### 4.1.4 Direct Assessment of Outcome (5) Teamwork

***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***

A total of 9 BSEE students were assessed at the Klamath Falls campus, and 6 BSEE students were assessed in the Portland-Metro campus (KF: N = 9; PM: N = 6). The results are presented in Table 11.

Klamath Falls, ENGR 465 – Spring 2022, Feng Shi

This outcome was assessed in ENGR 465 - Capstone project. The capstone project is a year-long (three-term) project that students complete in their senior year, which involves a major design experience. Students are required to work in teams, for some project the teams are multidisciplinary, including students from different engineering disciplines (e.g., electrical, mechanical, and renewable energy engineering). The student teams are asked to give three presentations throughout the year to demonstrate their project progress, as well as a submit a final written report at the conclusion of their project. The teams are also required to participate in the student senior project symposium in Spring term. This is an event featuring student projects from different programs at the university. Students, faculty, and members of the public are invited to attend. Participants typically deliver a poster presentation and a working demo. As attendees walk through the event hall, students get an opportunity to explain and demo their project to a broad and diverse audience.

The capstone project provides a unique opportunity for students to work collaboratively as part of a team. The team goes through the process of establishing the project goals, developing a plan to complete the project, and implementing their design solution to meet the project objectives.

Portland Metro, EE 325 – Spring 2022, Cristina Crespo

This outcome was assessed in the final project of EE 325 - Electronics III. Students were asked to work in groups of two or three to complete a project focused on a system-level application of electronic circuits. The project involved the design and simulation of the electronic system, followed by its implementation on a PCB and final verification and troubleshooting. As a first step, students were asked to develop a project plan, including project objectives and milestones, as well as distribute responsibilities and work collaboratively to meet the project goals.

Students were assessed based on their ability to work collaboratively and effectively to establish project objectives, distribute responsibilities and take leadership for individual assigned tasks in order to successfully complete the project.

Table 11: Results of direct assessment for student outcome (5) Teamwork

| Performance Criteria | 1 Developing | 2 Accomplished | 3 Exemplary | Students ≥2 |
|---|---|---|---|---|
| **Klamath Falls, ENGR 465, N=9** | | | | |
| 5.1 Leadership | 0 | 3 | 6 | 100% |
| 5.2 Collaboration | 0 | 3 | 6 | 100% |
| 5.3 Effectiveness | 0 | 3 | 6 | 100% |
| **Portland Metro, EE325, N=6** | | | | |
| 5.1 Leadership | 1 | 5 | 0 | 83% |
| 5.2 Collaboration | 0 | 4 | 2 | 100% |
| 5.3 Effectiveness | 3 | 3 | 0 | 50% |

### 4.1.5 Direct Assessment of Outcome (6) Experimentation

***An ability to develop and conduct appropriate experimentation, interpret data analyze and interpret data, and use engineering judgement to draw conclusions***

A total of 12 BSEE students were assessed at the Klamath Falls campus and 10 students at the Portland Metro campus (KF: N = 12; PM: N = 10). The results are shown in Table 12.

Klamath Falls, EE 333 Winter 2022, Anindita Paul

This outcome was assessed in a laboratory assignment, which involved the design of a digital clock using Arduino UNO. Students were asked to use DS1307 and Liquid Crystal Display(LCD) unit in this project with Arduino UNO that can display time in hh: mm: ss format and show the day of the week and date. To accomplish this task, students first needed to read the datasheet of DS1307 in detail to understand the internal structure of the real-time timer IC. Furthermore, they needed to read the datasheet of LCD to display the character on the screen correctly. Students had to write a program called sketch using Arduino IDE software to accomplish the task.

Students were required to place the RTC module with 32.768 kHz crystal into their breadboard. A 5V was used to power the RTC module chip. The GND pin of the module needed to connect to the common power/data ground to the chip. Finally, they needed to connect the I2C SCL and SDA pins to the RTC module from the microcontroller.

In the first part of the lab-assignment students were asked a few questions based on the model program given in the assignment to check their understanding of : 1) I2C communication protocol, 2) how to read the content of the timekeeper register of DS1307 IC so that the digital clock displays the correct time, date and day of the week. The first part of the lab assignment ensured that students could build up the correct experimental setup and write the appropriate program.

Finally, students were asked to generate a laboratory report where they needed to write down

all the answers to the questions asked in the assignment. Additionally, they needed to include a picture of the complete experimental setup and final output. A discussion of their results needed to be incorporated into the lab report. This assignment required the ability to design the proper hardware set up using the microcontroller, real-time timer IC, and LCD display and the students needed to write appropriate code to obtain the final output. The assignment also encompassed the enhancement of programming skills and embedded system designing skills.

Through this lab, students had to use engineering judgment to interpret the datasheet of the IC and determine how to configure it using the proper programming code to design the intended embedded system.

Portland Metro, EE 323 Winter 2022, Cristina Crespo

This outcome was assessed in the final project for the course, which involved the design of multistage amplifiers at the transistor level. Students were asked to produce a discrete multi-stage amplifier design to meet a set of specifications, as well as two op-amp designs, using BJT and MOSFET technology, respectively. Students had to use LTSpice to characterize the performance of their circuits in terms of parameters such as input/output resistance, input offset voltage, input and offset currents, CMRR, PSRR, output compliance, etc. Students were required to set up an appropriate set of experiments and perform the necessary measurements and calculations to determine the parameter values. Finally, students were asked to generate a project report including a presentation and discussion of their results, and a comparison between the performance of the different amplifiers.

