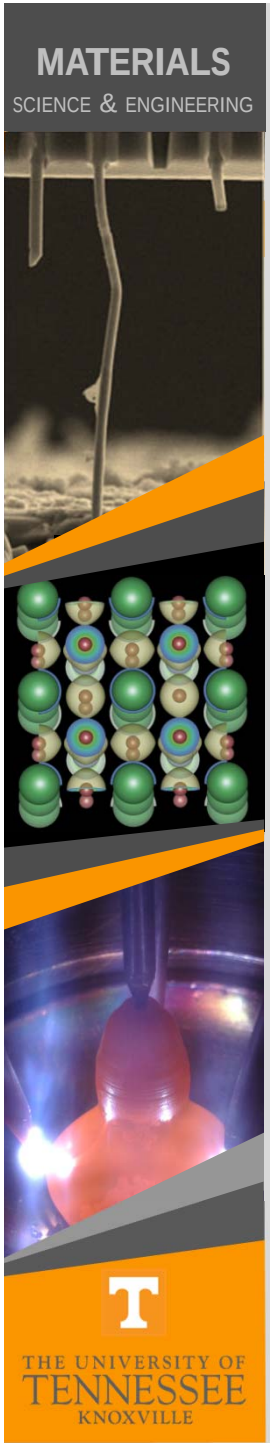

Closing the Assessment Loop

Materials Science & Engineering Faculty Meeting

David Keffer
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The University of Tennessee
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http://clausius.engr.utk.edu/

University of Tennessee, Knoxville
September 27, 2016

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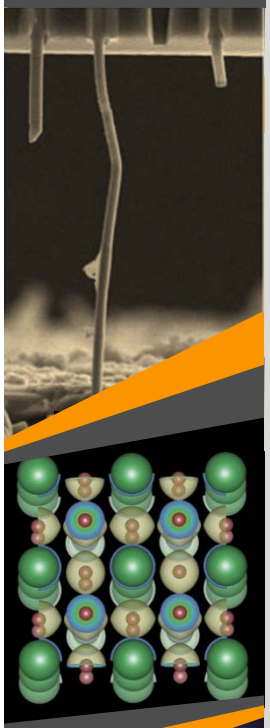
SCIENCE & ENGINEERING



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Three Purposes of this Presentation

The primary purpose of this presentation is to close the assessment loop based on the comprehensive evaluation of the student outcomes performed during the 2015-2016 academic year.

The second purpose is to present new program educational outcomes.

The third purpose is to let you know a request for data is coming.

MATERIALS
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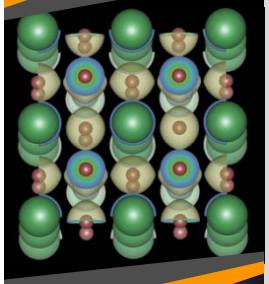

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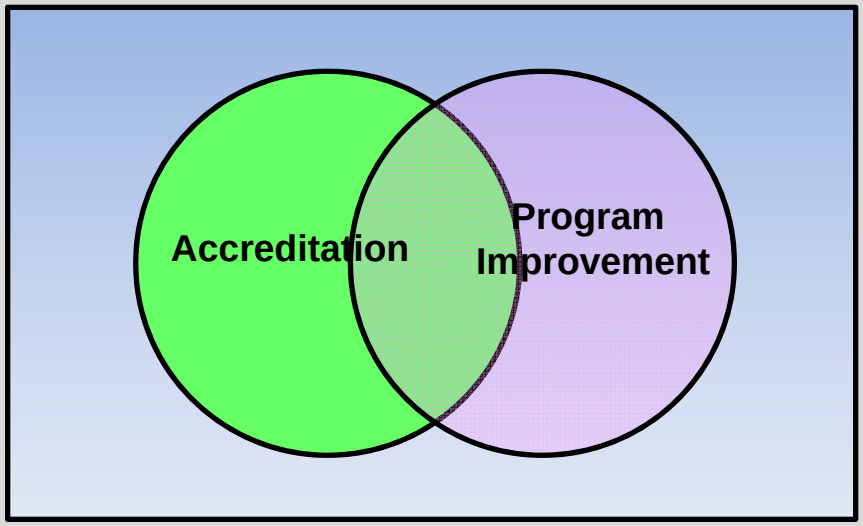
Departmental Objectives relevant to ABET

The MSE department has two objectives relevant to ABET.



- The first objective is to maintain its credentials as an accredited degree-granting program in materials science.
- The second objective is to create an effective process by which the program can continue to improve.

- The first objective is an external objective, which satisfies the requirements of ABET.
- The second objective is an internal objective, which satisfies the faculty of the UT MSE department.

