2021-2022 Annual Assessment Report for the Bachelor of Science in Engineering

Name of program: B.S. in Engineering
Type of program: Major
College of Arts and Sciences

I. Logistics

1. Contact information

Feedback should be sent to the Chair of the department, Prof. Hana Mori (hana.mori@usfca.edu).

2. Type of program

This is a report for the BS in Engineering major. This program has just started housing an Environmental Engineering minor, starting Fall 2022, for which we do not have any assessment data yet. We will report on this minor program starting next AY.

Affiliated minors not discussed here:

- Engineering Physics minor, housed under the department of Physics & Astronomy
- Architectural Engineering minor, housed under the department of Art + Architecture
- Environmental Engineering minor, housed under the department of Engineering. We will report on this minor starting next year.

3. Curriculum

The engineering program has three concentrations: Environmental engineering (ENVE), Sustainable Civil engineering (SCE), and Electrical & Computer engineering (ECE).

Curriculum Map

Tables 1-3 show the curricular maps for the three concentrations. The maps describe the level at which each ENGR course addresses each of the seven learning outcomes in each of the concentrations. The curricular maps for the three concentrations were approved at a department meeting on November 2, 2021.

Legend for Tables 1-2

●	introducing
O	developing
M	mastery

Table 1. Curriculum map for engineering major - all concentrations

Credits	**Course**	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7
0	ENGR 010: Engineering Fabrication Lab							●
2	ENGR 100: Becoming an Engineer			●	●	●		●
4	MATH 109: Calculus I	●						●
4	PHYS 150: Gen Physics I for Engineers	●		●			●	●
4	MATH 110: Calculus II	●						
4	ENGR 102: Intro to Programming for Engineers	●	●	●				●
4	PHYS 151: Gen Physics II for Engineers	●					●	●
4	ENGR 110: Engineering Project and Design I	O	O	O	●	O		
4	CHEM 150: Gen Chemistry I for Engineers	●		●			●	
4	ENGR 234: Sensors through History	●	O	O			●	
4	ENGR 210: Engineering Project and Design II	O	O	O	O	O	O	O
4	MATH 211: Multivariable Calc	O		O		O		O
4	MATH 360: Probability & Statistics			O			O	O
4	ENGR 202: Modeling Sustainable Systems	O	O		O			O
4	ENGR 310: Engineering Project and Design III	O	O	O	O	O	O	O
4	PHYS 371/ENGR 3XX: Math Methods/Applied Linear Algebra	O		O				O
4	ENGR 302: Scientific Computing	O	O	O		O		O
4	ENGR 410: capstone part I		M	M	M	M	M	M
4	ENGR 411: capstone part II		M		M	M	M	M

Table 2: Curriculum map for engineering major years 3-4 for three concentrations

Credits	**Course**	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7
For the Environmental Engineering concentration:								
4	CHEM 151: Gen Chem II for engineers	O		•		•	O	
4	ENVS 380: Environmental Engineering	O	•	•		•	•	
4	ENGR 3XX: Fate and Transport	O	O	O	O	O		O
4	ENGR 3XX: Water and Wastewater Treatment	M	O	O	O	M	O	M
For the Sustainable Civil Engineering concentration:								
4	ENGR 242: Intro to Structural Engineering	O	O	O		O		O
4	ENGR 244: Intro to Construction Materials			O	O	O	O	O
4	ENGR 346: Experimental Methods & Design	M	M	M	M	M	M	M
4	ENGR 34X: Sustainable Urban Systems	M		M	M	M		M
For the Electrical & Computer Engineering concentration:								
4	ENGR 262: Intro to Digital Electronics	O	O	O	•	O	O	O
4	ENGR 264: Electronics	O	O	O	•	O	O	O
4	ENGR 36X: Signals and Systems	O		O	•	O	O	O
4	ENGR 36X: Feedback Controls	M		O	O	O	M	O

PLOs to ILOs mapping

Table 3 describes when and how each program learning outcomes (PLOs) for the B.S. in ENGR degree maps onto the Institutional Learning Outcomes (ILOs) for the University of San Francisco.

Table 3: Mapping of ENGR PLOs to USF ILOs

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
ILO1				x			
ILO2	x					x	
ILO3		x					
ILO4			x		x		
ILO5	x	x				x	
ILO6	x	x				x	x
ILO7				x			

Institutional Learning Outcomes (ILOs) for the University of San Francisco

1. Students reflect on and analyze their attitudes, beliefs, values and assumptions about diverse communities and cultures and contribute to the common good (Critical Thinking)
2. Students explain and apply disciplinary concepts, practices and ethics of their chosen academic discipline in diverse communities (Critical Thinking)
3. Students construct, interpret, analyze and evaluate information and ideas derived from a multitude of sources (Critical thinking; quantitative reasoning; information literacy)
4. Students communicate effectively in written and oral forms to interact with their personal and professional communities (Written and oral communication)
5. Students use technology to access and communicate information in their personal and professional lives (component of information literacy)
6. Students use multiple methods of inquiry and research processes to answer questions and solve problems (Critical thinking; quantitative reasoning; information literacy)
7. Students describe, analyze, and evaluate global interconnectedness in social, economic, environmental and political systems that shape diverse groups within the San Francisco Bay Area and the world (Critical Thinking)

II. Mission statement and Program Learning Outcomes

1. Changes in mission statement since last assessment cycle

No changes since the last assessment cycle.

Mission Statement

USF Engineering's mission is to educate the whole person in the Ignatian tradition of transforming the world and ourselves. Through an innovative, inclusive, and applied education focusing on design, creation, and resourcefulness, it provides students the skills and perspective they need to succeed as professionals and the self-confidence, sensitivity, empathy, and cultural competency necessary to be ethical and responsible engineers empowered to effect meaningful change. It is distinguished by its high quality community- engaged scholarship, teaching, and research, and its interdisciplinary programming relevant to real projects locally, regionally, and internationally.

2. Changes in program learning outcomes since last assessment cycle

No changes to PLOs since the last assessment cycle. We have completed creating appropriate performance indicators for each PLO.

Program Educational Objectives

USF Engineering succeeds in its mission by graduating students who meet our four educational objectives to:

1. Demonstrate fluency with design thinking, systems thinking, creative problem solving, and self-directed scholarship as modes of approaching the engineering process.