This assignment required the ability to design and conduct appropriate experiments to obtain relevant data to characterize circuit performance. It also encompassed interpreting the data collected for the different amplifiers and using engineering judgement to draw conclusions regarding which type of amplifier may be better suited for particular types of applications based on the interpretation of the data.

Table 12: Results of direct assessment for student outcome (6) Experimentation

| **Performance Criteria** | **1 Developing** | **2 Accomplished** | **3 Exemplary** | **Students ≥2** |
|---|---|---|---|---|
| **Klamath Falls, EE 333, N=12** | | | | |
| 6.1 Experimentation | 1 | 5 | 6 | 92% |
| 6.2 Analysis | 2 | 4 | 6 | 83% |
| 6.3 Conclusions | 2 | 4 | 6 | 83% |
| **Portland Metro, EE 323, N=10** | | | | |
| 6.1 Experimentation | 0 | 5 | 5 | 100% |
| 6.2 Analysis | 2 | 3 | 5 | 80% |
| 6.3 Conclusions | 2 | 3 | 5 | 80% |

### 4.2 Indirect Assessment

In addition to direct assessment measures, student outcomes (1)-(7) were indirectly assessed through a senior exit survey of graduating students.

The following questions were posed to the BSEE graduating class for each of the outcomes listed above as part of the Senior Exit Survey:

- Q1 Rate your proficiency in the following areas
- Q2 Rate how much your experiences at Oregon Tech contributed to your knowledge, skills, and personal development in these areas

Students are asked to rate their proficiency in each of the program outcomes as well as the contribution of Oregon Tech to their attainment of each outcome on a 4-point scale (0-lowest to 3-highest). The departmental objective is to have at least 80% of participants give a rating of 2 or 3 in both questions.

A total of 9 BSEE graduating seniors completed the Senior Exit Survey (35% of the graduating class). The results of the indirect assessment for Q1 and Q2 are presented in Figures 1 and 2, respectively. The percentage of students scoring 2 or 3 in Q1 and Q2 exceeds 80% in every outcome, except outcomes (3) Communication and (4) Ethics. Only 56% of survey participants rated themselves as proficient or highly proficient in outcome (3) Communication, and 67% did in outcome (4) Ethics. In both cases, however, 78% of respondents felt that Oregon Tech contributed "3 - Very much" or "2 - Quite a bit" to their knowledge, skills, and personal development in these areas. These results were discussed by the BSEE faculty at the Closing-the-Loop meeting (see section 5).

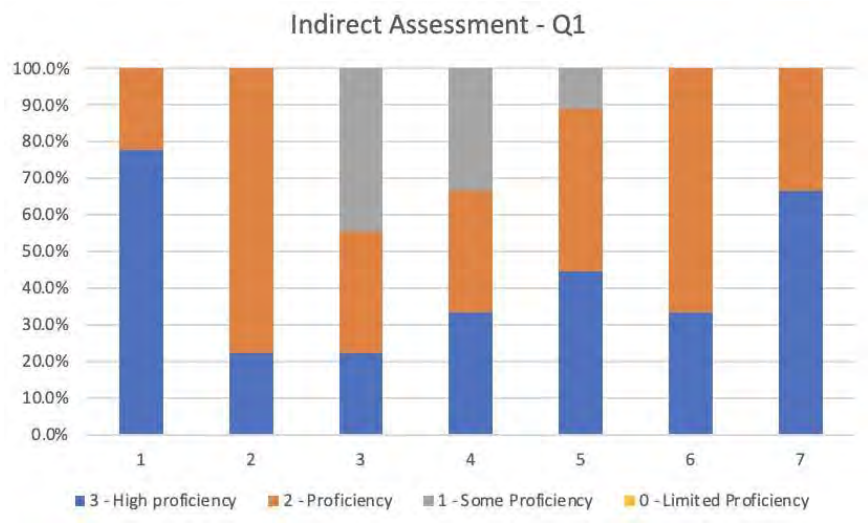


Figure 1: Results of indirect assessment, *Q1: Rate your proficiency in the following areas* (N=9)

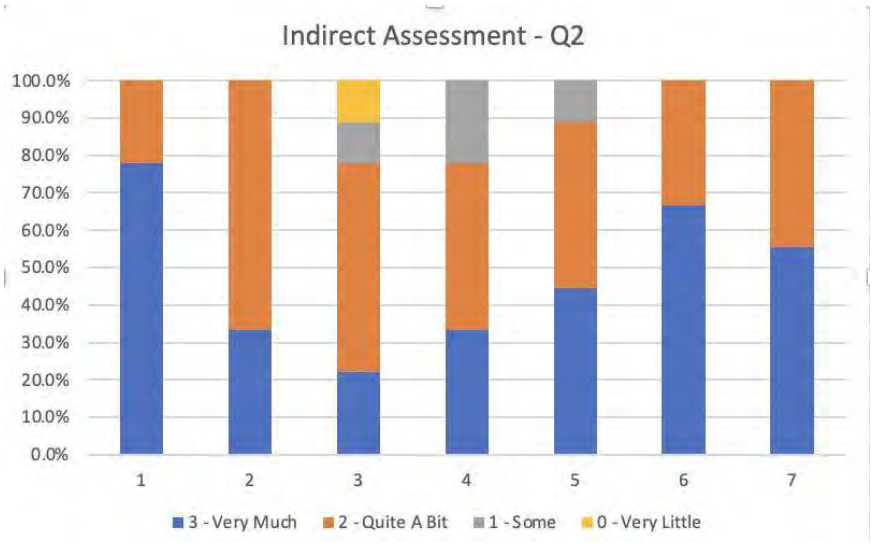


Figure 2: Results of indirect assessment, *Q2: Rate how much your experiences at Oregon Tech contributed to your knowledge, skills, and personal development in these areas* (N=9)

### 4.3 Degree Completion, Retention and Equity Data

The university has recently started tracking equity data as part of an initiative to identify and close equity gaps. To this end, the university has developed several dashboards that allow to track the 6-year graduation rates as well as the 1-year retention dates, and to sort this data along different demographic categories such as gender, race and socio-economic status.

