the MET 465 data, the FE Exam and Local Exam scored very high both years, while the Senior Survey results were improved in 2008. MATH 373 had considerably fewer in number and quality. This bears watching as the MATH 373 course changed Professors. MET 320 results were quite similar between 2008 and 2007.

Table 3-12 Action Review, Evaluation and Documentation from 2004 to 2009 for Outcome (a)

A= Action Needed, C= Continued, N=No action needed, W=Watch

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

2004

Previous Curriculum Action Review Summary

• There was no specific Curriculum Action specified at the end of 2003 for Outcome (a) during 2004.

Curriculum Review Summary

• Outcome (a) scores increased from 2003 to 2004.

• Outcome (a) score variation among the three metrics decreased from 2003 to 2004

• Outcome (a) assessment indicates improving student performance but statistical variation in the assessment process has not been established.

• No Action is needed at this time.

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

Previous Assessment Process Action Review Summary

• Seeking better instruments for Outcome (a) were suggested as an Assessment Process Action at the end of 2003 for Outcome (a) during 2004. Instruments were the specific target, not metrics.

Assessment Process Review Summary

• The instruments for Outcome (a) seem to be functioning better than thought at the end of 2003. The Assessment Process Action for 2004 in retrospect was not a significant need; however, there remains an interest in moving to more objective measures of student performance using somewhat standardized Instruments.

• A method of using the FE Exam results for the assessment of many of the Outcomes, including (a) has been developed and implemented.

• The use of questions on MET 320 and MATH 373 final exams is being considered for implementation. More objective measures are needed.

Code	*Assessment Process Action Title*	*Assessment Process Action Brief Description*
A	Better Assessment of Outcome (a)	Develop more objective instruments to assess Outcome (a).

2005

Previous Curriculum Action Review Summary

• There were no 2005 Curriculum Actions Needed.

Curriculum Review Summary

• Outcome (a) scores increased from 2004 to 2005.

• Outcome (a) score variation among the three metrics increased somewhat in 2005 compared to 2004.

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

Previous Assessment Process Action Review Summary

• The Assessment Process Actions for Outcome (a) for 2005 was the general action that all faculty members consider producing metrics that provide for more reliable measures of student achievement. This has taken the form of more objective measures as acquired through the Senior Exit Survey and the FE Exam.

Assessment Process Review Summary

• The current cadre of instruments appears to be good tools for assessing Outcome (a).

• The faculty are again asked to continually seek better measures of student performance.

• The Senior Survey is an excellent assessment instrument in that objective (faculty play no role in determining the assessment score) results are obtained.

• A Senior Exit Exam would be an excellent improvement that it would yield objective results in that the faculty would play no role in determining the assessment scores.

Code	*Assessment Process Action Title*	*Assessment Process Action Brief Description*
A	Develop a Senior Exit Exam	A Senior Exit Exam is needed to achieve better Assessment of Outcome (c).

Table 3-12 Action Review, Evaluation and Documentation from 2004 to 2009 for Outcome (a)

A= Action Needed, C= Continued, N=No action needed, W=Watch (Continued)

2006

Previous Curriculum Action Review Summary

• There were no 2005 Curriculum Actions stated for 2006.

Curriculum Review Summary

• Outcome (a) scores decreased from 2005 to 2006.

• Outcome (a) score variation among the three metrics increased from 2005 to 2006

• The decrease in student performance may be within the statistical variation for measuring Outcome (a); however, curriculum improvements are beneficial. To this end an improved and expanded textbook authored by the course instructor for MATH 373 will be introduced in 2007.

Code	*Curriculum Action Title*	*Curriculum Action Brief Description*
A	New Textbook for MATH 373	A new textbook for MATH 373 that addresses all the topics covered in the course, unlike current textbooks, will be written and introduced.

Previous Assessment Process Action Review Summary

A need for improved Assessment Process for Outcome (c) in the form of a Senior Exit Exam is an ongoing process improvement. Dr Howard will assume responsibility for coordinating this effort.