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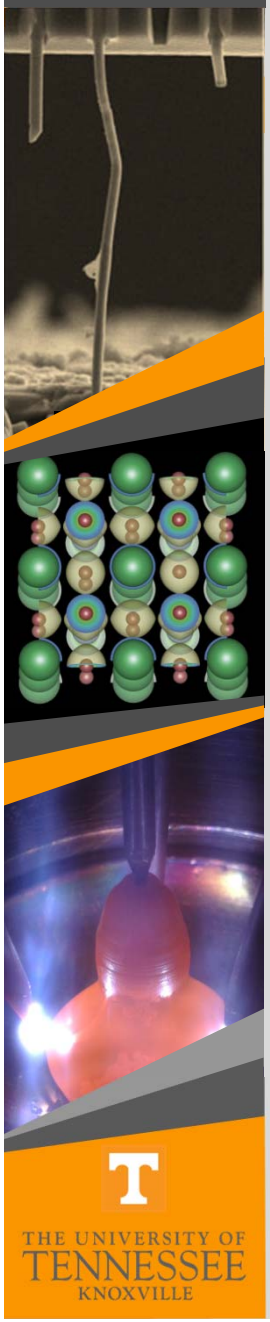

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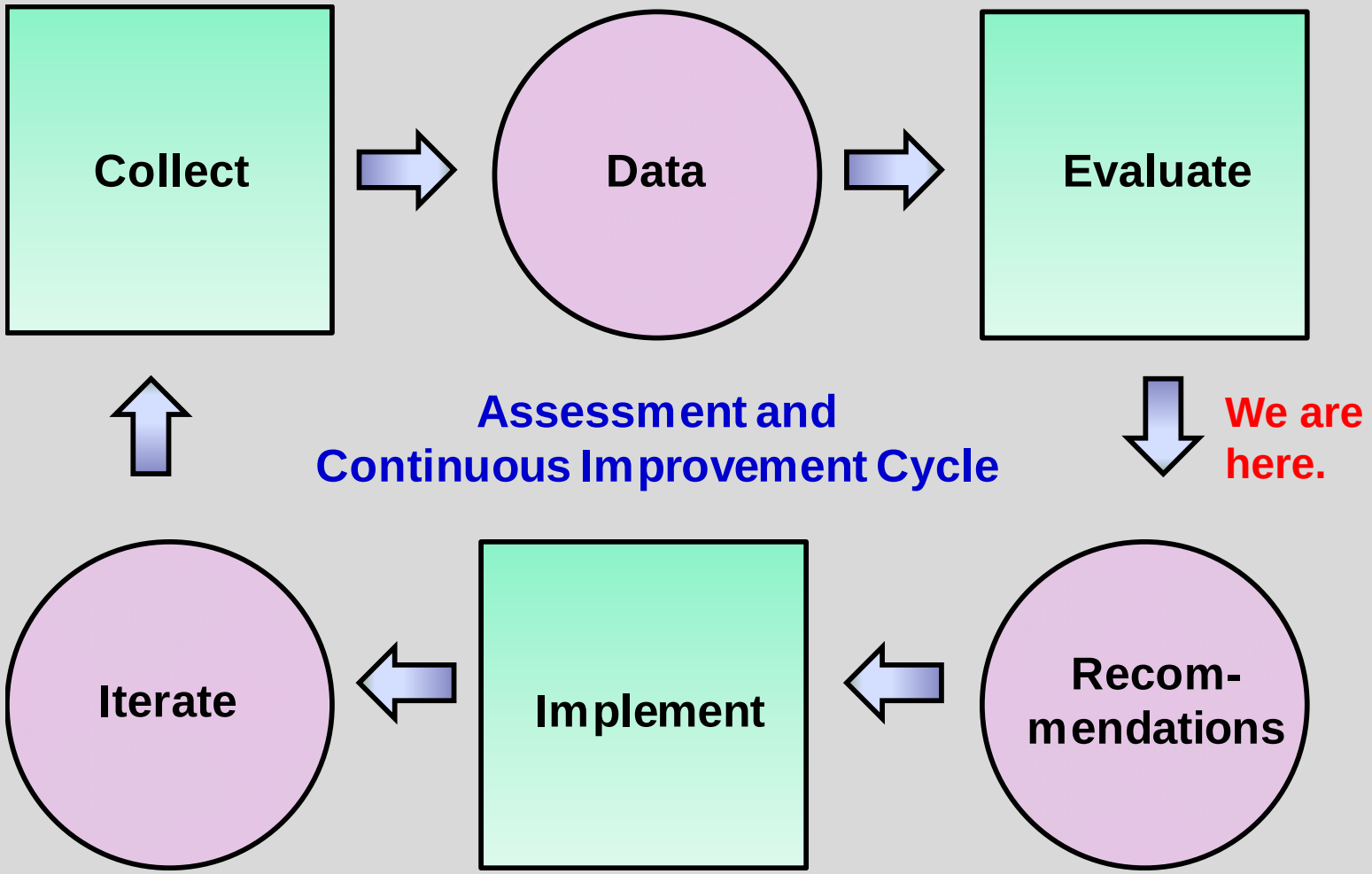
Continuous Improvement Process



