Hi Everyone:

I am addressing you because I'd like to share the assessment model currently used in Engineering. Although I will speak for the specific case of Electrical Engineering (EE), Mechanical Engineering (ME) and Mechanical Engineering Technology (MET) are virtually identical. Note that the text is adapted from our ABET Self Study (hence the weird figure labels).

The assessment done at the EE program follows the flowchart shown in Figure 4.A.1 (adapted from a Gloria Rogers[1] presentation). What we want is to turn data into information, which is converted into knowledge that we can use to make decisions that will result in curricular, program and possibly institutional improvements. To do this, we follow the plan delineated next:

1. Identify what data to collect.
2. Collect data
3. Analyze data (this results in information)
4. Evaluate information (this yields knowledge)
5. Make decisions about changes in the curriculum, program, and possibly institution
6. Implement them (i.e. obtain improvements). Note that after this step the process moves to a new round of assessment.

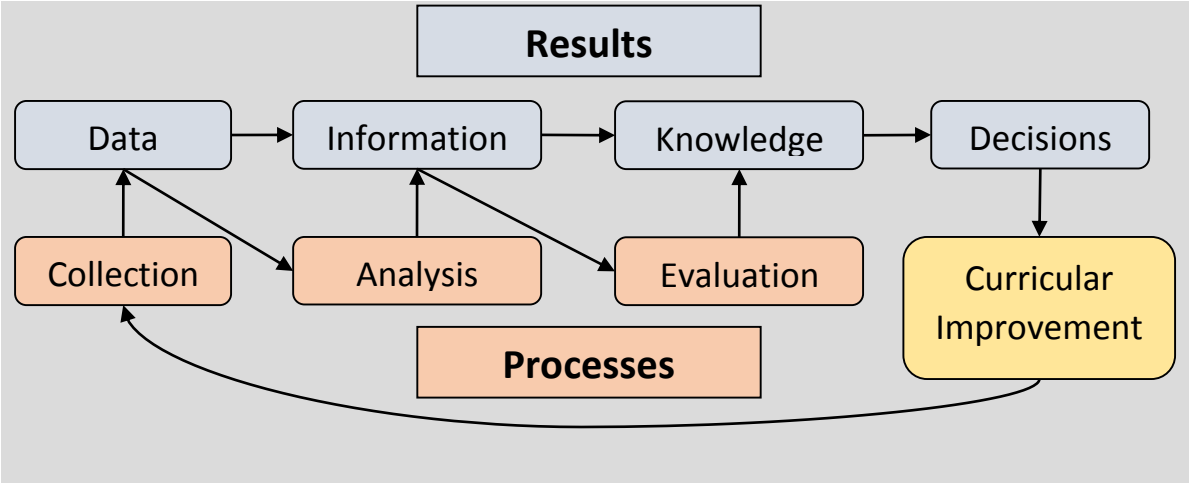

Figure 4.A.1. Flowchart of continuous improvement for the EE program.

In this section we describe the details of the processes we follow in our program to implement the flowchart in Figure 4.A.1.

1. Description of Data Collection Processes

There are three main mechanisms that are used systematically for collecting data to assess and evaluate achievement of each outcome.

[1] Gloria Rogers is an assessment expert very well known in the field. More info here: http://www.colorado.edu/ibs/decaproject/aboutus/rogers.html

i. Data from student work

Each one of the outcomes[2] is attached to two or more performance indicators (PIs). Data collected for each one of the PIs is assessed not based on grades, but on assessing selected "ABET assignments" against predetermined rubrics. These assignments may be homeworks, tests, quizzes, exams, projects, presentations, etc., carefully chosen to match a given PI. Note that many times only a portion of an "ABET assignment" is used for assessing the outcome. For example, if we are trying to assess Outcome (b) (i.e. an ability to design and conduct experiments…), and one of the PIs is related to analyzing data gathered during the experiment, then only the "Analysis" portion of a lab report will be used to assess the PI. The collection of ABET assessment-related data is transparent to the student, that is, students are never told which assignments are used to assess program outcomes.