Assessment Process Review Summary

• The current cadre of instruments appears to be good tools for assessing Outcome (a). The faculty are again asked to continually seek better measures of student performance.

• The current Assessment Processes should be continued to assess Outcome (a), but other objective assessment data are needed.

• A Senior Exam should be developed as was recommended last year.

Code	*Assessment Process Action Title*	*Assessment Process Action Brief Description*
A	Local Senior Exit Exam	Develop a Senior Exit Exam to be administered to seniors as they near graduation so as to gain objective assessment results specifically covering as many metrics as possible.

2007

Previous Curriculum Action Review Summary

• The Curriculum Action caling for the introduction of a new textbook for MATH 373 was completed in 2007.

Curriculum Review Summary

• The scores for Outcome (a) remained the same for 2007 as for 2006.

• New program faculty could benefit from mentoring and better integration with experienced faculty more familiar with the interfaces within the curriculum. Faculty training and mentoring could have sigificant affects on student performance.

Code	*Curriculum Action Title*	*Curriculum Action Brief Description*
A	New Faculty Curriculum Mentoring and Training	New faculty mentoring and training for the classroom and curriculum interfaces is needed.

Previous Assessment Process Action Review Summary

• The 2006 Assessment Process Actions Needed called for the development and implimentation of a Local Senior Exit Exam, now termed the Local Exam given to all seniors as they near graduation (usually during their last few weeks of course work). This action was completed during the year and is used for many Outcomes including Outcome (a). It is an excellent objective measurement.

Assessment Process Review Summary

• The drop in scores from 2005 and 2006 may be related to different reviewers as faculty turnovers occur. Faculty training in the Continuous Improvement Process is essential and should continue with renewed emphasis.

Code	*Assessment Process Action Title*	*Assessment Process Action Brief Description*
A	New Faculty Continuous Process Training	New faculty will be trained in the program's Continuous Improvement assessment processes and practices.

Table 3-12 Action Review, Evaluation and Documentation from 2004 to 2009 for Outcome (a)

A= Action Needed, C= Continued, N=No action needed, W=Watch (Continued)

2008

Previous Curriculum Action Review Summary

• As suggested for 2008, new faculty have undergone mentoring and training for the classroom and curriculum interfaces.

Curriculum Review Summary

• Student assessment of performance continues to decline. The new faculty integration and training is expected to show improved studetnt performance so no Curriculum Action is recommended.

• Faculty training and mentoring is an ongoing departmental process and will no longer be mentioned specifically.

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

Previous Assessment Process Action Review Summary

• As suggested for 2007, new faculty have undergone training in the program's Continuous Improvement assessment processes and practices.

Assessment Process Review Summary

• Student performance continues to decline. This may be the result of the assessed cohort's academic variation with the academically superior 2005/6 cohort. This suggests the possible normalization of outcome assessment results with cohort GPA's; however, that data is not readily available to the program from institutional databases.

• The most likely cause for performance decline is the recent turnover in program faculty.

• A watch of performance is warranted. If improvement is not seen in the coming year, action will be needed.

Code	***Assessment Process Action Title***	***Assessment Process Action Brief Description***
W	Senior Exit Exam	Determine if the Senior Exit Exam has less variation from year to year and how it compares with other metrics results.
C	Continued Faculty Training and Mentoring	New faculty are being trained in the program's Continuous Improvement assessment processes and practices.

2009

Previous Curriculum Action Review Summary

No Previous Curriculum Action Review Items were noted

Curriculum Review Summary

Mean student performance improved from 2008 to 2009, while the variation between instruments was considerably reduced.

•MATH 373 has ceased being a useful assessment tool.

A	MATH 373	Replace MATH 373

Previous Assessment Process Action Review Summary

Two Previous Assessment Process Action items were noted, a watch on the variation in the senior exit exam and a continuation action concerning faculty training.