Figure 3 shows the 6-year degree completion rates for students starting their degree in Fall 2011 through Fall 2015. Figure 4 shows the 4th term retention rates for students starting at Oregon Tech in Fall 2015 through Fall 2019. The 4th term retention rate represents the proportion of students who were still enrolled at Oregon Tech four terms after their start term (excluding Summer term). Both sets of data are presented for three student populations: (1) BSEE students, (2) College of ETM students, and (3) all Oregon Tech students. By overlapping these three populations, we can identify whether there are trends that pertain specifically to BSEE students, or whether they follow the overall college or university trend.

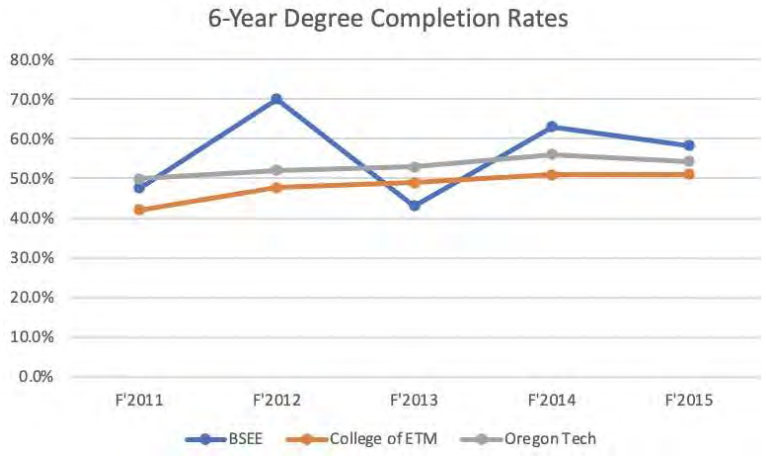


Figure 3: 6-year completion rates for students who started at Oregon Tech in Fall 2011 through Fall 2015.

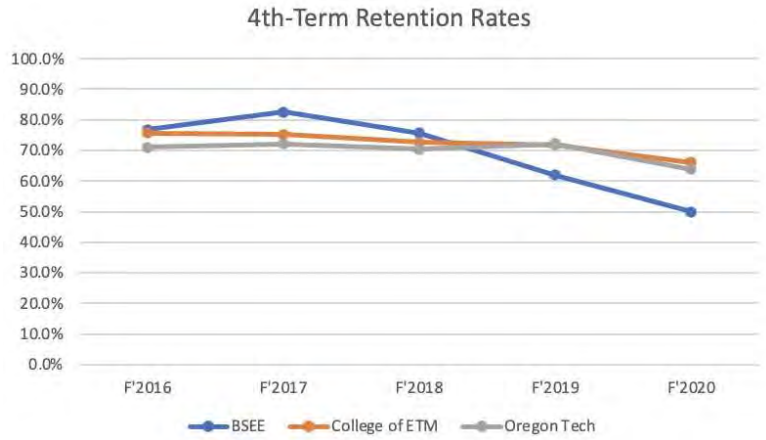


Figure 4: 4th term retention rates for students who started at Oregon Tech in Fall 2015 through Fall 2019.

For the 6-year degree completion rate, the BSEE program seems to follow a similar pattern to the College of ETM and the overall university, with slightly higher values in the last two years (for example, the proportion of students who started in Fall 2015 and graduated by Fall 2021 is 58%

for BSEE students, 51% for the College of ETM students, and 54% for all Oregon Tech students. The figure shows a divergence between the BSEE values and the college and university values for Fall 2012 and Fall 2013. Looking at the dashboard data, the BSEE faculty could not identify any obvious reason for this. The proportion of full-time to part-time students was similar for the five years shown, and the COVID-19 pandemic should not have affected the 6-year graduation rate for students who started their degrees in Fall 2013 (since the effects of the COVID-19 pandemic were not felt until Winter 2020). The most likely reason is that the represented BSEE population is much smaller in size (∼50 students) than the one for the College of ETM (∼500 students) and Oregon Tech as a whole (∼1,000 students), and therefore the data will be more noisy (i.e., small changes in absolute values are likely to create greater deviations in the percentage).

For the 4th term retention rate, the BSEE program has historically followed the trends for the College of ETM and the university. However, in the last two years reported (i.e. students starting in Fall 2019 or Fall 2020), the proportion of BSEE students enrolled four terms after their start date has been on a downward trend. For students who started in Fall 2020, the proportion of students who were still enrolled in Fall 2020 was 50%, which is around 15% lower than for the other two groups (ETM and university). This may be in part due to the impacts of the COVID-19 pandemic, which started having noticeable effects in Winter 2020.

From the current dashboards, it was difficult to extract meaningful information regarding equity in the degree completion and retention rates. The main problem is that the data is currently displayed as absolute numbers, instead of proportions or percentages. For example, out of the 48 students who started their BSEE degree in Fall 2015, 28 students graduated in 6 years. Per the dashboard, 5 out of these 28 were classified as “female” and 23 as “male”. Since the composition of the BSEE student body is not symmetrical with regards to gender (with males significantly outnumbering females), it is expected that the absolute number of males completing their degree within 6 years will exceed the number of females. Without knowing the male:female proportion in the original cohort of 48 students, it is difficult to establish whether there is an equity gap between the degree completion rates based on gender. This same principle applies to all equity categories.