MATERIALS
SCIENCE & ENGINEERING

Student Outcomes

verbatim from ABET

a) an ability to apply knowledge of mathematics, science, and engineering
b) an ability to design and conduct experiments, as well as to analyze and interpret data
c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
d) an ability to function on multidisciplinary teams
e) an ability to identify, formulate, and solve engineering problems
f) an understanding of professional and ethical responsibility
g) an ability to communicate effectively
h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
i) a recognition of the need for, and an ability to engage in life-long learning
j) a knowledge of contemporary issues
k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

from UT MSE

l) an understanding of the effect of composition, synthesis, and processing methods on structure and properties, and in turn to the performance in service of all classes of materials (metals, ceramics, polymers)
m) an ability to apply statistical and computational methods for data analysis and solution of problems in materials systems
n) an ability to integrate knowledge of processing, structure, properties, and performance to solve materials selection and design problems

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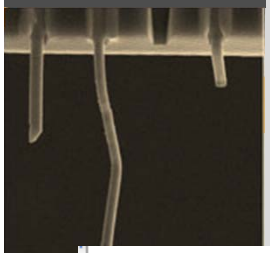
MATERIALS
SCIENCE & ENGINEERING



The Courses that Were Assessed (2015-2016)

	student outcome summary	course 1	course 2
A	mathematics, science, and engineering	260 (thermo)	302 (mechanical behavior)
B	design and conduct experiments	210 (intro lab)	304 (materials lab II)
C	design a system, component, or process	480 (materials selection)	489 (senior design)
D	multidisciplinary teams	210 (intro lab)	370 (materials processing)
E	solve engineering problems	340 (polymeric materials)	390 (metallic materials)
F	professional and ethical responsibility	405 (structural character.)	489 (senior design)
G	communicate effectively	300 (materials lab I)	405 (structural character.)
H	global, economic, environmental, and societal context	290 (professional develop)	
I	engage in life-long learning	290 (professional develop)	
J	contemporary issues	101 (intro seminar)	290 (professional develop)
K	use tools for engineering practice	250 (kinetics & transport)	405 (structural character.)
L	materials processing/structure/property relationships	370 (materials processing)	360 (ceramic materials)
M	statistical and computational methods	301 (statistics and numerical)	
N	materials selection and design problems	489 (senior design)	480 (materials selection)

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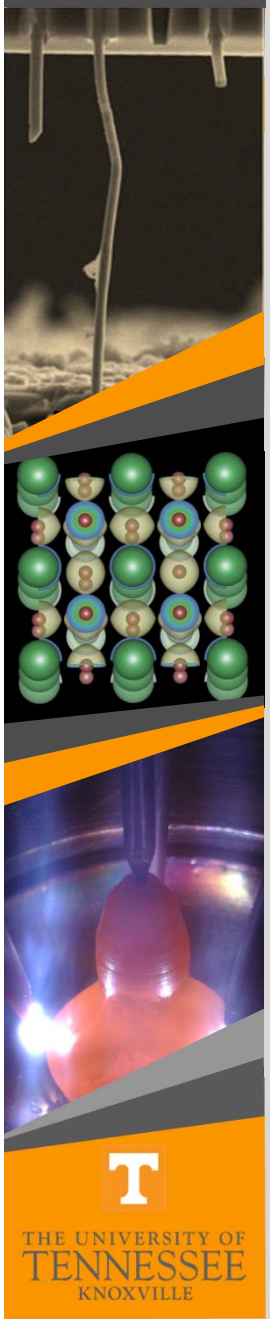
This data was successfully collected.
I thank everyone who participated.
We are now on a 3-year cycle.
Next assessment is 2018-2019.



What to do with the Results of the Assessment

A document will be distributed to all faculty members.

This document has two sections.

- A list of the rubrics used for Student Outcomes (a) through (n). The results are meaningless without knowing the performance criteria upon which the assessment was based.
- A one-page summary of each instance of each outcome being assessed. For example, outcome (a) was assessed in 260 and 302. Each has a one page summary.

Today, we are <u>not</u> reviewing all 23 instances. Instead, I lead you through one example. You can review classes you taught or will teach on your own.

Some of you are skeptical that this assessment, necessary for accreditation, is useful for program improvement. No one looking at the evaluations is one way to make sure that the assessment process is irrelevant to program improvement.

MATERIALS
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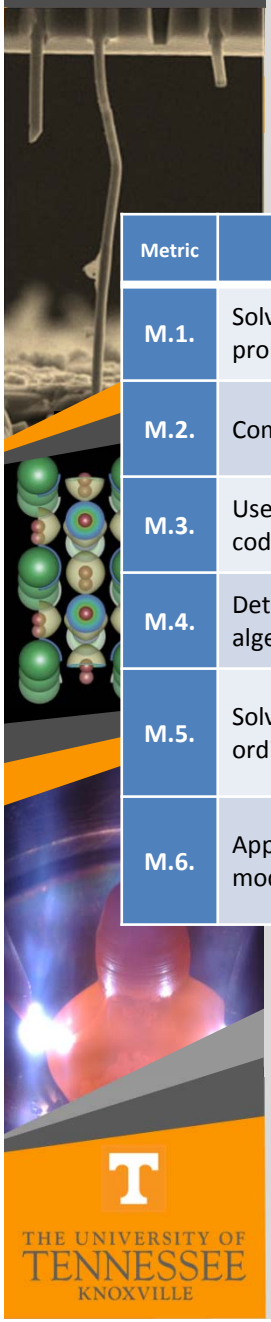