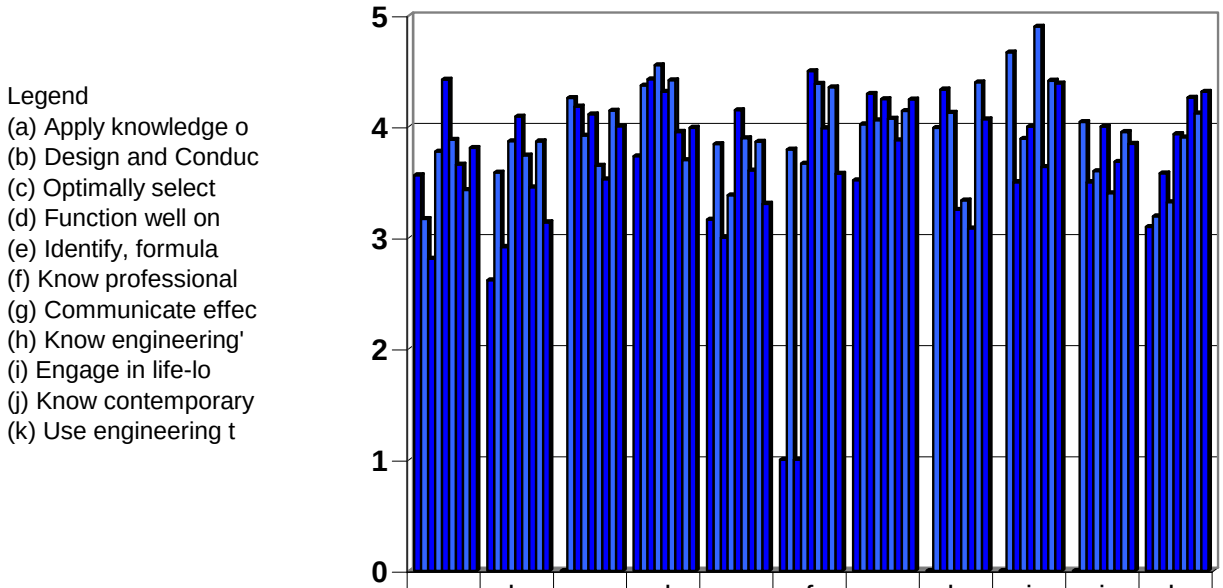
Assessment Process Review Summary

As previously, all student assessments for the local exam were the same. They were all very good, but with no variation. This may indicate some changes in questions or how the scores are apportioned is needed.

• No results were returned for MATH 373.

• Scores have stabilized so the extra faculty training is likely having an effect

A	MATH 373	Replace MATH 373
W	Local Exam	Variability within instrument still low



	a	b	c	d	e	f	g	h	i	j	k
2001	3.56	2.62	0.00	3.73	3.16	1.00	3.52	0.00	0.00	0.00	3.10
2002	3.17	3.59	4.26	4.37	3.84	3.79	4.02	3.99	4.67	4.04	3.19
2003	2.81	2.92	4.18	4.43	3.00	1.00	4.30	4.33	3.50	3.50	3.58
2004	3.77	3.87	3.92	4.55	3.38	3.67	4.06	4.13	3.89	3.60	3.32
2005	4.42	4.09	4.11	4.31	4.15	4.50	4.25	3.25	4.00	4.00	3.93
2006	3.88	3.74	3.65	4.42	3.90	4.39	4.07	3.34	4.90	3.40	3.90
2007	3.66	3.45	3.53	3.95	3.61	3.99	3.88	3.08	3.64	3.68	4.26
2008	3.43	3.87	4.14	3.70	3.86	4.35	4.14	4.40	4.41	3.95	4.12
2009	3.81	3.14	4.00	3.99	3.31	3.58	4.24	4.07	4.39	3.85	4.31

Figure 3-4 Grand Summary of all outcome assessments by one-year periods from 2001 through 2009