To ensure that we can extract meaningful information related to equity gaps, we have made the recommendation to the Executive Assessment Commission that the dashboards be modified to report proportions or percentages of the overall population in the equity data tables, instead of the absolute numbers that are currently being reported.

# 5 Continuous Improvement and Closing-the-Loop

The BSEE Closing-the-Loop meeting was held on 14 October 2021 to review the assessment results. A summary of the discussions and action plans based on assessment results are presented in the following sections.

## 5.1 Summary of Assessment Results

Table 13: Summary and historical results of BSEE assessment. The objective set by the EERE department is 80% attainment. The symbol * indicates performance criterion not attained to 80% in all campuses. See section 4.1 for details.

| **Student Outcome** | **AY18–19** | **AY19–20** | **AY20–21** | **AY21–22** | **Outcome Met?** |
|---|---|---|---|---|---|
| **(2) Design/Broader Factors**<br>**ISLO6 Diverse Perspectives** | | | $N = 13$ | $N = 4$ | |
| 2.1 Engineering Design | | | 100% | 100% | Yes |
| 2.2 Broader Factors | | | — | 100% | Yes |
| **(3) Communication**<br>**ISLO1 Communication** | | $N = 12$ | | $N = 12$ | |
| 3.1 Written | | 100% | | 100% | Yes |
| 3.2 Oral | | 83% | | 100% | Yes |
| 3.3 Graphical | | 83% | | 100% | Yes |
| 3.4 Audience | | 83% | | 100% | Yes |
| **(4) Ethics**<br>**ISLO3 Ethical Thinking** | $N = 12$ | | | $N = 14$ | |
| 4.1 Recognize | 100% | | | 100% | Yes |
| 4.2 Identify | 83% | | | 93% | Yes |
| 4.3 Judge* | 83% | | | 86% | Yes* |
| **(5) Teamwork**<br>**ISLO4 Teamwork** | | | | $N = 15$ | |
| 5.1 Leadership | | | | 93% | Yes |
| 5.2 Collaboration | | | | 100% | Yes |
| 5.3 Effectiveness* | | | | 80% | Yes* |
| **(6) Experimentation**<br>**ISLO5 Quantitative Literacy** | $N = 17$ | | | $N = 22$ | |
| 6.1 Experimentation | 82% | | | 95% | Yes |
| 6.2 Analysis | 82% | | | 82% | Yes |
| 6.3 Conclusions | 82% | | | 82% | Yes |

Table 13 shows a summary and history of results for the direct assessment of outcomes assessed in AY2021-22. The table shows the percentage of students scoring 2 (accomplished) or 3 (exemplary)

in each performance criteria. These results combine the total number of students assessed within the year from all campus locations. The objective set by the EERE department is to have at least 80% of the students perform at the level of accomplished or exemplary in all performance criteria.

## 5.2 Evaluation of Results and Proposed Changes

Below is a summary of the discussion and recommendations made by the BSEE faculty based on the evaluation of the assessment results:

1. **Outcome (2) Design/Broader Factors**
   Outcome assessed in ENGR 465 (PM).
   Direct and indirect assessments suggest outcome met. (Table 8)
   **Action Plan:** Will re-assess in AY2022-23 as part of ISLO assessment cycle (ISLO6 Diverse Perspectives). See Table 7. Courses: ENGR 465 (KF and PM). Must ensure broader factors/diverse perspectives component is included as part of the final capstone project report.
   **Person in Charge, Deadline:** Feng Shi (KF), Slobodan Petrovic (PM), Winter 2023.

2. **Outcome (3) Communication**
   Outcome assessed in ENGR465 (KF and PM).
   Direct assessment indicates high attainment (Table 9)
   Indirect assessment reflects almost half of surveyed graduates do not rate themselves as proficient in this area (although close to 80% acknowledge their experience at Oregon Tech has contributed to their communication skills). Faculty suggested that the phrasing of the rating categories (e.g., proficient or highly proficient) may suggest a high bar for students, beyond the expectation of a recent graduate in engineering (for example, they may be thinking that high proficiency might refer to the level expected of a Communications major).
   **Action Plan:** Faculty proposed to rephrase the different attainment categories in the Exit Survey to: *1-Limited Competency, 2-Some Competency, 3-Adequate Competency, and 4-High Competency*, as well as to add an explanatory note of the comparator group: *Competency evaluated against other graduates of ABET-accredited engineering programs.* In order to gain further insight into the reasons why students may perceive themselves as lacking competency in any of the outcomes, an additional question should be added to the survey: *If you rated any Outcomes at 2 or below, please indicate the reasons.*
   **Person in Charge, Deadline:** Mateo Aboy & Scott Prahl, Fall 2022.

3. **Outcome (4) Ethics**
   Outcome assessed in EE401 (KF) and ENGR 465 (PM).
   Direct assessment indicates high attainment in K Falls, lower attainment in PM (Table 10).
   Indirect assessment reflects less than 70% of respondents rated themselves as proficient in this area. However, close to 80% rated their experiences at Oregon Tech contributed to their knowledge in this area. This may be due to engineering ethics being only covered in a single course in the curriculum.
   **Action Plan:** Faculty proposed to provide students more opportunities to develop their

ethical judgement by including some coverage of ethics in other courses throughout the curriculum. An ethics module will be added to EE 461 - Control Systems I. **Person in Charge, Deadline:** Robert Melendy, Fall 2022.