Example Rubric: Student Outcome (m)

Metric	Criterion	Work Equivalent to Level 1	Work Equivalent to Level 3	Work Equivalent to Level 5	Score (1-5)
M.1.	Solves problems regarding probability.	Probability problems are interpreted incorrectly or not at all	Some probability problems are interpreted and solved correctly	Virtually all probability problems are interpreted and solved correctly	
M.2.	Computes statistical quantities.	Statistical quantities are computed incorrectly or not at all	Some statistical quantities are computed correctly	Virtually all statistical quantities are computed correctly	
M.3.	Uses an existing programming code.	An existing programming code cannot be used	An existing programming code can be used correctly	An existing programming code can be modified for a specific purpose	
M.4.	Determines roots to nonlinear algebraic equations.	The roots to nonlinear algebraic equations cannot be determined	The roots to nonlinear algebraic equations can sometimes be determined correctly	The roots to nonlinear algebraic equations can virtually always be determined correctly	
M.5.	Solves a system of nonlinear ordinary differential equations.	A system of nonlinear ordinary differential equations cannot be solved	A system of nonlinear ordinary differential equations can sometimes be solved correctly	A system of nonlinear ordinary differential equations can virtually always be solved correctly	
M.6.	Applies numerical techniques to model material behavior.	Numerical techniques cannot be applied to model material behavior	Numerical techniques can sometimes be applied to model material behavior correctly	Numerical techniques can virtually always be applied to model material behavior correctly	

Table 4.4. Assessment Rubric for MSE Student Outcome M: An ability to apply statistical and computational methods for data analysis and solution of problems in materials systems.

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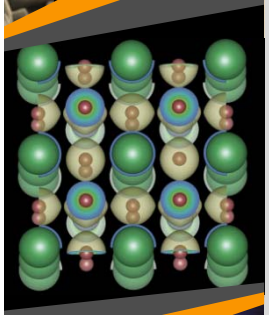

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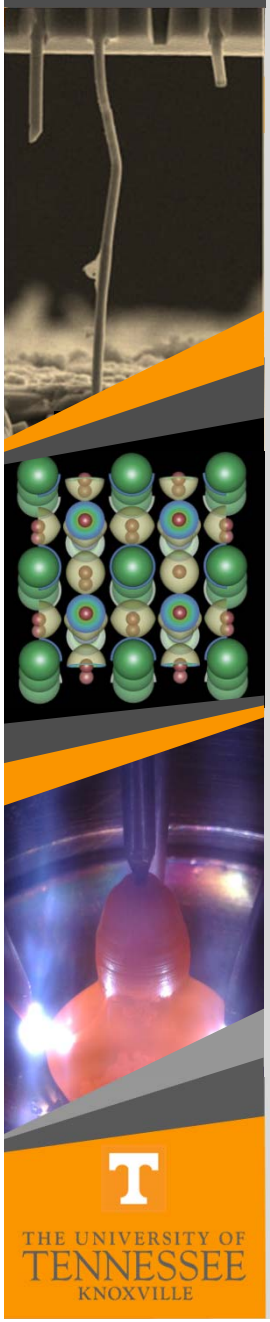
Example: Student Outcome (m)

M.1	**problem 3 of exam 1**
M.2	problem 1 of exam 2
M.3	problem 2 of exam 3
M.4	problem 2 of exam 3
M.5	problem 4 of exam 4
M.6	Project

Table 4.5. Identification of problem and assignment identified as a measure of each outcome item for Assessment Rubric for MSE Student Outcome M.



Example: Student Outcome (m)

		M.1	M.2	M.3	M.4	M.5	M.6
Student 1		5	5	5	5	4	1
Student 2		5	5	5	5	3	1
Student 3		5	5	5	5	4	5
Student 4		5	5	5	5	5	3
Student 5		5	5	5	5	5	4
Student 6		3	2	3	3	2	1
Student 7		5	4	4	4	4	3
…		…	…	…	…	…	…
Student N-2		5	5	5	5	5	5
Student N-1		5	4	5	5	5	5
Student N		5	3	5	5	1	1

Table 4.6. Student scores for each criterion on the rubric for student outcome (m). The criterion are given in Table 4.4. The problem used for assessment is given in Table 4.5.