Outcome assessment is done based on matching student work in the ABET assignment to the appropriate level in a rubric. The rubrics used for data collection allow four different ratings for each assignment:

1. Unsatisfactory
2. Below Average
3. Satisfactory
4. Exemplary

What the student should accomplish to be included in a given level is thoroughly described in the rubric. For an example for one PI for Outcome (*g*) please see Figure 4.A.2 below.

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[2] We assess 11 outcomes, named a-k:

Outcome (*a*): An ability to apply knowledge of mathematics, science and engineering.

Outcome (*b*): An ability to design and conduct experiments, as well as to analyze and interpret data.

Outcome (*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.

Outcome (*d*): An ability to function on multidisciplinary teams.

Outcome (*e*): An ability to identify, formulate, and solve engineering problems.

Outcome (*f*): An understanding of professional and ethical responsibility.

Outcome (*g*): An ability to communicate effectively.

Outcome (*h*): The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.

Outcome (*i*): A recognition of the need for, and an ability to engage in life-long learning.

Outcome (*j*): A knowledge of contemporary issues.

Outcome (*k*): An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Student Outcome (*g*): *An ability to communicate effectively.*

Performance Indicator	Unsatisfactory-1	Below Average-2	Satisfactory-3	Exemplary-4
Student must be able to describe a circuit/code/ algorithm design through a project report.	Student was unable to describe the circuit/code / algorithm design.	Student was able to list and identify the various circuit/code/ algorithm elements, but unable to explain its workings.	Student was able to correctly identify the various circuit/code / algorithm elements, and to describe most of the circuit/code/ algorithm design techniques used.	Student was able to describe the circuit/code / algorithm design process, as well as explain why the circuit/code/ algorithm behaves the way it does.

Figure 4.A.2. Sample rubric for *one* PI for Outcome (*g*). (There are more than one PIs for each outcome)

The collective of all PIs can be made available to the EWU Assessment Team, if requested, as well as all rubrics.

As mentioned above, data is collected only for *selected* representative student assignments. For example, for the PI in Figure 4.A.2, the data collected is shown in Figure 4.A.3.

PI: Student must be able to describe a circuit/code/algorithm design through a project report.

i. Circuit description of final project from Digital Circuits (EENG 160).
ii. Circuit/code/algorithm description of final project from Microcontroller Systems (EENG 260).

Figure 4.A.3. Sample of data collected for the PI shown in figure 4.A.1.

The list of all data collected for all PIs can be made available upon request.

Every single one of the data points for each PI is assessed based on a rubric like that of Figure 4.A.2. The faculty member will place each student work in one of the levels, which in turn will be turned into a percentile. For example, if there are 20 students in a class, and we have 2, 8, 6, and 4 students in the Unsatisfactory, Below Average, Satisfactory and Exemplary categories, respectively, the distribution of students would be:

1. Unsatisfactory: 10%
2. Below Average: 40%
3. Satisfactory: 30%
4. Exemplary: 20%

All data for a given PI are averaged to yield a final "achievement metric" for each level. One example of this is shown in Figure 4.A.4, where Data 1 corresponds to the data described in the previous paragraph. Note that this method gives equal weight to each data point, regardless of the number of students in the class.

		Unsatisfactory	Below Average	Satisfactory	Exemplary	Total
Data 1	No of Students	2	8	6	4	20
	Percentage	10%	40%	30%	20%	100%
Data 2	No of Students	1	3	12	1	17
	Percentage	6%	18%	71%	6%	100%
Data 3	No of Students	4	2	8	4	18
	Percentage	22%	11%	44%	22%	100%
Achievement Metric		**13%**	**23%**	**48%**	**16%**	**100%**

Figure 4.A.4. Calculation of the percentage of students achieving each of the four levels for a given PI, using 3 data points.

Once this calculation is done for each of the PIs for a given outcome, all data is combined into a bar graph, as shown in Figure 4.A.5, where PI#1 corresponds to the example presented in Figure 4.A.4. In the bar graph, we have chosen to color code the four levels for ease of viewing (i.e. Unsatisfactory = red, Below Average = yellow, Satisfactory = white, and Exemplary = green). Note that a PI is considered to be successfully met if the combination of Exemplary and Satisfactory (i.e. green and white) comprise over 70% of the data. In other words,

the combination of red and yellow should not be above the "*acceptable threshold,"* denoted with a thick black line.