4. **Outcome (5) Teamwork**
   Outcome assessed in ENGR 465 (KF) and EE 325 (PM).
   Direct assessment indicates high attainment in K Falls, lower attainment in PM, particularly in the area of team effectiveness (Table 11). It was noted that this was due to one out two teams assessed did not account for schedule differences when generating their project timeline. The team was able to eventually overcome this hurdle and distribute tasks to be able to make substantial progress, but unfortunately failed to accomplish all of the project objectives by the deadline.
   Indirect assessment reflects high ratings in this area (close to 90%).
   **Action Plan:** Team assignment will be modified to require students to take into account availability of team members in the planning stages, and include it in their project proposals.
   **Person in Charge, Deadline:** Cristina Crespo, Spring 2023.

5. **Outcome (6) Experimentation**
   Outcome assessed in EE 333 (KF) and EE 323 (PM).
   Direct and Indirect assessment reflect outcome met (Table 12).
   **Action Plan:** None. Outcome will be reassessed per assessment cycle.
   **Person in Charge, Deadline:** N/A

6. **Program Enrollment and Graduation Data**
   Data from Tables 1 and 2 reflect decrease in enrollment over the last two years (coinciding with the COVID-19 pandemic): 14% in AY2020-21 and 25% in AY2021-22. It was noted that around 70% of BSEE students at PM campus are transfers from local community colleges, and enrollment at Portland Community College was down 25%. Enrollment is typically affected by fluctuations in the economic cycle, with enrollment periodically decreasing during strong job market cycles.
   **Action Plan:** Continue to monitor enrollment data and collaborate with Admissions on recruiting and registration events.
   **Person in Charge, Deadline:** N/A

7. **Key results from Senior Exit Survey**
   (a) For the majority of participants, what attracted them to Oregon Tech was the degree offerings (30%), followed by small class sizes (22%) and location (18%).
   (b) Participants reported high levels of satisfaction with quality of instruction (100%). In general, 90% felt satisfied with curriculum and facilities, and 80% felt satisfied with advising and class schedule.
   (c) In general, participants reported high levels of satisfaction (80% or higher) regarding advisor availability, knowledge, and assistance with major requirements, options, and course selection. Less than 70% were satisfied with advisor's assistance in helping with career opportunities and development.
   (d) 11% of repondents had passed the FE exam by the time of the survey, 67% were planning

to take it within one year.
(e) One quarter of participants rated the quality of education at Oregon Tech as exceptional (5 out of 5). The average score was 3.9 out of 5.
(f) A recurrent suggestion for improvement was more flexibility and options in class schedule (courses offered more than once per year, more electives, etc.). The ability to do this largely depends on student and faculty numbers.
**Action Plan:** Advisors will direct students to Career Services for assistance with career opportunities and development.
**Person in Charge, Deadline:** N/A

8. **Degree Completion and Retention Data**
   6-Year degree completion rates 58%, slightly higher than Oregon Tech(54%) and College of ETM (51%). See Figure 3.
   4th-term retention rates have dropped since the incidence of the COVID-19 pandemic in Winter 2020, and as of Winter 2021 have not recovered. See Figure 4. During the same time period, there was a faculty strike and the resignation of several faculty members, which may have also impacted those numbers.
   **Action Plan:** Request for faculty positions to cover those of faculty who have recently resigned to continue to ensure program quality.
   **Person in Charge, Deadline:** Scott Prahl, Fall 2022.

9. **Equity Data**
   Dashboards not yet updated to reflect proportions in equity data, so it is not easy to draw meaningful conclusions.
   **Action Plan:** Cristina Crespo brought this up to the Executive Assessment Commission and will be working with the Director of Institutional Research to update dashboards to report equity data in a way that is informative. **Person in Charge, Deadline:** Cristina Crespo, Fall 2022.

10. **Other Program Changes**
    Based on faculty input and consultation with the IAB, last year EERE faculty decided to update the content of the ENGR 267 course. The previous version of the course covered Matlab ad LabView, the updated version effective AY2022-23 will cover Matlab and Python. This change was made to ensure the program keeps up with current industry needs and trends. Python programming skills seem to be in higher demand than LabView skills in the industry. This change will allow other EERE faculty to incorporate Python-based assignments in their courses where needed, as students will have a solid foundation without the need for professors to take time from their courses to cover Python programming basics.
    The number of student credits hours for the program was reduced from 188 SCH to 18 SCH based on a state mandate.

## 5.3 Review of Implementation of Changes from Prior Assessments

Below is the status of implementation of recommendations for changes based on prior assessments.

1. **Direct Assessment of Outcome (2) Design/Broader Factors**
   **Action Plan:** Outcome only partially assessed. Assignment did not cover performance criterion 1.2, and no assessment was conducted in PM. Outcome was to be reassessed this year, ensuring both campuses and all performance criteria were covered. In order to ensure broader factors are included in assessment, outcome would be assessed in ENGR 465 - Capstone Project.
   **Person in Charge/Deadline:** Aaron Scher/Spring 2022.
   **Status Update:** Completed. Outcome was assessed in Portland Metro in ENGR 465, will be reassessed in both campuses in AY2022-23 as part of the ISLO assessment cycle (ISLO6 Diverse Perspectives. See Table 7).