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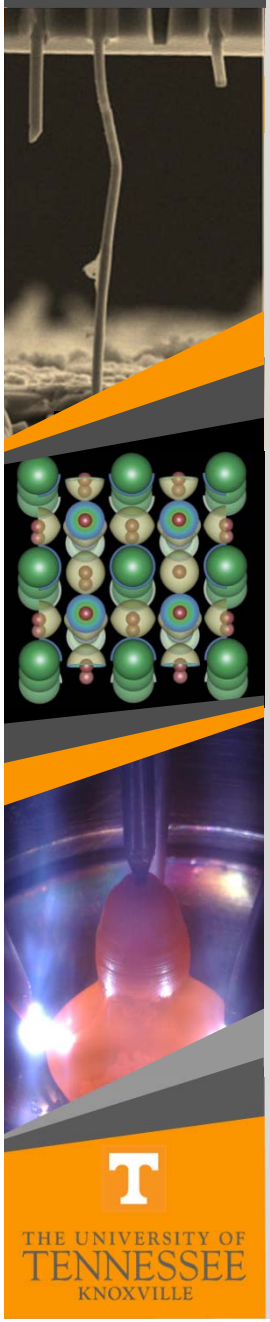

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Example: Student Outcome (m)

	M.1	M.2	M.3	M.4	M.5	M.6
average	4.60	4.65	4.75	4.75	4.45	3.80
standard deviation	0.86	0.79	0.62	0.62	0.80	1.40

Table 4.7. Average and standard deviation of scores.

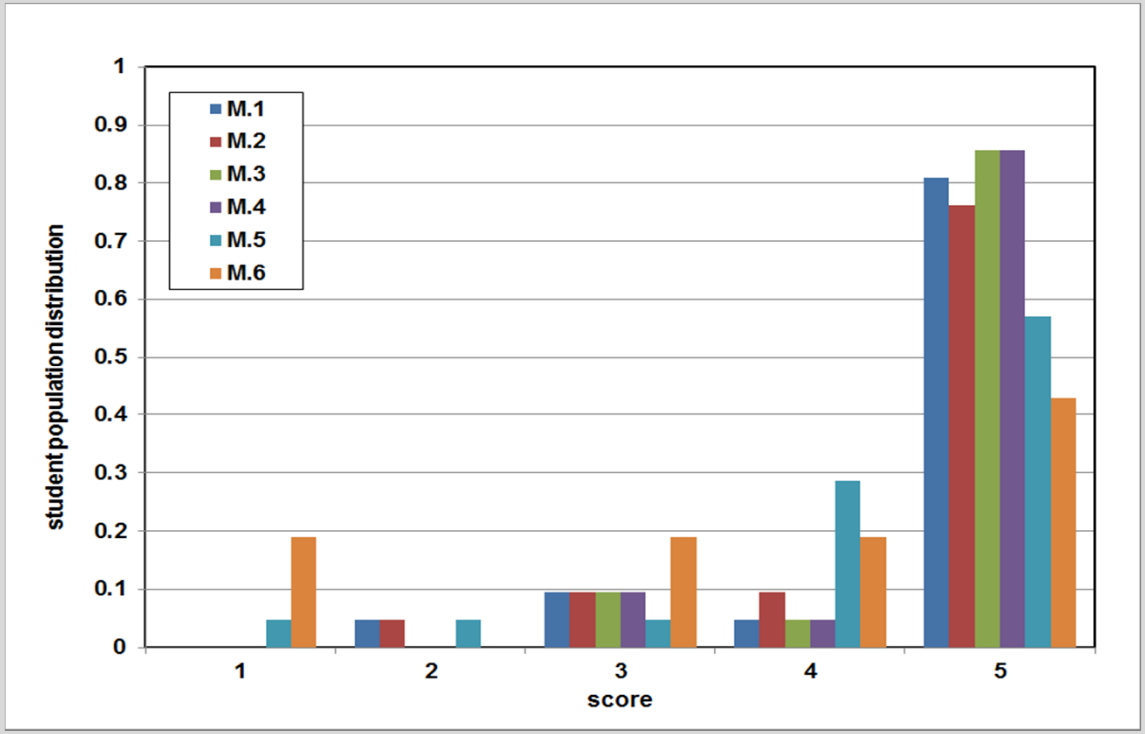

Figure 4.1.a. Histogram for Student Outcome (m).

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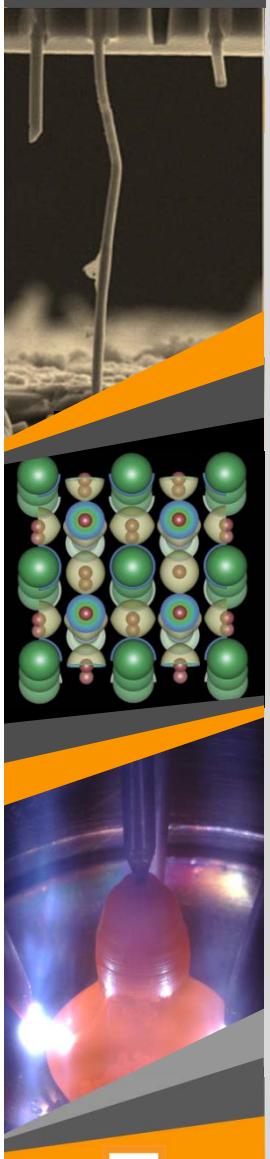