2. Implement a holistic approach to engineering which values context, integrates multiple perspectives through collaborative teamwork, questions need, and considers impacts on both individuals and society at large.
3. Lead responsibly through a fusion of engineering judgment, practice, and entrepreneurship, while representing the engineer's critical role in projects,organizations, the environment, and society.
4. Exhibit a professional and personal identity which upholds values of social justice, environmental sustainability, and respectful service even under unknown and challenging conditions.

Program Learning Outcomes ("Student Outcomes")

Our degree program will be meeting the requirements for professional accreditation by ABET, the agency which oversees accreditation of engineering programs. ABET requires a two-part statement of outcomes – in addition to the *Program Educational Objectives* stated above as part of the Mission, we will meet the following *Student Outcomes*.

Students will achieve an ability to:

- PLO1: Identify, formulate and solve complex engineering problems by applying principles of engineering, science and mathematics
- PLO2: Apply engineering design to produce solutions that meet specified needs with consideration of public health, safety and welfare, as well as global, cultural, social, environmental and economic factors
- PLO3: Communicate effectively with a range of audiences
- PLO4: Recognize ethical and professional responsibilities in engineering situations and make informed judgements, which must consider the impact of engineering solutions in global, economic, environmental and societal contexts
- PLO5: Function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks and meet objectives
- PLO6: Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
- PLO7: Acquire and apply new knowledge as needed, using appropriate learning strategies.

These program learning outcomes are prescriptively required by ABET, and were approved by the department in a general meeting of the curriculum committee in the Fall of 2018.

Program Learning Outcomes assessed in 2020/2021

In 2019-2020 we assessed PLO1 and PLO3. The learning outcomes were chosen based on the outcomes assessed in first year courses. Between PLO3, PLO5, and PLO7, we chose PLO3 as a priority to establish a baseline that we could compare to the next year.

1. PLO1: Identify, formulate and solve complex engineering problems by applying principles of engineering, science and mathematics
2. PLO3: Communicate effectively with a range of audiences

Program Learning Outcomes assessed in 2021/2022

In the second year, we are assessing PLO2 and PLO6 for the first time based on the course offerings. In addition, we are assessing PLO1 and PLO3 again to be able to compare to the first year results and to continue improving the methodology based on feedback from the first assessment cycle.

1. PLO1: Identify, formulate and solve complex engineering problems by applying principles of engineering, science and mathematics
2. PLO3: Communicate effectively with a range of audiences
3. PLO2: Apply engineering design to produce solutions that meet specified needs with consideration of public health, safety and welfare, as well as global, cultural, social, environmental and economic factors
4. PLO6: Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

Table 4 shows the mapping of the assessed PLOs to courses taught during the academic year 2020-2021 and the PLOs that we plan to assess in 2021/2022.

Table 4: Courses used for PLOs assessed in AY2021/2022

	Fall 2021	Spring 2022
PLO1: Solving	PHYS150, ENGR202, CHEM150	PHYS151, CHEM151, ENGR242, ENGR102
PLO2: Design	ENGR234	ENGR110, ENGR210, ENGR242
PLO3: Communication	PHYS150L, ENGR202	ENGR110
PLO6: Experimentation	CHEM150L, ENGR234, PHYS150L	PHYS151L, CHEM151L

III. Methodology for assessment

Overview and Rationale

As per last year's assessment report, we have decided to perform the assessment of our seven PLOs, using performance indicators. Performance indicators are specific measurable endpoints for each PLO, and provide a common agreement as to what specific performances should be expected from students for each of the outcomes, which allows temporal comparisons and program-level assessment. Performance indicators for PLO1 and PLO3 were created in AY2020/2021. During academic year 2021/2022, one of our major tasks was to develop performance indicators for all PLOs.

Process for developing performance indicators:
Performance indicators were drafted by faculty in the assessment committee who will be collecting data on the corresponding PLO. Draft indicators were then shared with all faculty for feedback. Feedback was incorporated and performance indicators were revised. This process was completed for all performance indicators as of September 2022. It was decided that we will collect data with current performance indicators, and indicators will be revised over time based on faculty feedback at the end of every semester.

Criteria and Rubrics for assessment

Criteria

The specific criteria used to assess each PLO correspond to the performance indicators that were developed. Below is a list of all performance indicators for all PLOs as is at this time. These indicators are not final and will be piloted as we continue to collect data.

Outcome 1: an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

1. Explain key science or engineering concepts that inform the solution to a problem.
2. Identify key variables (knowns and unknowns) and how they relate to each other with a flow diagram, equation or map of steps needed to solve an engineering problem.
3. Execute calculations with unit and dimensional consistency.
4. Quantitatively solve multi-step engineering problems by integrating knowledge.
5. Assess the appropriateness of an approach or solution (includes choice of method, validity of assumptions etc).
6. Design a system or experiment to address an engineering problem.

Outcome 2: An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors

1. Gather information, qualitative or quantitative, to understand context of design
2. Analyze context to specify needs
3. Demonstrate knowledge of the design process: Collect information, prototype, iterate
4. Propose a plan that integrates societal and environmental justice factors
5. Create a product in which social justice factors are embedded within the design solution

Outcome 3: an ability to communicate effectively with a range of audiences

1. Representing data and information succinctly using principles of visual design and clear organization.
2. Empathizing with an audience/user group to understand what they find important.
3. Preparing material to deliver content with confidence.
4. Active listening to engage in critical dialog and discourse.
5. Synthesizing content with tools of rhetoric to communicate a point.

Outcome 4: An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

1. Demonstrate knowledge of a professional code of ethics
2. Apply professional code of ethics to a real-life engineering problem.
3. Demonstrate knowledge of health and safety in engineering practice
4. Explain the ways in which the engineering profession and work products can impact society and the environment.
5. Contribution to the engineering profession/community and the engineering body of knowledge
6. Use proper citations to properly acknowledge other people's work - broaden to any kind of work not just lit review

Outcome 5: An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives

1. Collaboratively identify people's strengths and assign roles on the team
2. Establish goals and timelines for task completion
3. Adjust as needed to successfully meet objectives
4. Provide constructive feedback to group members
5. Receive constructive feedback and adjust approach

Outcome 6: an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

1. Conduct an experiment according to a given procedure
2. Compare experimental results to hypothesis or appropriate theoretical models
3. Evaluate results in the context of the technique used to collect or model the data
4. Interpret the modeled or experimental data to draw conclusions/explain results/reject hypothesis/ in the context of differences between measured and predicted values
5. Design an experiment specifying appropriate (dependent and independent) variables and tools for data collection.