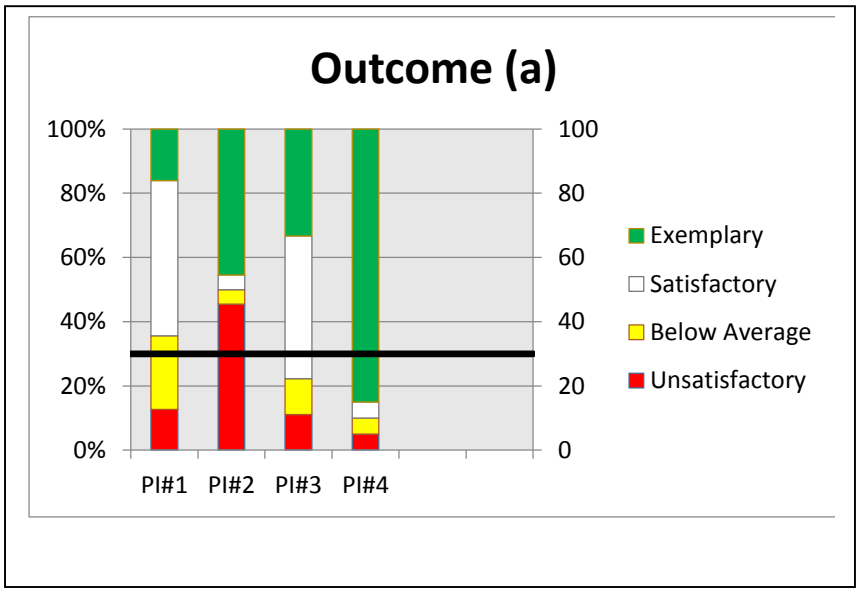

Figure 4.A.5. Bar graph displaying how the percentages achieved at each level for all PIs, for outcome (a). Note that four PIs were used in this example, where all PIs may have one or more data used for assessment.

The bar graph in Figure 4.A.4 does not correspond to real data. It was chosen to exemplify the process and to demonstrate various scenarios:

1. **PI#1** has *not* been met successfully. The combination of Unsatisfactory and Below Average is above the black line. As seen in Figure 4.A.4, the actual value is 13% + 23% = 36%.
2. **PI#2** was probably assessed incorrectly, as a large number of students placed either in Exemplary or in Unsatisfactory, with only a minor portion in the more common Satisfactory and Below Average levels. A number of possibilities could yield this, but more likely than not the faculty in charge of assessing this PI did not have a full understanding of the process.
3. **PI#3** was successfully met: the combination of green and white surpass the threshold line and no overwhelming skewing is seen in any extreme.
4. **PI#4** shows a situation that merits further investigation. Although it is possible that about 85% of the students did an Exemplary job in the given PI, we gain no insight about it from such data. Again, a number of possibilities could result in this, and it is the duty of the committee to determine whether further assessment needs to be done.

A matrix that shows all course's covering of each outcome is shown in Figure 4.A.6. As can be seen by careful inspection, not all courses are used to assess all outcomes. Shaded in green are shown the outcomes assessed by each one of the

courses. "x"s in white imply that an outcome *could* be assessed in the given class, but is not currently used.

			Criteria										
			a	b	c	d	e	f	g	h	i	j	k
Courses	EENG	160	x	x		x	x		x	x		x	x
	EENG	209	x	x			x		x				x
	EENG	210	x	x			x		x				x
	EENG	250	x	x	x	x	x		x				x
	EENG	260	x	x	x	x	x		x		x	x	x
	EENG	320	x				x		x				x
	EENG	321	x				x		x				x
	EENG	330	x	x	x		x		x			x	x
	EENG	331	x	x	x		x		x				x
	EENG	350	x	x	x	x	x		x			x	x
	EENG	360	x		x		x						x
	EENG	383	x	x		x	x		x			x	x
	EENG	388	x	x		x	x		x			x	x
	TECH	393						x	x	x	x	x	x
	EENG	401	x				x						x
	EENG	420	x				x						x
	EENG	430	x	x	x		x	x					x
	EENG	440	x				x						x
	EENG	450	x		x		x						x
	EENG	460	x		x		x						x
	EENG	470	x		x		x						x
	EENG	490	x	x	x	x	x	x	x	x	x	x	x