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Example: Student Outcome (m)

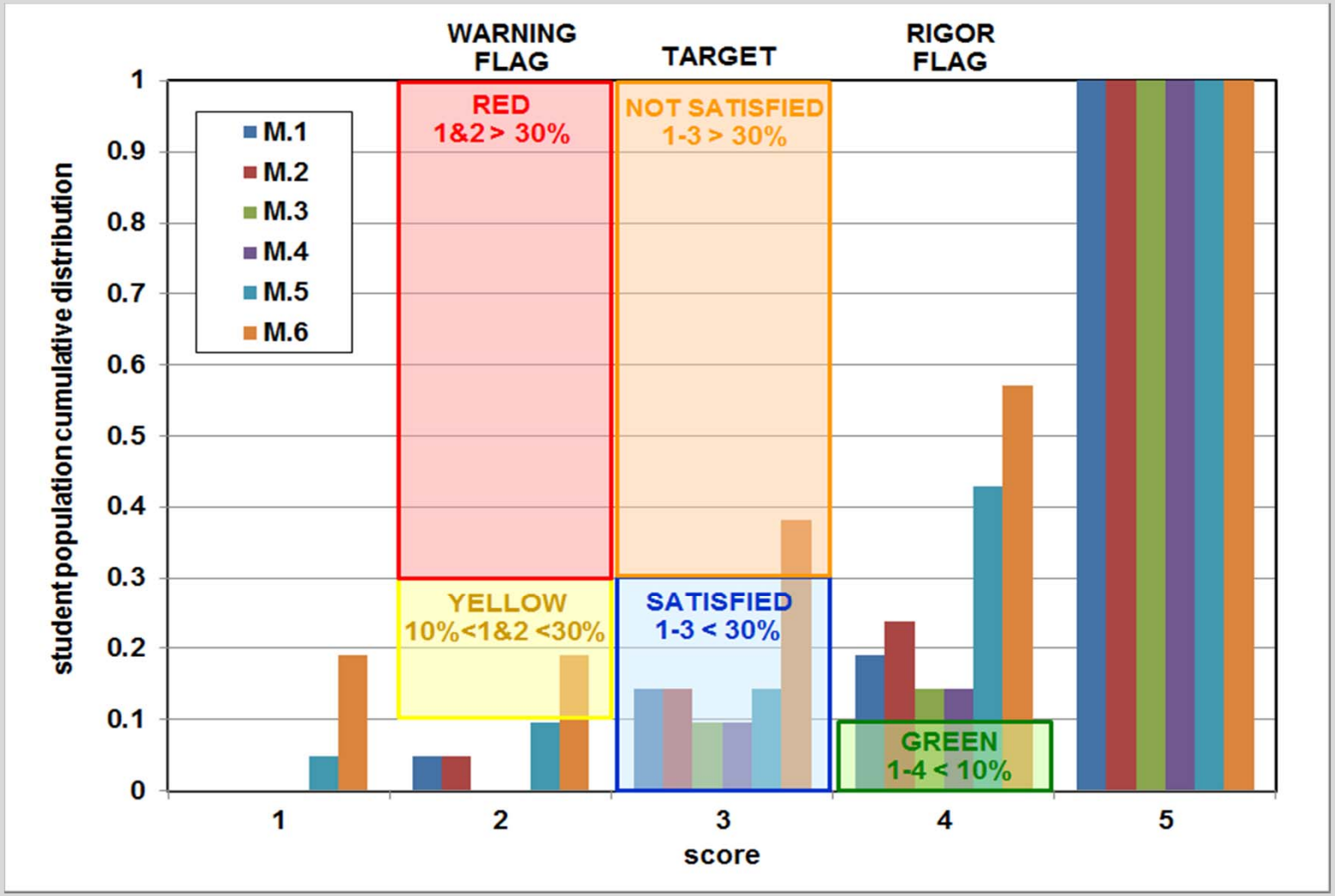
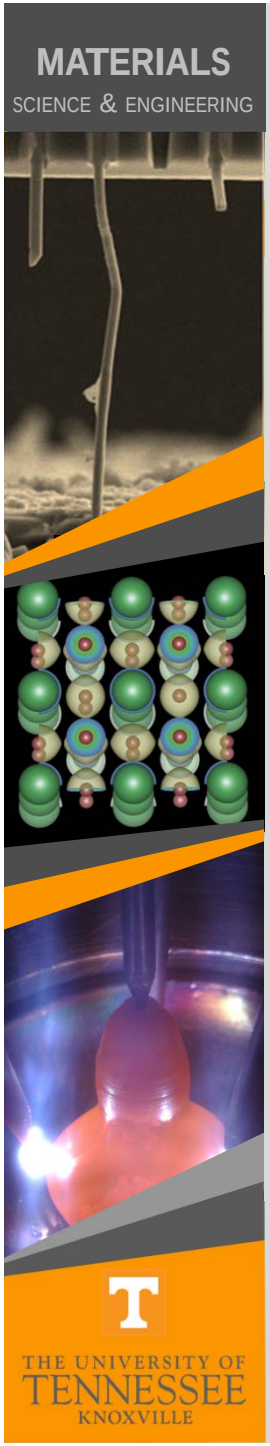


Figure 4.1.b. Cumulative Histogram for Student Outcome (m).