Outcome 7: An ability to acquire and apply new knowledge as needed, using appropriate learning strategies

1. Identify knowledge gaps for a project
2. Attempt solving problems even with incomplete/uncertain information by making appropriate assumptions
3. Continuously learn from failure in order to iterate
4. Acquire new knowledge to address knowledge gaps or inform project design (includes research, collection of data, methods etc.)
5. Apply new knowledge and/or appropriate methods or tools to a project
6. Use software and/or instrumentation independently for solving engineering problems.
7. Ability to learn independently from reliable sources of information

Rubrics

Rubrics for all courses in our curriculum are evaluated on a scale from 1 - 4.

1. Student work is below expectations, at an introductory level.
2. Student work is developing towards meeting expectations, but does not meet expectations yet.
3. Student work meets expectations
4. Student work exceeds expectations.

Since each faculty member evaluated different work products, we were interested to see how faculty perceive these categories for each indicator. We expect that there is consistency in what each level means, given the significant specificity of the performance indicators. Rubrics were collected for each course that collected data. There were generally three categories of rubrics:

A. Rubric set according to what grade a student received on a particular question. This was possible for questions that were intentionally designed to meet a particular indicator. In such cases, the grade that the student received in the question reflects which category from 1-4 their work product belongs into.

B. Rubric set according to the frequency with which a student successfully completed a task. As an example: A student was asked to solve 4 simple problems with unit and dimensional consistency. They received a 1 if they only solved 1 correctly, 2 if they solved 2 correctly, 3 if they solved 3 correctly and 4 if they solved all 4 correctly. This approach is chosen for tasks where consistency in performing the task correctly is of importance.

C. Rubric set according to qualitative criteria set by faculty. In many instances, faculty chose to create rubrics specifically for assessment, depending on which specific parts of the task students performed successfully. One example is shown below.

Table 5: Example of rubric used to assess PHYS151 assignment

Outcome 1: an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics			
Indicator 5: Assess the appropriateness of an approach or solution (includes choice of method, validity of assumptions etc)			
Assignment: Thermometer Lab - students discussed the appropriateness of a method discussed in the class			
exceeds expectations (4 pts)	meets expectations (3 pts)	developing (2 pts)	introductory level (1 pt)
* well-supported conclusion presented * all relevant criteria presented for critiquing appropriateness	* adequate conclusion presented * most key criteria identified for critiquing appropriateness	* gaps in the conclusion presented * able to identify some criteria for critiquing appropriateness	* major gaps in the conclusion presented or no clear conclusion presented * missing many criteria for critiquing appropriateness

Data collection process

In short, data were collected via direct communication with faculty who taught courses that pertained to the chosen PLOs. Faculty self selected the appropriate indicators, and provided the data via email.

Modification to process compared to last year: When we first rolled out our assessment process, our plan was to use Canvas for automatic collection of data. While Canvas provides a seamless platform to collect assessment data for work products under the category “Assignments”, it does not do the same for work products for Test or “Quizzes”. Faculty tend to complete their grading of tests, a common work product for assessment, outside of Canvas, and input their grades in Excel spreadsheets. Canvas also presents difficulties in assessing group assignments. For these reasons, we allowed faculty the flexibility to submit assessment data in the format that was most appropriate to them, and most did via Excel. In the future, we will provide an Excel template that can be then used by the assessment committee to automate the data analysis process.

The detailed process for collecting data is outlined below, and has been slightly modified since last year (as per the above comments):

The following steps outline the process followed for identification of courses to be assessed, data collection and reporting.

At student registration time (two months in advance of the beginning of each semester):

1. The assessment committee requests for each course to identify the PLOs and the indicators that each instructor will be assessing in their course the upcoming year. Based on this, PLOs to be assessed for the upcoming year will be decided.

During the semester:

2. The instructor creates a work product to assess the chosen performance indicators. The instructor may need to adapt the rubric to make it more specific to their work product.
3. At the time of grading of the work product, the instructor assesses the work product for each student directly on Canvas on the following scale, Does not meet expectations (1) , Developing (2), Meets expectations (3), Exceed expectations (4) according to the rubric the instructor developed.
4. The instructor will submit the following to the assessment team:
    - A description of which part of the work products was assessed (e.g., question 1 of part 2 of work product 1)
    - A reflection on the experience + feedback for next year
    - We decided that we will not be collecting the student work products, as per the feedback received in our assessment report last year that advised us to simplify our process.

   We expect the instructor will spend about 2-3 hours for preparation (steps 2-3) and another 2-3 hours on assessment of their work products while grading (step 4).

At the end of the semester:

5. The assessment team contacts the faculty to collect the data and creates a summary presentation including the following:
    - Complete quantitative analysis of the data
    - Assemble and summarize any relevant qualitative data
6. Assessment committee submits annual assessment report (this document)

At the beginning of the upcoming semester:

7. Two department meetings (one per semester) are devoted to the discussion of the assessment report, and the collection of feedback for upcoming rounds of assessment.
8. Modifications are proposed for improvement of the process and/or rubrics.

Data analysis process

Data from all classes for all PLO and indicators were collated in a single table with the following attributes:

Student ID
Student Major
PLOX-Y (where X is the PLO number and Y is the performance indicator number)
….
… (one column per PLO/Indicator pair assessed)
….
Instructor
Term
Course code

This structure will allow automated processing of the data in upcoming semesters either in Excel or via R/Python scripts.

Once the data were collected, frequency statistics were automatically generated in order to produce the graphs illustrated in the following section. The assessment committee will maintain this database over time to allow for analysis as needed, both for internal analysis and for generation of evidence for ABET accreditation documents.

IV. Results and major findings

In AY2021/2022 we collected data from eleven classes. The resulting findings included: 1. improvements in teaching and learning practices, and 2. Reflections on the assessment methodologies. These results were shared individually with the faculty members teaching the course, to gather any insights, and then presented at faculty department meetings in April and December. Findings are summarized below.