Figure 4.A.6. Matrix mapping which courses are used in the program to assess each of objectives *(a)-(k)*.

ii. *Data from focus groups*

The department chair meets with a group of students towards the end of the academic year (typically the second week in May, note that the academic year ends in mid-June) and gathers information on anything students may be willing to share with him or her. This conversation is typically open ended and no direct questions are posed, although the chair may choose to encourage the candid voicing of opinions by asking the group to comment on, say, the quality of the labs, or what classes they think the department should offer as electives, etc.

iii. *Data from exit survey*

All students taking the capstone course (EENG 490) take an exit survey that asks directly how well they think the program met the various outcomes. Most students take the capstone course during their last year in the program, although in some cases they may come back for one more quarter to finish general education electives or, occasionally, a technical elective.

A portion of the survey is shown below in Figure 4.A.7.

	Electrical Engineering Student Exit Survey	Exemplary	Satisfactory	Below Average	Unsatisfactory	Not Applicable
1	**Rate how well you think EWU prepared you to apply mathematics, science, engineering concepts, techniques and modern tools in the field of Electrical Engineering**					
	Overall					
	Rate your ability to apply knowledge of mathematics, science and engineering					
	Rate your ability to design and conduct experiments, as well as to analyze and interpret data					
	Rate your ability to design a system, component, or process to meet desired needs within realistic constraints					
	Rate your ability to identify, formulate, and solve engineering problems					
	Rate your ability to keep up with contemporary issues in the field					
	Rate your ability to use the techniques, skills, and modern engineering tools in Electrical Engineering					
2	**Rate how well you think EWU prepared you to develop social and leadership skills such as effective communication skills, team work skills and independent learning ability**					
	Overall					
	Rate your ability to function effectively in teams					
	Rate your ability to maintain an ethically rigorous record					
	Rate your ability to communicate effectively					
	Rate your ability to learn independently					
	Rate how well you think you understand the impact of professionalism, ethical responsibility, and social, economic, technical and global implications of their engineering contributions					
	Rate your recognition of the need to engage in lifelong learning					

Figure 4.A.7. A portion of the exit survey taken by all graduating seniors.

2. Frequency of Assessment Process

The process is separated into the following steps:

i. *Identifying data to be collected.*

Based on the PIs for each outcome, all EE faculty determine what will constitute "ABET Assignments" (please see Section 4.A.1.i, page 27) for description of ABET Assignment) for the academic year during the yearly planning meeting held in September before the beginning of the academic year. It is possible that many ABET Assignments will remain unchanged from one year to the next. Although the intent is to identify ABET Assignments as accurately as possible at the yearly planning meeting, it is possible that modifications are made during the course of the year. If this is the case, the faculty member making a change must update the rest of the faculty on the modification.

ii. *Collecting data*

Each faculty collects data from the ABET assignments that correspond to his/her courses. Note that we only maintain copies of student work from the last time a course is offered.

iii. *Preparing data for evaluation*

Data is prepared for evaluation in a quarterly "ABET Meeting" that is merely held to enter all data into the spreadsheet that will generate the bar graph shown in Figure 4.A.5 (page 32).

iv. *Evaluating data*

Data is evaluated once a year in the yearly planning meeting, done before the beginning of the academic year. At this point, the following information will be available to the faculty:

a. Bar-graphs for all outcomes, as well as detailed information about the data used to generate the graphs.
b. Summary of the focus group done by the Chair.
c. Summary of the exit survey data.

The frequency of data collection for each one of the instruments is described next.

i. Data from student work

During the 6-year accreditation cycle, data for outcomes *(a)-(k)* is collected in the order shown in Table 4.A.1.

Student Outcome	Yr1	Yr2	Yr3	Yr4	Yr5	Yr6
a	C			C		
b		C			C	
c			C			C
d	C			C		
e		C			C	
f			C			C
g	C			C		
h		C			C	
i			C			C
j	C			C		
k		C			C	

Table 4.A.1. Schedule for data collection of data from student work.