Example: Student Outcome (m)

Action Taken:
The instructor indicated (M.6) was based on a project using regular solution theory to generate a eutectic phase diagram, a hard project. He indicated that he would attempt to improve the project statement to address issues where weaker students struggled with the project.

Action Items

- Take a look at courses relevant to you.

- If you take an action, based on this information, please send me a short email, containing a statement like that above summarizing your action. I will include it in the report.

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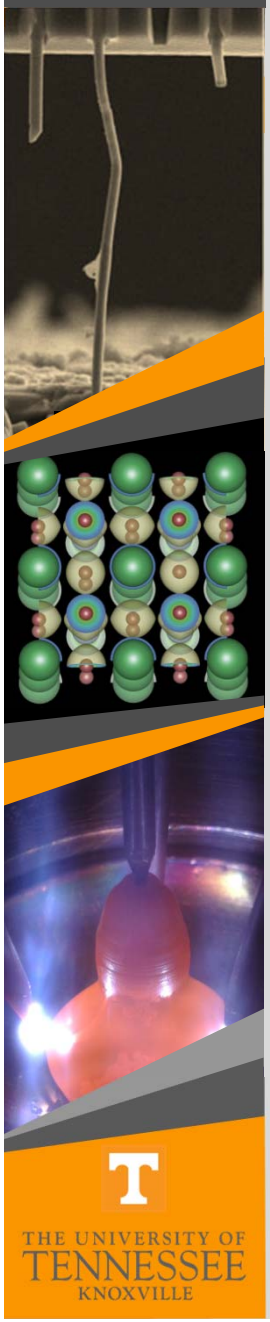

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Program Educational Objectives

The educational objectives of the program for the degree of Bachelor of Science in Materials Science and Engineering are:

- Our graduates will demonstrate a thorough understanding of general engineering principles and a deep understanding of the discipline of materials science and engineering.

- Our graduates will contribute to their disciplines and society and advance to leadership roles in their chosen career field.

- Our graduates will be prepared to successfully complete competitive postgraduate education programs.

http://www.engr.utk.edu/mse/future/undergrad_objectives.html

These very broad objectives were adopted after the previous objectives were deemed a weakness during the 2011 ABET review.

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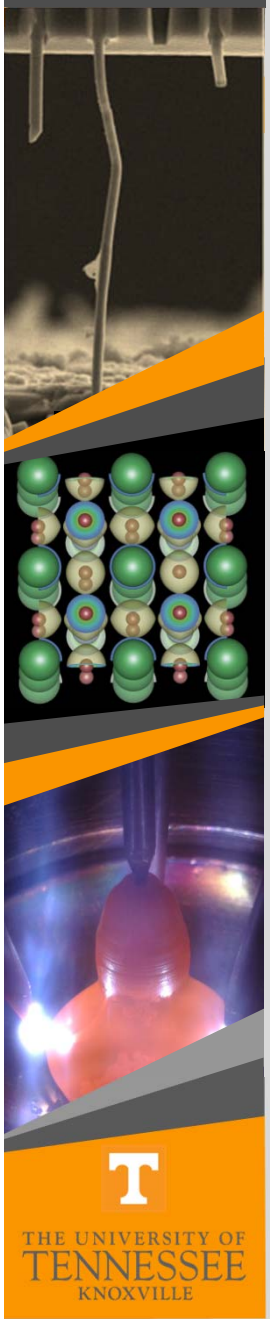

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Program Educational Objectives

The ABET consultant, hired by the UTK College of Engineering, recommended every department adopt three very simple objectives, “an industry”, a “grad school” and a “leadership” objective. Specifically, he recommended

- Graduates will meet or exceed the expectations of employers of materials scientists and engineers
- Qualified graduates will pursue advanced study if desired
- Graduates will pursue leadership positions in their profession and/or communities

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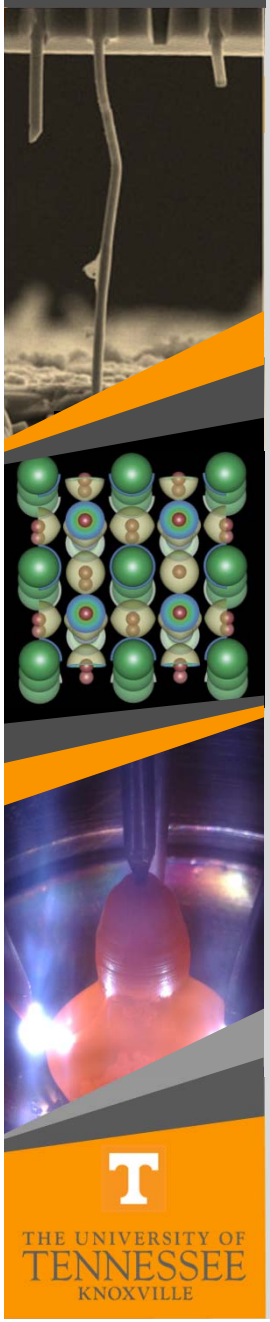