2. **Indirect Assessment**
   **Action Plan:** Incorrect outcomes were used for indirect assessment (ABET ETAC outcomes, instead of ABET EAC outcomes). Action plan was to communicate with the Office of Academic Excellence to ensure Senior Exit Survey was corrected to include EAC outcomes. Most notably, only 70% of students felt OIT contributed to their attaining the communication outcome. This could be due to this graduating cohort having been impacted by the COVID-19 pandemic, which forced courses to be offered online and therefore limited the ability to have oral presentations, class discussions, and similar exchanges in an in-person setting.
   **Person in Charge/Deadline:** Scott Prahl/Spring 2022.
   **Status Update:** Completed. Survey was corrected for AY2021-22. No further action needed.

3. **Degree Completion, Retention and Equity Data**
   **Action Plan:** Communicate with the Executive Assessment Commission to recommend that the dashboards be modified to display proportions or percentages of the overall population in the equity data tables.
   **Person in Charge/Deadline:** Cristina Crespo/Spring 2022.
   **Status Update:** In progress. This was communicated to the Exec. Assessment Commission. Due to other priorities, no action was taken on it in AY2021-22. This was brought up again in the first meeting of AY2022-23. Cristina Crespo was assigned to work with the Director of Institutional Research in AY2022-23 to address these issues.

# 6 Rubrics

The following rubrics are used by the program faculty for direct assessment of student outcomes. To promote consistency and reliability of assessment results, all faculty assessing a particular outcome use the same rubric.

**EAC RUBRIC: OUTCOME (1) – PROBLEM SOLVING**

**Outcome (1)** An ability to identify, formulate, and solve complex engineering problems[1] by applying principles of engineering, science, and mathematics

| CRITERIA | 1-DEVELOPING | 2-ACCOMPLISHED | 3-EXEMPLARY | SCORE |
|---|---|---|---|---|
| **ABILITY TO IDENTIFY A COMPLEX ENGINEERING PROBLEM** | An engineering problem is not identified, or the identification is too vague or unclear. | An engineering problem of reasonable complexity is adequately identified and its significance minimally explained. | A complex engineering problem is properly identified and clearly stated. Its significance is thoroughly explained. | |
| **ABILITY TO FORMULATE A COMPLEX ENGINEERING PROBLEM BY APPLYING PRINCIPLES OF ENGINEERING, SCIENCE AND MATHEMATICS** | A complex engineering problem is not properly formulated in engineering, scientific, and/or mathematical terms. Most of the assumptions and specifications are either missing or unclear. | A complex engineering problem is adequately formulated in engineering, scientific, and/or mathematical terms, but some of the assumptions and specifications may be missing or not clearly presented. | A complex engineering problem is clearly formulated with a valid and complete set of assumptions and specifications. | |
| **ABILITY TO SOLVE A COMPLEX ENGINEERING BY APPLYING PRINCIPLES OF ENGINEERING, SCIENCE AND MATHEMATICS** | The solution to a complex engineering problem is not developed according to engineering, scientific, and mathematical principles, or it does not follow the original set of assumptions and specifications. | The solution to a complex engineering problem is developed according to engineering, scientific, and mathematical principles. The solution reasonably meets most of the original set of assumptions and specifications. | The solution to a complex engineering problem is very well developed according to engineering, scientific, and mathematical principles. The solution meets or exceeds the original set of assumptions and specifications. | |

[1] As defined by ABET, complex engineering problems include one or more of the following characteristics: involving wide-ranging or conflicting technical issues, having no obvious solution, addressing problems not encompassed by current standards and codes, involving diverse groups of stakeholders, including many component parts or sub-problems, involving multiple disciplines, or having significant consequences in a range of contexts.

**EAC RUBRIC: OUTCOME (2) – BROADER FACTORS**

**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

| CRITERIA | 1-DEVELOPING | 2-ACCOMPLISHED | 3-EXEMPLARY | SCORE |
|---|---|---|---|---|
| **ABILITY TO APPLY ENGINEERING DESIGN TO PRODUCE SOLUTIONS THAT MEET SPECIFIED NEEDS** | Does not follow the engineering design process, or the designed solution does not meet the specified need(s). | Reasonably follows the engineering design process to produce a solution that adequately meets the specified need(s). | Methodically follows the engineering design process to produce a solution that thoroughly meets the specified need(s). | |
| **ABILITY TO DESIGN SOLUTIONS ACCOUNTING FOR BROADER CONSIDERATIONS, SUCH AS PUBLIC HEALTH, SAFETY, AND WELFARE, AS WELL AS GLOBAL, CULTURAL, SOCIAL, ENVIRONMENTAL, AND ECONOMIC FACTORS** | The solution provided does not take into account broader practical considerations, such as public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors. | The solution provided takes into account and partially addresses some of the broader practical considerations, such as public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors. | The solution provided takes into account and thoroughly addresses several of the broader practical considerations, such as public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors. | |