Any outcome will be reassessed after a cause for significant concern is identified during the evaluation process. Once the concern has been eliminated, the outcome returns to be assessed at its original schedule.

ii. Data from focus groups

A focus group is carried out yearly every Spring quarter.

iii. Data from exit survey

The survey is done yearly during the Spring quarter.

3. Expected level of Attainment of Each Outcome

In the data obtained from student work, it is expected for all outcomes to reach a 70% in the combination of Exemplary and Satisfactory student work. It is possible, however, that an outcome must be reevaluated earlier regardless of student assessment meeting the 70% mark. This could occur, for example, if both the exit survey and the focus group points out glaring deficiencies in one of the outcomes.

On the other hand, if the 70% mark has not been met, but the other instruments overwhelmingly demonstrate the opposite, immediate reassessment may be postponed.

In describing our assessment process, it is my intent to emphasize that we take assessment seriously, it is not something that is done either lightly or simply to satisfy our accreditation agency: we do it to continuously improve our program.

I know that there are four literacies that the University would like to assess (briefly: reading, writing, public speaking and quantitative analysis). I would like to propose that instead of having to do the "every course, every section" assessment that has been proposed, for engineering to be able to use our current assessment methodology. For example, one way to address, say, quantitative analysis would be to provide to the EWU Assessment team the "grade" for the outcome that matches such literacy, e.g. "**Outcome (*a*)**: An ability to apply knowledge of mathematics, science and engineering."

Continuing, we could use the data we currently already use for assessing "**Outcome (g)**: An ability to communicate effectively" to come up with "grades" for writing and public speaking literacies (it wouldn't be as direct as for **Outcome (a)**, as we would have to be more granular with the data to separate the writing from the public speaking portion).

I have to admit I am at a loss on how to map any of our outcomes to the reading literacy. However, since we only have to choose one of the 4 literacies to assess this year, "reading" wouldn't be pose a problem for us this year.

Do you think this could be acceptable? Note that while we do not use every course and every section, we are strategic in choosing data and applying our rubrics. For example, the full rubric for **Outcome (a)** looks as follows:

Performance Indicator	Unsatisfactory-1	Below Average-2	Satisfactory-3	Exemplary-4
Student must be able to apply math to solve problems in Electromagnetics.	The student had no idea where to start	The student knew where to start but could not finish the problem	The student was able to setup the problem and solve it correctly.	The student was able to setup the problem and solve it correctly showing thorough understanding of the concept..
Student must be able to apply math to solve problems in signals and systems.	Student did not know the difference between time domain and frequency domain.	The student knew where to start but could not finish the problem	The student was able to setup the problem and solve it correctly.	The student was able to setup the problem and solve it correctly showing thorough

Performance Indicator	Unsatisfactory-1	Below Average-2	Satisfactory-3	Exemplary-4
				understanding of the concept..
Student must be able to solve simple circuits using KVL's and KCLS	Student did not know what a KVL and/or KCL is.	Student was able to apply a KVL/KCL but could not solve for the function of interest.	Student was able to solve a simple circuit using KVL/KCL.	Student was able tom use both KVL and KCL to solve for the function of interest for a complicated circuit.
Student must be able to simplify a Boolean algebraic expression to its simplest form	Student was not able to simplify a Boolean expression to its simplest form.	Student was able to perform some Boolean operations but did not get it in the simplest form.	Student was able to reduce the expression into its simplest form.	Student was able to simplify the expression using both graphical techniques and Boolean algebra.

That is, it has 4 PIs, each PI has multiple pieces of data (which I am not attaching for brevity).

Please let me know if my request is accepted or denied.

I also have to clarify that this only applies to our Engineering programs. Technology and Visual Communication Design are currently not accredited and would probably need to follow your assessment process. Thus, I would like to request to be sent, in written form, a step-by-step set of instructions describing exactly what we should be doing to be in compliance with the university-wide assessment program currently under way. It would be useful if an electronic tool to input data is also made available. a

Thank you very much for your time and consideration. If there is something that does not make sense in this text, please feel free to ask me any questions.

Best regards,

Esteban