1. Results from Classes

Overall, we collected data from 11 classes, resulting in 270 data points across all indicators and all PLOs. Most of our data have been in areas covered by multiple courses, most notably PLO1: Solving engineering problems, PLO3: communication through visuals and PLO6: Conducting experiments (Figure 1):

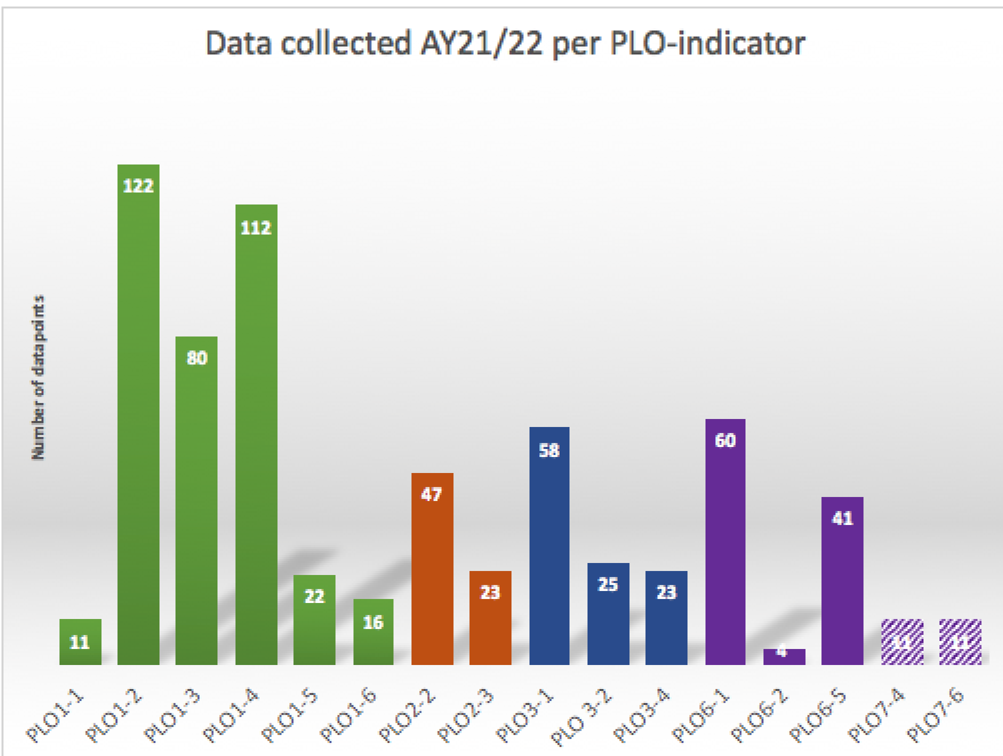


Figure 1: Number of datapoints per PLO-indicator collected during academic year 2021/2022. Bars are color coded by PLO. Green: PLO1 problem solving, Orange PLO2 Design, Blue PLO3 Communication, Purple: PLO6 Experimentation. PLO7 was assessed only for one course and results are tentative.

PLO1

PLO1 assesses the students ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics. PLO1 is assessed through a total of six indicators. This academic year, PLO1 was assessed in seven classes during the Fall and Spring semesters. All indicators were assessed, since both lower divisions and upper division courses were used for data collection.

Indicators assessed, in increasing complexity from 1 to 6:

- Indicator 1: Explain key science or engineering concepts that inform the solution to a problem.
- Indicator 2: Identify key variables (knowns and unknowns) and how they relate to each other with a flow diagram, equation or map of steps needed to solve an engineering problem.
- Indicator 3: Execute calculations with unit and dimensional consistency.
- Indicator 4: Quantitatively solve multi-step engineering problems by integrating knowledge.
- Indicator 5: Assess the appropriateness of an approach or solution (includes choice of method, validity of assumptions etc).
- Indicator 6: Design a system or experiment to address an engineering problem.

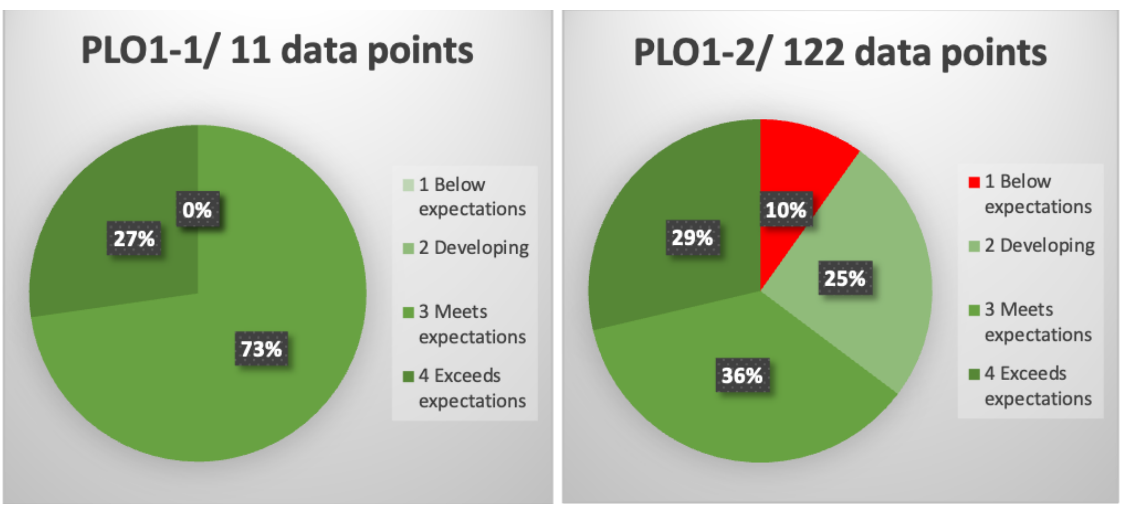


Figure 2: Results for PLO1 indicators 1 and 2. Results shown as % of students.