## EAC RUBRIC: OUTCOME (3) – COMMUNICATION

**Outcome (3)** An ability to communicate effectively with a range of audiences

| CRITERIA | 1-DEVELOPING | 2-ACCOMPLISHED | 3-EXEMPLARY | SCORE |
|---|---|---|---|---|
| **ABILITY FOR EFFECTIVE ORAL COMMUNICATION** | The main ideas are not clearly presented. Low volume or monotonous tone make it hard for audience to engage. Speaker does not transmit any interest or enthusiasm about the topic. | The main ideas are clearly presented. Adequate volume and dynamic tone are used to engage audience. Speaker occasionally transmits interest and enthusiasm about the topic. | Speaker is an excellent communicator. The main ideas are clearly presented. Speaker is eloquent and dynamic, effective at engaging the audience. Speaker displays and transmits a strong interest and enthusiasm about the topic. | |
| **ABILITY FOR EFFECTIVE WRITTEN COMMUNICATION** | Content is disorganized, the main ideas are not clearly stated and developed. Writing style is rough or imprecise. Frequent grammar/spelling errors. Document presentation and format rough or inconsistent. | Content is well organized and the main ideas are clearly stated and reasonably developed. Writing style is adequate for purpose and readable. Grammar/spelling mostly correct. Document presentation and format adequate and consistent. | Content is very well organized and easy to follow, main ideas are clearly presented and thoroughly developed. Writing style is adequate for purpose, readable, and tailored to intended audience. Grammar/spelling correct. Work is professionally presented and very well formatted. | |
| **ABILITY FOR EFFECTIVE GRAPHICAL COMMUNICATION** | Inadequate use of figures, charts, and/or tables to display data. Figures are not well placed, many figures, charts, and tables missing key formatting elements, such as titles, labels, units, captions, etc. Overall, figures do not contribute to a better understanding of key ideas or results. | Adequate use of figures, charts, and tables to display data. Figures are well placed, most figures, charts, and tables are properly labeled and formatted. Figures moderately contribute to a better understanding of key ideas or results. | Excellent use of figures, charts, and tables to display data. All figures, charts, and tables properly labeled and formatted, easy to read and interpret. Figures substantially and effectively contribute to a better understanding of key ideas or results. | |
| **ABILITY TO ADDRESS A RANGE OF AUDIENCES** | Does not address target audience. Content is too technical or too superficial to be understood by and of interest to a wide range of audiences. | Adequately addresses the target audience. Content has a reasonable balance of technical and non-technical information to be understood by and of interest to a wide range of audiences. | Effectively addresses the target audience. Content has the right balance of technical and non-technical information to be understood by and of interest to a wide range of audiences. | |

**EAC RUBRIC: OUTCOME (4) – ETHICS**

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

| CRITERIA | 1-DEVELOPING | 2-ACCOMPLISHED | 3-EXEMPLARY | SCORE |
|---|---|---|---|---|
| **ABILITY TO RECOGNIZE ETHICAL AND PROFESSIONAL RESPONSIBILITIES IN ENGINEERING SITUATIONS** | Description of ethical and professional responsibilities is limited or rudimentary. | Description of ethical and professional responsibilities is substantive. | Description of ethical and professional responsibilities is complete and thorough. | |
| **ABILITY TO IDENTIFY GLOBAL, ECONOMIC, ENVIRONMENTAL, AND SOCIETAL CONTEXTS IN ENGINEERING SITUATIONS** | Identifies a single context area relevant in an engineering situation. Explanation of the context is rudimentary. | Identifies most context areas relevant in an engineering situation. Explanation of the contexts is substantive. | Identifies all context areas relevant in an engineering situation. Explanation of contexts is complete and thorough. | |
| **ABILITY TO JUDGE THE IMPACT OF ENGINEERING SOLUTIONS ON GLOBAL, ECONOMIC, ENVIRONMENTAL, AND SOCIETAL CONTEXTS** | Analysis and judgement of the impact of engineering solutions on contexts is rudimentary. | Analysis and judgement of the impact of engineering solutions on contexts is substantive. | Analysis and judgement of the impact of engineering solutions on contexts is complete and thorough. | |

**EAC RUBRIC: OUTCOME (5) – TEAMS**

| **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 | | | | |
|---|---|---|---|---|
| CRITERIA | 1—DEVELOPING | 2—ACCOMPLISHED | 3—EXEMPLARY | SCORE |
| **ABILITY TO PROVIDE TEAM LEADERSHIP** | Lacks adequate ability to resolve problems and conflicts. Lacks ability to provide adequate leadership in decision making, planning, and goal setting. Does not show appreciation for other team members' contributions. Exhibits poor team communication skills (e.g., interrupts others, gets defensive, does not ask questions, gets distracted). Does not motivate others or lead by example. | Capable of resolving problems and conflicts. Demonstrates adequate leadership ability in decision making, planning, and goal setting. Occasionally shows appreciation for other team members' contributions. Exhibits reasonable team communication skills. Capable of motivating others. Willing to share problems and progress. Mainly does assigned work instead of willingly taking on additional responsibilities. | Proficient in resolving problems and conflicts and exhibits proficient leadership ability in decision making, planning, and goal setting. Appropriately recognizes and shows appreciation for other team members' contributions. Exhibits proficient team communication skills including good body language and active listening. Transparent about expectations and objectives. Motivates others and leads by example. Willing to share problems and take on additional responsibilities and help others when necessary. | |
| **ABILITY TO CREATE A COLLABORATIVE AND INCLUSIVE ENVIRONMENT AS A TEAM MEMBER** | Rarely uses respectful language or show cooperative communication skills. Does not demonstrate mutual respect and tends to dismiss others' unique perspectives, opinions, or ideas. Does not demonstrate ability and willingness to compromise with other group members. | Generally, uses respectful language and shows cooperative communication skills. Does not disrespect other group members or dismiss their unique perspectives, opinions, or ideas. Demonstrates adequate ability and willingness to compromise with other group members. Does not dismiss the sharing of ideas. | Uses respectful language and shows cooperative communication skills. Actively demonstrates mutual respect and welcomes others' unique perspectives. Demonstrates high ability and willingness to compromise with other group members. Makes other group members feel safe and valued through openly encouraging the sharing of ideas. | |
| **ABILITY TO ESTABLISH GOALS, PLAN TASKS, AND MEET OBJECTIVES AS A TEAM MEMBER** | Lacks basic awareness of team duties and responsibilities. Lacks basic awareness of the links between project goals and tasks. Fails to identify risks to meet project deadlines. | Capable of performing most team duties and responsibilities. Capable of establishing goals and performing necessary talks on time to meet project deadlines and identifies most issues impacting project success. | Proficient execution of all team duties and responsibilities. Proficient in establishing goals and performing necessary tasks on time to meet project deadlines and identifies issues impacting projects success. | |