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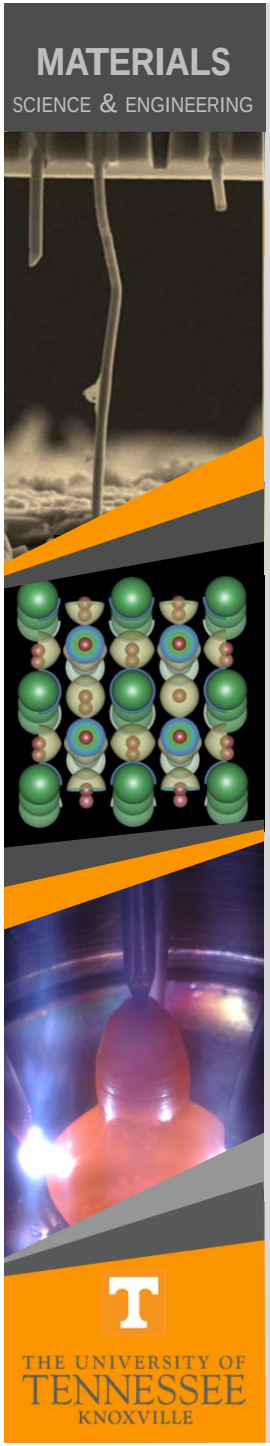
Program Educational Objectives

I recommend we change our PEOs to:

- Our graduates will successfully complete competitive postgraduate education programs.
- Our graduates will successfully perform the work of materials scientists and engineers in industry, academia and government.
- Our graduates will contribute to their disciplines and to society and will advance to leadership roles in their chosen career field.

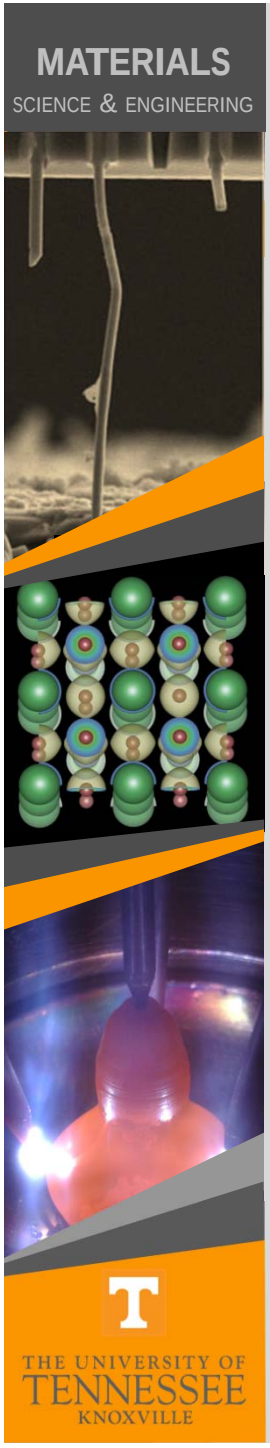
These objectives have been examined by the MSE ABET committee.
I move that they be approved by faculty vote today.



Program Educational Objectives

Georgia Tech MSE
http://www.mse.gatech.edu/undergraduate

- Our graduates will rapidly rise to leadership roles in materials-related positions in industry, academia, government, and other career pursuits.
- Our graduates will be global leaders, collaborating with diverse, multi-disciplinary teams while incorporating emerging materials developments and engineering technologies that are positively changing society and the human condition.
- Our graduates will continue to grow their cumulative knowledge base by engaging in life-long learning via career-appropriate options, including post-graduate education and professional designations.
- Our graduates will be entrepreneurs, continually discovering, designing and creating new materials of all types, building on the process-structure-properties-performance paradigm to exert positive economic and social impacts across the field and society.



Forthcoming Request for Information

The ABET Self-Study Report requires a lot of information about the program. To the greatest extent possible, I am relying on staff, not faculty, to provide this information. However, some information must come from the faculty. I thank those who I have already called upon who have provided information.

- Syllabi (in ABET format) for required courses are due Friday.
- Two page CVs will be recycled from the Academic Program Review of Fall, 2015. If you want changes, tell Martha.

Soon each of you will receive an email requesting a slew of other data necessary to fill required tables in the self-study report. This information includes. (I am trying to make sure I request all the required info in one fell swoop.)

- percentage distribution between teaching and research
- level of activity in professional organizations, consulting, etc. (High, Medium, Low)
- list of professional development activities
- etc.