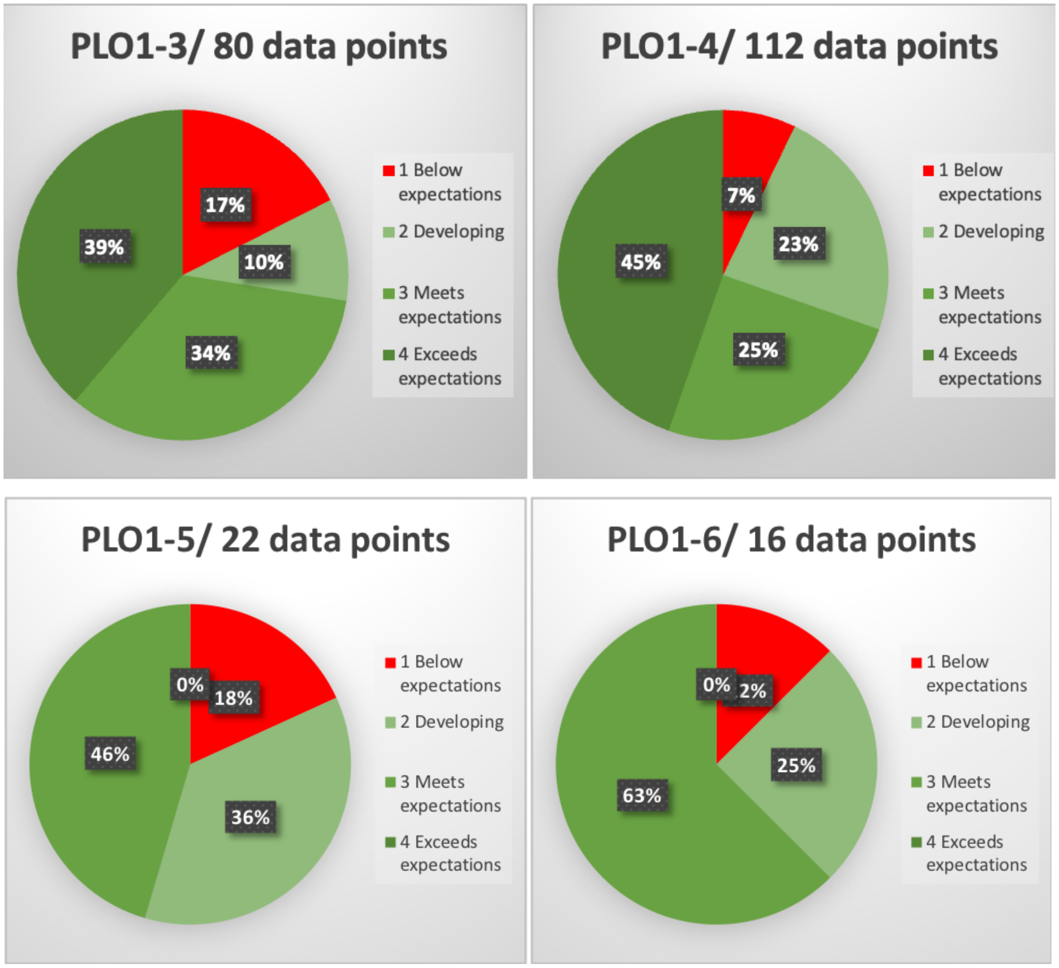


Figure 3: Results for PLO1 indicators 3-6. Results shown as % of students.

Indicators under PLO1 are presented in increasing complexity with indicator 1 being lower in the cognitive and analytical effort required and with indicator 6 being the most complex. Students are not expected to show mastery for indicators 4-6 until they progress through a significant portion of the curriculum, after having gotten exposure to advanced topics and after having repeatedly practiced the process of problem solving from simple to complex scenarios.

These expectations are reflected in our results, with an increasing proportion of students not performing well (below expectations). There are two main findings:

a. Unit and dimensional consistency is a point where students struggle significantly. We attribute that to the fact that unit and dimensional consistency requires that students have an understanding of both the concepts and the mathematics they are performing. This data is collected mostly from introductory courses like physics and chemistry, where students are just starting to get practice with problem solving in the context of physical systems, which requires units and dimensional consistency. At this stage of their academics, students are still grappling with mathematical skills, and they are just starting to develop their ability to layer the context on top of the mathematics.

b. Indicators 5 and 6 showed that a significant proportion of students does not meet expectations (12 and 18% respectively). This is expected as these indicators are only expected to be mastered after repeated exposure to complex problem solving.

c. A minimum of 30% of our students exceed expectations in indicators 2, 3, and 4, which is exceedingly rewarding for us as faculty. These are the indicators that are expected to be satisfactorily met by the students in their first two years of study

d. We did not collect enough data for indicator 1 to establish a solid baseline in terms of the students' ability to explain basic concepts in engineering. Most students are expected to be meeting expectations for this indicator, however, identifying students who do not meet this indicator will allow creating support structures necessary for incoming students who are not adequately prepared for a rigorous engineering curriculum.

Data for PLO1 were collected the year prior, which allows us to study the longitudinal progress of our students for PLO1. Last assessment cycle we did not use performance indicators, but we can roughly correlate the criteria used to our current indicators. The graphs below show the progression over the last two years for PLO1, indicators 2, 3 and 4.