**EAC RUBRIC: OUTCOME (6) – EXPERIMENTATION**

**Outcome** (6) An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

| CRITERIA | 1-DEVELOPING | 2-ACCOMPLISHED | 3-EXEMPLARY | SCORE |
|---|---|---|---|---|
| **ABILITY TO DEVELOP AND CONDUCT AN EXPERIMENT** | Demonstrates inadequate knowledge and abilities for conducting experiments with standard test and measurement equipment to collect experimental data. May not observe lab safety and procedures. | Demonstrates adequate knowledge and abilities for conducting experiments. Able to use standard test and measurement equipment to collect experimental data. Reasonably capable of troubleshooting to overcome measurement problems. May require supervision and steering in the right direction. Overall, observes lab safety plan and procedures. | Demonstrates comprehensive knowledge, exceptional abilities, and resourcefulness for conducting experiments. Selects appropriate equipment and measuring devices and methodology for conducting experiments. Demonstrates a proficient ability to troubleshoot, predict and overcome measurement problems. Observes established lab safety plan and procedures. Proposes improvements as necessary. | |
| **ABILITY TO ANALYZE AND INTERPRET DATA** | Demonstrates inadequate knowledge and abilities for analyzing and interpreting experimental results. Reporting methods are unsatisfactory. | Demonstrates adequate abilities for experimental data analysis, interpretation, and visualization. Able to draw some reasonable conclusions based on experimental results. Demonstrates an awareness for measurement error. Reporting methods are satisfactorily organized, logical, and complete | Demonstrates exceptional ability for experimental data analysis, interpretation, and visualization. Able to draw insightful conclusions based on experimental results. Analyzes and interprets data using appropriate theory, accounts for measurement error into analysis and interpretation, reporting methods are well-organized, logical, and complete. | |
| **ABILITY TO USE ENGINEERING JUDGEMENT TO DRAW CONCLUSIONS** | Lacks the ability and awareness for interpreting experimental data to draw meaningful conclusions, decide, act, and/or communicate suggestive actions using of appropriate scientific/engineering principles, standards, and practices. Not adept at navigating complexity, open ended problems, or ambiguous data. | Adequately capable of interpreting experimental data to draw meaningful conclusions, decide, act, and/or communicate suggestive actions based upon the use of appropriate scientific/engineering principles, standards, and practices. May require significant guidance in the face of complexity, open ended problems, or ambiguous data. | Proficient in interpreting experimental data to draw meaningful conclusions, decide, act, and/or communicate suggestive actions based upon the use of appropriate scientific/engineering principles, standards, and practices. Able to make quality engineering decisions/conclusions, especially in the face of complexity, open-ended problems, or ambiguous data. | |

**EAC RUBRIC: OUTCOME (7) – LEARNING**

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

| CRITERIA | 1-DEVELOPING | 2-ACCOMPLISHED | 3-EXEMPLARY | SCORE |
|---|---|---|---|---|
| **ABILITY TO ACQUIRE NEW KNOWLEDGE USING APPROPRIATE LEARNING STRATEGIES** | Shows poor ability and little openness to acquire new knowledge and diagnosing their learning needs. Does not identify proper opportunities or resources to expand knowledge and skills. Unable or uninterested to find new information without significant guidance and prompting. Lacks awareness at one's current knowledge and skills for identifying basic gaps in understanding. Lacks the strategies and motivation necessary for self-directed learning. | Shows sufficient ability and openness to acquire new knowledge and diagnosing their learning needs. Able to identify some opportunities or resources to expand knowledge and skills. Able and interested to find new information, perhaps with some prompting. Uses current knowledge and skills to identify basic gaps in understanding. Exhibits adequate strategies and motivation necessary for self-directed learning. | Demonstrates proficient ability and openness to acquire new knowledge and diagnosing their learning needs. Independently identifies and uses a diverse range of resources to expand knowledge and skills. Able and interested to find new information with minimal prompting. Uses current knowledge and skills to identify key gaps in understanding. Exhibits exemplary strategies and motivation necessary for self-directed learning. | |
| **ABILITY TO APPLY NEW KNOWLEDGE AS NEEDED** | Inadequately unmotivated and skilled at applying new knowledge as needed for decision making, completing tasks, drawing conclusions, and/or understanding a topic in more depth. Insufficiently understands and determines the significance or relevance of the learned information needed for the task. | Adequately motivated and skilled at applying new knowledge as needed for decision making, completing tasks, drawing conclusions, and/or understanding a topic in more depth. Partially understands and determines the significance or relevance of the learned information needed for the task. | Proficiently skilled and motivated at applying new knowledge as needed for decision making, completing tasks, drawing conclusions, and/or understanding a topic in more depth. Understands and determines the significance or relevance of the learned information needed for the task. | |

# 7 Raw Assessment Data

The EERE department stores all data used for direct assessment in the *EERE/Assessment* folder in Teams. The raw data for the BSEE direct assessments performed in AY2020-21 can be found in the folder *EERE/Assessment/BSEE/2020-21*. The documentation in the folder includes, for every direct assessment performed, a copy of the assignment used for assessment of the outcome, the individual student work, and a spreadsheet listing the scores given to each student in the different performance criteria for the outcome, according to the outcome rubric. This data is not included in the report for space considerations, but access to this data is available upon request.