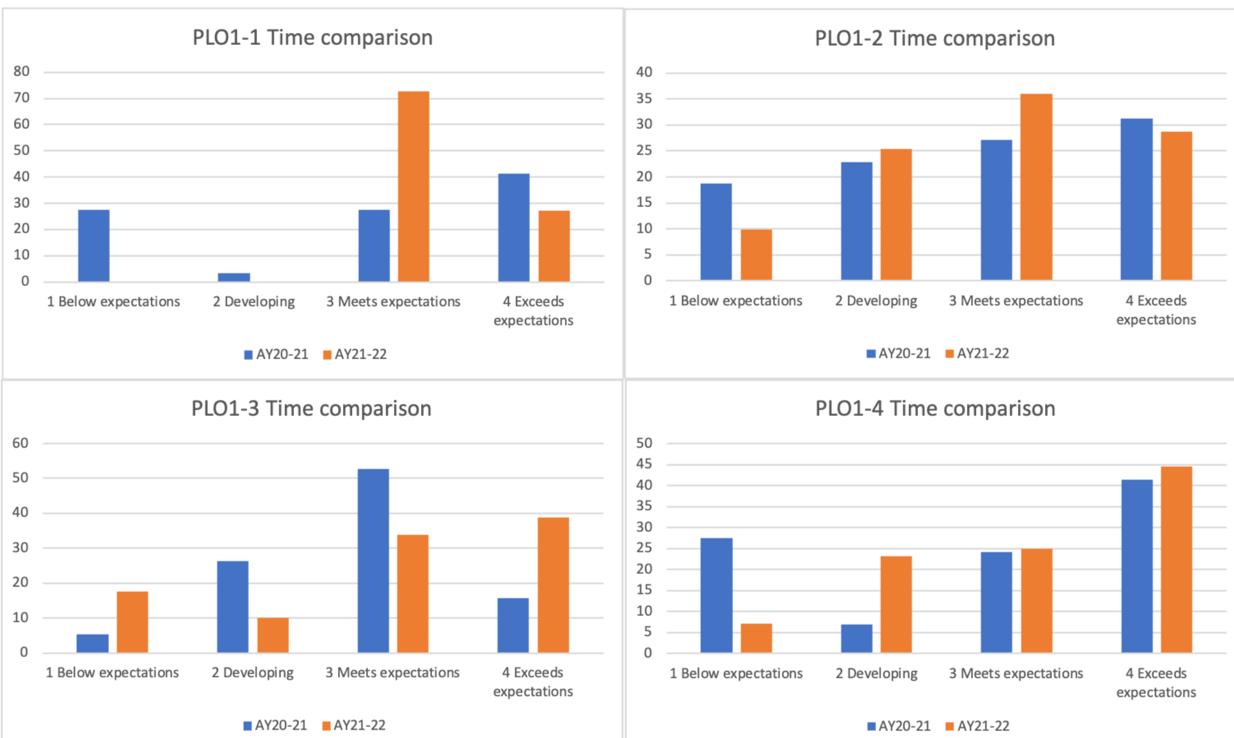
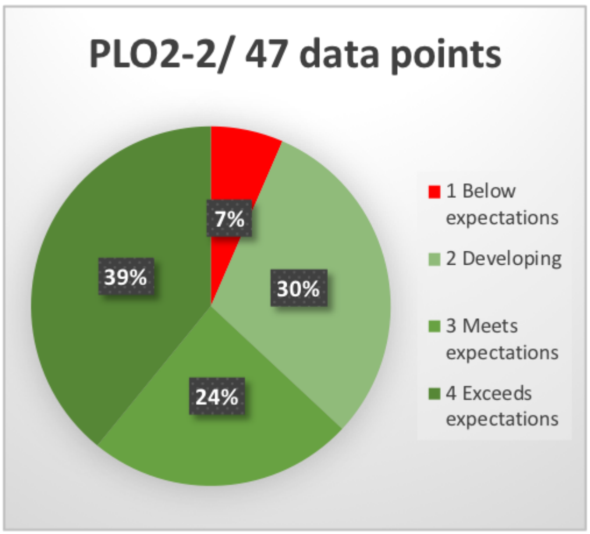


Figure 4 : Results for PLO1 indicators 1-4. Results shown as % of students. Comparison between AY20/21 and AY21/22 for the first four indicators of PLO1.

PLO2

PLO2 assesses the students' ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors. This PLO was assessed in four classes. Indicators 2 and 3 were assessed.

- Indicator 2: Analyze context to specify needs
- Indicator 3: Demonstrate knowledge of the design process: Collect information, prototype, iterate



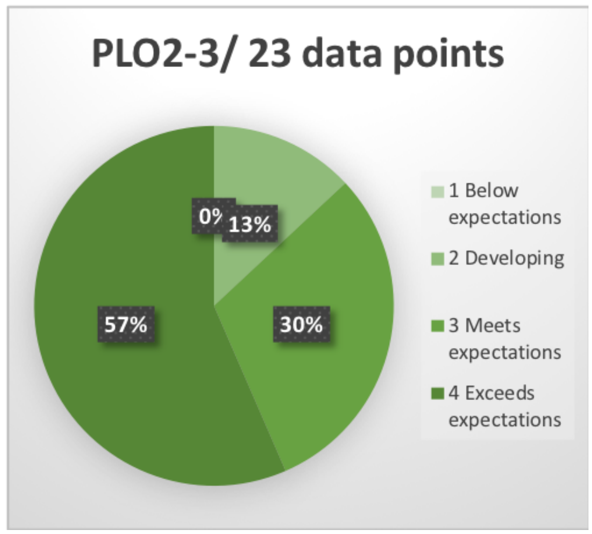


Figure 5: Results for PLO2 indicators 2 and 3. Results shown as % of students.

As with PLO1, indicators for PLO2 were designed to represent increasing complexity in the design process. The evaluation of PLO2 and the students' development in the design area is primarily assessed in the project Arch, and in courses that involve a significant project component, where students design their own prototypes/processes/ideas, with varying levels of guidance and complexity depending on the place of the course in the curriculum.

The results show that students struggle more with indicator 2, where they need to analyze the context of a design project in order to specify the needs that need to be met by the final design. Not only do more students perform below expectations in indicator 2, but also fewer students exceed expectations. A consistent 25-30% of the students meet expectations, which is in line with our findings for PLO1, although slightly reduced. We will continue our efforts to evaluate student learning in PLO2 and provide students with more opportunities to practice their design thinking skills .

PLO3

PLO3 assesses the students' ability to communicate effectively with a range of audiences. This PLO was assessed in three classes, using indicators 1, 2 and 4:

- Indicator 1: Representing data and information succinctly using principles of visual design and clear organization.
- Indicator 2: Empathizing with an audience/user group to understand what they find important.
- Indicator 4: Active listening to engage in critical dialog and discourse.

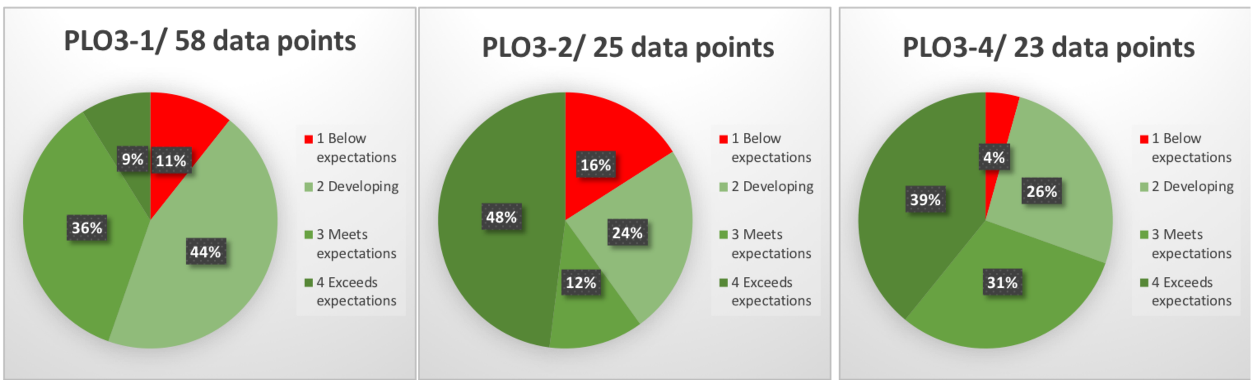


Figure 6: Results for PLO3 indicators 1,2 and 4. Results shown as % of students.

PLO3 was assessed using three indicators that are not in a particular order of complexity; rather they fall into two categories: presenting with visuals and listening/engaging with the audience in an empathetic manner.

Presenting using visuals: More than 40% of the students perform above or at the expected level. A little more than half of the students are not meeting expectations. More opportunities for presentations using visuals will allow students to improve in this area. Note that these results were obtained only from 3 classes, all at the introductory level. Data from future years will allow us to assess how students develop over time in their presentation skills.

Empathetic engagement in dialogue: While these two indicators were only assessed for 25 and 23 students respectively, the results provide some interesting insights: The distribution for indicator 2 (empathizing with audience) is showing that almost 50% of the students exceed expectations, while 40% of the students are below expectations. This presents challenges on how to bring students to the same level over time. More data will help assess how to proceed. In contrast, most students (~70%) meet or exceed expectations when it comes to active listening to engage in critical dialogue.

PLO6

PLO6 assesses the students' ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions. This PLO was assessed in five classes, using indicators 1, 2 and 5:

- Indicator 1: Conduct an experiment according to a given procedure
- Indicator 2: Compare experimental results to hypothesis or appropriate theoretical models
- Indicator 5: Design an experiment specifying appropriate (dependent and independent) variables and tools for data collection.

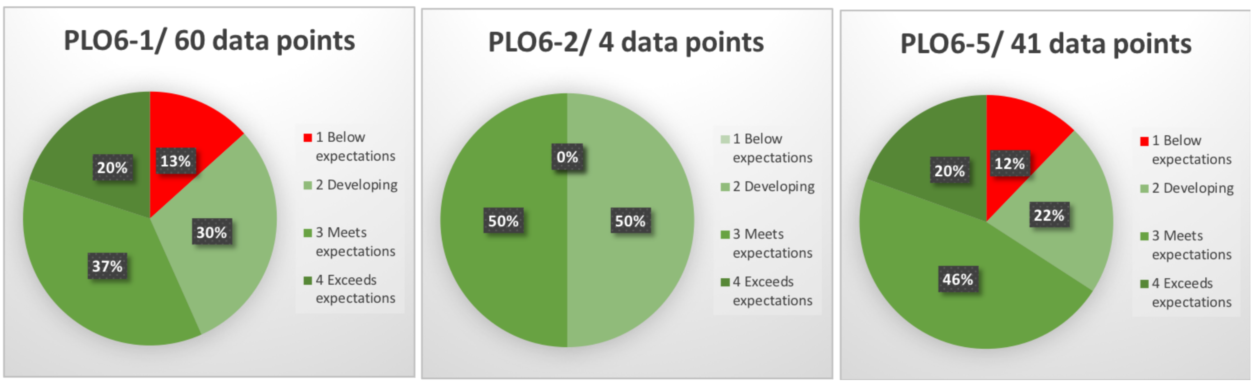


Figure 7: Results for PLO6 indicators 1, 2 and 5. Results shown as % of students.

PLO6 has been developed similar to PLO1, in that the indicators increase in complexity from 1 to 5. Indicator 1 is meant to be mastered in the first year of studies, while indicator 5 is not to be mastered until the end of the curriculum. Students get experience in all aspects involved in indicator 5 throughout all years but repeated exposure is necessary to master such complex experimental development skills. PLO6 was assessed in introductory courses in physics and chemistry, where students develop their experimentation skills for the first time.

Based on the results, we conclude the following:

- Even though indicator 1 was expected to be sufficiently easy for most students to perform satisfactorily, 43% of the students do not meet expectations. More than 50% of students met or exceeded expectations. This indicates that a significant proportion of our students has not had exposure to conducting experiments prior to college, and more effort should be placed into bringing them up to speed with the rest of their cohort.
- There is insufficient data to assess PLO6 Indicator 2. More data will be collected next year.

- Despite being the most challenging, a significant proportion of our students (66%) met or exceeded expectations when asked to design an experiment. There are two things to note regarding this result: this dataset was collected in introductory courses where students receive significant guidance as they are designing their experiments, and where there is not a lot of room for error. In some experiments, both the variables and the tools are provided, and students simply have to execute. We need to reassess appropriate work products to adequately represent the students ability and progression through the curriculum in designing experiments following all steps of experimental design, as appropriate for each course. Another note is that this data includes Environmental Science majors, who do get significantly more exposure to experimentation and lab procedures.

2. Results from instructor feedback

This year we focused on collecting feedback on the performance indicators developed for all PLOs. Faculty mentioned in conversations that the data collection process via Excel/Email was straightforward. We did not implement Canvas-based collection of data this year (see methods).

3. Reflections on the Assessment Methodology

As members of the assessment committee, we continued to learn how to better implement the assessment process through this year. Below is a summary of what worked well throughout the assessment process:

- One on one discussions- This was a faculty driven process. We connected through zoom to chat about our process with faculty providing data. Starting the conversation early with faculty members allowed for adjustments clarifying the expectations in terms of rubric and assignments.
- The assessment committee helped with intentional assignment creation that supported the assessment process by holding individual meetings with faculty early in the semester to brainstorm and provide feedback on assignments.
- Integrating with Canvas proved to be not inclusive as the platform only allows assessing learning outcomes for assignments, while many faculty use tests to collect assessment data.

Elements of the assessment process we will be changing and improving:

- Clarify and emphasize the purpose of the committee in department meetings and in one on one discussion. Our goals are to:

   a. Create culture of continuous improvement
   b. Ensure that we are meeting accreditation criteria
- Devise more efficient method in collecting feedback from instructors.
- Devise more efficient method in collecting and comparing rubrics.
- Update performance indicators based on faculty input

V. Closing the loop

As the engineering program is working towards applying for ABET accreditation next year, we are actively in the process of refining the assessment process and collecting as much data as possible that will help us make the case for accreditation of our program during our ABET visit. In the subsections following we outline how we integrated feedback from the FDCD, findings from our strategic plan, and our 2021/22 goals.

Progress check

As per last year's assessment report, our three objectives (listed below) have been achieved

1. Continuous improvement: we improved our assessment process, our assessment criteria and our data collection mechanisms
2. Completion of performance indicators for all PLOs: we completed the development of the first draft of the performance indicators for all PLOs and we are implementing them with our current courses.
3. Completion of performance indicator map across the curriculum. We have completed the curriculum map of the assessed indicators for the courses offered thus far in years 1 and 2 of the program. Results indicate that we are lacking data for indicators at the higher complexity levels (PI 4-6) and in PLO4,5 and 7. This data will be collected in Year 3 and in Year 4 of the program (Figure 8).

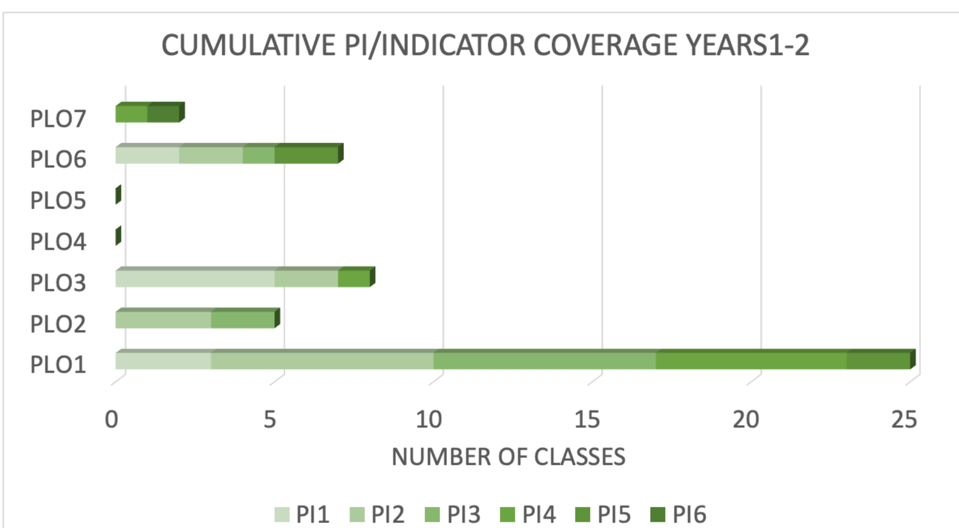


Figure 8: Graphical representation of Indicator coverage per PLO and indicator.

Feedback from the FDCD

Feedback from our previous report was very positive. We were advised to continue to use best practices on assessment as we did in the past, and that we continue to work towards ABET accreditation. Having created our performance indicators that are meaningful to our program and consistent with our values, the data collection process is underway and will continue without any anticipated complications. This rich dataset will allow us to demonstrate specifically the skills and knowledge our students are gaining in our program.

To that end we plan to do the following:

- Collect a complete set of data that will allow us to make the case for our continuous improvement over time, and that will demonstrate the thoroughness with which we are evaluating the ABET Student Outcomes.
- Having access to three years' worth of data will allows us to study temporal trends in how our students are achieving mastery in our curriculum
- We will continue to be evaluating whether the developed indicators are representative of what is covered in our courses and we will focus on making that case that when our students meet expectations in these indicators they meet the ABET SOs, in a way that is consistent with our values and priorities as a department and consistent with the USF mission.
- We will continue to streamline the process for data collection and analysis.
- We will start the process of summarizing the information we have collected in our Preparedness report to be submitted 10/2023 and the full report to be submitted 7/2024.

Goals for 2022/23

Continuous improvement

The engineering department is creating a framework for continuous improvement, as outlined by ABET requirements. Program assessment is one element of this framework, but we aim to incorporate several other elements that will help us iteratively enhance the student experience and demonstrate student learning, while also taking into account faculty engagement, professional growth and time limitations.

This past year, in addition to collecting and assessing PLO1 and PLO3 in our program, we initiated paths to have regular input that will result in continuous improvement of our program. These steps include:

- Annual faculty workshops to discuss assessment requirements (e.g. performance indicators)
- One on one discussions with faculty about assessment results that includes conversations about the assessment process
- Collection of annual data for repeated assessment.
- Development of a complete curriculum map to assess whether all indicators are met in our curriculum for each PLO.
- Establishing a goal for how many courses or number of students need to be providing data for each indicator that we want to our students to master in our curriculum
- Iteratively improve indicators to keep those that are covered and are important to us and the mission of the department, and to assess whether those not covered sufficiently can be covered by curricular changes.

Application for ABET accreditation plan

Members of the Engineering faculty have started preparations for the multi-step application process for ABET accreditation review. The procedure calls for the review to take place in the academic year immediately following the first successful graduation of students - even a single student. For us, this means the review would take place in the 2024-25 school year. The basic calendar of key steps is as follows:

2022/23 Winter - begin preparation of Readiness Review report (an abbreviated form of the main review application)
2023 October 1 - submit Readiness Review Self-Study report
2024 January 31 - submit Request for Evaluation
2024 July 1 - submit full Self-Study report
2024 Fall - sometime between Sept and Dec, on-site visit by ABET review team
2025 Spring - iterative due process review period
2025 July - ABET commission meeting to decide
2025 August 31 - Final Statement of decision is sent to us by this date

It is critical that we receive accreditation on the first try, so that we do not have any graduated students whose degrees are not accredited. We will be summarizing our needs and requesting support from the Dean’s office and Provost’s Office of Assessment and Accreditation Support to ensure that we have the time and resources available to succeed.